-FINAL DRAFT-

COST OF COMPLIANCE WITH WATER QUALITY CRITERIA FOR TOXIC POLLUTANTS FOR OREGON WATERS

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Acronyms and Abbreviations

7Q10	Minimum 7-day average stream flow that occurs every 10 years
30Q5	Minimum 30-day average stream flow that occurs every 5 years
ACWA	Association of Clean Water Agencies
ASB	Aerated stabilization basin
AMEL	Average monthly effluent limit
AWQC	Ambient water quality criterion
AWQP	Agricultural Water Quality Program
AWQMA	Agricultural Water Quality Management Area
AWQMAP	Agricultural Water Quality Management Area Plan
ATSDR	Agency for Toxic Substances and Disease Registry
ADWDF	Average dry weather design flow
BAF	Bioaccumulation factor
BBSM	Boise Building Solutions Manufacturing, LLC
BCF	Bioconcentration factor
BLS	Bureau of Labor Statistics
BMP	Best management practice
BW	Human body weight
C_b	Ambient background concentration
C_{ce}	Calculated effluent concentration of the pollutant
cfs	Cubic feet per second
CMZ	Concentration of the pollutant at the edge of the mixing zone
CAS	Columbia Analytical Services
CFR	Code of Federal Regulations
CWA	Clean Water Act
CCTV	Closed circuit television
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
CV	Coefficient of variance
D	Dilution factor
DI	Drinking water intake
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane
DESP	Dry electrostatic precipitator
DHS	Department of Health Services
EBMUD	East Bay Municipal Utility District
EPA	Environmental Protection Agency
EQC	Environmental Quality Commission
f_d	Translator to convert dissolved methylmercury into total mercury
FI	Human fish consumption
FPA	Forest Practices Act
FPR	Forest Practice Rules
ft	foot
FTE	Full time equivalent

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GSA	General Services Agreement
gpd	grams per day
IDEQ	Idaho Department of Environmental Quality
I&I	Inflow and infiltration
LAC	Local Advisory Committee
MCL	Maximum Contaminant Level
MDEL	Maximum daily effluent limit
MDL	Method detection limit
MEP	Maximum extent practicable
MPPA	Minnesota Pollution Prevention Agency
mgd	million gallons per day
MS4	Municipal separate storm sewer system
MWRA	Massachusetts Water Resources Authority
MWMC	Metropolitan Wastewater Management Commission
NRC	Neilson Research Corporation
ng/l	nanograms per liter
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
OAR	Oregon Administrative Rules
ODA	Oregon Department of Agriculture
ODEQ	Oregon Department of Environmental Quality
ODF	Oregon Department of Forestry
ODHS	Oregon Department of Health Services
OSA	Orphan site account
OTA	Office of Technical Assistance
PCBs	Polychlorinated biphenyls
PCS	Permit compliance system
PCE	Tetrachloroethylene
P2	Pollution prevention
PAH	Polycyclic aromatic hydrocarbons
POTW	Publicly owned wastewater treatment work
QL	Practical quantification level
PSA	Public service announcement
PVC	Polyvinylchloride
PWB	Portland Water Bureau
PWSP	Process water storage pond
q1*	Cancer potency factor
Q_b	Ambient flow
Q_e	Effluent flow
RCO-1	Regenerative catalytic/thermal oxidizer
RfD	Reference dose
RP	Reasonable potential
RPA	Reasonable potential analysis
RSC	Relative source contribution
RWQCP	Regional Water Quality Control Plant
SD	Sanitation district

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SP/OWW	Settling pond/open water wetland
SWCP	Storm water pollution control plan
SWMP	Storm water management program
TMDL	Total maximum daily load
TRC	Tissue residual concentration
UCB	University of California at Berkeley
µg/L	micrograms per liter
WQBEL	Water quality based effluent limit
WQC	Water quality criterion
WQS	Water quality standards

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Executive Summary

The Oregon Department of Environmental Quality (ODEQ) is considering revising the fish consumption rate for calculating water quality criteria applicable to waters in the state. This report provides estimates of the potential incremental compliance actions and costs that may be associated with such a change to the state's water quality standards (WQS).

ES.1 Background

In May 2004, the Oregon Environmental Quality Commission (EQC) adopted revisions to Oregon Administrative Rules (OAR) covering water quality criteria for toxics (OAR 340-041 - 0033). The EQC revised the representative fish consumption rate for deriving human health criteria from 6.5 grams per day (gpd) to 17.5 gpd based on EPA (2000a) guidance. On July 8, 2004, ODEQ submitted the revised toxics criteria to EPA Region 10 for review and approval. The more stringent criteria took effect on February 15, 2005 before EPA Region 10 approval (those criteria that are less stringent than the existing criteria cannot be implemented without EPA approval). However, the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and other tribes objected to the revised criteria on the basis that the fish consumption rate does not account for higher fish consuming populations, which include Tribal members. As a result, ODEQ is considering adopting a more protective fish consumption rate for calculating revised human health criteria.

ES.2 Scope of Analysis

The purpose of this analysis is to identify, using available water quality and discharge data and information, the potential incremental compliance actions and costs that publicly owned wastewater treatment works (POTWs) and industrial point source dischargers may incur as a result of potential revised criteria. These impacts may occur as a result of changes to the National Pollutant Discharge Elimination System (NPDES) permits for these facilities to incorporate revised water quality based effluent limits (WQBELs). Because ODEQ has yet to implement WQBELs reflecting existing criteria for toxic pollutants, we also identify the level of controls and costs that would be needed in the absence of any revisions to the fish consumption rate. Due to time and resource constraints, including the large number of pollutants of concern and limited monitoring data, the estimates of statewide compliance costs reflect the extrapolation of results for a small sample of dischargers.

Although the focus of this analysis is compliance costs for wastewater point sources, the revised standards may also result in a need for incremental controls by municipal storm water and nonpoint sources discharging to surface waters. However, the data and information needed to evaluate potential control needs is more limited. Thus, we identify the types of controls and costs that may be incurred for these sources but do not develop statewide cost estimates.

For changes to water quality criteria within an existing water quality standards and NPDES permitting program, compliance costs likely represent the major component of total potential social costs. There may be some incremental regulatory program costs under the higher fish consumption rates associated with an increased number of impaired waters and TMDL

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development. However, for the most part, data are not sufficient to estimate these government costs.

Social costs will be accompanied by the social benefits resulting from the control actions. Similarly, adverse economic impacts (municipal and industrial expenditures financed through user fees and profits) will be accompanied by increased employment, incomes, revenues, and profits to sectors supplying compliance technologies and services (which may be within or external to Oregon). The scope of this analysis is limited to an evaluation of potential compliance costs; this report does not provide estimates of potential benefits of revised standards or an economic impact analysis.

ES.3 Baseline for the Analysis

OAR 340-041-0033, Table 33A and Table 20 provide existing water quality criteria for the protection of human health based on consumption of water and organisms (e.g., fish) and organisms only. ODEQ established the criteria in Table 33A in 2004 based on EPA's recommended national fish consumption rate of 17.5 gpd. Only those criteria in Table 33A more stringent than the previous criteria in Table 20 are applicable; those less stringent are not to be implemented in NPDES permits until ODEQ receives EPA approval.

Toxic pollutants can be introduced to surface water through point sources (e.g., municipal and industrial effluents), storm water discharges, and nonpoint sources (e.g., agricultural runoff, forestry, mines, and atmospheric deposition). Point source and storm water discharges are regulated under the NPDES permit program. However, in Oregon, these permits do not currently include WQBELs reflecting the baseline human health criteria. Nonpoint sources are primarily controlled through various management plans and policies and TMDL load allocations, although these baseline requirements to attain existing criteria (including TMDLs for nontoxic pollutants that could result in reduced levels of toxics) have not been fully implemented. Thus, even in the absence of revised fish consumption rates for calculating human health criteria, some dischargers will need to take actions to comply with existing criteria.

ES.4 Potential Revised Criteria

ODEQ is considering several revised fish consumption rates for calculating human health criteria, including 63.2 gpd, 113 gpd, 175 gpd, 389 gpd, and 620 gpd. For most pollutants, revising the fish consumption rate would result in criteria more stringent than the existing baseline criteria (exceptions include nickel, benzene, and chloroform, among others). For some pollutants, the change in fish consumption rate will not have an incremental impact on projected effluent limits compared to baseline criteria because both baseline and revised criteria are below applicable quantification limits (QLs; the levels to which dischargers have to reduce effluent concentrations). Nevertheless, there are 91 pollutants with baseline and revised human health criteria more stringent than the existing aquatic life criteria.

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ES.5 Method for Evaluating Effect on Point Sources

Compliance costs for municipal and industrial point sources may result from changes to NPDES permit requirements. To evaluate the potential effect of the potential revised criteria on NPDES permit conditions and compliance actions for wastewater point sources, we evaluated available effluent and ambient data for a sample of facilities. We first evaluated compliance with baseline criteria by conducting a reasonable potential analysis (RPA), estimating load reductions, and determining controls (or alternative compliance measures) and costs needed for compliance. Then, we evaluated the incremental reductions that would be needed under the revised criteria, and estimated incremental compliance actions and costs.

ODEQ (2005) procedures provide permit writers instructions for determining whether dischargers have RP to cause or contribute to an exceedance of WQS, and how to calculate effluent limits for those pollutants with RP. We used these procedures in determining RP and effluent limits under the baseline as well as the revised criteria, although there is uncertainty regarding implementation procedures that may accompany a revised fish consumption rate. For mercury, we used EPA procedures and default values for translating the fish tissue criterion into a water column number for implementation into permits (U.S. EPA, 2001).

To identify potential compliance actions, we evaluated likely sources of the pollutants in the effluent and the effectiveness of different methods to reduce effluent concentrations. Analysis of the available data for a small sample of facilities indicates that there are likely to be exceedances of projected effluent limits for 4,4'-DDT, alpha-BHC, arsenic, bis(2-ethylhexyl) phthalate, dioxin, and mercury. There are a number of potential alternatives for compliance with effluent limits for these pollutants, including:

- Optimizing treatment processes (e.g., adding chemicals to increase flocculation or filtration efficiency) to increase pollutant removal efficiencies
- Source control (e.g., pollution prevention program, inflow and infiltration reductions, more stringent pretreatment standards)
- Installing end-of-pipe treatment technology (e.g., reverse osmosis, granular activated carbon, or chemical precipitation)
- Alternative compliance mechanisms (e.g., site-specific criterion, TMDL, or variance).

Dischargers will pursue the lowest cost means of compliance with effluent limits. However, for the potential revised criteria, technical feasibility is also an issue. For many pollutants, the lowest levels achievable through end-of-pipe treatment are highly uncertain due to the fact that no other dischargers have been required to treat to such low levels and performance data are not available. Thus, due to the uncertainty of achievable effluent levels, we did not identify any end-of-pipe treatment technologies capable of producing the necessary effluent concentrations on a consistent and reliable basis. In addition, even for technologies that could in theory result in compliance, other factors such as disposal of residual streams and very high costs per pound of pollutant removed may render such solutions infeasible, especially at municipal facilities. Hence, there may be a need for alternative compliance mechanisms.

For example, mercury and arsenic are the two main pollutants of concern for the sample facilities we evaluated. There are currently no proven end-of-pipe treatment technologies that can achieve

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low mercury levels (e.g., <10 ng/L) on a consistent basis. Pollution prevention (P2) or source control is a cost-effective means of reducing mercury in wastewater effluents. However, there could be some maximum level of effort beyond which a P2 program would not provide additional reductions and a discharger may need to pursue alternative compliance mechanisms such as a variance.

For arsenic, we estimated a range of actions and costs that included intake credits, best management practices, inflow and infiltration (I&I) reduction programs, and variances. Since the source in municipal wastewater may be from contaminated groundwater leaking into the sewer system, I&I controls might enable compliance with baseline and revised criteria. We estimated the potential cost of such actions based on unit costs from a consulting firm specializing in I&I reduction programs. However, such a scenario may be unlikely for compliance with WQBELs for arsenic alone due to the fact that I&I reduction may be needed for other reasons (reduce flow to treatment plant, which reduces treatment costs, and to reduce sewer overflows). Indeed, state infrastructure needs include I&I reduction at a number of municipal systems (OECDC, 2007).

Thus, due to the uncertainties associated with estimating compliance actions and costs, we included a range of costs based on the most likely compliance scenarios.

ES.6 Method for Evaluating Effect on Nonpoint Sources

Unlike point sources, ODEQ typically does not require nonpoint sources and municipal storm water dischargers to achieve numeric WQBELs for human health pollutants. The regulatory baseline for evaluating the potential impact of the revised criteria includes some requirements for nonpoint sources and storm water dischargers to implement BMPs and load allocations as part of TMDLs. ODEQ has developed TMDLs for a number of toxic pollutants already and will be developing TMDLs for others. However, the pollutant loading reductions and discharge concentrations that will be achieved through baseline BMPs is uncertain. Thus, there is also uncertainty in the extent of incremental controls that could be required under the potential revised criteria.

Instream monitoring data can be used to assess the impact that a change in the fish consumption rate may have on attainment of water quality criteria and thus, control of potential nonpoint sources. Although not representative of all surface waters, ODEQ's Laboratory Analytical Storage and Retrieval (LASAR) database contains water quality monitoring data for the pollutants of concern. LASAR contains 3,889 water column and 676 fish tissue observations (for mercury) collected between 1997 and 2007 from locations other than point source outfalls for which there is either a reported value or detection limit.

The LASAR data indicate that most of the pollutants with detected values have concentrations that exceed the baseline criteria (the exception is nickel, for which potential revised criteria are less stringent than baseline criteria). Thus, source controls are necessary in the absence of revisions to the fish consumption rate. For antimony, beta-BHC, and mercury, the percent of the data that exceeds the criteria increases with increasing consumption rates (e.g., by a factor of 3 for antimony between baseline criteria and criteria based on the highest consumption rate). In

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addition, there may be other pollutants exceeding baseline and revised water quality standards for which detection levels are too high or data are unavailable. Nonpoint sources and storm water may be at least partially responsible for these potential impairments.

ES.7 Results

Costs for compliance with baseline criteria include costs associated with implementation of existing permit limits, plans, and policies that reflect existing criteria. Incremental costs associated with compliance with the potential revised criteria represent the costs of any actions or controls above and beyond those needed to meet baseline requirements.

Point Source Costs

Exhibit ES-1 provides a summary of the potential total and incremental (i.e., above and beyond those needed for compliance with baseline standards) annual statewide costs, both with and without the costs for I&I controls to reduce arsenic in municipal sewer systems. In addition, one-time expenditures associated with variance applications could range from $1.43 million to $7.05 million under the baseline; incremental variance-related expenditures could range from $0.59 million to $2.68 million under revised criteria.

Exhibit ES-1. Summary of Potential Annual Compliance Costs (millions of $2007)

Scenario	Total		Incremental[1]	
	With I&I Costs[2]	No I&I Costs	With I&I Costs[2]	No I&I Costs
Baseline	$3.62 - $29.7	$3.62 - $3.92	NA	NA
63.2 gpd	$3.69 - $29.8	$3.69 - $4.04	$0.075 - $0.13	$0.075 - $0.13
113 gpd	$3.96 - $30.1	$3.96 - $4.31	$0.35 - $0.40	$0.35 - $0.40
175 gpd	$3.96 - $31.0	$3.96 - $4.36	$0.35 - $1.32	$0.35 - $0.45
389 gpd	$4.46 - $31.6	$4.46 - $4.86	$0.85 - $1.82	$0.85 - $0.95
620 gpd	$4.46 - $31.6	$4.46 - $4.86	$0.85 - $1.82	$0.85 - $0.95

NA = Not applicable

1. Represents the difference between total annual cost and baseline costs (i.e., incremental costs above and beyond those needed for compliance with baseline criteria).
2. High estimate includes cost of I&I to reduce arsenic in municipal sewer systems.

The costs for minor dischargers are highly uncertain because there is a lack of data to evaluate effluent quality. For municipal minors, ODEQ (2005) indicates that only domestic sources with a dry weather design flow greater than 1 mgd must sample for toxic pollutants. Thus, unless this requirement changes, it is unlikely that minor municipal dischargers would incur costs for compliance with the baseline or revised criteria. For minor industrial dischargers, ODEQ (2005) indicates that industrial dischargers subject to effluent limitation guidelines would be required to monitor for toxic pollutants. However, effluent toxics data from one of the sample facilities (Oregon Steel Mills) indicates that most toxics are not likely to be present at levels of concern, and those that may be (e.g., arsenic) may not contribute significantly to receiving water concentrations, resulting in BMP requirements rather than numeric WQBELs. Thus, costs to minor industrial facilities for compliance with baseline or revised criteria could be minimal depending on state implementation procedures.

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Nonetheless, one potential pollutant of concern for minor municipal dischargers is mercury. Under the 620 gpd alternative fish consumption rate, the revised mercury criterion could be below the detection level of 0.005 µg/L. Due to its ubiquitous nature in the environment (e.g., mercury is found in many household products and can be excreted in human waste because of mercury in dental fillings), it may be unlikely that any municipal discharger would be able to consistently achieve nondetect effluent levels without implementation of controls. Thus, if ODEQ were to require monitoring by minor municipals under such a scenario, these facilities might need to implement P2 for compliance. Annual P2 costs might range from 10% to 50% of the P2 cost for small major facilities, with the range reflecting the potential for piggybacking on the efforts of other nearby facilities. Thus, total annual costs for all 157 minor municipal dischargers for compliance with mercury criteria based on consumption of 620 gpd of fish could range from $0.8 million to $3.9 million. This may be a conservative estimate given the current lack of monitoring requirements for toxic pollutants for municipal dischargers less than 1 mgd.

Indirect dischargers to municipal wastewater treatment plants could also incur costs associated with the baseline and revised criteria if the municipality imposes more stringent pretreatment standards or requirements on these dischargers in an effort to reduce effluent loads. However, indirect dischargers of pollutants for which a municipal wastewater treatment plant would not have RP or need to reduce effluent loads would not be affected. To account for these potential costs, we estimated costs to indirect dischargers to municipal wastewater treatment plants under a mercury P2 program (discussed in Appendix B). For other pollutants, identifying groups of indirect dischargers likely to be contributing to the influent load at the treatment plant is more difficult because the pollutants are no longer actively used (e.g., legacy pesticides), could be formed as a byproduct of numerous processes (e.g., dioxin), or there is a lack of site-specific information available for each discharger to identify where the pollutant is originating [e.g., arsenic, bis(2-ethylhexyl) phthalate]. Thus, it is not possible to estimate pretreatment or P2 costs to indirect dischargers for pollutants other than mercury without specific information on the types of industrial dischargers in each service area.

Nonpoint Source and Storm Water Costs

Under the baseline, control costs for nonpoint sources (e.g., agricultural and forest operations; contamination from historic mining sites) and municipal storm water include those needed to reduce instream pollutant levels to baseline criteria or TMDL targets. Existing regulatory programs have not been fully implemented, and the extent of implementation efforts is uncertain. Thus, the additional controls needed for compliance under the baseline cannot be estimated. There are, however, indications that baseline compliance costs for nonpoint sources and storm water discharges could be substantial. For example, given the impairment status of waters throughout the state for mercury based on existing data and the fact that point source dischargers are not likely to be significant sources of mercury to those waters, it is possible that nonpoint source controls are needed to improve water quality to meet baseline criteria.

There could also be incremental costs to nonpoint and storm water sources associated with meeting new or revised load allocations. However, because baseline programs have not yet been fully implemented, it is uncertain whether some incremental level of control would be necessary for compliance with the revised criteria. For any situation in which controls beyond those required under the baseline are necessary, controls could include:

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- Agricultural and forest lands – sediment and erosion controls beyond those specified under existing state and federal regulations and plans
- Mining – cleanup and remediation including excavation and onsite capping of contaminated soils, capping of onsite solid waste mining debris, regrading of tailings to mitigate mass wasting and off-site migration, and abatement and mitigation of physical hazards
- Storm water discharges – increased or additional nonstructural BMPs (e.g., institutional, education, or pollution prevention practices designed to limit generation of runoff or reduce the pollutants load of runoff); and structural controls (e.g., engineered and constructed systems designed to provide water quantity or quality control).

Government Regulatory Costs

Identifying the full scope of regulatory program costs associated with implementing existing criteria and programs is outside the scope of this analysis. There is also substantial uncertainty associated with identifying any incremental impact of revised criteria, since the baseline is not fully implemented. Finally, there is uncertainty regarding the attribution of regulatory program expenditures to criteria revisions. However, as the fish consumption rate increases, the applicable human health criteria decrease, which could result in more stringent and infeasible permit limits for point sources, and incremental impairments and need for TMDL development under the revised criteria.

If dischargers pursue variances for compliance with permit limits for mercury, arsenic, bis(2-ethylhexyl) phthalate, DDT, alpha-BHC, and dioxin, ODEQ costs associated with application review may range from $159,000 under the baseline to $65,000 under the revised criteria. For the most part, data are too limited to identify incremental impairments. For one pollutant, mercury, available ambient monitoring data indicate a potential increase of 9 TMDLs at a consumption rate of 63.2 gpd and 21 TMDLs at a consumption rate of 620 gpd. If, for example, TMDL development costs range from approximately $26,000 to $500,000 (EPA, 2001b), this implies an increased level of expenditure of between $0.23 million and $4.5 million for mercury at a consumption rate of 63.2 gpd, and $0.55 million to $10.5 million for mercury at a consumption rate of 620 gpd. Note that the variance application review and TMDL development costs would not be incurred in any single year; rather, the cost would be spread out over several years (e.g., 5 or 10 year time period).

ES.8 Uncertainties in the Analysis

There are a number of uncertainties in the analysis associated with data limitations, potential pollutant load reductions achievable, and how dischargers would respond to potential revised requirements and permit conditions that affect the estimated costs.

The lack of available data for both point and nonpoint sources adds uncertainties to the analysis of potential costs associated with compliance with the revised criteria, including:

- Data are not available for all pollutants or are extremely limited for some of the sample facilities making it difficult to determine whether the facility is in compliance with baseline standards and whether incremental controls would be needed for compliance with revised criteria. Thus, costs could be higher or lower than shown.

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- Lack of effluent flow data from which to calculate appropriate human health dilution factors which could result in lower dilution ratios than actually available, and thus, potentially higher costs.
- In estimating baseline control costs, facility permits and evaluation reports do not provide detailed information on the extent of controls and activities already underway. Thus, baseline costs could be overestimated because facilities may already be implementing controls to address issues such as I&I and P2 programs.
- Lack of available instream monitoring data prevents the estimation of potential statewide costs associated with reductions in pollutant loads from nonpoint sources.
- Lack of data regarding pollutant reductions that have already been or are being achieved with the implementation of BMPs to address existing impairments for conventional pollutants such as temperature and dissolved oxygen. Attainment of standards for these types of pollutants could also result in attainment of the baseline and revised criteria for toxic pollutants, negating the need for additional controls on nonpoint sources.

There is also uncertainty regarding the pollutant loading reductions that would result from compliance with baseline and revised criteria. As the criteria become more stringent under increasing consumption rates, the feasibility of compliance with revised effluent limitations may decrease for some pollutants (e.g., mercury) that are ubiquitous in the environment and for which end-of-pipe treatment to very low levels is unproven. If compliance is not feasible, pollutant load reductions may be minimal.

For point sources, we assumed that facilities would pursue the lowest cost option for compliance with either baseline or revised criteria. However, without site-specific data and analysis, it is uncertain whether any particular control option would guarantee compliance.

In addition, there is uncertainty associated with the levels achievable with baseline controls. For both point and nonpoint sources, we assumed that in some cases baseline controls would result in compliance with revised criteria. It is not clear at which consumption rates the criteria would become low enough to warrant additional controls above and beyond those needed for compliance under the baseline, or whether additional reductions are feasible.

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1. Introduction

The Oregon Department of Environmental Quality (ODEQ) is considering revising the fish consumption rate for calculating water quality criteria applicable to waters in the state. This report provides estimates of the potential incremental compliance actions and costs that may be associated with such a change to the state's water quality standards (WQS).

1.1 Background

The Clean Water Act (CWA) directs states, with oversight by the U.S. Environmental Protection Agency (EPA), to adopt WQS to protect the public health and welfare, enhance the quality of water, and serve the purposes of the CWA. Under Section 303, state WQS must include: (1) designated uses for all water bodies within their jurisdictions, (2) water quality criteria sufficient to protect the most sensitive of the uses, and (3) an antidegradation policy consistent with the regulations at 40 CFR 131.12. The CWA also requires states to hold public hearings once every three years for the purpose of reviewing applicable WQS and, as appropriate, modifying and adopting standards. The results of this triennial review must be submitted to EPA, and EPA must approve or disapprove any new or revised standards.

In May 2004, the Oregon Environmental Quality Commission (EQC) adopted revisions to Oregon Administrative Rules (OAR) covering water quality criteria for toxics (OAR 340-041 - 0033). The EQC revised the representative fish consumption rate for deriving human health criteria from 6.5 grams per day (gpd) to 17.5 gpd based on EPA (2000a) guidance. On July 8, 2004, ODEQ submitted the revised toxics criteria to EPA Region 10 for review and approval. The more stringent criteria took effect on February 15, 2005 before EPA Region 10 approval (those criteria that are less stringent than the existing criteria cannot be implemented without EPA approval). However, the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and other tribes objected to the revised criteria on the basis that the fish consumption rate does not account for higher fish consuming populations, which include Tribal members. As a result, ODEQ is considering adopting a more protective fish consumption rate for calculating revised human health criteria.

1.2 Purpose and Scope of the Analysis

The purpose of this analysis is to identify, using available water quality and discharge data and information, the potential incremental compliance actions and costs that publicly owned wastewater treatment works (POTWs) and industrial point source dischargers may incur as a result of potential revised criteria. These impacts may occur as a result of changes to the National Pollutant Discharge Elimination System (NPDES) permits for these facilities to incorporate revised water quality based effluent limits (WQBELs). Because ODEQ has yet to implement WQBELs reflecting existing criteria for toxic pollutants, we also identify the level of controls and costs that would be needed in the absence of any revisions to the fish consumption rate. Due to time and resource constraints, including the large number of pollutants of concern and limited monitoring data, the estimates of statewide compliance costs reflect the extrapolation of results for a small sample of dischargers.

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Although the focus of this analysis is compliance costs for wastewater point sources, the revised standards may also result in a need for incremental controls by municipal storm water and nonpoint sources discharging to surface waters. However, the data and information needed to evaluate potential control needs is more limited. Thus, we identify the types of controls and costs that may be incurred for these sources but do not develop statewide cost estimates.

For changes to water quality criteria within an existing water quality standards and NPDES permitting program, compliance costs likely represent the major component of total potential social costs. There may be some incremental regulatory program costs under the higher fish consumption rates associated with an increased number of impaired waters and TMDL development. However, for the most part, data are not sufficient to estimate these government costs.

Social costs will be accompanied by the social benefits resulting from the control actions. Similarly, adverse economic impacts (municipal and industrial expenditures financed through user fees and profits) will be accompanied by increased employment, incomes, revenues, and profits to sectors supplying compliance technologies and services (which may be within or external to Oregon). The scope of this analysis is limited to an evaluation of potential compliance costs; this report does not provide estimates of potential benefits of revised standards or an economic impact analysis.

1.3 Organization of Report

This remainder of this report is organized as follows:

Section 2: Baseline for the Analysis – describes the current applicable toxic criteria and ODEQ procedures for implementing the criteria in NPDES permits, sources of toxic pollutants to surface waters, water quality impairments from toxic pollutants, and ongoing efforts to reduce and eliminate these impairments.

Section 3: Potential Revised Criteria – outlines the changes to existing water quality standards based on alternative fish consumption rates.

Section 4: Method for Estimating Potential Costs: Point Sources – describes the method for estimating compliance costs associated with baseline and revised criteria for point sources in terms of revisions to NPDES permits.

Section 5: Method for Estimating Potential Costs: Nonpoint Sources – describes the method for identifying compliance costs associated with baseline and revised criteria for nonpoint sources.

Section 6: Potential Compliance Costs – provides estimates of potential costs to comply with the revised water quality standards, and discusses the uncertainties associated with the estimates.

Section 7: References – provides the references used in the analysis.

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The appendices provide detailed analyses and additional information:

Appendix A: provides data and information on individual sample facilities, and analyses of potential impacts under the different scenarios.

Appendix B: describes pollution prevention programs and estimated costs.

Appendix C: provides details for various end-of-pipe treatment technologies, including estimated costs, where available.

Appendix D: describes the applicable analyses for obtaining a temporary variance from WQBELs based on economic factors.

Appendix E: provides descriptions and costs for best management practices for nonpoint sources and storm water discharges.

Appendix F: summarizes the sample facility results and shows calculations for the extrapolation of statewide costs.

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2. Baseline for the Analysis

This section describes the applicable baseline for evaluating the incremental costs associated with potential revised fish consumption rates for calculating water quality criteria, including current water quality criteria, potential sources of the pollutants of concern, and the current level of impairment in Oregon waters.

2.1 Water Quality Criteria

OAR 340-041-0033, Table 33A, provides existing water quality criteria for the protection of human health based on consumption of water and organisms (e.g., fish) and organisms only. ODEQ proposed the criteria, which are based on EPA's recommended national fish consumption rate of 17.5 gpd, on May 20, 2004. Those criteria that are more stringent than the previous criteria became effective February 15, 2005. The remaining criteria are not to be implemented in NPDES permits until EPA approves the criteria because they are less stringent than the previous criteria. Thus, the previous criteria (OAR 340-041-0033, Table 20) are the applicable baseline criteria for these pollutants.

Exhibit 2-1 shows the applicable baseline criteria for toxic pollutants. ODEQ designates all waters (except Bull Run River which has no dischargers) for the protection of both aquatic life and human health. Thus, pollutants for which the aquatic life criteria are more stringent than the human health criteria are not of concern for the analysis because compliance costs will be driven by the more stringent aquatic life criteria.

Exhibit 2-1. Baseline Human Health Criteria for Pollutants of Concern[1]

Pollutant	Freshwater Aquatic Life (µg/L)		Saltwater Aquatic Life (µg/L)		Human Health (µg/L)	
	Acute	Chronic	Acute	Chronic	Water and Fish	Fish Only
1,1,1-Trichloroethane	-	-	-	-	18,400 a	1,030,000 a
1,1,2,2-Tetrachloroethane	-	-	-	-	0.17	4
1,1,2-Trichloroethane	-	-	-	-	0.59	16
1,1-Dichloroethylene	-	-	-	-	330	7,100
1,2,4,5-Tetrachlorobenzene	-	-	-	-	0.97	1.1
1,2,4-Trichlorobenzene	-	-	-	-	35	70
1,2-Dichlorobenzene	-	-	-	-	420	1,300
1,2-Dichloroethane	-	-	-	-	0.38	37
1,2-Dichloropropane	-	-	-	-	0.5	15
1,2-Diphenylhydrazine	-	-	-	-	0.036	0.2
1,2-Trans-Dichloroethylene	-	-	-	-	140	10,000
1,3-Dichlorobenzene	-	-	-	-	320	960
1,3-Dichloropropene	-	-	-	-	0.34	21
1,4-Dichlorobenzene	-	-	-	-	63	190
2,3,7,8-TCDD (Dioxin)	-	-	-	-	0.000000005	5.1E-09
2,4,5-Trichlorophenol					1,800	3,600
2,4,6-Trichlorophenol	-	-	-	-	1.2 a	2.4
2,4-Dichlorophenol	-	-	-	-	77	290
2,4-Dimethylphenol	-	-	-	-	380	850

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Exhibit 2-1. Baseline Human Health Criteria for Pollutants of Concern[1]

Pollutant	Freshwater Aquatic Life (µg/L)		Saltwater Aquatic Life (µg/L)		Human Health (µg/L)	
	Acute	Chronic	Acute	Chronic	Water and Fish	Fish Only
2,4-Dinitrophenol	-	-	-	-	69	5,300
2,4-Dinitrotoluene	-	-	-	-	0.11	3.4
2,4-Dinitro-o-Cresol	-	-	-	-	13.4	765
2-Chloronaphthalene	-	-	-	-	1,000	1,600
2-Chlorophenol	-	-	-	-	81	150
2-Methyl-4,6-Dinitrophenol	-	-	-	-	13	280
3,3'-Dichlorobenzidine	-	-	-	-	0.021	0.028
4,4'-DDD	-	-	-	-	0.00031	0.00031
4,4'-DDE	-	-	-	-	0.00022	0.00022
4,4'-DDT	-	-	-	-	0.000024 a	0.000024 a
Acenaphthene	-	-	-	-	670	990
Acrolein	-	-	-		190	290
Acrylonitrile	-	-	-	-	0.051	0.25
Aldrin	3	-	1.3	-	0.000049	0.00005
alpha-BHC	-	-	-	-	0.0026	0.0049
Anthracene	-	-	-	-	8,300	40,000
Antimony	-	-	-	-	5.6	640
Arsenic	-	-	-	-	0.0022 a	0.0175 a
Arsenic (III)	360	190	69	36	-	-
Barium	-	-	-	-	1,000	-
Benzene	-	-	-	-	0.66 a	40 a
Benzidine	-	-	-	-	0.000086	0.0002
Benzo(a) Anthracene	-	-	-	-	0.0038	0.018
Benzo(a) Pyrene	-	-	-	-	0.0038	0.018
Benzo(b) Fluoranthene	-	-	-	-	0.0038	0.018
Benzo(k) Fluoranthene	-	-	-	-	0.0038	0.018
Beryllium	-	-	-	-	0.0068 a	0.117
beta-BHC	-	-	-	-	0.0091	0.017
Bis(2-Chloroethyl) Ether	-	-	-	-	0.03 a	0.53 a
Bis(2-Chloroisopropyl) Ether	-	-	-	-	34.7 a	4,360 a
Bis (Chloromethyl) Ether	-	-	-	-	3.7E-09 a	0.00184 a
Bis(2-Ethylhexyl) Phthalate	-	-	-	-	1.2	2.2
Bromoform	-	-	-	-	4.3	140
Butylbenzyl Phthalate	-	-	-	-	1,500	1,900
Cadmium	3.9 a,b	1.1 a,b	43 a	9.3 a	10	-
Carbon Tetrachloride	-	-	-	-	0.23	1.6
Chlordane	2.4	0.0043	0.09	0.004	0.00046 a	0.00048 a
Chloride	860,000	230,000	-	-	-	-
Chlorine	19	11	13	7.5	-	-
Chlorobenzene	-	-	-	-	130	1,600
Chlorodibromomethane	-	-	-	-	0.4	13
Chloroform	-	-	-	-	0.19 a	15.7 a
Chlorpyrifos	0.083	0.041	0.011	0.0056	-	-
Chromium (III)	1,700 a,b	210 a,b	-	-	170,000	3,433,000

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Exhibit 2-1. Baseline Human Health Criteria for Pollutants of Concern[1]

Pollutant	Freshwater Aquatic Life (µg/L)		Saltwater Aquatic Life (µg/L)		Human Health (µg/L)	
	Acute	Chronic	Acute	Chronic	Water and Fish	Fish Only
Chromium (VI)	16	11	1,100	50	50	-
Chrysene	-	-	-	-	0.0038	0.018
Copper	18 a,b	12 a,b	2.9 a	2.9 a	-	-
Cyanide	22	5.2	1	1	140	140
Demeton	-	0.1	-	0.1	-	-
Dibenzo(a,h)Anthracene	-	-	-	-	0.0038	0.018
Dibutylphthalate	-	-	-	-	35,000	154,000
Dichlorobromomethane	-	-	-	-	0.55	17
Dieldrin	0.24	0.0019	0.71	0.0019	0.000052	0.000054
Diethyl Phthalate	-	-	-	-	17,000	44,000
Dimethyl Phthalate	-	-	-	-	270,000	1,100,000
Di-n-Butyl Phthalate	-	-	-	-	2,000	4,500
Endosulfan	0.22	0.056	0.034	0.0087	62	89
Endosulfan Sulfate	-	-	-	-	62	89
Endrin	0.086	0.0023	0.037	0.0023	0.059	0.06
Endrin Aldehyde	-	-	-	-	0.29	0.3
Ethylbenzene	-	-	-	-	530	2,100
Fluoranthene	-	-	-	-	42 a	54 a
Fluorene	-	-	-	-	1,100	5,300
gamma-BHC (Lindane)	0.95	0.08	0.16	-	0.0186 a	0.0625 a
Heptachlor	0.52	0.0038	0.053	0.0036	0.000079	0.000079
Heptachlor Epoxide	-	-	-	-	0.000039	0.000039
Hexachlorobenzene	-	-	-	-	0.00028	0.00029
Hexachlorobutadiene	-	-	-	-	0.44	18
Hexachlorocyclohexane	-	-	-	-	0.0123	0.0414
Hexachlorocyclopentadiene	-	-	-	-	40	1,100
Hexachloroethane	-	-	-	-	1.4	3.3
Ideno(1,2,3-cd)Pyrene	-	-	-	-	0.0038	0.018
Iron	-	1,000	-	-	300	-
Isophorone	-	-	-	-	35	960
Lead	82 a,b	3.2 a,b	140 a	5.6 a	50 a	-
Malathion	0.1	-	0.1	-	-	-
Manganese	-	-	-	-	50 a	100 a
Methyl Bromide	-	-	-	-	47	1,500
Methylene Chloride	-	-	-	-	4.6	590
Mercury	2.4	0.012	2.1	0.025	0.144	0.146
Methoxychlor	-	0.03	-	0.03	100	-
Methylene Chloride	-	-	-	-	4.6	590
Methylmercury	-	-	-	-	-	300 µg/kg[2]
Mirex	-	0.001	-	0.001	-	-
Monochlorobenzene	-	-	-	-	488 a	-
Nickel	1,400 a,b	160 a,b	75 a	8.3 a	13.4 a	100 a
Nitrates	-	-	-	-	10,000	-
Nitrobenzene	-	-	-	-	17	690

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Exhibit 2-1. Baseline Human Health Criteria for Pollutants of Concern[1]

Pollutant	Freshwater Aquatic Life (µg/L)		Saltwater Aquatic Life (µg/L)		Human Health (µg/L)	
	Acute	Chronic	Acute	Chronic	Water and Fish	Fish Only
Nitronsamines	-	-	-	-	0.0008	1.24
N-Nitronsodibutylamine	-	-	-	-	0.0063	0.22
N-Nitrosodiethylamine	-	-	-	-	0.0008	1.24
N-Nitrosodimethylamine	-	-	-	-	0.00069	3
N-Nitrosodi-n-Propylamine	-	-	-	-	0.005	0.51
N-Nitrosodiphenylamine	-	-	-	-	3.3	6
N-Nitrosopyrrolidine	-	-	-	-	0.016	34
N-Nitrosodi-n-Propylamine	-	-	-	-	0.0050	0.51
Parathion	0.065	0.013	-	-	-	-
Pentachlorobenzene	-	-	-	-	1.4	1.5
Pentachlorophenol	20 a	13 a	13	7.9	0.27	3
Phenol	-	-	-	-	3,500 a	1,700,000
Phosphorus Elemental	-	-	-	0.1	-	-
PAHs	-	-	-	-	0.0028 a	0.0311 a
PCBs	2	0.014	10	0.03	0.000064	0.000064
Pyrene	-	-	-	-	830	4,000
Selenium	260 a	35 a	410 a	54 a	10 a	4,200
Silver	4.1 a,b	0.12 a	2.3 a	-	50*	-
Sulfide-Hydrogen Sulfide	-	2	-	2	-	-
Tetrachloroethylene	-	-	-	-	0.69	3.3
Thallium	-	-	-	-	0.24	0.47
Toluene	-	-	-	-	1,300	15,000
Toxaphene	-	-	-	-	0.00028	0.00028
Trichloroethylene	-	-	-	-	2.5	30
Vinyl Chloride	-	-	-	-	0.025	2.4
Zinc	120 a,b	110 a,b	95 a	86 a	7,400	26,000

Source: OAR 340-041-0033, Table 20 (denoted with an "a") and Table 33A.
a = indicates Table 20 criteria.
b = criteria calculated based on 100 mg/L hardness.
1. Effective human health criteria include criteria from OAR 2340-041-0033 Table 33A that became effective February 2005 (revised criteria that became effective without EPA approval) and Table 20 (original criteria since ODEQ's 2004 proposed criteria are not effective pending EPA approval).
2. Criterion based on concentration of pollutant in fish tissue.

Note that for Section 303(d) listings, the revised criteria based on a fish consumption rate of 17.5 gpd cannot be used until ODEQ receives EPA Region 10 approval for the revisions.

2.2 Sources of Toxic Pollutants to Surface Waters

Toxic pollutants can be introduced to surface water through natural and human activities, including municipal and industrial effluents, storm water discharges, agricultural runoff, forestry (chemical application), mines, and atmospheric deposition.

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2.2.1 Municipal and Industrial Dischargers

EPA's Permit Compliance System (PCS) database indicates that there are 390 municipal and industrial NPDES permitted dischargers in Oregon. **Exhibit 2-2** shows the number of facilities by type (major/minor) and industrial category specified in PCS.

Exhibit 2-2. NPDES Permitted Direct Dischargers in Oregon

Category[1]	Majors	Minors
Agricultural Production – Crops	-	1
Fishing, Hunting, and Trapping	-	5
Metal Mining	-	1
Nonmetallic Minerals	-	5
Food and Kindred Products	2	11
Lumber and Wood Products	1	29
Paper and Allied Products	11	1
Chemicals and Allied Products	2	5
Stone, Clay, and Glass Products	-	4
Primary Metal Industries	4	2
Fabricated Metal Products	-	2
Industrial Machinery and Equipment	-	1
Electronic and Other Electronic Equipment	1	3
Transportation Equipment	-	2
Measuring, Analyzing, and Controlling Instruments	-	1
Water Transportation	-	1
Transportation by Air	-	2
Electric, Gas, and Sanitary Services; except 4952	-	17
Sewerage Services (Municipal Wastewater)	49	157
Wholesale Trade	-	8
Real Estate	-	4
Hotels and Other Lodging Places	-	3
Miscellaneous Repair Services	-	1
Educational and Social Services	-	6
Museums, Botanical, Zoological Gardens	-	1
Engineering, Accounting, Research, Management, and Related Services	-	1
Public Administration	-	2
Nonclassifiable Establishments	-	1
Not specified in PCS	-	36
Total	70	313

"-" = None.
1. Based on 2-digit standard industrial classification (SIC) code.
Source: U.S. EPA (2007); Accessed June 8, 2007.

ODEQ issues general NPDES permits for 15 different discharger categories, including cooling water/heat pumps, filter backwash, fish hatcheries, log ponds, boiler blowdown, seafood processing, storm water from gravel mining, construction that disturbs one acre or more, industrial storm water, oily storm water runoff, oil/water separators, tanks cleanup and treatment of groundwater, washwater, and noncontact geothermal water. Currently there are no effluent limits or monitoring requirements for any of the pollutants of concern in these permits.

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2.2.2 Storm Water

Storm water discharges are generated by precipitation and runoff from land, pavements, building rooftops, and other surfaces. Storm water from municipal and industrial areas may contribute toxic pollutants to surface waters. ODEQ regulates storm water discharges from municipal separate storm sewer systems (MS4s) through general permits. The MS4 permits require the discharger to develop and implement a storm water management program (SWMP), with the goal of controlling pollutant discharges to the maximum extent practicable (MEP). ODEQ interprets the MEP requirement to require all controls that are reasonable and available. The management programs specify the best management practices (BMPs) that will be used in the following areas: public education and outreach; public participation and involvement; illicit discharge detection and elimination; construction runoff control; post-construction runoff control; and pollution prevention and good housekeeping. Permittees implement BMPs through an adaptive management or iterative approach.

ODEQ has issued 6 area-wide "Phase I" MS4 permits. Phase I MS4s are those systems serving populations greater than 100,000. "Phase II" (or "small") MS4s are those systems serving municipalities with populations less than 100,000 located within Census Bureau-defined urbanized areas. There are 18 cities and counties in Oregon required to obtain "Phase II" MS4 permits. Federal regulations also provide states the discretion to require other MS4s outside of urbanized areas to apply for a permit.

Industrial dischargers, including those engaged in manufacturing, transportation, mining, and steam electric power industries, scrap yards, landfills, certain sewage treatment plants, and hazardous waste management facilities may have storm water requirements in their NPDES permits. ODEQ requires industrial storm water dischargers to develop a Storm Water Pollution Control Plan (SWPCP) that includes a monitoring plan and discussion of the site controls that the discharger will implement to prevent storm water pollution (ODEQ, 2004).

2.2.3 Agriculture

Pesticides applied to agricultural lands can reach surface waters through irrigation return flow, storm water runoff, and erosion of soils. Oregon's Department of Agriculture's (ODA) Agricultural Water Quality Program (AWQP) is charged with assisting the agriculture industry in reducing pollution from agricultural sources. The legal foundation of the AWQP is the Agricultural Water Quality Management Act (SB1010) created in 1993 (ODA, 2007). SB1010 provides the department with enforcement authority to deal with situations where corrective action is needed, but is not voluntarily being taken by an operator. In those cases where a farmer or rancher refuses to take action, the law authorizes the department to require corrective measures or use civil penalties to address the issue.

The ODA has identified 39 watershed-based agricultural water quality management areas (AWQMA). Within each AWQMA is a local advisory committee (LAC) consisting of water quality specialists, local farmers, ranchers, and community leaders. All 39 LACs have approved Agricultural Water Quality Management Area Plans (AWQMAP) along with enforceable administrative rules to ensure all landowners do their part to avoid and resolve water quality

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problems. AWQMAPs must describe a program to achieve water quality standards. AWQMA rules must be sufficient to assure that landowners will prevent and control water pollution from agricultural activities and soil erosion.

Agricultural sediment and erosion controls may be required to meet total maximum daily loads (TMDLs) for several toxic pollutants. For example, elevated fish tissue concentrations of DDT and dieldrin, now banned pesticides, exist in the Snake River. In developing the Snake River – Hells Canyon TMDL, ODEQ assumed that existing loadings of these compounds occur solely from legacy application or contamination (ODEQ and IDEQ, 2003). The implementation plan for the TMDL recommends sediment/erosion control practices to meet the load allocation defined in the TMDL. These controls will be outlined and enforced in AWQMAPs for Owyhee, Malheur, Burnt, Powder, and Wallowa basins (ODEQ and IDEQ, 2003).

Elevated fish tissue concentrations of mercury exist in the Willamette Basin. The Willamette Basin Mercury TMDL states that relative contribution of mercury to the basin from erosion of native mercury-containing soils is approximately 48% (ODEQ, 2006b). ODEQ is implementing an incremental phased approach for this TMDL with plans to update current recommendations in 2011. As part of the update, ODEQ plans to further investigate the relative contributions of mercury from various sources (ODEQ, 2006c). The current implementation plan offers sector level, general recommendations to reduce the level of mercury in the Willamette River system. ODEQ recommends updating applicable AWQMAPs to include strategies for minimizing soil erosion and controlling the use of mercury containing products.

2.2.4 Forestry

Forest pesticides, which include herbicides, fungicides, insecticides, and rodenticides, are commonly used to aid in the reestablishment, growth, and survival of forest tree species throughout Oregon (ODF, 2000). The Oregon Department of Forestry (ODF) regulates forest operations on nonfederal forestland through the Forest Practice Rules (FPR). The legal foundation for the FPRs is the Oregon Forest Practices Act (FPA). ODF administers forest practice chemical rules to ensure that chemicals used on forestland do not enter surface waters in quantities that would degrade water quality or be harmful to the overall maintenance of terrestrial wildlife or aquatic life (ODF, 2007a). FPRs related to chemical applications require:

- Written notification to ODF at least 15 days before conducting a chemical application
- Operators (landowners, loggers, and pesticide applicators) must maintain chemical handling equipment in a leak proof condition
- Whenever water is taken from any stream or water impoundment for use in mixing chemicals, the operator must prevent chemicals from entering the water
- Operator must conduct mixing, transfer, and staging of chemical applications in locations where the site does not provide a route for any chemical spill to run into water
- Chemical label requirements must be followed
- Operators must obey buffer requirements for chemical application in the vicinity of water bodies (e.g., 10 feet for ground applications; 60 feet for aerial applications of herbicides, rodenticides, and biological insecticides; and 100 feet for aerial applications of fungicides and nonbiological insecticides) (ODF, 2007b).

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As described above, the Willamette Basin Mercury TMDL states that relative contribution of mercury to the basin from erosion of mercury containing soils is approximately 48%. ODEQ recommends implementing BMPs required by the FPA that minimize soil erosion to reduce mercury loads from erosion from forestland (ODEQ, 2006c).

2.2.5 Mines

Abandoned and inactive mines exist throughout Oregon, including historic mining districts in eastern Oregon, southwest Oregon, and the Willamette Basin. Over the last century, minerals and metals such as gold, silver, copper, zinc, and mercury have been extracted from these mines. State and federal agencies have identified over 140 mines in Oregon for possible further investigation or cleanup, and have initiated assessment of about 95 (ODEQ, 2006a).

ODEQ relies on the Orphan Site Account (OSA) to pay for clean up of contaminated sites, including abandoned mines, where the responsible party is unknown, unable, or unwilling to perform cleanup. However, state OSA funds have decreased significantly over the past several years (ODEQ, 2006a). Faced with monetary constraints, ODEQ prioritizes sites based on risks to human health and the environment. The ODEQ also works closely with federal agencies (U.S. EPA, U.S. Forest Service, and federal Bureau of Land Management) to try to secure cleanup funds for abandoned mines that are located on both public and private land (ODEQ, 2006a).

Controls at mine sites may be required to meet existing TMDLs for toxic pollutants including mercury. For example, the Willamette Basin Mercury TMDL (ODEQ, 2006b) states that relative contribution of mercury to the basin from legacy mining operations is only 0.6%. However, ODEQ indicates that mercury residuals from old mining operations represent a significant source of mercury (approximately 75%) in the Cottage Grove Watershed within the Willamette Basin. ODEQ is implementing an incremental phased approach for this TMDL with plans to update the current recommendation in 2011. The current implementation strategy includes a continuation of ODEQ efforts to remediate abandoned mine sites to minimize the flow of mercury into adjacent water bodies (ODEQ, 2006c).

Elevated concentrations of mercury in fish tissues also exist in the Snake and Owyhee Rivers. ODEQ and IDEQ (2003) analyzed the mercury loading in the Snake River – Hells Canyon drainage and concluded that legacy gold, silver, and mercury mining in the drainage area may be a moderate to substantial contributor of the total mercury loading. Most of this legacy mining was located in the watershed of the Owyhee River, a tributary to the Snake River (ODEQ and IDEQ, 2003). ODEQ and IDEQ did not develop a TMDL for mercury due to limited data; however, both have plans to develop a TMDL in the future.

In its Mercury Reduction Strategy, ODEQ identified planned activities at mercury contaminated mines (ODEQ, 2007a):

- Black Butte Mine: Interim soil removal
- Horse Heaven Mine: Second phase of remedial action
- Opalite and Bretz Mines: Exploring joint funding options with the Vale District of the Bureau of Land Management
- Ochoco Mercury District: Phase 2 Abandoned Mine Lands study.

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2.2.6 Atmospheric Deposition

Atmospheric deposition may be a potential nonpoint source to surface waters through either direct or indirect deposition. Direct deposition occurs when pollutants deposited directly on surface waters from the atmosphere. Indirect deposition reflects the process by which metals and other pollutants such as pesticides deposited on the land surface are washed off during storm events and enter surface water through storm water runoff. Atmospheric deposition is not directly addressed through any existing regulation, but is indirectly addressed through TMDLs.

Atmospheric deposition is identified as a major source of mercury in both the Willamette Basin and the Snake River – Hells Canyon reach. ODEQ estimated the relative contribution of direct and indirect atmospheric deposition of mercury in the Willamette Basin to be approximately 6% and 42%, respectively (ODEQ, 2006b). The Willamette Basin mercury TMDL implementation strategy includes a combination of voluntary BMPs to reduce emissions from air mobile, area, and industrial sources. The adoption of BMPs to control mercury movement on the landscape in urban, agriculture, and forestry environments, such as through erosion control practices, will help control mercury (ODEQ, 2006c).

ODEQ and IDEQ's initial analysis of the Snake River – Hells Canyon drainage identified atmospheric deposition as a potentially substantial source of mercury - primarily from the combustion of fossil fuels (ODEQ and IDEQ, 2003). ODEQ plans to develop a TMDL to further investigate mercury in this drainage.

2.3 Water Quality

There are approximately 58,000 miles and 5,000 acres of surface water on Oregon's 2004 303(d) list that are impaired. **Exhibit 2-3** summarizes the number of water bodies impaired for each pollutant.

Exhibit 2-3. Summary of Oregon's 2004 303(d) List of Impairments

Pollutant	Number of Water Bodies	Number of River Miles	Number of Lake Acres
Aldrin	1	72.0	NA
Ammonia	16	279.0	*
Aquatic Weeds or Algae	23	276.2	169
Arsenic	14	501.8*	NA
Arsenic (tri)	7	135.9	NA
Beryllium	12	144.6	NA
Biological Criteria	32	479.1*	NA
Cadmium	3	33.1	NA
Chlordane	1	7.8	NA
Chlorine	3	55.3	NA
Chlorophyll a	30	621.6	*
Chlorpyrifos	4	20.1	NA
Chromium (hex)	2	*	*
Copper	13	107.1*	*
DDT	5	240.9	NA
DDT Metabolite (DDE)	3	222.5	NA

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Exhibit 2-3. Summary of Oregon's 2004 303(d) List of Impairments

Pollutant	Number of Water Bodies	Number of River Miles	Number of Lake Acres
Dichloroethylenes	2	22.6*	NA
Dieldrin	8	216.1	NA
Dioxin (2,3,7,8-TCDD)	3	802.7	NA
Dissolved Oxygen	131	3,279*	706*
E Coli	94	1,906*	NA
Enterococcus	1	2.6	NA
Fecal Coliform	136	2,514	NA
Flow Modification	530	11,295	NA
Guthion	1	5.6	NA
Habitat Modification	615	10,546*	3,017*
Heptachlor	1	2.8	NA
Iron	43	1,060*	NA
Lead	9	59.9*	*
Manganese	27	605.0*	NA
Mercury	15	667.9	780
Nickel	1	12.8	NA
Nitrates	4	53.3	NA
PCB	4	292.8	NA
Pentachlorophenol	1	24.8	NA
pH	64	1,660	134
Phosphorus	48	667.5*	184
PAHs	3	92.5	NA
Sedimentation	90	1,273.2	NA
Silver	4	52.8	*
Temperature	840	16,841*	NA
Tetrachloroethylene	2	22.6*	NA
Total Dissolved Gas	3	326.4	NA
Trichloroethylene	1	22.6	NA
Turbidity	4	96.4	NA
Zinc	6	25.7*	*
Total**	2,860	57,648	4,990

Source: ODEQ (2006d).
NA = not applicable
*Missing acreage or river miles for one or more water bodies.
**Some water bodies are listed for more than one pollutant.

The Oregon Department of Health has also issued fish consumption advisories for mercury (7 lakes/reservoirs and 4 rivers), PCBs (3 rivers), and pesticides (2 rivers).

Exhibit 2-4 summarizes the targets, load allocations, and implementation plans in completed TMDLs for the toxic pollutants of concern. TMDLs for other pollutants that result in a need for controls that reduce a variety of pollutants (e.g., forest buffers that increase shade and reduce temperature but also reduce runoff of toxics) will also impact the baseline relevant to estimating the incremental impacts of the revised standards.

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Exhibit 2-4. Summary of Toxic Pollutant TMDLs in Oregon

Water Body	Pollutant/Trigger	Load Allocations	Implementation
Columbia River (ODEQ, 1991)	Dioxin – high fish tissue concentrations	Watershed Allocations: Columbia R. above WA/Canada border = 2.31 mg/day; Snake R. Basin above Ice Harbor Dam = 1.18 mg/day; Willamette R. Basin above Columbia R. = 0.54 mg/day Pulp and Paper Mills: Potlatch = 0.39 mg/day; Pope and Talbot = 0.19 mg/day; Boise Cascade, Wallula = 0.25 mg/day; James River, Camas = 0.42 mg/day; Longview Fibre = 0.08 mg/day; Weyerhaeuser = 0.26 mg/day; Boise Cascade, St. Helens = 0.27 mg/day; James River, Wauna = 0.21 mg/day	No implementation strategies identified to meet allocations.
Columbia Slough (ODEQ, 1998)	DDT – fish tissue exceed 1.29 μg/kg Dieldrin – fish tissue exceed 3.5 μg/kg PCBs – fish tissue exceed 2.46 μg/kg Dioxin – fish tissue exceed 0.07 ng/kg	DDT: Sediments = 4.88×10^{-4} mg/day; Storm Water = 3.24 mg/day; Future Growth = 1.62 mg/day Dieldrin: Sediments = 0.0108 mg/day; Storm Water = 9.6 mg/day; Future Growth = 4.8 mg/day PCBs: Sediments = 0.161 mg/day; Storm Water = 5.3 mg/day; Future Growth = 10.6 mg/day; NuWay Oil = 1.82×10^{-4} mg/day Dioxin: Sediments = 1.31×10^{-3} mg/day; Storm Water = 1.31×10^{-3} mg/day; Future Growth = 1.31×10^{-3} mg/day	Phase I implementation strategies include: • Implement BMPs to reduce erosion and sedimentation. • Monitor effectiveness of BMPs. • Monitor contribution of contaminated sediment sites. • Develop allocations for contaminated sediment sites. • Remediate contaminated sediment in Buffalo Slough.
Snake River (ODEQ and IDEQ, 2003)	DDT – high fish tissue concentrations and exceeds water quality criterion Dieldrin – exceeds water quality criterion	DDT: New applications = 0 kg/yr Legacy application and transport (RM 409 to 335) = 0.31 kg/yr Brownlee and Oxbow Reservoirs = 0.33 kg/yr Dieldrin: New applications = 0 kg/yr Legacy application and transport (RM 409 to 335) = 0.88 kg/yr Brownlee and Oxbow Reservoirs = 1.0 kg/yr	Implementation strategies include: • Implement waste load allocations for point sources though NPDES permits. • Implement numeric effluent limits or specific management measures into general permits. • Designated management agencies will select management measures to be included in implementation plans, determine if the source and/or management measure is applicable within their jurisdiction; monitor the frequency and extent of application measures for each identified source.
Willamette Basin (ODEQ, 2006b; 2006c)	Mercury – exceeds fish advisory screening level	Interim Mercury Allocations: Runoff of atmospherically deposited mercury = 39.2 kg/yr; Direct deposition to open water = 5.5 kg/yr; Erosion of mercury containing soils = 44.8 kg/yr; Legacy mine discharges = 0.6 kg/yr; Sediment resuspension = 0 kg/yr; POTW discharges = 2.6 kg/yr; Industrial discharges = 1.1 kg/yr	Implementation strategies include: • Require selected NPDES permittees to monitor for mercury and develop and implement mercury reduction plans as interim implementation measures. • Ensure MS4s are addressing mercury through their permits and require Phase I permittees to collect data on mercury in runoff so they may be appropriately

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Exhibit 2-4. Summary of Toxic Pollutant TMDLs in Oregon

Water Body	Pollutant/Trigger	Load Allocations	Implementation
			considered in the 2011 TMDL update. • Require implementation of BMPs for the 1200Z general permit. • Incorporate mercury reduction strategies into implementation plans for Non-MS4 areas, Agricultural Water Quality Management Area Plans, Forest Practices Act, plans from the federal land managers, and air sectors. • Support ongoing efforts between the ODEQ Land Quality Program, BLM, and other stakeholders who are working to address mercury runoff from abandoned mines.

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3. Potential Revised Criteria

ODEQ is considering revising the fish consumption rate for calculating human health criteria. The criteria can be calculated based on the pollutant reference dose (for noncarcinogens) or cancer potency factor (for carcinogens), bioconcentration factor, and fish consumption rate (EPA, 1980):

$$AWQC = (RfD * RSC) * \left[\frac{BW}{DI + (FI * BCF)} \right]$$

$$AWQC = \left(\frac{10^{-6}}{q1*} \right) * \left[\frac{BW}{DI + (FI * BCF)} \right]$$

where,
AWQC = ambient water quality criterion in mg/L
BW = human body weight default value of 70 kg
RfD = reference dose based on noncancer human health effects in mg/kg body weight-day
RSC = relative source contribution (%)
DI = drinking water intake default value of 2 L/day
FI = human fish consumption in kg fish/day
BCF = bioconcentration factor in L/kg fish
q1* = cancer potency factor in kg body weight-day/mg.

U.S. EPA (2002) provides the applicable RfD, RSC, BCF, and q1* values for each pollutant of concern.

In 2001, EPA published a revised methylmercury criterion based on the concentration of methylmercury in fish tissue, calculated using the following equation (EPA, 2001a):

$$TRC = \frac{BW * (RfD - RSC)}{\sum_{i=2}^{4} FI_i}$$

where,
TRC = tissue residual concentration in mg methylmercury/kg fish
FI_i = human fish consumption of trophic level[1] i (kg fish/day)
RSC = relative source contribution in mg methylmercury/kg body weight-day.

Exhibits 3-1 and 3-2 summarize the human health criteria for the pollutants of concern (i.e., those pollutants with baseline and revised human health criteria more stringent than the existing aquatic life criteria and for which reference dose/cancer potency factor and bioconcentration factor are available) for select fish consumption rates and ODEQ's quantification limits (QLs)

[1] Trophic levels are defined by the food relationship of fish in the food chain. There are four trophic levels that make up the aquatic food chain: primary producers such phytoplankton and other plants; zooplankton, benthic filter feeders, grazers, and herbivorous fish; small predacious fish; and large, predator fish.

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which represent the minimum level to which dischargers need to measure each pollutant. Note that for some pollutants, the baseline criteria are more stringent than the revised criteria based on alternative fish consumption rates (e.g., benzene, chloroform, and nickel, among others).

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Exhibit 3-1. Human Health Criteria for Select Consumption Rates: Consumption of Water and Fish

Pollutant	QL (µg/L)	Baseline Criteria (µg/L)	Revised Criteria based on Select Consumption Rates (µg/L)				
			63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
1,1,2,2-Tetrachloroethane	0.5	0.17	0.15	0.14	0.12	0.089	0.069
1,1,2-Trichloroethane	0.5	0.59	0.54	0.49	0.44	0.33	0.26
1,1-Dichloroethylene	0.5	330	300	270	230	170	130
1,2,4,5-Tetrachlorobenzene	1.0	0.97	0.29	0.16	0.11	0.048	0.030
1,2,4-Trichlorobenzene	0.5	35	15	9.4	6.4	3.0	1.9
1,2-Dichlorobenzene	0.5	420	230	150	110	53	35
1,2-Dichloroethane	0.5	0.38	0.37	0.36	0.35	0.31	0.28
1,2-Dichloropropane	0.5	0.5	0.46	0.42	0.38	0.29	0.23
1,2-Diphenylhydrazine	5.0	0.036	0.024	0.018	0.014	0.0075	0.0050
1,2-Trans-Dichloroethylene	0.5	140	130	130	120	110	94
1,3-Dichlorobenzene	0.5	320	170	110	80	40	26
1,3-Dichloropropene	0.5	0.34	0.33	0.32	0.30	0.26	0.22
1,4-Dichlorobenzene	0.5	63	34	23	16	7.9	5.1
2,3,7,8-TCDD (Dioxin)	5.0E-06	5.0E-09	1.4E-09	7.9E-10	5.1E-10	2.3E-10	1.4E-10
2,4,5-Trichlorophenol	2.0	1,800	780	490	330	160	100
2,4,6-Trichlorophenol	1.0	1.2	0.55	0.34	0.23	0.11	0.067
2,4-Dichlorophenol	1.0	77	46	32	23	12	7.7
2,4-Dimethylphenol	2.0	380	180	110	76	36	23
2,4-Dinitrophenol	5.0	69	67	65	62	54	48
2,4-Dinitrotoluene	1.0	0.11	0.10	0.093	0.084	0.065	0.052
2-Chloronaphthalene	1.0	1,000	380	230	150	69	44
2-Chlorophenol	1.0	81	33	20	14	6.5	4.1
2-Methyl-4,6-Dinitrophenol	2.0	13	12	10	9.2	6.6	5.0
3,3'-Dichlorobenzidine	1.0	0.021	0.0072	0.0042	0.0027	0.0013	0.0008
4,4'-DDD	0.01	0.00031	0.000086	0.000048	0.000031	0.000014	0.0000088
4,4'-DDE	0.01	0.00022	0.000061	0.000034	0.000022	0.0000099	0.0000062
4,4'-DDT	0.01	0.000024	0.000061	0.000034	0.000022	0.0000098	0.0000062
Acenaphthene	1.0	670	240	140	95	44	28
Acrolein	5.0	190	70	42	28	13	8.1
Acrylonitrile	5.0	0.051	0.033	0.024	0.018	0.0095	0.0063

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Exhibit 3-1. Human Health Criteria for Select Consumption Rates: Consumption of Water and Fish

Pollutant	QL (µg/L)	Baseline Criteria (µg/L)	Revised Criteria based on Select Consumption Rates (µg/L)				
			63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
Aldrin	0.01	0.000049	0.000014	0.0000078	0.0000050	0.0000023	0.0000014
alpha-BHC	0.01	0.0026	0.0011	0.00067	0.00045	0.00021	0.00013
Anthracene	1.0	8,300	5,400	3,900	2,900	1,500	1,000
Antimony	0.1	5.6	5.4	5.3	5.1	4.7	4.3
Arsenic	0.05	0.0022	0.0083	0.0057	0.0041	0.0021	0.0014
Benzene	0.5	0.66	2.0	1.8	1.6	1.2	0.89
Benzidine	10.0	0.000086	0.000040	0.000026	0.000018	0.0000084	0.0000054
Benzo(a) Anthracene	1.0	0.0038	0.0025	0.0018	0.0013	0.00070	0.00047
Benzo(a) Pyrene	1.0	0.0038	0.0025	0.0018	0.0013	0.00070	0.00047
Benzo(b) Fluoranthene	1.0	0.0038	0.0025	0.0018	0.0013	0.00070	0.00047
Benzo(k) Fluoranthene	1.0	0.0038	0.0025	0.0018	0.0013	0.00070	0.00047
Beryllium	0.1	0.0068	0.0051	0.0039	0.0031	0.0017	0.0012
beta-BHC	0.01	0.0091	0.0038	0.0023	0.0016	0.00074	0.00047
Bis(2-Chloroethyl) Ether	1.0	0.03	0.026	0.023	0.020	0.014	0.010
Bis(2-Chloroisopropyl) Ether	2.0	34.7	1,300	1,200	1,200	950	790
Bis(Chloromethyl) Ether	a	3.7E-09	5.3E-05	3.5E-05	2.4E-05	1.2E-05	7.7E-06
Bis(2-Ethylhexyl) Phthalate	1.0	1.2	0.49	0.30	0.20	0.095	0.061
Bromoform	0.5	4.3	4.0	3.7	3.3	2.6	2.0
Butylbenzyl Phthalate	1.0	1,500	500	290	190	86	54
Carbon Tetrachloride	0.5	0.23	0.17	0.13	0.10	0.058	0.040
Chlordane	0.1	0.00046	0.00022	0.00013	0.000081	0.000036	0.000023
Chlorobenzene	0.5	130	110	88	74	47	33
Chlorodibromomethane	0.5	0.4	0.37	0.34	0.31	0.24	0.19
Chloroform	0.5	0.19	5.1	4.7	4.3	3.3	2.7
Chrysene	1.0	0.0038	0.0025	0.0018	0.0013	0.00070	0.00047
Dibenzo(a,h)Anthracene	1.0	0.0038	0.0025	0.0018	0.0013	0.00070	0.00047
Dichlorobromomethane	0.5	0.55	0.50	0.47	0.43	0.33	0.26
Dieldrin	0.01	0.000052	0.000015	0.0000083	0.0000053	0.0000024	0.0000015
Diethyl Phthalate	1.0	17,000	8,500	5,500	3,800	1,800	1,200
Dimethyl Phthalate	1.0	270,000	160,000	120,000	84,000	44,000	29,000
Di-n-Butyl Phthalate	1.0	2,000	920	580	400	190	120
Endosulfan Sulfate	0.01	62	22	13	8.5	3.9	2.5

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Exhibit 3-1. Human Health Criteria for Select Consumption Rates: Consumption of Water and Fish

Pollutant	QL (µg/L)	Baseline Criteria (µg/L)	Revised Criteria based on Select Consumption Rates (µg/L)				
			63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
Endrin	0.01	0.059	0.017	0.0093	0.0060	0.0027	0.0017
Endrin Aldehyde	0.01	0.29	0.083	0.047	0.030	0.014	0.0085
Ethylbenzene	0.5	530	320	220	160	84	55
Fluoranthene	2.0	42	37	21	14	6.2	3.9
Fluorene	1.0	1,100	720	520	390	200	140
gamma-BHC (Lindane)	0.01	0.0186	0.0053	0.0032	0.0022	0.0010	0.00065
Heptachlor	0.01	0.000079	0.000022	0.000012	0.0000079	0.0000036	0.0000022
Heptachlor Epoxide	0.01	0.000039	0.000011	0.0000061	0.0000039	0.0000018	0.0000011
Hexachlorobenzene	1.0	0.00028	0.000079	0.000044	0.000029	0.000013	0.0000081
Hexachlorobutadiene	2.0	0.44	0.41	0.39	0.36	0.29	0.24
Hexachlorocyclopentadiene	2.0	40	37	34	30	23	18
Hexachloroethane	2.0	1.4	0.67	0.42	0.29	0.14	0.089
Ideno(1,2,3-cd)Pyrene	1.0	0.0038	0.0025	0.0018	0.0013	0.00070	0.00047
Isophorone	10.0	35	32	30	27	20	16
Methyl Bromide	0.5	47	44	40	37	28	23
Methylene Chloride	0.5	4.6	4.5	4.4	4.3	4.0	3.6
Methylmercury	0.00005	-	0.081 mg/kg[1]	0.045 mg/kg[1]	0.029 mg/kg[1]	0.013 mg/kg[1]	0.0082 mg/kg[1]
Nickel	10.0	13.4	280	190	140	69	45
Nitrobenzene	1.0	17	16	15	14	11	9.2
N-Nitrosodibutylamine	10.0	0.0063	0.0058	0.0054	0.0050	0.0039	0.0031
N-Nitrosodiethylamine	10.0	0.00080	0.00080	0.00080	0.00079	0.00078	0.00076
N-Nitrosodimethylamine	1.0	0.00069	0.00069	0.00069	0.00068	0.00068	0.00068
N-Nitrosodi-n-Propylamine	2.0	0.005	0.0048	0.0047	0.0046	0.0041	0.0037
N-Nitrosodiphenylamine	1.0	3.3	1.3	0.82	0.55	0.26	0.17
N-Nitrosopyrrolidine	10.0	0.016	0.016	0.016	0.016	0.016	0.016
Pentachlorobenzene	10.0	1.4	0.15	0.087	0.056	0.025	0.016
Pentachlorophenol	2.0	0.27	0.22	0.18	0.15	0.09	0.066
Phenol	1.0	3,500	20,000	19,000	19,000	17,000	15,000
PCBs	0.5	0.000064	0.000018	0.0000099	0.0000064	0.0000029	0.0000018
Pyrene	1.0	830	540	390	290	150	100
Selenium	2.0	10	150	140	120	91	70
Tetrachloroethylene	0.5	0.69	0.45	0.32	0.24	0.13	0.084

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Exhibit 3-1. Human Health Criteria for Select Consumption Rates: Consumption of Water and Fish

Pollutant	QL (µg/L)	Baseline Criteria (µg/L)	Revised Criteria based on Select Consumption Rates (µg/L)				
			63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
Thallium	0.1	0.24	0.10	0.063	0.043	0.020	0.013
Toluene	0.5	1,300	1,000	870	720	450	320
Toxaphene	0.5	0.00028	0.000077	0.000043	0.000028	0.000012	0.0000078
Trichloroethylene	0.5	2.5	2.1	1.7	1.4	0.91	0.65
Vinyl Chloride	0.5	0.025	0.024	0.023	0.023	0.020	0.018

a = Contact DEQ laboratory

1. Represents a fish tissue criterion, and would be applicable to all waters (fresh and marine).

Exhibit 3-2. Human Health Criteria for Select Consumption Rates: Consumption of Fish Only

Pollutant	QL (µg/L)	Baseline Criteria (µg/L)	Revised Criteria based on Select Consumption Rates (µg/L)				
			63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
1,1,2,2-Tetrachloroethane	0.5	4	1.1	0.62	0.40	0.18	0.11
1,1,2-Trichloroethane	0.5	16	4.3	2.4	1.6	0.70	0.44
1,1-Dichloroethylene	0.5	7,100	2,000	1,100	710	320	200
1,2,4,5-Tetrachlorobenzene	1.0	1.1	0.30	0.17	0.11	0.048	0.030
1,2,4-Trichlorobenzene	0.5	70	19	11	7.0	3.2	2.0
1,2-Dichlorobenzene	0.5	1,300	360	200	130	58	37
1,2-Dichloroethane	0.5	37	10	5.7	3.7	1.6	1.0
1,2-Dichloropropane	0.5	15	4.0	2.3	1.5	0.66	0.41
1,2-Diphenylhydrazine	5.0	0.2	0.056	0.031	0.020	0.0090	0.0057
1,2-Trans-Dichloroethylene	0.5	10,000	2,800	1,600	1,000	460	290
1,3-Dichlorobenzene	0.5	960	270	150	96	43	27
1,3-Dichloropropene	0.5	21	5.8	3.3	2.1	0.95	0.59
1,4-Dichlorobenzene	0.5	190	53	30	19	8.7	5.4
2,3,7,8-TCDD (Dioxin)	5.0E-06	5.1E-09	1.4E-09	7.9E-10	5.1E-10	2.3E-10	1.4E-10
2,4,5-Trichlorophenol	2.0	3,600	1,000	560	360	160	100
2,4,6-Trichlorophenol	1.0	2.4	0.67	0.38	0.24	0.11	0.068
2,4-Dichlorophenol	1.0	290	82	46	29	13	8.3
2,4-Dimethylphenol	2.0	850	240	130	85	38	24
2,4-Dinitrophenol	5.0	5,300	1,500	830	530	240	150
2,4-Dinitrotoluene	1.0	3.4	0.94	0.52	0.34	0.15	0.096
2-Chloronaphthalene	1.0	1,600	440	250	160	71	45

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Exhibit 3-2. Human Health Criteria for Select Consumption Rates: Consumption of Fish Only

Pollutant	QL (µg/L)	Baseline Criteria (µg/L)	Revised Criteria based on Select Consumption Rates (µg/L)				
			63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
2-Chlorophenol	1.0	150	41	23	15	6.7	4.2
2-Methyl-4,6-Dinitrophenol	2.0	280	79	44	28	13	8.0
3,3'-Dichlorobenzidine	1.0	0.028	0.0079	0.0044	0.0028	0.0013	0.00080
4,4'-DDD	0.01	0.00031	0.000086	0.000048	0.000031	0.000014	0.0000088
4,4'-DDE	0.01	0.00022	0.000061	0.000034	0.000022	0.0000099	0.0000062
4,4'-DDT	0.01	0.000024	0.000061	0.000034	0.000022	0.0000098	0.0000062
Acenaphthene	1.0	990	270	150	99	45	28
Acrolein	5.0	290	80	45	29	13	8.2
Acrylonitrile	5.0	0.25	0.068	0.038	0.025	0.011	0.0070
Aldrin	0.01	0.00005	0.000014	0.0000078	0.0000050	0.0000023	0.0000014
alpha-BHC	0.01	0.0049	0.0014	0.00076	0.00049	0.00022	0.00014
Anthracene	1.0	40,000	11,000	6,200	4,000	1,800	1,100
Antimony	0.1	640	180	99	64	29	18
Arsenic	0.05	0.0175	0.014	0.0080	0.0052	0.0023	0.0015
Benzene	0.5	40	14	7.9	5.1	2.3	1.4
Benzidine	10.0	0.0002	0.000055	0.000031	0.000020	0.0000089	0.0000056
Benzo(a) Anthracene	1.0	0.018	0.0051	0.0028	0.0018	0.00082	0.00052
Benzo(a) Pyrene	1.0	0.018	0.0051	0.0028	0.0018	0.00082	0.00052
Benzo(b) Fluoranthene	1.0	0.018	0.0051	0.0028	0.0018	0.00082	0.00052
Benzo(k) Fluoranthene	1.0	0.018	0.0051	0.0028	0.0018	0.00082	0.00052
Beryllium	0.1	0.117	0.0140	0.0076	0.0049	0.0022	0.0014
beta-BHC	0.01	0.017	0.0047	0.0026	0.0017	0.00077	0.00048
Bis(2-Chloroethyl) Ether	1.0	0.53	0.150	0.082	0.053	0.024	0.015
Bis(2-Chloroisopropyl) Ether	2.0	4,360	18,000	10,000	6,500	2,900	1,800
Bis(2-Ethylhexyl) Phthalate	1.0	2.2	0.61	0.34	0.22	0.099	0.062
Bis(Chloromethyl) Ether	a	0.00184	0.000080	0.000045	0.000029	0.000013	0.0000081
Bromoform	0.5	140	37	21	14	6.1	3.8
Butylbenzyl Phthalate	1.0	1,900	540	300	190	87	55
Carbon Tetrachloride	0.5	1.6	0.45	0.25	0.16	0.074	0.046
Chlordane	0.1	0.00048	0.00022	0.00013	0.000081	0.000036	0.000023
Chlorobenzene	0.5	1,600	430	240	160	70	44
Chlorodibromomethane	0.5	13	3.5	2.0	1.3	0.57	0.36

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Exhibit 3-2. Human Health Criteria for Select Consumption Rates: Consumption of Fish Only

Pollutant	QL (µg/L)	Baseline Criteria (µg/L)	Revised Criteria based on Select Consumption Rates (µg/L)				
			63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
Chloroform	0.5	15.7	48	27	17	7.9	4.9
Chrysene	1.0	0.018	0.0051	0.0028	0.0018	0.00082	0.00052
Dibenzo(a,h) Anthracene	1.0	0.018	0.0051	0.0028	0.0018	0.00082	0.00052
Dichlorobromomethane	0.5	17	4.8	2.7	1.7	0.77	0.49
Dieldrin	0.01	0.000054	0.000015	0.0000083	0.0000054	0.0000024	0.0000015
Diethyl Phthalate	1.0	44,000	12,000	6,800	4,400	2,000	1,200
Dimethyl Phthalate	1.0	1,100,000	310,000	170,000	110,000	50,000	31,000
Di-n-Butyl Phthalate	1.0	4,500	1,200	700	450	200	130
Endosulfan Sulfate	0.01	89	25	14	8.9	4.0	2.5
Endrin	0.01	0.06	0.017	0.0094	0.0060	0.0027	0.0017
Endrin Aldehyde	0.01	0.3	0.084	0.047	0.030	0.014	0.0085
Ethylbenzene	0.5	2,100	590	330	210	96	60
Fluoranthene	2.0	54	39	22	14	6.3	3.9
Fluorene	1.0	5,300	1,500	830	530	240	150
gamma-BHC (Lindane)	0.01	0.0625	0.0066	0.0037	0.0024	0.0011	0.00067
Heptachlor	0.01	0.000079	0.000022	0.000012	0.0000079	0.0000036	0.0000022
Heptachlor Epoxide	0.01	0.000039	0.000011	0.0000061	0.0000039	0.0000018	0.0000011
Hexachlorobenzene	1.0	0.00029	0.000080	0.000045	0.000029	0.000013	0.0000081
Hexachlorobutadiene	2.0	18	5.1	2.9	1.8	0.83	0.52
Hexachlorocyclopentadiene	2.0	1,100	310	170	110	50	31
Hexachloroethane	2.0	3.3	0.91	0.51	0.33	0.15	0.093
Ideno(1,2,3-cd)Pyrene	1.0	0.018	0.0051	0.0028	0.0018	0.00082	0.00052
Isophorone	10.0	960	270	150	96	43	27
Methyl Bromide	0.5	1,500	410	230	150	67	42
Methylene Chloride	0.5	590	160	92.0	59.0	27.0	17.0
Methylmercury	0.00005	300 µg/kg[1]	0.081 mg/kg[1]	0.045 mg/kg[1]	0.029 mg/kg[1]	0.013 mg/kg[1]	0.0082 mg/kg[1]
Nickel	10.0	100	470	260	170	77	48
Nitrobenzene	1.0	690	190	110	69	31	20.0
N-Nitrosodibutylamine	10.0	0.22	0.060	0.034	0.022	0.0098	0.0062
N-Nitrosodiethylamine	10.0	1.24	0.13	0.071	0.046	0.021	0.013
N-Nitrosodimethylamine	1.0	3	0.84	0.47	0.30	0.14	0.085
N-Nitrosodi-n-Propylamine	2.0	0.51	0.14	0.078	0.051	0.023	0.014

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Exhibit 3-2. Human Health Criteria for Select Consumption Rates: Consumption of Fish Only

Pollutant	QL (µg/L)	Baseline Criteria (µg/L)	Revised Criteria based on Select Consumption Rates (µg/L)				
			63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
N-Nitrosodiphenylamine	1.0	6	1.7	0.93	0.60	0.27	0.17
N-Nitrosopyrrolidine	10.0	34	9.5	5.3	3.4	1.5	0.96
Pentachlorobenzene	10.0	1.5	0.16	0.087	0.056	0.025	0.016
Pentachlorophenol	2.0	3	0.84	0.47	0.30	0.14	0.086
Phenol	1.0	1,700,000	470,000	270,000	170,000	77,000	48,000
PCBs	0.5	0.000064	0.000018	0.0000099	0.0000064	0.0000029	0.0000018
Pyrene	1.0	4,000	1,100	620	400	180	110
Selenium	2.0	4,200	1,200	650	420	190	120
Tetrachloroethylene	0.5	3.3	0.91	0.51	0.33	0.15	0.093
Thallium	0.1	0.47	0.13	0.073	0.047	0.021	0.013
Toluene	0.5	15,000	4,100	2,300	1,500	670	420
Toxaphene	0.5	0.00028	0.000077	0.000043	0.000028	0.000012	0.0000078
Trichloroethylene	0.5	30	8.3	4.6	3.0	1.3	0.85
Vinyl Chloride	0.5	2.4	0.68	0.38	0.24	0.11	0.069

a = Contact DEQ laboratory.

1. Represents a fish tissue criterion.

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4. Method for Estimating Potential Costs: Point Sources

This section describes the method for estimating the potential costs to point sources associated with compliance with both baseline criteria and revised criteria that incorporate the alternative fish consumption values. Compliance costs for municipal and industrial point sources may result from changes to NPDES permit requirements.

4.1 Sample Selection

Factors that may affect the potential magnitude of compliance costs include flow and facility type. Larger flows are typically associated with the largest treatment costs, although per-unit costs may decrease due to economies of scale. A certainty sample of the largest facilities ensures that this high potential for cost is captured in the analysis. Industrial category may also be indicative of the potential to incur costs. Treatment requirements differ for municipal and industrial discharges, and effluent quality may be similar across categories of facilities. Minor dischargers typically do not have monitoring requirements for toxic pollutants and, may not contribute significantly to instream loads even if such pollutants were present in the effluent from these facilities. Thus, the potential for minor facilities to incur costs as a result of an increased fish consumption rate is low.

As shown in Exhibit 2-2, there are 77 major (49 municipal and 28 industrials) and 313 minor (157 municipal and 156 industrials) individually permitted wastewater discharges to waters for which the potential revised human health criteria would apply. EPA uses the designation of "major" for municipal discharges of 1 million gallons per day (mgd) or more, and industrial discharges with a major rating code (based on the presence of toxics and size of discharge flow) over a specified value (e.g., 80) (U.S. EPA, 2008).

To incorporate the facilities with highest potential for cost, we evaluated the four largest facilities based on the facility information section of EPA's PCS database (four municipals, one of which is dominated by flow from a pulp and paper plant).[2] ODEQ also selected one minor industrial to represent a potential worse case based on industrial process (steel mill). To evaluate potential for costs at the remaining municipal and industrial facilities, we selected a representative random sample of 13 major facilities and 2 minor facilities (one municipal and one industrial).

Exhibit 4-1 provides a summary of the sample for evaluation. **Appendix A** provides additional information on these facilities.

Exhibit 4-1. Summary of Sample Facilities

NPDES Number	Name	Major/ Minor	Type	Flow (mgd)
Certainty Sample				

[2] PCS does not contain flow data for the industrial facilities in Oregon.

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Exhibit 4-1. Summary of Sample Facilities

NPDES Number	Name	Major/ Minor	Type	Flow (mgd)
OR0026905	City of Portland, Columbia Blvd WWTP	Major	Municipal	108.3
OR0031224	Metro Wastewater Management, Eugene-Springfield WPCF	Major	Municipal	49
OR0020834	St. Helens-Boise Cascade WWTP	Major	Municipal[1]	40
OR0026409	City of Salem, Willow Lake WWTP	Major	Municipal	35
OR0000451	Oregon Steel Mills	Minor	Industrial	0.79**
Random Sample				
OR0029777	Clean Water Services, Rock Creek WWTP	Major	Industrial	15
OR0031259	Tri-City Service District	Major	Municipal	8.4
OR0034002	McMinnville WRF	Major	Municipal	5.6
OR0027561	Astoria WWTP	Major	Municipal	4.2
OR0020001	Woodburn WWTP	Major	Municipal	3.1
OR0026221	Clackamas City, Kellogg Creek WWTP	Major	Municipal	2.7
OR0023361	North Bend WWTP	Major	Municipal	2.2
OR0023582	Coos Bay WWTP #2	Major	Municipal	2
OR0020354	Brookings WWTP	Major	Municipal	1.3
OR0001074	Pope & Talbot Inc., Halsey Bleach-Kraft Pulp Mill	Major	Industrial	10.3*
OR0000566	Blue Heron Paper Company	Major	Industrial	9.7**
OR0002402	Heinz Food Company	Major	Industrial	3.4**
OR0000060	Reynolds Metals Company	Major	Industrial	1.95*
OR0030660	Shady Cove WWTP	Minor	Municipal	0.45
OR0002411	Boise Cascade, Elgin Sawmill	Minor	Industrial	NA

Source: EPA (2007).
NA = Not available.
*Represents the average of average monthly effluent flows reported in the Effluent Measurements/Violations section of EPA's PCS database.
**Flow as reported in permit.
1. Dominated by industrial flow.

Note that the flows reported in PCS for St. Helens-Boise Cascade WWTP and Rock Creek WWTP do not match the average flows specified in their permits (the exhibit shows flows reported in PCS).

4.2 Determining Reasonable Potential

ODEQ (2005) procedures provide permit writers instructions for determining whether dischargers have reasonable potential (RP) to cause or contribute to an exceedance of WQS. These procedures apply to:

- All industrial sources ODEQ requires to perform effluent monitoring (see Table 4)
- All industrial sources ODEQ does not require to monitor, but has identified a concern for toxic pollutants (e.g., a facility that stores hazardous chemicals on site and has a recorded history of spills into to the wastewater stream that could potentially pass through the treatment system into the receiving water)
- All domestic sources greater than 1 mgd average dry weather design flow (ADWDF)
- All domestic sources less than 1 mgd ADWDF with a significant industrial user that may be a potential source of pollutants, discharging to a receiving water body providing less

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than 10:1 dilution, with a treatment system that is based on biological treatment, as opposed to a lagoon system, or where the individual permit writer feels conditions exist that warrant an analysis.

The first step in determining RP is to identify the applicable criteria. For freshwater, permit writers should use human health criteria for consumption of water and organisms. Human health criteria for consumption of organisms only apply to marine and estuarine waters. For mercury, the criterion represents the concentration of methylmercury in fish tissue. It is uncertain how ODEQ will implement this fish tissue-based criterion in NPDES permit. However, for this analysis, we converted the criterion into an ambient water quality criterion (AWQC) for total mercury using bioaccumulation factors (BAFs):

$$AWQC_{THg} = (RfD - RSC)\left[\frac{BW}{DI + \sum_{i=2}^{4}(FI_i * BAF_i)}\right] \div f_d$$

where,

AWQC = ambient water quality criterion in mg/L
BW = human body weight default value of 70 kg
RfD = reference dose based on noncancer human health effects in mg/kg body weight-day
RSC = relative source contribution in mg/kg body weight-day
DI = drinking water intake default value of 2 L/day
FI = human fish consumption in kg fish/day
BAF_i = bioaccumulation factor for trophic level i (L/kg fish)
f_d = translator to convert dissolved methylmercury into total mercury.

For this analysis, we assumed that ODEQ would use EPA's default values to convert the methylmercury fish tissue criterion into a total mercury water column criterion:

- National BAFs: BAF_2 = 120,000 L/kg; BAF_3 = 680,000 L/kg; BAF_4 = 2,700,000 L/kg
- Trophic level specific consumption rate percentages: FI_2 = 22%; FI_3 = 46%; FI_4 = 33%
- Dissolved methylmercury to total mercury translator: 0.014 for river; 0.032 for lakes.

Exhibit 4-2 shows the AWQC for mercury for rivers and lakes at alternative fish consumption rates calculated using EPA's default values.

Exhibit 4-2. Baseline and Potential Revised AWQC for Mercury

Water Body Type	Baseline Criteria (µg/L)	Alternative Fish Consumption Rate Criteria (µg/L)				
		63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
Rivers	0.017	0.0047	0.0026	0.0017	0.00076	0.00048
Lakes	0.0075	0.0021	0.0011	0.00075	0.00033	0.00021

AWQC = ambient water quality criterion

Note that ODEQ's applicable QL for mercury is 0.01 µg/L based on using either Method 245.7 or Method 1631; ODEQ specifies the QL for methylmercury at 0.00005 µg/L using Method 1630. Thus, converting the methylmercury fish tissue criterion into a total mercury water column value would result in less stringent requirements for dischargers (because dischargers would only need to reduce total mercury to the QL of 0.01 µg/L under existing implementation procedures). To be conservative (i.e., erring on the side of higher costs), we assumed that

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dischargers would only use clean methods (i.e., Method 1631) to monitoring for total mercury with a QL of 0.0005 µg/L.

The next step in the reasonable potential analysis (RPA) is to calculate the concentration of pollutants in the discharge. For noncarcinogens, this value is the maximum observed effluent value times a multiplying factor for the 95% confidence level and 95% probability basis (EPA, 1991; Tables 3-1 and 3-2). For carcinogens, this value is the geometric mean effluent concentration times the multiplying factor. The fewer number of data points available for the analysis, the larger the multiplying factor. For example, if only one effluent value is available, the multiplying factor would be 6.2 [using a coefficient of variance (CV) of 0.6], and the RPA would be based on an effluent concentration that is over six times greater than the actual measured value.

If all effluent observations are nondetect and the criterion is greater than QL (ODEQ, 2005; Appendix B), the calculated effluent concentration should be set equal to the lowest method detection limit (MDL) or QL, whichever is lower and/or available. If the QL is lower than the criterion, there is no RP, and if the criterion is less than the QL and all values are nondetect, there would only be monitoring requirements to ensure that effluent levels remain below specified QLs.

If the calculated effluent concentration (or lowest QL if all observations are nondetect) is less than the applicable criterion, there is no RP. If the concentration is greater than the criterion, the permit writer must determine whether a mixing zone is appropriate. For this analysis, where the ambient concentration is greater than the applicable criterion or a pollutant is on the 303(d) list as impaired in the water body, we considered a scenario in which a mixing zone would not be appropriate. If a mixing zone is not appropriate, there is RP. With mixing, RP is based on comparison of the concentration of the pollutant at the edge of the mixing zone boundary to the criterion:

$$C_{MZ} = \frac{C_{ce} + C_b * (D-1)}{D}$$

where,

C_{MZ} = Concentration of the pollutant at the edge of the mixing zone
C_{ce} = Calculated effluent concentration of the pollutant
C_b = Ambient background concentration (set to zero where all observations are nondetect or data are not available)
D = Dilution factor.

The dilution factor is calculated as:

$$D = \frac{Q_e + Q_b}{Q_e}$$

where,

Q_e = Effluent flow
Q_b = Ambient flow (harmonic mean for carcinogens and 30Q5 for noncarcinogens).

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If the concentration at the edge of the mixing zone is less than the applicable criterion, there is no RP; if the mixing zone concentration is greater than the criterion, the permit writer must determine whether the point source is a significant contributor to the receiving water concentration of the pollutant. ODEQ (2005) indicates that a point source is a significant contributor to a receiving water load if:

- For persistent bioaccumulative and toxic pollutants (PBTs) (e.g., mercury, aldrin, dieldrin, benzo(a)pyrene, chlordane, DDT, dioxins and furans, hexachlorobenzene, alkyl-lead, mirex, octachlorostyrene, PCBs, and toxaphene), downstream receiving water concentrations are at least 1% greater than upstream concentrations
- For non-PBTs (e.g., arsenic), downstream receiving water concentrations are at least 10% greater than upstream concentrations.

However, without upstream and downstream measurements, it is difficult to determine whether any dischargers would be considered significant contributors. Thus, we assumed that if the concentration at the edge of the mixing zone exceeds the applicable criterion there is RP.[3]

Exhibit 4-3 summarizes the RPA for the sample facilities; Appendix A provides the details of the analyses. As shown in the exhibit, under current procedures (ODEQ, 2005), dischargers in the sample have RP and thus need WQBELs for the following pollutants: 4,4'-DDT, alpha-BHC, arsenic, bis(2-ethylhexyl) phthalate, dioxin, mercury, and tetrachloroethylene.

Exhibit 4-3. Summary of Reasonable Potential Results for Sample Facilities

Facility Name	Baseline	63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
Astoria WWTP	As	As	As	As, Hg	As, Hg	As, Hg
Brookings WWTP	None	None	None	None	None	None
Coos Bay WWTP	None	As, BEHP	As, BEHP	As, BEHP	As, BEHP	As, BEHP, Hg
Eugene-Springfield WPCF	4,4'-DDT, alpha-BHC	4,4'-DDT, alpha-BHC	4,4'-DDT, alpha-BHC	4,4'-DDT, alpha-BHC	4,4'-DDT, alpha-BHC	4,4'-DDT, alpha-BHC
Kellogg Creek WWTP	As, Hg	As, Hg	As, Hg	As, Hg	As, Hg	As, Hg
McMinnville WRF	As	As, Hg	As, Hg	As, Hg	As, Hg	As, Hg
North Bend WWTP	As	As	As	As	As	As
Portland, Columbia Blvd WWTP - 001	Dioxin, As	Dioxin, As	Dioxin, As	Dioxin, As	Dioxin, As	Dioxin, As, Hg
Portland, Columbia Blvd WWTP - 003	As	As	As, Hg	As, BEHP, Hg	As, BEHP, Hg	As, BEHP, Hg, PCE
Rock Creek WWTP	None	Hg	Hg	Hg	Hg	Hg
Salem, Willow Lake WWTP	As, Hg	As, BEHP, Hg	As, BEHP, Hg	As, BEHP, Hg	As, BEHP, Hg	As, BEHP, Hg
St. Helens WWTP	As	As, Hg	As, Hg	As, Hg	As, Hg	As, Hg
Tri-City S.D.	As, Hg	As, Hg	As, Hg	As, Hg	As, Hg	As, Hg

[3] Ultimately, attaining WQS in a water body, which affects the ambient concentration for calculating the size of the mixing zone or results in removal of a 303(d) listing, could make effluent limits less stringent for point sources to waters in which ODEQ allows mixing zones. However, these potential benefits (avoided costs) will not be realized until standards are attained, which for many pollutants of concern will require controls on a variety of sources.

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Exhibit 4-3. Summary of Reasonable Potential Results for Sample Facilities

Facility Name	Baseline	63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
Woodburn WWTP	As, BEHP	As, BEHP	As, BEHP	As, BEHP	As, BEHP	As, BEHP
Shady Cove WWTP	None	None	None	None	None	None
Blue Heron Paper	Hg	Hg	Hg	Hg	Hg	Hg
Collins Products	None	None	None	None	None	None
Pope & Talbot	As, Hg	As, Hg	As, Hg	As, Hg	As, Hg	As, Hg
Reynolds Metals Co	None	None	None	None	None	None
Boise Cascade	None	None	None	None	None	None
Oregon Steel Mills	As	As	As	As	As	As

As = arsenic
BEHP = bis(2-ethylhexyl) phthalate
Hg = mercury
TCE = tetrachloroethylene

4.3 Projecting Effluent Limits

If there is RP, the permit writer should calculate average monthly and maximum daily effluent limits using the following equation:

$$AMEL = D \times (WQC - C_b) + C_b$$

where,
AMEL = Average monthly effluent limit
D = Dilution factor
WQC = Water quality criterion
C_b = Ambient background concentration.

The maximum daily effluent limit (MDEL) is calculated by multiplying the AMEL by a factor determined based on effluent variability and the number of samples per month using (EPA, 1991; Table 5-3).

We compared the maximum observed effluent concentration (MEC) to the AMEL to determine compliance. This method ensures that dischargers only monitoring pollutants once per month are discharging below applicable limits. Thus, if the MEC is below the projected AMEL, or there is no RP for a pollutant, there are unlikely to be any compliance costs. However, if effluent concentrations exceed the projected limits, compliance actions and associated costs are likely.

Exhibit 4-4 provides a comparison of observed MECs with projected average monthly effluent limits and QLs for the dischargers in the sample that have RP for a particular pollutant. Limits shown in bold represent scenarios in which effluent reductions are likely needed for compliance.

Exhibit 4-4. Summary of Projected AMELs for Sample Facilities

Name	MEC (µg/L)	QL[1] (µg/L)	Projected AMELs[2] (µg/L)					
			Baseline	63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
4,4'-DDT								
Eugene-Springfield WPCF	0.08	0.01	**0.00025**	**0.00065**	**0.00035**	**0.00023**	**0.00010**	**0.000066**
Alpha-BHC								

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Exhibit 4-4. Summary of Projected AMELs for Sample Facilities

Name	MEC (µg/L)	QL[1] (µg/L)	Projected AMELs[2] (µg/L)					
			Baseline	63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
Eugene-Springfield WPCF	0.068	0.01	**0.028**	**0.012**	**0.0071**	**0.0048**	**0.0022**	**0.0014**
Arsenic								
Astoria WWTP	1.05	0.05	**0.61**	**0.49**	**0.28**	**0.18**	**0.081**	**0.053**
Coos Bay WWTP	0.25	0.05	NA	NA	NA	**0.21**	**0.094**	**0.062**
Kellogg Creek WWTP	1.3	0.05	**0.0022**	**0.0083**	**0.0057**	**0.0041**	**0.0021**	**0.0014**
McMinnville WRF	1.3	0.05	**0.0022**	**0.0083**	**0.0057**	**0.0041**	**0.0021**	**0.0014**
North Bend WWTP	0.72	0.05	1.8	1.5	0.84	**0.55**	**0.24**	**0.16**
Portland, Col. Blvd Outfall 1	4.08	0.05	**0.0022**	**0.0083**	**0.0057**	**0.0041**	**0.0021**	**0.0014**
Portland, Col. Blvd Outfall 3	1.71	0.05	**0.0022**	**0.0083**	**0.0057**	**0.0041**	**0.0021**	**0.0014**
Salem, Willow Lake WWTP	11	0.05	**0.026**	**0.10**	**0.068**	**0.049**	**0.025**	**0.017**
St. Helens WWTP	2.28	0.05	**0.0022**	**0.0083**	**0.0057**	**0.0041**	**0.0021**	**0.0014**
Tri-City S.D.	1.0	0.05	**0.0022**	**0.0083**	**0.0057**	**0.0041**	**0.0021**	**0.0014**
Woodburn WWTP	6.78	0.05	**0.0022**	**0.0083**	**0.0057**	**0.0041**	**0.0021**	**0.0014**
Pope & Talbot	1.80	0.05	**0.31**	**1.2**	**0.82**	**0.59**	**0.30**	**0.20**
Oregon Steel Mills	2.04	0.05	**0.0022**	**0.0083**	**0.0057**	**0.0041**	**0.0021**	**0.0014**
Bis(2-ethylhexyl) phthalate								
Coos Bay WWTP	55.4	0.05	NA	**25**	**14**	**9.0**	**4.1**	**2.5**
Portland, Col. Blvd Outfall 3	24.8	0.05	NA	NA	NA	**18**	**8.7**	**5.6**
Salem, Willow Lake WWTP	13	0.05	NA	**5.9**	**3.6**	**2.4**	**1.1**	**0.73**
Woodburn WWTP	17.9	0.05	1.9	**0.78**	**0.48**	**0.32**	**0.15**	**0.098**
Dioxin								
Portland, Col. Blvd Outfall 1	5.5E-06	1.0E-07	**1.3E-08**	**1.4E-09**	**7.9E-10**	**5.1E-10**	**2.3E-10**	**1.4E-10**
Mercury								
Astoria WWTP	0.042	0.0005	NA	NA	NA	0.059	**0.027**	**0.017**
Coos Bay WWTP	0.0069	0.0005	NA	NA	NA	NA	NA	0.02
Kellogg Creek WWTP	0.013	0.0005	0.017	**0.0047**	**0.0026**	**0.0017**	**0.00076**	**0.00048**
McMinnville WRF	0.011	0.0005	NA	**0.0047**	**0.0026**	**0.0017**	**0.00076**	**0.00048**
Portland, Col. Blvd Outfall 1	0.075	0.0005	NA	NA	NA	NA	NA	**0.04**
Portland, Col. Blvd Outfall 3	0.38	0.0005	NA	NA	**0.24**	**0.16**	**0.07**	**0.04**
Rock Creek WWTP	0.0051	0.0005	NA	**0.0047**	**0.0026**	**0.0017**	**0.00076**	**0.00048**
Salem, Willow Lake WWTP	0.07	0.0005	**0.017**	**0.0047**	**0.0026**	**0.0017**	**0.00076**	**0.00048**

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Exhibit 4-4. Summary of Projected AMELs for Sample Facilities

Name	MEC (µg/L)	QL[1] (µg/L)	Projected AMELs[2] (µg/L)					
			Baseline	63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
St. Helens WWTP	0.037	0.0005	NA	**0.0047**	**0.0026**	**0.0017**	**0.00076**	**0.00048**
Tri-City S.D.	0.020	0.0005	**0.017**	**0.0047**	**0.0026**	**0.0017**	**0.00076**	**0.00048**
Blue Heron Paper	0.20	0.0005	**0.017**	**0.0047**	**0.0026**	**0.0017**	**0.00076**	**0.00048**
Pope & Talbot	0.0073	0.0005	0.017	**0.0047**	**0.0026**	**0.0017**	**0.00076**	**0.00048**
Tetrachloroethylene								
Portland, Col. Blvd Outfall 3	4.9	0.5	NA	NA	NA	NA	NA	7.7

1. QL for mercury represents level achievable using Method 1631.
2. Limits shown in bold represent scenarios in which effluent reductions are likely needed for compliance.
AMEL = Average monthly effluent limit
gpd = grams per day
MEC = Maximum effluent concentration
NA = Not applicable (no RP)
QL = Quantification limit

Exhibit 4-5 shows the pollutant load reductions (in pounds per year) needed for compliance with the baseline and revised criteria. Load reductions are based on reducing the MEC to the AMEL, except for pollutants with limits less than the applicable QL, the load reductions represent the amount needed to reduce effluent levels to the QL.

Exhibit 4-5. Summary of Projected Baseline and Incremental Load Reductions for Sample Facilities (lbs/yr)

Facility Name	Baseline Reduction	Incremental (over baseline) Reduction				
		63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
4,4'-DDT						
Eugene Springfield	10.4	-	-	-	-	-
Alpha-BHC						
Eugene Springfield	6.0	2.4	2.7*	2.7*	2.7*	2.7*
Arsenic						
Astoria WWTP	5.6*	-	-	-	-	-
Coos Bay WWTP	NA	NA	NA	0.25	0.96	1.16
Kellogg Creek WWTP	27*	-	-	-	-	-
McMinnville WRF	21*	-	-	-	-	-
North Bend WWTP	NA	NA	NA	1.14	3.21	3.75
Portland, Col. Blvd Outfall 1	354*	-	-	-	-	-
Portland, Col. Blvd Outfall 3	196*	-	-	-	-	-
Salem, Willow Lake WWTP	1167*	-	-	-	-	-
St Helens WWTP	204*	-	-	-	-	-
Tri-City Service District	24*	-	-	-	-	-
Woodburn WWTP	68*	-	-	-	-	-
Pope & Talbot	73	-	-	-	0.5	5.4
Oregon Steel Mills	4.8	-	-	-	-	-
Bis(2-ethylhexyl) Phthalate						
Coos Bay WWTP	NA	187	255	285	315	325
Portland, Col. Blvd Outfall 3	NA	NA	NA	331	784	935

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Exhibit 4-5. Summary of Projected Baseline and Incremental Load Reductions for Sample Facilities (lbs/yr)

Facility Name	Baseline Reduction	Incremental (over baseline) Reduction				
		63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
Salem, Willow Lake WWTP	NA	756	1,002	1,129	1,268	1,307
Woodburn WWTP	162	11.4	14.4	16.0	17.7	18.3
Dioxin						
Portland, Col. Blvd.	1.2E-03*	-	-	-	-	-
Mercury						
Astoria WWTP	NA	NA	NA	NA	0.19	0.32
Kellogg Cr. WWTP	NA	0.18	0.22	0.24	0.26	0.27*
Portland, Col. Blvd Outfall 1	NA	NA	NA	NA	NA	7.5
Portland, Col. Blvd Outfall 3	NA	NA	6.8	10.7	15.1	16.6
McMinnville WWTP	NA	0.11	0.14	0.16	0.17	0.18*
Rock Creek WWTP	NA	0.047	0.30	0.40	0.52	0.55*
Salem WWTP	NA	1.31	1.53	1.63	1.73	1.76*
St Helens WWTP	NA	2.95	3.14	3.22	3.31	3.33*
Tri-City SD	NA	0.31	0.37	0.39	0.42	0.42*
Blue Heron Paper	NA	0.36	0.43	0.45	0.48	0.49*
Pope & Talbot, Hasley Mill	NA	0.13	0.23	0.28	0.32	0.34*

"-" = No incremental load reduction because baseline and revised limits are below the QL or baseline limit is more stringent.
gpd = grams per day
NA = Not applicable (no load reductions needed)
*Represents reductions to the QL, not projected effluent limit.
1. Load reduction calculated based on maximum observed effluent concentration and average dry weather design flow. For pollutants with limits less than the applicable QL, load reductions represent the amount needed to reduce effluent levels to the QL. For the revised criteria, load reductions represent incremental reductions needed above and beyond those needed for compliance with baseline criteria

4.4 Identifying Compliance Scenarios

Analysis of the available data for a small sample of facilities indicates that there are likely to be exceedances of projected effluent limits for 4,4'-DDT, alpha-BHC, arsenic, bis(2-ethylhexyl) phthalate, dioxin, and mercury. There are a number of potential alternatives for compliance with effluent limits for these pollutants, including:

- Optimizing treatment processes (e.g., adding chemicals to increase flocculation or filtration efficiency) to increase pollutant removal efficiencies
- Source control (e.g., pollution prevention program, inflow and infiltration reductions, more stringent pretreatment standards)
- Installing end-of-pipe treatment technology (e.g., reverse osmosis, granular activated carbon, or chemical precipitation)
- Alternative compliance mechanisms (e.g., site-specific criterion, TMDL, or variance).

Dischargers will pursue the lowest cost means of compliance with effluent limits. However, for the potential revised criteria, technical feasibility is also an issue. Hence, there may be a need for alternative compliance mechanisms.

4.4.1 Process Optimization

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The lowest cost option is likely the adjustment of existing treatment (process optimization). This option would be most feasible where relatively low pollutant reductions are needed or monitoring data indicate that pollutant loads increase throughout the treatment process as a result of chemical additions or treatment techniques.

Process optimization usually involves process analysis and process modifications. Process analysis is an investigation of the performance-limiting factors of the treatment process and is a key factor in achieving optimum treatment efficiency. Performance-limiting factors for common wastewater treatment processes (e.g., sedimentation, activated sludge, filtration) may include operator training, response to changes in wastewater quality, maintenance activities, automation, and process control testing. The cost of process analysis includes the cost of additional or continuous monitoring throughout the treatment process, and a treatment performance evaluation. These costs vary based on the number of treatment processes analyzed and the magnitude of the reductions needed.

Process modifications include activities short of adding new treatment technology units (conventional or unconventional) to the treatment train. For increasing pollutant removal efficiencies, process modifications could include adjusting coagulant doses to increase settling, equalizing flow if pollutant concentrations spike during wet weather events, increasing filter maintenance activities or backwash cycles, training operators, and installing automation equipment including necessary hardware and software. Several months of adjustments may be needed to achieve a desired level of process optimization. In practice, the process modifications necessary would be determined by the process analysis study.

Process optimization costs depend on the pollutant needing reductions and existing treatment processes and operations. For example, a facility could add a flocculant aid to secondary treatment to increase solids removal, and thus, the removal of any pollutants that adhere to particulates [e.g., mercury and bis(2-ethylhexyl) phthalate]. In addition, chemicals used in wastewater treatment could contain contaminants (e.g., chlorine contaminated with low levels of mercury), and for certain pollutants (e.g., mercury) the use of such chemicals could result in exceedances. Thus, switching chemicals or the source of chemicals could be another low cost process optimization control option.

The effectiveness of process optimization largely depends on the efficiency of current operations, the existing treatment processes, and the fate and transport of the pollutant through the treatment train. For example, if a facility is already well maintained and operated, implementing process optimization may not result in additional pollutant reductions because the existing treatment processes are already performing at their feasible limits. Also, because most conventional treatment technologies are designed to maximize removal of suspended solids, process optimization aimed at increasing those removal efficiencies may not result in significant reductions for pollutants existing primarily in dissolved form. Given the available information for the sample facilities, it is generally not possible to determine the reductions achievable with process optimization; rather, a detailed, site-specific study would be necessary.

4.4.2 Source Controls

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If adjusting existing operations would not be feasible or would not be sufficient to achieve the necessary reductions, source controls would likely be the next most cost-effective control option. Source control could be used alone, or in conjunction with process optimization. The feasibility of source control efforts depends on the makeup of the influent and potential sources of the pollutant. For example, certain toxic pollutants are primarily used in industrial processes. Thus, for a municipal facility, a feasible source control option would be regulating indirect industrial dischargers through pretreatment permits. However, for pollutants in which the main sources are commercial and residential wastewater (e.g., mercury), a facility would likely have to concentrate efforts on public outreach and education or a sewer use ordinance. Other pollutants, such as arsenic, may be due to natural sources (e.g., groundwater), and reducing inflow and infiltration (I&I) or treating source water may be necessary.

Costs for source control activities depend on the pollutant and the measures or controls implemented. For this analysis, we estimated that the sample facilities would pursue pollution prevention (P2) programs (for mercury, DDT, BHC, dioxin, and bis(2-ethylhexyl) phthalate) or I&I reduction projects (for arsenic) to reduce toxic pollutant concentrations in effluents.

Pollution Prevention Program

Successful P2 programs will likely include at least some of the following steps:

- Identify sources – particularly sources that contribute the greatest load to the influent
- Form a workgroup – preferably composed of representatives from government, industry, community, and environmental organizations that are either familiar with P2 strategies or familiar with the pollutant
- Define program goals – including a statement of how the municipality intends to reduce pollutant levels in its effluent, the purpose for doing so, and a time line for completion
- Develop an approach – including selecting sectors for P2 efforts, the criteria for targeting efforts (e.g., size of the source loading, authority available to control the source, time required to produce desired results), whether efforts will be voluntary or regulatory, and who will execute each program effort
- Estimate program costs – develop estimates and identify entities that will bear the costs
- Implement Program – starting with the most cost-effective measures and modifying activities and approach based on measured results
- Assess progress – including both successes and failures (i.e., lessons learned) throughout the duration of the program
- Provide follow-up – necessary to ensure P2 measures continue to be implemented
- Develop a contingency plan – including a description of actions to be taken if plan efforts are unsuccessful.

The focus and approach of the program will be different for each community and sector targeted. As such, plans vary in complexity and in the resources necessary to achieve the goals set forth.

The reductions in mercury achievable through P2, and thus the ability to achieve compliance with numeric effluent limits using P2 alone, will vary based on existing treatment processes, the makeup and size of the service area (e.g., number of potential mercury sources), and the level of P2 already being implemented in the community. Large municipal facilities with numerous

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potential mercury sources may see significant reductions after implementation of a measure that targets a major influent mercury source, such as a sewer use ordinance requiring all dental offices to install amalgam separators. However, facilities with much smaller service areas may not be able to achieve the same reductions in their effluent with P2 due to a lower percent of easily identifiable and controllable sources contributing to the influent mercury load. For example, sources from the residential sector are not as easy to identify as those from industrial and commercial sectors since they may originate from a wide range of products and smaller municipalities are likely to receive most of their inflow from the residential sector.

The Western Lake Superior Sanitation District (WLSSD) in Minnesota was one of the first municipalities to implement P2 for mercury, with efforts dating back to 1989. As a result of in-house process changes and an ongoing public awareness program, WLSSD reduced mercury in dry sludge from 4.5 ppm in 1990 to 0.9 ppm in 2001 (80% reduction). During the same period, effluent levels decreased from 0.58 µg/L to 0.005 µg/L (99% reduction) (WLSSD, 2002).

A number of communities in California have also demonstrated results. The Mt. View Sanitary District has three dental offices, two hospitals, and one laboratory that discharge to the wastewater treatment plant. During an audit of the hospitals and laboratory, the District found they had all already replaced mercury containing-equipment and chemicals. In 2002, the District held onsite inspection audits at each dental office in its service area to encourage implementation of a list of BMPs. During the audits, they discovered that two of the offices were disposing of wastes from their vacuum systems in the sink or storm drain, and advised the offending offices on the proper disposal methods. As shown in **Exhibit 4-6**, after a spike in average influent concentrations between fiscal year (FY) 2001-2002 and FY 2002-2003, influent concentrations decreased by about 55% in FY 2003-2004; effluent concentrations continued to decrease each year (this trend could be due to improvements in treatment performance or an increase of influent particulate mercury which is more easily removed with conventional treatment processes and so would not significantly affect effluent concentrations). However, since that time, the District has not been able to identify any additional likely sources of mercury (Engler Environmental Associates, 2005). Thus, future reductions from P2 may be more difficult to achieve, especially as the residential population in the service area increases.

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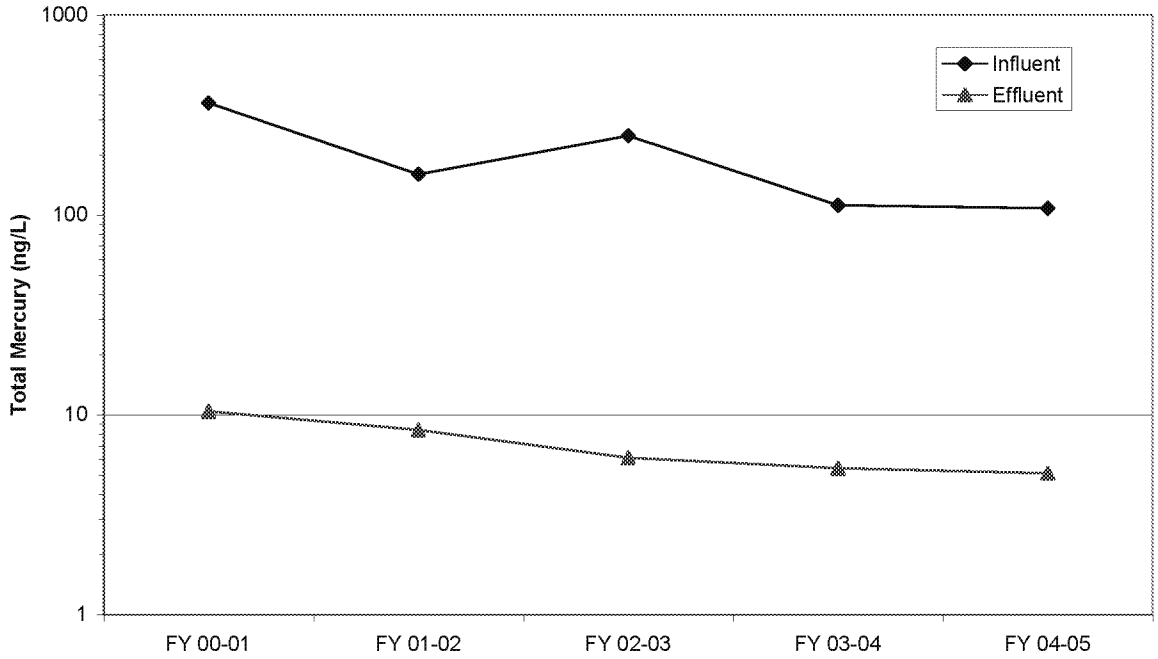
Exhibit 4-6. Average Annual Influent and Effluent Mercury Concentrations, Mt. View SD



There are a number of known and controllable source of mercury. However, the effectiveness for other pollutants such as 4,4'-DDT, alpha-BHC, bis(2-ethylhexyl) phthalate, and dioxin will vary based on whether there are any existing sources in the service area or if the presence of the pollutant is due to legacy use.

Other limiting factors of P2 effectiveness could be treatment performance capability and the percent of dissolved mercury in the effluent. For traditional wastewater treatment plants (i.e., plants without advanced end-of-pipe treatment), the particulate fraction of a pollutant is more easily removed than the dissolved fraction. Therefore, if P2 primarily reduces particulate mercury in the influent, the treatment removal efficiency may decrease because there is less particulate mercury to remove. A decrease in effluent removal rates associated with decreased influent loads could also be due to the mechanisms by which the pollutant is removed (e.g., settling and adsorption) reaching equilibrium (i.e., there is some minimum pollutant level that a particular treatment process cannot go below).

Exhibit 4-7 shows how removal efficiencies for mercury at EBMUD vary with influent concentrations (Mena, 2005). The data shows that, for the most part, as influent mercury concentrations decrease, the percent of mercury removed also decreases. Thus, while P2 may effectively reduce influent mercury loads and the total load of mercury to the environment, the total benefits of P2 (e.g., reductions in sludge concentrations, which may be released to air through incineration) may not be predicted or measured through changes in effluent levels alone (or compliance with applicable effluent limits).

Exhibit 4-7. Influent Mercury Concentrations versus Percent Removal, EBMUD

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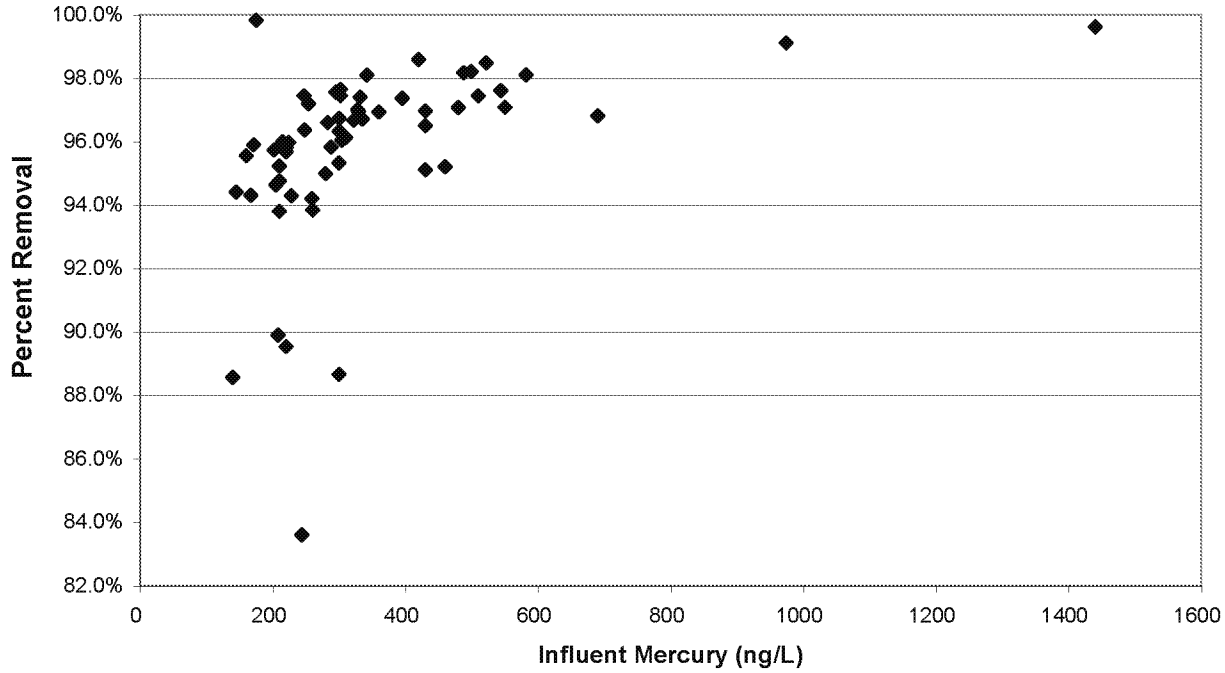

There is little information available on the cost of P2 programs for individual pollutants because facilities typically do not account for pollutant-specific P2 costs as a budget item that can be verified apart from other base program costs. However, the experiences of facilities that have already developed P2 programs for pollutants such as mercury provide some information on likely program components and costs.

Community size is likely to be a factor affecting P2 program costs. For example, it is unlikely that a minor facility would need the same amount of resources for program development and outreach efforts as a large major municipal facility because the service area is smaller and contains fewer households and commercial/industrial dischargers to target. Smaller facilities may also pool their resources together and develop a joint P2 program to save time and money on program development and outreach materials. For this analysis, we assumed that P2 program costs for mercury may be approximately $50,000 per year for a small municipal facility (1 mgd to 5 mgd), $100,000 for a medium-sized municipal facility (≥5 mgd to 20 mgd), and to $150,000 per year for a large municipal facility (> 20 mgd). P2 program costs for pollutants with fewer potential sources would likely be lower ($25,000 to $50,000). **Appendix B** discusses the basis for these estimates.

We also estimated costs to indirect dischargers to municipal wastewater treatment plants under a mercury P2 program (see Appendix B). For other pollutants, identifying groups of indirect dischargers likely to be contributing to the influent load at the treatment plant is more difficult because the pollutants are no longer actively used (e.g., legacy pesticides), could be formed as a byproduct of numerous processes (e.g., dioxin), or there is a lack of information available. Thus, it is not possible to estimate pretreatment or P2 costs to indirect dischargers for pollutants other than mercury without specific information on the types of industrial dischargers in each service area.

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I&I Reduction Projects

The main components of an I&I reduction program are identifying sources through field investigations, designing and constructing rehabilitation improvements, and monitoring post-construction flows to determine the effectiveness of the rehabilitation (King County, 2005).

Identifying I&I sources can involve a wide range of field inspections and testing procedures. For most collection systems, I&I is the result of defects in pipelines and manhole structures or entry from connected storm sewers (Wade, 2002). Source identification activities include smoke testing, manhole inspections, pipeline cleaning, closed circuit television (CCTV) inspections, dyed-water testing, building inspections, and private lateral inspections (Wade, 2002). The exact combination of actions depends on the size and makeup of the system and extent of the I&I problem. Wade (2007) estimates that a comprehensive study to identify I&I problems would cost approximately $2.50/ft of sewer system pipe.

The results of the source identification study dictate the selection of rehabilitation and control projects. Thirty years ago, I&I reduction projects were mainly limited to pipe replacement or construction of a parallel sewer, making repair costs prohibitive (Wade, 2002). However, today there are no-dig or trenchless construction practices available to reduce I&I as well as project costs. **Exhibit 4-8** provides unit costs for various rehabilitation options.

Exhibit 4-8. Inflow and Infiltration Rehabilitation Unit Costs

Activity	Units	Unit Cost	Comments
Pipeline Rehabilitation	Linear Feet	$30 - $100	Full trenchless or replacement
Partial Pipeline Rehabilitation	Each	$1,000 - $2,500	Point repairs, partial renewal
Manhole Replacement	Each	$2,000 - $5,000	
Manhole Rehabilitation	Vertical Feet	$20 - $200	Grouting, coating, lining
Capacity Improvements	Linear Feet	$50 - $150	Relief sewers (8"-15")
Wet-Weather Storage/Treatment	Gallons	$0.50 - $1.00	

Source: Wade and Cate (2004)

Wade and Cate (2004) indicate that basic control costs for sewer rehabilitation could be as much as $7 per linear foot of sewer pipe (2004 dollars). Escalated to 2007 dollars, using the Engineering News Record Construction Cost Index, unit costs would be approximately $8 per linear foot.[4] The useful life of sewer pipes in Oregon may range from 20 year to 50+ years (OECD, 2007). For an estimate of annual costs, we annualized total costs by 7% over 20 years.

[4] Wade (2004) also estimates that the costs for a comprehensive control program that includes sewer rehabilitation and controls to handle wet weather flows (e.g., relief sewers, detention basins, and treatment plant improvements) could be three times greater than basic program costs. However, this additional level of infrastructure upgrade to accommodate increased flow for storm water control is not necessary for controlling infiltration which reduces flows.

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There are no data available evaluating the effectiveness of an I&I reduction program on effluent arsenic concentrations at a wastewater treatment plant. The effectiveness of the program to reduce groundwater infiltration depends on the completeness of the source identification study and the funds available to rehabilitate the system. Wade (2002) estimates that most cities should be able to reduce peak flows to the treatment plant by 30% to 50% for programs specifically designed to reduce wet-weather overflows and bypasses. Similar estimates are not available for reducing infiltration only, primarily because estimating the volume of flow from infiltration is difficult because it is not directly correlated with rain events; groundwater infiltration tends to be higher in winter when water usage is lower due to a higher groundwater table and vice versa in the summer (Santa Rosa, 2006).

4.4.3 End-of-Pipe Treatment

If process optimization or source control would not be sufficient for compliance with the baseline or revised criteria, alternative discharge options or end-of-pipe treatment technologies may be necessary. However, at the higher alternative fish consumption rates many of the criteria approach extremely low levels (e.g., mercury) or fall below QLs [e.g., bis(2-ethylhexyl) phthalate]. In addition, for many pollutants, the lowest levels achievable through end-of-pipe treatment are highly uncertain due to the fact that no other dischargers have been required to treat to such low levels and performance data are not available.

For metals such as mercury and arsenic, technologies that primarily target the dissolved fraction of the pollutant are most likely to achieve low effluent levels because most of the particulate fraction will already be removed with existing treatment controls designed to remove solids (see discussion of Process Optimization). For organic pollutants such as 4,4;-DDT, alpha-BHC, and dioxin, similar treatment technologies can be used, although operating parameters may have to be adjusted to achieve optimal removal rates. Bis(2-ethylhexyl) phthalate is a semi-volatile organic pollutant that is primarily attached to particulates larger than 0.1 µm (Marttinen, et al., 2003). With such a high percentage of the pollutant sorbed to particulates, the potential for biological degradation is low. Thus, treatment technologies that target removal of solids should also remove bis(2-ethylhexyl) phthalate.

Exhibit 4-9 summarizes some of the end-of-pipe treatment technologies that could be used to remove the pollutants of concern. Note that although these technologies should theoretically be able to achieve the levels needed for compliance with the baseline and revised criteria, there is no evidence that any point source discharger to surface waters has actually implemented such controls for compliance with toxic effluent limits. Thus, there are no performance data available on which to base design criteria or to substantiate theoretical claims.

Exhibit 4-9. Summary of Potential End-of-Pipe Treatment Technologies

Technology	Pollutants Removed	Comments
Reverse Osmosis	Inorganics (e.g., arsenic and mercury), radium, pesticides, and microbial contaminants	Pretreatment (e.g., microfiltration) to prevent fouling; may need multiple units in series to achieve low effluent levels.
Selective Sorbents	Metals (e.g., arsenic and mercury), nitrate, and radionuclides	System would have to be optimized for removal of a specific pollutant to achieve low effluent levels.

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Exhibit 4-9. Summary of Potential End-of-Pipe Treatment Technologies

Technology	Pollutants Removed	Comments
Chemical Precipitation	Metals (e.g., arsenic and mercury) and phosphorus	Preoxidation likely necessary to achieve low effluent levels; removal rates may be highly dependent on pH and other wastewater characteristics
Granular Activated Carbon	Refractory organics (DDT, BHC, dioxin), and volatile organics (bis(2-ethylhexyl) phthalate)	Pretreatment to remove solids and prevent fouling; disposal of spent media could be costly.
Advanced Oxidation	Refractory organics (e.g., DDT, BHC, and dioxin)	Destroys pollutants so that residuals management is not an issue; may result in formation of harmful byproducts.

Appendix C provides detailed information on each treatment technology as well as available unit costs. Due to the uncertainty of achievable effluent levels, we did not identify any end-of-pipe treatment technologies capable of producing the necessary effluent concentrations on a consistent and reliable basis.

4.4.4 Alternative Compliance Mechanisms

If none of the control options discussed above would result in compliance with baseline or revised effluent limitations, or if the costs of available treatment would be prohibitive, dischargers would likely need some form of relief from the requirements.

Site-Specific Criteria

If dischargers suspect that the characteristics in the vicinity of their discharge warrant alternative criteria values (e.g., resulting in less stringent effluent limitations in their permit), they may work to collect data for consideration by permitting authorities. ODEQ may also implement site-specific criteria as part of a TMDL process (i.e., identifying the appropriate target value). ODEQ (2007b) indicates that site-specific criteria are justifiable if one of the following is true:

- Species at the site are more or less sensitive than those used by EPA to develop the national recommended criteria
- Physical and/or chemical characteristics of the site alter the biological availability or toxicity of the chemical (e.g., alkalinity, pH, hardness, suspended solids, and salinity influence the concentration of the toxic forms of some heavy metals, ammonia, and other chemicals)
- EPA may not have criteria recommendation for a pollutant adversely affecting the designated use of a particular water body.

The site-specific criteria must be based on sound scientific rationale and not affect the existing designated use (ODEQ, 2007b). EPA must also review and approve the criteria prior to implementation.

Because additional data are likely required to assess the appropriateness of site-specific criteria at a particular location, the extent of use of this mechanism by dischargers is uncertain. However, consideration by ODEQ within the context of a TMDL is likely, and may or may not

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reflect an incremental increase in effort above that associated with current TMDLs (this type of data collection and evaluation may already be a part of TMDL development efforts).

Intake Credits

Under 40 CFR 122.45(g), EPA allows dischargers to request that effluent limits be adjusted to reflect credit for pollutants in the discharger's intake water if either:

- The applicable effluent limitations and standards contained in 40 CFR subchapter N specifically provide that they shall be applied on a net basis
- The discharger demonstrates that the control system it proposes or uses to meet applicable technology-based limits and standards would, if properly installed and operated, meet the limits and standards in the absence of pollutants in the intake waters.

Intake credits will only be granted to the extent necessary to meet the applicable limit, up to a maximum value equal to the influent value. In most cases, intake credits will only be granted to dischargers that can demonstrate that the intake water is drawn from the same body of water into which the discharge is made. However, EPA may waive this requirement if no environmental degradation will result. Thus, depending on the how the water is used/altered in the treatment process and the location of intakes and outfalls, dischargers in Oregon may be eligible for intake credits.

Variances

OAR 340-041-0061(2) allows the state's EQC to grant point source dischargers variances from meeting water quality standards if attaining the water quality standard is not feasible for one of the following reasons:

1. Naturally occurring pollutant concentrations prevent the attainment of the use.
2. Natural, ephemeral, intermittent, or low flow conditions or water levels prevent the attainment of the use, unless these conditions may be compensated for by the discharge of sufficient volume of effluent discharges to enable uses to be met without violating state water conservation requirements.
3. Human-caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place.
4. Dams, diversions, or other types of hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the water body to its original condition or to operate such modification in a way which would result in the attainment of the use.
5. Physical conditions related to the natural features of the water body, such as the lack of a proper substrate, cover, flow, depth, pools, riffles, and unrelated to water quality preclude attainment of aquatic life protection uses.
6. Controls more stringent than those required by sections 301(b) and 306 of the federal Clean Water Act would result in substantial and widespread economic and social impact.

Note that these are the same considerations that EPA has established for changing a use that is not an existing use in a use attainability analysis.

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To demonstrate that any of the first five conditions above apply as part of an application for a variance, dischargers would likely prepare documentation of the conditions warranting the variance. For example, New Jersey Department of Environmental Protection (NJDEP) was considering adopting more stringent water quality criteria for mercury, PCBs, and DDT. However, because the proposed criteria reflected extremely low concentration levels, and available analytical methods for DDT and PCBs cannot detect at such low levels, NJDEP evaluated the technological feasibility of available treatment technologies for reducing these pollutants in wastewater (U.S. EPA, 2005).

Such an evaluation may require a comprehensive literature search and analysis of the data compiled from the search. The literature search may encompass general information identifying the treatment technologies capable of removing the pollutants of concern, background on the processes driving the removal or reduction of pollutants, and performance data showing the effluent levels demonstrated at pilot-, demonstration-, and full-scale wastewater treatment plants. Dischargers seeking a variance based on the third factor would also need to evaluate the feasibility of each technology as it relates to its own effluent characteristics and treatment train (e.g., through a comparison of performance data and theoretical effluent levels cited in the literature to their own treatment operations).

Unfortunately, given the fact that few, if any, wastewater treatment plants discharging to surface waters have installed advanced end-of-pipe treatment technologies for compliance with toxics standards, performance data will be extremely limited. Thus, it may not be possible to determine whether any of the identified technologies could in fact achieve the desired effluent levels without collecting additional data or conducting studies designed to measure the limits of performance of each technology. For this reason, dischargers may evaluate whether installing any of the identified treatment technologies would result in adverse economic and social impacts before conducting any pilot tests or studies.

To evaluate the potential for control costs to cause substantial and widespread economic and social impacts (the sixth condition above), dischargers are likely to follow EPA's (1995) Interim Economic Guidance for Water Quality Standards Workbook which provides worksheets and instructions for public and private sector entities. Following EPA (1995), dischargers conduct a two-step analysis, first determining whether the control costs would have a substantial adverse financial impact and, if so, whether that impact would cause widespread adverse impacts on the surrounding community. **Appendix D** provides a discussion of the analysis.

Often times, permitting authorities require facilities to implement a P2 or source control program as part of the conditions for granting a variance. It is not clear whether ODEQ would require such actions when granting a variance. However, OAR 340-041-0061(2)(C) states that ODEQ may condition the variance on the performance of additional studies, monitoring, management practices, and other controls deemed necessary. Thus, to be conservative (i.e., err on the side of overestimating costs), we assumed that facilities would need to implement a P2 program as part of a variance.

Potential Costs

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The potential costs associated with pursuing alternative compliance mechanisms will depend to some extent on the implementation procedures accompanying the final revised criteria (e.g., some states have sought to minimize individual discharger demonstrations of applicable variance factors by establishing multidischarger variance procedures). There is also uncertainty regarding the relief mechanism and specific factors that a discharger will address. However, legal costs (often incurred by private companies) must be attributed to discharger preferences and not the regulation, because legal services are not necessary to prepare the analyses or applications related to any of the alternative compliance mechanisms discussed above.

For temporary variances from WQBELs, dischargers are most likely to base applications on technical (factor 3) and economic (factor 6) infeasibility. **Exhibit 4-10** provides estimates of levels of effort that may be associated with technological feasibility analyses. Note that initial efforts regarding technological feasibility may serve to reduce costs of subsequent applications (e.g., dischargers may rely on previously developed materials), since the pollutants for which achieving compliance may not be technologically feasible are likely to be common across dischargers (e.g., arsenic and mercury). Indeed, reducing costs of individual discharger applications is the motive behind some current state procedures establishing provisions for granting multidischarger variances from WQBELs for mercury. Thus, cost may decrease over time. There is also uncertainty regarding the extent to which such efforts represent an incremental effect attributable to revising the fish consumption rate versus efforts that dischargers will undertake routinely as part of maintaining wastewater treatment facilities absent any regulatory changes.

Exhibit 4-10. Potential Level of Effort to Investigate Technological Feasibility

Component	Hours	Cost[1]
Literature search	180	$19,800
Write up and evaluation of theory and performance data from search	100	$11,000
Evaluation of existing treatment performance	40	$4,400
Total	320	$35,000

1. Based on a labor rate of $100/hr, reflecting the average wage rage for an environmental engineer in Oregon escalated to May 2007 dollars ($35.86; BLS, 2006; 2007a) and multiplied by a factor of 3.03 to account for overhead, benefits, and profit (PSMJ, 2007).

The cost associated with individual applications demonstrating adverse economic and social impacts would likely include the cost of a preliminary engineering analysis (preconceptual design; detailed design work is not necessary) and subsequent financial analysis for which EPA (1995) provides guidance and worksheets. This level of engineering analysis, in conjunction with the financial impact analyses (described in Appendix D) may vary based on facility size (larger facilities may have more alternatives and issues to evaluate, and more capabilities compared to smaller facilities). To provide some indication of the potential magnitude of such costs, we assumed that dischargers will likely complete the studies and variance application within a relatively short time period (e.g., 4 months) with contract labor. Assuming that the scope of a study for large facilities (>20 mgd) could warrant a level of effort equivalent to approximately 4 full time consultants over this amount of time (e.g., 680 hours per consultant), costs would be approximately $300,000 (at an average hourly wage rate of $110, including benefits, overhead, and fee). We assumed that the level of effort involved in completing studies and applications would be one-third less for medium-sized facilities (>5 mgd and <20 mgd) (i.e.,

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approximately $200,000), and two-thirds less (i.e., approximately $100,000) for small-sized facilities (>1 mgd to 5 mgd).

ODEQ would also have to review any requests for variances. As for dischargers, there is uncertainty regarding the extent to which variance-related efforts represent incremental effects attributable to either baseline or revised criteria versus basic discharge-related program components. Nonetheless, assuming the State's review of the engineering cost and financial impact analysis could require up to 100 hours[5] and the average hourly wage rate for an environmental engineer at ODEQ is $39.20 including benefits (ODEQ, 2008; BLS, 2007b)[6], per-review cost to ODEQ could be approximately $3,900.

OAR 340-041-0061(2) indicates that variances only last for three years or the life of a permit, whichever is less. Costs for variance renewals for both dischargers and ODEQ are likely to be minimal.

Costs to develop analyses for site-specific criteria would likely fall within the range for variance applications for the different factors, and intake credit justification costs would likely be minimal.

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[5] We assumed that the review process could take 32 hours, including validating source data, checking calculations, and evaluating the engineering design and the conclusions regarding potential financial and community impacts. ODEQ's variance procedures also require a notification and public comment period. Based on time estimates to review and respond to comments on an individual permit issue to a single concentrated animal feeding operation (U.S. EPA, 2000b), we assumed that, on average, the notification and response to comments activities would require an average of 68 hours. Thus, the total time requirement for each request is 100 hours.

[6] The average hourly rate across salary levels for an environmental engineer is $26.83. The benefits multiplier from BLS (2007b) is 1.46.

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5. Method for Estimating Potential Costs: Nonpoint Sources

Unlike point sources, ODEQ typically does not require nonpoint sources and municipal storm water dischargers to achieve numeric WQBELs for human health pollutants. The regulatory baseline for evaluating the potential impact of the revised criteria includes some requirements for nonpoint sources and storm water dischargers to implement BMPs and wasteload allocations as part of TMDLs (see Section 2). ODEQ has developed TMDLs for a number of toxic pollutants already (Exhibit 2-5) and will be developing TMDLs for others (Exhibit 2-4). However, the pollutant loading reductions and discharge concentrations that will be achieved through baseline BMPs is uncertain. Thus, there is also uncertainty in the extent of incremental controls that could be required under the potential revised criteria.

5.1 Available Data

Instream monitoring data can be used to assess the impact that a change in the fish consumption rate may have on attainment of water quality criteria and thus, control of potential nonpoint sources. Although not representative of all surface waters, ODEQ's Laboratory Analytical Storage and Retrieval (LASAR) database contains water quality monitoring data for the pollutants of concern. LASAR contains 3,889 water column and 676 fish tissue observations (for mercury) collected between 1997 and 2007 from locations other than point source outfalls for which there is either a reported value or detection limit. **Exhibit 5-1** provides a summary of these data.

ODEQ's 303(d) listing policy requires at least two exceedances of water quality standards for a water to be classified as impaired and needing a TMDL (Category 5). If data are insufficient, but there is one exceedance, ODEQ (2006e) indicates that the water should be classified as one of potential concern (Category 3B).

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Exhibit 5-1. Summary of Select Ambient Monitoring Data[1]

Pollutant	Number of Stations	Number of Observations		Percent of Detected Values Exceeding Criteria[2]					
		Total	Detect	Baseline[3]	62.3 gpd	113 gpd	175 gpd	389 gpd	620 gpd
1,1,2,2-Tetrachloroethane	1	1	0	NA	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethylene	1	1	0	NA	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	1	1	0	NA	NA	NA	NA	NA	NA
1,1-Dichloroethylene	1	1	0	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	2	2	0	NA	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	2	2	0	NA	NA	NA	NA	NA	NA
1,2-Dichloroethane	1	1	0	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	1	1	0	NA	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	2	2	0	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	2	2	0	NA	NA	NA	NA	NA	NA
2,4,6-Trichlorophenol	1	1	0	NA	NA	NA	NA	NA	NA
2,4-Dichlorophenol	1	1	0	NA	NA	NA	NA	NA	NA
2,4-Dimethylphenol	1	1	0	NA	NA	NA	NA	NA	NA
2,4-Dinitrophenol	1	1	0	NA	NA	NA	NA	NA	NA
2,4-Dinitrotoluene	1	1	0	NA	NA	NA	NA	NA	NA
2-Chloronaphthalene	1	1	0	NA	NA	NA	NA	NA	NA
2-Chlorophenol	1	1	0	NA	NA	NA	NA	NA	NA
4,4`-DDD	23	81	11	100	100	100	100	100	100
4,4`-DDE	25	83	12	100	100	100	100	100	100
4,4`-DDT	23	81	15	100	100	100	100	100	100
4,6-Dinitro-2-methylphenol	1	1	0	NA	NA	NA	NA	NA	NA
Acenaphthene	2	2	0	NA	NA	NA	NA	NA	NA
Acenaphthylene	2	2	0	NA	NA	NA	NA	NA	NA
Acrolein (2-Propenal)	1	1	0	NA	NA	NA	NA	NA	NA
Aldrin	23	69	1	100	100	100	100	100	100
alpha-BHC	29	126	0	NA	NA	NA	NA	NA	NA
Anthracene	2	2	0	NA	NA	NA	NA	NA	NA
Antimony	153	468	29	10	14	17	17	28	31
Arsenic	209	534	68	100	100	100	100	100	100
Benzene	1	1	0	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	1	1	0	NA	NA	NA	NA	NA	NA
Benzo[a]Anthracene	2	2	0	NA	NA	NA	NA	NA	NA

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Exhibit 5-1. Summary of Select Ambient Monitoring Data[1]

Pollutant	Number of Stations	Number of Observations		Percent of Detected Values Exceeding Criteria[2]					
		Total	Detect	Baseline[3]	62.3 gpd	113 gpd	175 gpd	389 gpd	620 gpd
Benzo[a]pyrene	1	1	0	NA	NA	NA	NA	NA	NA
Benzo[b]Fluoranthene	2	2	0	NA	NA	NA	NA	NA	NA
Benzo[k]Fluoranthene	2	2	0	NA	NA	NA	NA	NA	NA
Beryllium	99	183	82	100	100	100	100	100	100
beta-BHC	23	81	1	0	0	0	100	100	100
Bis(2-chloroethyl)ether	1	1	0	NA	NA	NA	NA	NA	NA
Bis(2-chloroisopropyl)ether	1	1	0	NA	NA	NA	NA	NA	NA
Bis(2-ethylhexyl)phthalate	1	1	0	NA	NA	NA	NA	NA	NA
Bromodichloromethane	1	1	0	NA	NA	NA	NA	NA	NA
Bromoform	1	1	0	NA	NA	NA	NA	NA	NA
Butylbenzylphthalate	1	1	0	NA	NA	NA	NA	NA	NA
Carbon Tetrachloride	1	1	0	NA	NA	NA	NA	NA	NA
Chlordane	23	56	0	NA	NA	NA	NA	NA	NA
Chlorobenzene	1	1	0	NA	NA	NA	NA	NA	NA
Chloroform	1	1	0	NA	NA	NA	NA	NA	NA
Chrysene	2	2	0	NA	NA	NA	NA	NA	NA
Dibenzo[a,h]Anthracene	2	2	0	NA	NA	NA	NA	NA	NA
Dibromochloromethane	1	1	0	NA	NA	NA	NA	NA	NA
Dieldrin	29	138	7	100	100	100	100	100	100
Diethylphthalate	1	1	0	NA	NA	NA	NA	NA	NA
Dimethylphthalate	1	1	0	NA	NA	NA	NA	NA	NA
di-n-Butylphthalate	1	1	0	NA	NA	NA	NA	NA	NA
Endosulfan sulfate	1	1	0	NA	NA	NA	NA	NA	NA
Endrin	18	76	0	NA	NA	NA	NA	NA	NA
Endrin Aldehyde	23	74	0	NA	NA	NA	NA	NA	NA
Ethyl Benzene	1	1	0	NA	NA	NA	NA	NA	NA
Fluoranthene	2	2	0	NA	NA	NA	NA	NA	NA
Fluorene	2	2	0	NA	NA	NA	NA	NA	NA
Heptachlor	23	69	5	100	100	100	100	100	100
Heptachlor Epoxide	23	81	5	100	100	100	100	100	100
Hexachlorobenzene	23	69	2	100	100	100	100	100	100
Hexachlorocyclopentadiene	12	32	0	NA	NA	NA	NA	NA	NA

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Exhibit 5-1. Summary of Select Ambient Monitoring Data[1]

Pollutant	Number of Stations	Number of Observations		Percent of Detected Values Exceeding Criteria[2]					
		Total	Detect	Baseline[3]	62.3 gpd	113 gpd	175 gpd	389 gpd	620 gpd
Hexachloroethane	1	1	0	NA	NA	NA	NA	NA	NA
Ideno[1,2,3-cd]pyrene	2	2	0	NA	NA	NA	NA	NA	NA
Isophorone	1	1	0	NA	NA	NA	NA	NA	NA
Mercury[4]	77	304	242	1	19	28	40	74	94
Mercury (fish tissue)[5]	108	676	648	46	87	97	100	100	100
Methylene Chloride	1	1	0	NA	NA	NA	NA	NA	NA
Nickel	206	526	340	1	0	0	0	0	0
Nitrobenzene	1	1	0	NA	NA	NA	NA	NA	NA
N-Nitrosodiphenylamine	1	1	0	NA	NA	NA	NA	NA	NA
Pentachlorophenol	1	1	0	NA	NA	NA	NA	NA	NA
Pyrene	2	2	0	NA	NA	NA	NA	NA	NA
Selenium	153	467	35	0	0	0	0	0	0
Thallium	153	467	38	100	100	100	100	100	100
Toluene	1	1	0	NA	NA	NA	NA	NA	NA
Toxaphene	23	56	0	NA	NA	NA	NA	NA	NA
trans-1,2-Dichloroethylene	1	1	0	NA	NA	NA	NA	NA	NA
Trichloroethylene	1	1	0	NA	NA	NA	NA	NA	NA
Vinyl Chloride	1	1	0	NA	NA	NA	NA	NA	NA

NA = not applicable

1. Source: ODEQ (2007c); data from 1997 and 2007. Does not include stations directly downstream of point sources.
2. Human health criteria for consumption of water and organisms.
3. Compared to existing criteria [i.e., effective human health criteria include criteria from OAR 2340-041-0033 Table 33A that became effective February 2005 (revised criteria that became effective without EPA approval) and Table 20 (original criteria since ODEQ's 2004 proposed criteria are not effective pending EPA approval)].
4. Water column data compared to potential water column criteria based on the revised fish tissue criteria, calculated using EPA default BAFs, trophic level consumption percentages, and water column translator.
5. Wet weight fish tissue concentrations compared to revised fish tissue criteria.

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5.2 Identifying Exceedances

Based on the data in Exhibit 5-1, most of the pollutants with detected values have concentrations that exceed the baseline criteria[7] (the exception is nickel, for which potential revised criteria are less stringent than baseline criteria). Thus, source controls are necessary in the absence of revisions to the fish consumption rate. If such controls do not also result in compliance with the potential revised criteria, nonpoint sources could be impacted in terms of additional controls (e.g., increased rate of BMP implementation). For antimony, beta-BHC, and mercury, the percent of the data that exceeds the criteria increases with increasing consumption rates (e.g., by a factor of 3 for antimony between baseline criteria and criteria based on the highest consumption rate). Again, higher rates of control could be required if controls to achieve baseline criteria are not sufficient for compliance with potential revised criteria. However, most BMPs are not designed to achieve a specific percent reduction in pollutants in a manner similar to how point source controls are typically implemented (e.g., specific treatment units in a treatment train can be operated to achieve more or less pollutant reductions depending on permit requirements). Thus, without more detailed data on the sources of the pollutants, and the instream concentrations that would be achieved from baseline levels of controls, the potential magnitude of incremental impact is uncertain.

5.2.1 Antimony

There are 3 samples (of 29 detects) that exceed the baseline criteria, and no water bodies currently listed as impaired for antimony. Each of the baseline criteria exceedances are on different water bodies. Thus, based on the existing listing policy these waters would be of potential concern but not impaired.

There are 9 exceedances of the most stringent revised criterion (based on a fish consumption rate of 620 gpd), representing 8 different water bodies. Based on the existing listing policy, only one new water body would be considered impaired for the revised criterion based on a consumption rate of 620 gpd; the remaining water bodies would be of potential concern due to a lack of data. In addition, there would be no new listings for the other criteria based on consumption rates of 63.2 gpd, 113 gpd, 175 gpd, and 389 gpd, only additional waters of potential concern. Thus, the data indicate that there could be an incremental impact associated with the revised criteria for antimony at a consumption rate of 620 gpd.

Antimony can enter surface waters through atmospheric deposition (e.g., antimony released into the air by volcanoes and forest fires), soil erosion and weathering of antimony-containing ores and soil, and commercial or industrial processes, such as metal smelting and refining, coal-fired power plants, and refuse incineration (ATSDR, 1992). Much of the antimony found in sediment, soil, and rock is so strongly attached to dust and dirt or buried in minerals that it is unlikely to

[7] Effective human health criteria include criteria from OAR 2340-041-0033 Table 33A that became effective February 2005 (revised criteria that became effective without EPA approval) and Table 20 (original criteria since ODEQ's 2004 proposed criteria are not effective pending EPA approval).

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enter surface waters (ATSDR, 1992). Thus, likely sources of antimony include runoff from agricultural and forest lands, storm water, and industrial point sources.

It is uncertain whether additional data would indicate impairments or the need for an increase in the level of control above and beyond those needed for compliance with baseline standards. For example, BMPs for agricultural and forest lands required as part of the existing regulatory framework or to achieve load allocations for other pollutants could also reduce antimony loads.

5.2.2 Beta-BHC

There is one detected concentration of beta-BHC, which exceeds the criteria for consumption rates of 175 gpd and greater. The detected value is located on Zollner Creek, which is already on the existing 303(d) list for a number of pollutants including arsenic, chlordane, and dieldrin. Chlordane and dieldrin are similar to BHC in that both were found in pesticides/insecticides and are no longer used or produced (ATSDR, 2005). Thus, the potential sources would likely be the same and controls implemented to reduce chlordane and dieldrin to address the existing impairments would also likely reduce concentrations of beta-BHC. However, if additional data indicate new impairments for beta-BHC, some level of incremental controls may be needed.

5.2.3 Mercury

Fish tissue concentrations of mercury exceed the baseline criterion of 0.3 mg/kg in 296 of 648 samples, and 3 of 242 detected samples exceed the baseline water column criterion of 0.144 µg/L. These exceedances represent data from 24 water bodies, only 5 of which are on the current 303(d) list for mercury. The number of water bodies impaired based on the current listing policy would increase with increasing fish consumption rates. **Exhibit 5-2** summarizes the number of exceedances and impairments for each scenario.

Exhibit 5-2. Potential Number of Exceedances and Impairments for Mercury[1]

Scenario	Number of Exceedances		Water Bodies of Potential Concern (Category 3A)		Impaired Water Bodies (Category 5)	
	Total	Incremental[2]	Total	Incremental[2]	Total	Incremental[2]
Baseline	299	NA	3	NA	21	NA
63.2 gpd	610	311	4	1	30	9
113 gpd	693	394	2	-1[3]	33	12
175 gpd	744	445	5	2	36	15
389 gpd	827	528	5	2	42	21
620 gpd	827	528	5	2	42	21

NA = Not applicable
1. Includes both potential fish tissue and water column exceedances and impairments.
2. Represents the difference between total number for each scenario and baseline (i.e., incremental number above and beyond the baseline).
3. There are a greater number of exceedances for certain water bodies, moving them from being of potential concern to impaired, thus, resulting in a negative incremental number of water bodies potentially of concern.

As shown in the exhibit, the number of impaired water bodies doubles at consumption rates of 389 gpd and 620 gpd over baseline impairments. Thus, controls above and beyond those needed for compliance with the baseline criteria could be needed under the revised criteria alternatives.

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Mercury occurs naturally as a mineral and is distributed throughout the environment by both natural and anthropogenic processes (ATSDR, 1999). Natural sources include volcanoes, geothermal springs, geologic deposits, and the ocean. Human-related sources primarily include coal combustion, waste incineration, industrial uses, and mining (USGS, 2003). The Willamette Basin Mercury TMDL identifies runoff and erosion from agricultural and forest lands, storm water, legacy mining, and municipal and industrial dischargers as potential sources of mercury. Natural sources and atmospheric deposition are generally difficult to control. Thus, future mercury TMDLs are likely to focus on sources similar to those identified in the Willamette Basin TMDL. Once point sources are in compliance with the revised standards and BMPs for all other TMDLs have been implemented (see Exhibit 2-4), there may or may not be some incremental level of control above and beyond what is already required under baseline conditions for compliance with the revised criteria.

5.3 Identifying Potential Compliance Actions and Costs

Data are too limited to reliably estimate the extent of nonpoint source and storm water controls needed to achieve the baseline water quality standards and the incremental controls necessary to comply with potentially revised criteria. In addition to antimony, beta-BHC, and mercury, discussed above, there may be other pollutants exceeding baseline and revised water quality standards for which detection levels are too high or data are unavailable. Nonpoint sources and storm water may be at least partially responsible for these potential impairments.

The magnitude of impacts attributable to the potential revisions depend on the extent to which additional practices, more costly practices, or regulation of a greater number of sources are needed for compliance with the potential revisions in comparison to compliance with existing baseline standards. **Appendix E** provides examples of applicable BMPs and unit costs for nonpoint sources and storm water discharges.

If an additional number of TMDLs are needed under the revised criteria, there may be an increase in government regulatory costs. For example, the data for mercury in Exhibit 5-2 indicate a potential increase of between 9 and 21 impaired waters. EPA (2001b) estimates that TMDL development costs per water body typically range from under $26,000 to over $500,000 depending on the number of TMDLs, their level of difficulty and the extent to which impaired waters are clustered together for TMDL development.[8] If ODEQ expenditures are on a similar level and TMDLs are developed for each water, ODEQ costs would range from $0.23 million to $4.5 million for revised criteria based on a fish consumption rate of 63.2 gpd and $0.55 million to $10.5 million for revised criteria based on a fish consumption rate of 620 gpd (and less if it is feasible to conduct fewer TMDLs to address all of the segments).

[8] EPA (2001) anticipates that in the future, states will increasingly adopt efficient practices when developing TMDLs, thus potentially reducing develop costs.

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6. Potential Compliance Costs

This section summarizes the estimates of potential compliance costs, and discusses the limitations and uncertainties associated with the analysis.

6.1 Point Sources

Costs for compliance with baseline criteria include costs to point source dischargers associated with implementation of NPDES permit limits that reflect existing criteria. Incremental costs associated with compliance with the potential revised criteria represent the costs of any actions or controls above and beyond those needed to meet baseline requirements.

NPDES permits for facilities in Oregon do not currently include WQBELs reflecting the baseline criteria. Thus, even in the absence of revised fish consumption rates for calculating human health criteria, some facilities will need to take actions to comply with revised permit conditions based on the existing criteria. Analysis of a small sample of dischargers suggests that reductions in effluent concentrations of at least six pollutants would be needed under the baseline criteria: 4,4'-DDT, alpha-BHC, arsenic, bis(2-ethylhexyl) phthalate, dioxin, and mercury.

DDT and alpha-BHC are legacy pollutants that are no longer used or manufactured in the United States. Many surface waters in Oregon have high natural background concentrations of arsenic, and most of the sample facilities do not use or generate arsenic during wastewater treatment. Bis(2-ethylhexyl) phthalate is found mainly in plastics and is used as a plasticizer for polyvinylchloride (PVC) and other polymers. The plasticizers can be released from plastics manufacturing wastes or through release from plastic goods (Environment Canada, 1994). Bis(2-ethylhexyl) phthalate in can also be associated with sampling and/or laboratory analysis conditions (Fairfield-Suisun SD, 2003). Dioxin is primarily a byproduct formed during chlorination by wastewater treatment plants or in the manufacture of certain organic chemicals (ATSDR, 1999). Sources of dioxin to and within wastewater treatment plants are difficult to control without completely eliminating the use of chlorine throughout the service area. In fact, one municipality predicted that implementation of all identified control strategies to reduce dioxin only had the potential to reduce the load to the treatment plant by a relatively small percentage (Palo Alto, 1997). Thus, it is likely that for these pollutants, source control would be the only cost-effective treatment option, although it would not necessarily result in compliance with baseline criteria and alternative compliance mechanisms (such as intake credits or a variance) may be needed.

Mercury is the only pollutant for which reductions would be needed for the sample facilities to comply with baseline criteria that is actively used in a number of industrial and commercial applications. Thus, controlling mercury though P2 or source controls programs would not only be cost-effective but could also result in the reductions needed for baseline compliance.

Thus, given these considerations, we identified the most likely compliance scenarios under the baseline to include:

- 4,4'-DDT – alternative compliance mechanism (such as variance with P2 program)
- Alpha-BHC – alternative compliance mechanism (such as variance with P2 program)

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- Arsenic – alternative compliance mechanism (such as intake credits or site specific criteria)
- Bis(2-ethylhexyl) phthalate – cleaner sampling or P2 program
- Dioxin – alternative compliance mechanism (such as variance with P2 program)
- Mercury – P2 program.

The analysis of the sample dischargers also indicated that an incremental level of control may be needed to achieve criteria for the following pollutants under revised fish consumption rates: arsenic, bis(2-ethylhexyl) phthalate, and mercury. We identified the most likely compliance scenarios for the revised criteria to include:

- Arsenic – alternative compliance mechanism (such as a variance)
- Bis(2-ethylhexyl) phthalate – cleaner sampling or P2 program
- Mercury – P2 program with or without alternative compliance mechanism (such as a variance).

In addition, since the source of arsenic in municipal wastewater may be from contaminated groundwater leaking into the sewer system, I&I controls might enable compliance with baseline and revised criteria. We estimated the potential cost of such actions based on unit costs from a consulting firm specializing in I&I reduction programs, although such a scenario may be unlikely for compliance with WQBELs alone. I&I reduction may be needed for other reasons (reduce flow to treatment plant, which reduces treatment costs, and to reduce sewer overflows). Indeed, state infrastructure needs include I&I reduction at a number of municipal systems (OECDC, 2007).

The cost associated with pursuing alternative compliance mechanisms is uncertain because the particular mechanism is unknown. Implementation procedures accompanying the revised criteria may affect compliance scenarios. ODEQ (2005) also identifies a need to address the high natural background arsenic concentrations through various strategies for performing RP analyses and setting WQBELs, such as allowing greater than 25% of the stream flow for dilution calculations or basing requirements on the relative source contribution of a particular discharger. For this analysis, we estimated costs based on pursuing a variance as an individual discharger, which may represent the most costly of potential alternative compliance mechanisms that may ultimately be pursued.

Exhibit 6-1 provides a summary of the potential total and incremental (i.e., above and beyond those needed for compliance with baseline standards) annual statewide costs, both with and without the costs for I&I controls to reduce arsenic in municipal sewer systems. In addition, one-time expenditures associated with variance applications could range from $1.43 million to $7.05 million under the baseline; incremental variance-related expenditures could range from $0.59 million to $2.68 million under revised criteria. **Appendix F** shows the derivation of these estimates from the sample facility results.

Exhibit 6-1. Summary of Potential Annual Compliance Costs (millions of $2007)

Scenario	Total		Incremental[1]	
	With I&I Costs[2]	No I&I Costs	With I&I Costs[2]	No I&I Costs
Baseline	$3.62 - $29.7	$3.62 - $3.92	NA	NA
63.2 gpd	$3.69 - $29.8	$3.69 - $4.04	$0.075 - $0.13	$0.075 - $0.13

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Exhibit 6-1. Summary of Potential Annual Compliance Costs (millions of $2007)

Scenario	Total		Incremental[1]	
	With I&I Costs[2]	No I&I Costs	With I&I Costs[2]	No I&I Costs
113 gpd	$3.96 - $30.1	$3.96 - $4.31	$0.35 - $0.40	$0.35 - $0.40
175 gpd	$3.96 - $31.0	$3.96 - $4.36	$0.35 - $1.32	$0.35 - $0.45
389 gpd	$4.46 - $31.6	$4.46 - $4.86	$0.85 - $1.82	$0.85 - $0.95
620 gpd	$4.46 - $31.6	$4.46 - $4.86	$0.85 - $1.82	$0.85 - $0.95

NA = Not applicable

1. Represents the difference between total annual cost and baseline costs (i.e., incremental costs above and beyond those needed for compliance with baseline criteria).

2. High estimate includes cost of I&I to reduce arsenic in municipal sewer systems.

Under both the baseline and revised criteria scenarios, there are no pollutant load reductions associated with alternative compliance mechanisms such as intake credits and variances. Even if ODEQ requires dischargers to implement P2 programs as a condition of a variance, load reductions could still be minimal especially for legacy pollutants for which there may be no active, easily identifiable sources. Even for a pollutant such as mercury for which sources are relatively easy to identify and P2 can be a cost-effective control option, there is uncertainty regarding the load reductions achievable through such actions. At some point, additional individual facility P2 program activities and expenditures may not provide additional reductions. Because there are currently no proven end-of-pipe treatment technologies that can achieve low mercury levels (e.g., <10 ng/L) on a consistent basis, dischargers may pursue a variance (e.g., based on manmade conditions that cannot be remedied or economic factors). Thus, as the criteria become more stringent (due to higher fish consumption rates), potential load reductions may become constant because additional reductions may be infeasible at this time.

The compliance costs will be incurred as ODEQ renews discharger permits and updates TMDLs to reflect the revised criteria, which may occur at different times for different entities. NPDES permits are for five years, and compliance is upon permit adoption. The "annual" compliance costs in the report are rough order of magnitude estimates of the annual level of expenditures (the annual level of capital outlay or annualized capital costs, and annual operations and maintenance) needed to maintain full compliance. These costs do not drop to zero because the useful life of capital is limited and will continue to need replacement to maintain the level of pollution control. For example, I&I control may require continued capital outlays. For P2, there are likely to be continual challenges (e.g., changes in the community discharging to the sewer system) in maintaining compliance. However, technological capabilities will also change in the future.

The costs for minor dischargers are highly uncertain because there is a lack of data to evaluate effluent quality. However, for municipal minors, ODEQ (2005) indicates that only domestic sources with a dry weather design flow greater than 1 mgd must sample for toxic pollutants. Thus, unless this requirement changes, it is unlikely that minor municipal dischargers would incur costs for compliance with the baseline or revised criteria.

For minor industrial dischargers, ODEQ (2005) indicates that industrial dischargers subject to effluent limitation guidelines would be required to monitor for toxic pollutants. However, effluent toxics data from one of the sample facilities (Oregon Steel Mills) indicates that most

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toxics are not likely to be present at levels of concern, and those that may be (e.g., arsenic) may not contribute significantly to receiving water concentrations, resulting in BMP requirements rather than numeric WQBELs. Thus, costs to minor industrial facilities for compliance with baseline or revised criteria could be minimal depending on state implementation procedures.

Nonetheless, one potential pollutant of concern for minor municipal dischargers however is mercury. Under the 620 gpd alternative fish consumption rate, the revised mercury criterion could be below the detection level of 0.005 µg/L. Due to its ubiquitous nature in the environment (e.g., mercury is found in many household products and can be excreted in human waste because of mercury in dental fillings), it may be unlikely that any municipal discharger would be able to consistently achieve nondetect effluent levels without implementation of controls. Thus, if ODEQ were to require monitoring by minor municipals under such a scenario, these facilities might need to implement P2 for compliance. Annual P2 costs might range from 10% to 50% of the P2 cost for small major facilities, with the range reflecting the potential for piggybacking on the efforts of other nearby facilities. Thus, total annual costs for all 157 minor municipal dischargers for compliance with mercury criteria based on consumption of 620 gpd of fish could range from $0.8 million to $3.9 million. This may be a conservative estimate given the current lack of monitoring requirements for toxic pollutants for municipal dischargers less than 1 mgd.

Indirect dischargers to municipal wastewater treatment plants could also incur costs associated with the baseline and revised criteria if the municipality imposes more stringent pretreatment standards or requirements on these dischargers in an effort to reduce effluent loads. However, indirect dischargers of pollutants for which a municipal wastewater treatment plant would not have RP or need to reduce effluent loads would not be affected. To account for these potential costs, we estimated costs to indirect dischargers to municipal wastewater treatment plants under a mercury P2 program (discussed in Appendix B). For other pollutants, identifying groups of indirect dischargers likely to be contributing to the influent load at the treatment plant is more difficult because the pollutants are no longer actively used (e.g., legacy pesticides), could be formed as a byproduct of numerous processes (e.g., dioxin), or there is a lack of site-specific information available for each discharger to identify where the pollutant is originating [e.g., arsenic, bis(2-ethylhexyl) phthalate]. Thus, it is not possible to estimate pretreatment or P2 costs to indirect dischargers for pollutants other than mercury without specific information on the types of industrial dischargers in each service area.

6.2 Nonpoint Sources and Storm Water

Costs for compliance with baseline criteria include costs to nonpoint sources (e.g., agricultural and forest operations; contamination from historic mining sites), and municipal storm water sources associated with implementation of existing programs and TMDLs. Incremental costs associated with compliance with the potential revised criteria represent the costs of any actions or controls above and beyond those needed to meet baseline requirements.

Under the baseline, control costs for these include those needed to reduce instream pollutant levels to baseline criteria or TMDL targets. Existing regulatory programs have not been fully implemented, and the extent of implementation efforts is uncertain. Thus, the additional controls

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needed for compliance under the baseline cannot be estimated. There are, however, indications that baseline compliance costs for nonpoint sources and storm water discharges could be substantial. For example, given the impairment status of waters throughout the state for mercury based on existing data and the fact that point source dischargers are not likely to be significant sources of mercury to those waters, it is possible that nonpoint source controls are needed to improve water quality to meet baseline criteria.

There could also be incremental costs to nonpoint and storm water sources associated with meeting new or revised load allocations. However, because baseline programs have not yet been fully implemented, it is uncertain whether some incremental level of control would be necessary for compliance with the revised criteria. For any situation in which controls beyond those required under the baseline are necessary, controls could include:

- Agricultural and forest lands – sediment and erosion controls beyond those specified under existing state and federal regulations and plans
- Mining – cleanup and remediation including excavation and onsite capping of contaminated soils, capping of onsite solid waste mining debris, regrading of tailings to mitigate mass wasting and off-site migration, and abatement and mitigation of physical hazards
- Storm water discharges – increased or additional nonstructural BMPs (e.g., institutional, education, or pollution prevention practices designed to limit generation of runoff or reduce the pollutants load of runoff); and structural controls (e.g., engineered and constructed systems designed to provide water quantity or quality control).

6.3 Government Regulatory Costs

Identifying the full scope of regulatory program costs associated with implementing existing criteria and programs is outside the scope of this analysis. There is also substantial uncertainty associated with identifying any incremental impact of revised criteria, since the baseline is not fully implemented. Finally, there is uncertainty regarding the attribution of regulatory program expenditures to criteria revisions. However, as the fish consumption rate increases, the applicable human health criteria decrease, which could result in more stringent and infeasible permit limits for point sources, and incremental impairments and need for TMDL development under the revised criteria.

If dischargers pursue variances for compliance with permit limits for mercury, arsenic, bis(2-ethylhexyl) phthalate, DDT, alpha-BHC, and dioxin, ODEQ costs associated with application review may range from $159,000 under the baseline to $65,000 under the revised criteria. For the most part, data are too limited to identify incremental impairments. For one pollutant, mercury, available ambient monitoring data indicate a potential increase of 9 TMDLs at a consumption rate of 63.2 gpd and 21 TMDLs at a consumption rate of 620 gpd. If, for example, TMDL development costs range from approximately $26,000 to $500,000, this implies an increased level of expenditure of between $0.23 million and $4.5 million for mercury at a consumption rate of 63.2 gpd, and $0.55 million to $10.5 million for mercury at a consumption rate of 620 gpd. Note that the variance application review and TMDL development costs would not be incurred in any single year; rather, the cost would be spread out over several years (e.g., 5 or 10 year time period).

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6.4 Uncertainties in the Analysis

There are a number of uncertainties in the analysis associated with data limitations, potential pollutant load reductions achievable, and how dischargers would respond to potential revised requirements and permit conditions that affect the estimated costs.

6.3.1 Data Limitations

The lack of available data for both point and nonpoint sources adds uncertainties to the analysis of potential costs associated with compliance with the revised criteria.

Point Sources

Data are not available for all pollutants for all sample facilities. Without data, we are not able to determine whether the facility is in compliance with baseline standards and whether incremental controls would be needed for compliance with revised criteria. For example, the Eugene Springfield WWTP data does not contain effluent measurements for mercury and arsenic, the two pollutants for which other major municipal facilities would incur the greatest compliance costs. Thus, costs could be higher than shown if additional data indicates a need for pollutant reductions.

For several facilities with effluent data, the data available are limited. For example, there is only one data point for each pollutant for Oregon Steel Mills. Additional data could result in compliance cost estimates higher or lower than shown.

We are also lacking effluent flow data from which to calculate appropriate human health dilution factors. In those instances we used chronic aquatic life dilution factors based on the 7Q10 flow, rather than the 30Q5 or harmonic mean stream flow. The 7Q10 flow is often less than the 30Q5 and harmonic mean flows; thus, more dilution may be available, which means estimated costs may be overstated.

In estimating baseline control costs, facility permits and evaluation reports do not provide detailed information on the extent of controls and activities already underway. Thus, baseline costs could be overestimated because facilities may already be implementing controls to address issues such as I&I and P2 programs. For some facilities, we had information on existing activities, and could reduce baseline control costs accordingly. Facility permits and evaluation reports also lack sufficient information on the sources of pollutants in a facility's influent. For example, permits often state the number of significant industrial users to a plant, but do not describe the types of industries. Without such information, it is difficult to determine whether P2 or stricter pretreatment controls would effectively reduce pollutant concentrations.

Nonpoint Sources

The lack of available instream monitoring data prevents the estimation of potential statewide costs associated with reductions in pollutant loads from nonpoint sources. Additional data could show that some incremental level of control on nonpoint sources and storm water discharges is

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needed to meet the revised standards. However, without more information, the magnitude of those costs cannot be estimated.

There is also a lack of data regarding pollutant reductions that have already been or are being achieved with the implementation of BMPs to address existing impairments for conventional pollutants such as temperature and dissolved oxygen. Attainment of standards for these types of pollutants could also result in attainment of the baseline and revised criteria for toxic pollutants, negating the need for additional controls on nonpoint sources.

6.3.2 Load Reductions

There is uncertainty regarding the pollutant loading reductions that would result from compliance with baseline and revised criteria. As the criteria become more stringent under increasing consumption rates, the feasibility of compliance with revised effluent limitations may decrease for some pollutants (e.g., mercury) that are ubiquitous in the environment and for which end-of-pipe treatment to very low levels is unproven. If compliance is not feasible, pollutant load reductions may be minimal.

Detection limits also add uncertainty to the estimated load reductions under more stringent criteria. If the revised criteria are below the QL, dischargers would only be required to treat to the QL (e.g., arsenic) because levels lower than that could not be measured. Thus, there may not be measurable or quantifiable incremental pollutant load reductions from wastewater point sources associated with more stringent human health criteria.

6.3.3 Response to Revised Requirements

For point sources, we assumed that facilities would pursue the lowest cost option for compliance with either baseline or revised criteria. However, it is uncertain whether any particular control option would guarantee compliance. For example, the effluent reductions achievable through P2 activities and the level of effort needed for compliance are highly site-specific and cannot be estimated without a detailed analysis of the facility's service area and existing plant processes and operations. In some cases, facilities may discover than treatment chemicals are contributing to mercury effluent levels, and switching to another manufacturer or chemical results in compliance. In others, extensive P2 may not be sufficient and an alternative compliance mechanism (such as a variance) would be necessary.

In addition, the costs of controls are likely facility-specific and may be higher or lower than shown. For example, we assumed a single unit cost for pipe rehabilitation for I&I reduction program costs. Results of source identification determine the control measures needed to reduce I&I to a sewer system. Thus, it is uncertain how much system rehabilitation will cost until the source identification study is complete.

Dischargers may also explore more holistic approaches that address problems in addition to compliance with the revised criteria which means costs may be overstated. For example, to address an increasing demand in water supply (due to increases in population and changes in climate), the Orange County water and sanitation districts partnered together to implement an advanced water purification project known as the Groundwater Replenishment (GWR) System.

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The GWR system purifies highly treated sewer effluent to replenish groundwater supplies. The system provides a new reliable, high-quality water supply for north and central Orange County, eliminates any immediate need for another ocean outfall pipe for wastewater, diversifies local water supplies, and over time, will help lower the mineral content in the groundwater basin (GWRS, 2008). Industrial dischargers may also make changes that could indirectly affect effluent quality to deal with issues such as energy usage and raw material suppliers.

For both point and nonpoint sources, we assumed that in some cases baseline controls would result in compliance with revised criteria. It is not clear at which consumption rates the criteria would become low enough to warrant additional controls above and beyond those needed for compliance under the baseline, or whether additional reductions are feasible.

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Appendix A. Facility Analyses

Facility Name	Page #
Major Municipals	
Astoria WWTP	A-2
Brookings WWTP	A-9
Coos Bay WWTP #2	A-10
Eugene Springfield WPCF	A-17
Kellogg Creek WWTP	A-22
McMinnville WRF	A-31
North Bend WWTP	A-39
Portland Columbia Boulevard WWTP	A-45
Rock Creek WWTP	A-57
Salem Willow Lake WWTP	A-64
St. Helen-Boise Cascade WWTP	A-75
Tri-City Service District	A-83
Woodburn WWTP	A-92
Minor Municipals	
City of Shady Cove WWTP	A-99
Major Industrials	
Blue Heron Paper Company	A-100
Heinz Food Company	A-106
Pope and Talbot Inc.	A-107
Reynolds Metals Company	A-114
Minor Industrials	
Boise Cascade, Elgin Sawmill	A-116
Oregon Steel Mills	A-118

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City of Astoria Wastewater Treatment Plant

Facility Description

The City of Astoria Wastewater Treatment Plant (NPDES permit number OR0027561) was built in 1974 and serves a population under 10,000. The facility was originally designed to treat wastes from canneries as well as domestic wastewater, although the canneries are no longer in service. ODEQ classifies this 4.2 mgd (ADWDF) facility as a major discharger. The facility discharges treated effluent into the Columbia River at river mile 18.0. The facility does not treat effluent from any categorical or significant industrial users, and therefore is not required to have a federal pretreatment program. However, ODEQ has requested that the facility conduct an industrial waste survey from which it may reevaluate the need for a pretreatment program.

Treatment Processes

The 2001 NPDES permit for the facility lists current treatment processes as headworks, two aerated lagoons, a polishing lagoon, and chlorine contact chamber. The headworks consists of a bar screen and a Parshall flume flow meter. The aerated lagoons are 6.8 acres (22 million gallons) and 5.8 acres (18.9 million gallons) each and are operated in series. There is also a 7.6 acre polishing lagoon. The permit indicates that the lagoons have not been dredged for sludge.

Effluent Data and Limits

Exhibit A-1 summarizes monitoring data from September 2003 to September 2006 for those pollutants of concern for which effluent data are available. The facility does not have effluent limits for any toxic pollutants.

Exhibit A-1. Effluent Data Summary, City of Astoria[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
1,1,2,2-Tetrachloroethane	3	3	0.003	-	-	-
1,1,2-Trichloroethane	3	3	0.002	-	-	-
1,1-Dichloroethylene	3	3	0.005	-	-	-
1,2,4-Trichlorobenzene	2	2	0.005	-	-	-
1,2-Dichlorobenzene	3	3	0.002	-	-	-
1,2-Dichloroethane	3	3	0.002	-	-	-
1,2-Dichloropropane	3	3	0.002	-	-	-
1,2-Trans-Dichloroethylene	3	3	0.003	-	-	-
1,3-Dichlorobenzene	3	3	0.002	-	-	-
1,4-Dichlorobenzene	3	3	0.002	-	-	-
2,4,6-Trichlorophenol	4	4	25	-	-	-
2,4-Dichlorophenol	4	4	25	-	-	-
2,4-Dimethylphenol	4	4	25	-	-	-
2,4-Dinitrophenol	4	4	62.5	-	-	-
2,4-Dinitrotoluene	2	2	0.005	-	-	-
2-Chloronaphthalene	2	2	0.005	-	-	-

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Exhibit A-1. Effluent Data Summary, City of Astoria[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
2-Chlorophenol	2	2	0.005	-	-	-
2-Methyl-4,6-Dinitrophenol	3	3	62.5	-	-	-
3,3'-Dichlorobenzidine	3	3	0.005	-	-	-
4,4'-DDD	3	3	0.2	-	-	-
4,4'-DDE	3	3	0.5	-	-	-
4,4'-DDT	3	3	0.5	-	-	-
Acenaphthene	3	3	0.005	-	-	-
Acrolein	3	3	0.01	-	-	-
Acrylonitrile	3	3	0.01	-	-	-
Aldrin	3	3	0.5	-	-	-
alpha-BHC	3	3	0.5	-	-	-
Anthracene	3	3	0.005	-	-	-
Antimony	3	0	-	0.61	0.33	0.19
Arsenic	10	1	5	1.05	0.61	0.32
Benzene	3	3	0.003	-	-	-
Benzidine	3	3	0.06	-	-	-
Benzo(a) Anthracene	3	3	0.005	-	-	-
Benzo(a) Pyrene	3	3	0.005	-	-	-
Benzo(b) Fluoranthene	3	3	0.005	-	-	-
Benzo(k) Fluoranthene	3	3	0.005	-	-	-
Beryllium	3	3	0.1	-	-	-
beta-BHC	3	3	0.5	-	-	-
Bis(2-Chloroethyl) Ether	3	3	0.005	-	-	-
Bis(2-Chloroisopropyl) Ether	3	3	0.01	-	-	-
Bis(2-Ethylhexyl) Phthalate	3	1	0.01	0.073	0.028	0.011
Bromoform	3	3	0.02	-	-	-
Carbon Tetrachloride	3	3	0.003	-	-	-
Chlordane	3	3	25	-	-	-
Chloroform	3	3	0.002	-	-	-
Chrysene	3	3	0.005	-	-	-
Dibenzo(a,h)Anthracene	3	3	0.005	-	-	-
Dichlorobromomethane	3	3	0.005	-	-	-
Dieldrin	3	3	0.5	-	-	-
Diethyl Phthalate	3	3	0.005	-	-	-
Dimethyl Phthalate	3	3	0.005	-	-	-
Di-n-Butyl Phthalate	3	3	0.01	-	-	-
Endosulfan Sulfate	3	3	1	-	-	-
Endrin	3	3	0.5	-	-	-
Endrin Aldehyde	3	3	0.5	-	-	-
Ethylbenzene	3	3	0.002	-	-	-
Fluoranthene	3	3	0.005	-	-	-
Fluorene	3	3	0.005	-	-	-
Gamma-BHC (Lindane)	3	3	0.04	-	-	-
Heptachlor	3	3	0.5	-	-	-

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Exhibit A-1. Effluent Data Summary, City of Astoria[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
Heptachlor Epoxide	3	3	0.5	-	-	-
Hexachlorobenzene	3	3	0.005	-	-	-
Hexachlorobutadiene	3	3	0.01	-	-	-
Hexachlorocyclopentadiene	3	3	0.01	-	-	-
Hexachloroethane	3	3	0.01	-	-	-
Ideno(1,2,3-cd)Pyrene	3	3	0.005	-	-	-
Isophorone	3	3	0.005	-	-	-
Mercury	9	0	-	0.042	0.016	0.006
Methylene Chloride	3	3	0.003	-	-	-
Nickel	10	1	20	7.52	4.80	3.84
Nitrobenzene	3	3	0.005	-	-	-
N-Nitrosodimethylamine	3	3	0.005	-	-	-
N-Nitrosodi-n-Propylamine	3	3	0.01	-	-	-
N-Nitrosodiphenylamine	3	3	0.005	-	-	-
PCBs[3]	3	3	0.5	-	-	-
Pentachlorophenol	4	4	25	-	-	-
Phenol	6	6	100	-	-	-
Pyrene	3	3	0.005	-	-	-
Selenium	3	1	0.5	1.13	0.90	0.72
Tetrachloroethylene	3	3	0.002	-	-	-
Thallium	3	2	0.1	0.14	0.14	0.14
Toluene	3	1	0.002	0.019	0.0094	0.005
Toxaphene	3	3	25	-	-	-
Trichloroethylene	3	3	0.02	-	-	-
Vinyl Chloride	3	3	0.02	-	-	-

QL = Quantification limit.
1. Represents effluent data from Sept 2003 to Sept 2006.
2. May not match approved QLs because data was collected prior to November 2007 when ODEQ revised applicable QLs.
3. Represents the lowest QL for the 7 congeners sampled (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, and Aroclor 1260).

Receiving Water Data

There are no upstream ambient receiving water data available for this facility.

Potential Impacts

Baseline Criteria

Exhibit A-2 summarizes the RPA for baseline criteria for those pollutants detected in the effluent (there will be no RP or monitoring requirements if all observations are nondetect). The Columbia River at river mile 18 is estuarine; thus, human health criteria for consumption of organisms only are applicable. Flow data from which to calculate the harmonic mean or 30Q5 flows are not available, however, based on the facility's existing permit, the dilution factor is 35.

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The Columbia River at river mile 18 is on the state's 303(d) list as impaired for DDE, dioxin, and PCBs; thus, the discharger would not receive dilution for these pollutants.

Exhibit A-2. RPA for Baseline Criteria, Astoria WWTP

Parameter	Calculated Effluent Conc.[1] (µg/L)	Ambient Conc.[2] (µg/L)	Conc. at Edge of Mixing Zone[3] (µg/L)	Human Health Criterion (µg/L)	Reasonable Potential
Antimony	1.83	0	0.052	640	No
Arsenic	0.89	0	0.026	0.0175	**Yes**
Bis(2-Ethylhexyl) Phthalate	0.084	0	0.0024	2.2	No
Mercury[4]	0.074	0	0.0021	0.017	No
Nickel	9.41	0	0.27	100	No
Selenium	3.39	0	0.097	4200	No
Thallium	0.42	0	0.012	0.47	No
Toluene	0.057	0	0.0016	15000	No

1. Represents the calculated geometric mean concentration for carcinogens and the calculated maximum concentration for noncarcinogens based on a CV of 0.6 for all pollutants except arsenic (CV = 0.39), mercury (CV = 0.57), and nickel (CV = 0.23) (see Section 3.2).
2. Represents the geometric mean of detected values and zero if data are not available or if all values are nondetect.
3. Dilution based on facility's existing permit (factor = 35).
4. Potential water column criteria based on the revised fish tissue criteria, calculated using EPA default BAFs, trophic level consumption percentages, and water column translator (see Section 4).

As shown in the exhibit, the discharger has RP to exceed baseline criteria for arsenic because the concentration at the edge of the regulatory mixing zone is greater than the applicable existing human health criterion. Under existing procedures, the applicable AMEL is 0.61 µg/L and the MDEL is 1.02 µg/L. Since the average arsenic concentration is 0.66 µg/L and the maximum effluent concentration is 1.05 µg/L, slightly above the projected limits, the discharger may need to reduce arsenic in its effluent.

Arsenic and arsenic-containing chemicals are not used in wastewater treatment, and the facility does not have any significant or categorical industrial users. However, drinking water and groundwater infiltration are two potential sources to the treatment plant. Astoria's public water system draws water from three surface water intakes: Bear Creek, Cedar Creek, and Middle Lake. Most arsenic samples (organic plus inorganic) from the surface waters since 1986 are nondetect below the minimum reporting levels; there were 3 detected values ranging from 3 µg/L to 9 µg/L in the early 1990s (ODHS, 2007a). The minimum reporting levels are not specified, and the drinking water maximum contaminant level is 10 µg/L, which is higher than current wastewater effluent concentrations and human health criteria. Therefore, from these data it is not possible to determine with any certainty whether drinking water is contributing to high arsenic levels in the wastewater effluent. However, if the facility determines that drinking water is the source of high arsenic values in the wastewater, it is likely that the facility would pursue a variance or request that ODEQ consider granting the facility intake credits.

There would be no compliance costs associated with an intake credit scenario. The one-time cost associated with pursuing a variance could range from $35,000 to $100,000, with minimal costs associated with renewal. If the arsenic effluent levels are the result of infiltration of arsenic-contaminated groundwater, total costs could be $4,270,000 for a comprehensive I&I reduction

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program that includes source identification and pipe rehabilitation for a system with 77 miles of sewer pipes (approximately $403,000 per year annualized at 7% over 20 years). Note that if groundwater infiltration is not the only source of arsenic to the treatment plant, an I&I reduction program alone may not be sufficient for compliance and the discharger would not likely undertake such a program for compliance with toxic criteria alone.

Revised Criteria

Exhibit A-3 summarizes the RPA for the revised human health criteria for consumption of organisms only for those pollutants detected in the effluent (there will be no RP or monitoring requirements if all observations are nondetect).

Exhibit A-3. RPA for Revised Criteria, Astoria WWTP

Parameter	Conc. at Edge of Mixing Zone[1] (µg/L)	Human Health Criteria at Alternative FCRs (µg/L)				
		63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
Antimony	0.052	180	99.0	64.0	29.0	18.0
Arsenic	0.026	**0.014***	**0.0080***	**0.0052***	**0.0023***	**0.0015***
Bis(2-Ethylhexyl) Phthalate	0.0024	0.61	0.34	0.22	0.099	0.062
Mercury[2]	0.0021	0.0047	0.0026	**0.0017***	**0.00076***	**0.00048***
Nickel	0.27	470	260	170	77.0	48.0
Selenium	0.097	1200	650	420	190	120
Thallium	0.012	0.13	0.073	0.047	0.021	0.013
Toluene	0.0016	4100	2300	1500	670	420

*Bolded values represent RP equal to "Yes."
FCRs = Fish consumption rates.
1. Dilution based on facility's existing permit (factor = 35).
2. Potential water column criteria based on the revised fish tissue criteria, calculated using EPA default BAFs, trophic level consumption percentages, and water column translator (see Section 4).

As shown in the exhibit, the discharger could have RP for arsenic and mercury based on the alternative fish consumption rates.

Arsenic

The discharger would have RP for arsenic at consumption rates of 63.2 gpd, 113 gpd, 175 gpd, 389 gpd, and 620 gpd. **Exhibit A-4** shows the projected effluent limits for these consumption rates.

Exhibit A-4. Projected Effluent Limits for Arsenic, Astoria WWTP

Limit Type	Fish Consumption Rate				
	63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
AMEL (µg/L)	0.49	0.28	0.18	0.081	0.053
MDEL (µg/L)	0.81	0.47	0.30	0.13	0.087

As described in the baseline analysis, the discharger may need to reduce effluent concentrations for compliance with baseline criteria, or pursue alternative compliance measures. These are the same compliance scenarios that would apply under all of the potential revised criteria. The

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baseline I&I reduction program includes a comprehensive study to identify all potential infiltration sources and rehabilitation of those sources. Thus, baseline controls, or alternative actions, should also enable compliance with the revised criteria, and there would be no incremental compliance costs.

Mercury

The discharger would have RP for mercury at consumption rates of 175 gpd, 389 gpd, and 620 gpd. **Exhibit A-5** shows the projected AMELs and MDELs for each consumption rate based on the water column criteria in the RPA exhibit.

Exhibit A-5. Projected Effluent Limits for Mercury, Astoria WWTP

Limit Type	Fish Consumption Rate				
	63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
AMEL (µg/L)	NA	NA	0.059	0.027	0.017
MDEL (µg/L)	NA	NA	0.12	0.052	0.033

The maximum effluent concentration at the facility is 0.042 µg/L, which is lower than both projected limits for a consumption rate of 175 gpd. Thus, the facility would not likely implement controls for compliance with the revised criterion.

The maximum effluent concentration is greater than the AMEL for a consumption rate of 389 gpd and the AMEL and MDEL for a consumption rate of 620 gpd. Thus, the facility may need to implement controls to reduce effluent mercury concentrations for compliance with these limits. Since the projected effluent levels are in the range achievable by municipal wastewater treatment plants that have implemented P2, the facility would likely implement a P2 program for compliance with the projected effluent limits. Annual P2 program costs for a 4.2 mgd municipal facility may be approximately $100,000 (see Appendix B for details). As described in Appendix B, P2 costs also include expenditures by indirect dischargers to implement controls (see Exhibit B-2). Based on information on the discharger's service area, incremental indirect discharger costs may be minimal (e.g., there are no universities in the service area).

Summary

Exhibit A-6 provides a summary of the potential range in annual costs associated with the baseline and revised criteria. For the alternative fish consumption rates, the incremental costs represent the any costs above and beyond those that would be needed for compliance with baseline criteria. Under a variance scenario for arsenic, costs would likely fall within the range shown in the exhibit (e.g., a one-time expenditure of approximately $35,000 to $100,000).

Exhibit A-6. Summary of Potential Costs, Astoria WWTP

Alternative	Compliance Scenario	Total Annual Costs ($/yr)	Incremental Costs[1]
Baseline	• Intake credits, variance, or I&I reduction program (arsenic)	$0 - $403,000	NA
63.2 gpd	• Intake credits, variance, or I&I reduction program (arsenic)	$0 - $403,000	$0
113 gpd	• Intake credits, variance, or I&I reduction program (arsenic)	$0 - $403,000	$0
175 gpd	• Intake credits, variance, or I&I reduction program (arsenic)	$0 - $403,000	$0

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Exhibit A-6. Summary of Potential Costs, Astoria WWTP

Alternative	Compliance Scenario	Total Annual Costs ($/yr)	Incremental Costs[1]
389 gpd	• Intake credits, variance, or I&I reduction program (arsenic) • P2 program (mercury)	$100,000 - $503,000	$100,000
620 gpd	• Intake credits, variance, or I&I reduction program (arsenic) • P2 program (mercury)	$100,000 - $503,000	$100,000

NA = Not applicable

1. Annual costs for baseline criteria represent the costs needed for compliance under existing conditions; costs for revised criteria represent the difference between total annual cost and baseline costs (i.e., incremental costs above and beyond those needed for compliance with baseline criteria).

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City of Brookings Wastewater Treatment Plant

Facility Description

The City of Brookings Wastewater Treatment Plant (NPDES permit number OR0020354) is a secondary treatment facility that serves Brookings and the Harbor Sanitary District. Based on 1995 estimates, the facility serves a population of 9,700, and primarily treats wastewater from domestic sources including residential and commercial sites. ODEQ classifies the facility as a major discharger. The ADWDF for the plant is 1.75 mgd. The facility discharges all treated effluent into the Pacific Ocean through outfall 001. There are 10 other outfalls used only in emergency overflow situations.

Treatment Processes

The 2000 NPDES permit for the facility lists current treatment processes as screening, grit removal, primary sedimentation, tricking filter/ solids contact secondary treatment, secondary clarification, and disinfection with chlorine gas. Sludge is sent to an anaerobic digester equipped with a sludge thickening system, and land applied to approved beneficial use sites.

Effluent Data and Limits

There are no effluent data available for the pollutants of concern, and the facility does not have effluent limits for any toxic pollutants in its current permit.

Receiving Water Data

There are no upstream ambient data available for this facility.

Potential Impacts

The facility discharges less than 2 mgd of treated effluent 500 feet offshore into the Pacific Ocean. The facility's acute dilution factor (which is generally lower than the human health dilution factors) is 70. Given such a large dilution factor, it is unlikely that the facility would have RP to cause or contribute to exceedances of the baseline criteria or the revised criteria based on alternative fish consumption rates.

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City of Coos Bay Wastewater Treatment Plant #2

Facility Description

The City of Coos Bay Wastewater Treatment Plant #2 (NPDES permit number OR0023582) is located in Coos Bay, Oregon and serves the City of Coos Bay and the Charleston Sanitary District. The treatment facility receives primarily domestic wastewater from residential and commercial sources from a population of approximately 10,000. The average dry weather design flow to the facility equals 2.02 mgd. ODEQ classifies the facility as a major discharger. The facility discharges all treated effluent into Coos Bay through outfall number 001. There are 4 other outfalls used only in emergency overflow situations.

Treatment Processes

The 2003 NPDES permit for the facility lists current treatment processes as activated sludge with effluent chlorination. Primary and secondary sludge is settled in the primary clarifier and pumped to anaerobic digesters. Digested sludge is trucked to the facultative sludge lagoon. The facility removes sludge from the lagoon after a year or more with a floating dredge and applies it to private farmlands and forest sites as a beneficial supplement.

Effluent Data and Limits

Exhibit A-7 summarizes monitoring data from July 2006 for those pollutants of concern for which effluent data are available. The available data represent maximum and average values of three samples. Because the raw data are not available, the exhibit shows only the maximum and average concentrations for the detected values. The facility does not have effluent limits for any toxic pollutants.

Exhibit A-7. Effluent Data Summary, Coos Bay WWTP #2[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)	
	Total	Nondetect	MDL[2] (µg/L)	Maximum	Average
1,1,2,2-Tetrachloroethane	3	3	0.12	-	-
1,1,2-Trichloroethane	3	3	0.11	-	-
1,1-Dichloroethylene	3	3	0.07	-	-
1,2,4-Trichlorobenzene	3	3	4.85	-	-
1,2-Dichlorobenzene	3	3	4.85	-	-
1,2-Dichloroethane	3	3	0.14	-	-
1,2-Dichloropropane	3	3	0.012	-	-
1,2-Diphenylhydrazine	3	3	4.85	-	-
1,2-Trans-Dichloroethylene	3	3	0.05	-	-
1,3-Dichlorobenzene	3	3	4.85	-	-
1,4-Dichlorobenzene	3	3	4.85	-	-
2,4,6-Trichlorophenol	3	3	4.85	-	-
2,4-Dichlorophenol	3	3	4.85	-	-
2,4-Dimethylphenol	3	3	9.71	-	-

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Exhibit A-7. Effluent Data Summary, Coos Bay WWTP #2[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)	
	Total	Nondetect	MDL[2] (µg/L)	Maximum	Average
2,4-Dinitrophenol	3	3	4.85	-	-
2,4-Dinitrotoluene	3	3	2.91	-	-
2-Chloronaphthalene	3	3	2.91	-	-
2-Chlorophenol	3	3	4.85	-	-
3,3'-Dichlorobenzidine	3	3	4.85	-	-
4,4'-DDD	1	1	0.0962	-	-
4,4'-DDE	1	1	0.0962	-	-
4,4'-DDT	1	1	0.0962	-	-
Acenaphthene	3	3	2.91	-	-
Acrolein	3	3	7.5	-	-
Acrylonitrile	3	3	2.1	-	-
Aldrin	1	1	0.0962	-	-
alpha-BHC	3	3	0.0962	-	-
Anthracene	3	3	2.91	-	-
Antimony	3	3	0.102	-	-
Arsenic	3	0	-	0.25	0.21
Benzene	3	3	0.03	-	-
Benzidine	3	3	58.3	-	-
Benzo(a) Anthracene	3	3	2.91	-	-
Benzo(a) Pyrene	3	3	2.91	-	-
Benzo(k) Fluoranthene	3	3	2.91	-	-
Beryllium	3	3	0.128	-	-
beta-BHC	1	1	0.0962	-	-
Bis(2-Chloroethyl) Ether	3	3	2.91	-	-
Bis(2-Chloroisopropyl) Ether	3	3	4.85	-	-
Bis(2-Ethylhexyl) Phthalate	3	0	-	55.4	24.9
Bromoform	3	3	0.08	-	-
Butylbenzyl Phthalate	3	3	2.91	-	-
Carbon Tetrachloride	3	3	0.07	-	-
Chlordane	3	3	0.481	-	-
Chloroform	3	0	-	1.2	0.64
Chrysene	3	3	2.91	-	-
Dibenzo(a,h)Anthracene	3	3	2.91	-	-
Dichlorobromomethane	3	3	0.09	-	-
Diethyl Phthalate	3	3	2.91	-	-
Dimethyl Phthalate	3	3	2.91	-	-
Di-n-Butyl Phthalate	3	3	2.91	-	-
Endosulfan Sulfate	1	1	0.0962	-	-
Endrin	1	1	0.0962	-	-
Endrin Aldehyde	1	1	0.0962	-	-
Ethylbenzene	3	3	0.04	-	-
Fluoranthene	3	3	2.91	-	-
Fluorene	3	3	2.91	-	-
gamma-BHC	1	1	0.0962	-	-

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Exhibit A-7. Effluent Data Summary, Coos Bay WWTP #2[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)	
	Total	Nondetect	MDL[2] (µg/L)	Maximum	Average
Heptachlor	1	1	0.0962	-	-
Heptachlor Epoxide	1	1	0.0962	-	-
Hexachlorobenzene	3	3	2.91	-	-
Hexachlorobutadiene	3	3	4.85	-	-
Hexachlorocyclopentadiene	3	3	4.85	-	-
Hexachloroethane	3	3	4.85	-	-
Ideno(1,2,3-cd)Pyrene	3	3	2.91	-	-
Isophorone	3	3	2.91	-	-
Mercury	3	0	-	0.0069	0.0032
Methylene Chloride	3	0	-	0.24	0.16
Nickel	3	0	-	1.64	1.49
Nitrobenzene	3	3	2.91	-	-
N-Nitrosodimethylamine	3	3	4.85	-	-
N-Nitrosodi-n-Propylamine	3	3	2.91	-	-
N-Nitrosodiphenylamine	3	3	2.91	-	-
Pentachlorophenol	3	3	4.85	-	-
Phenol	6	6	19.1	-	-
PCBs	1	1	0.481	-	-
Pyrene	3	3	2.91	-	-
Selenium	3	0	-	0.34	0.31
Tetrachloroethylene	3	3	0.06	-	-
Thallium	3	0	-	0.07	0.044
Toluene	3	0	-	3.21	1.71
Toxaphene	1	1	4.81	-	-
Trichloroethylene	3	3	0.05	-	-
Vinyl Chloride	3	3	0.05	-	-

MDL = Method detection limit.
1. Represents maximum and average effluent data from July 2006.
2. Represents the method detection limit reported by the facility's analytical laboratory.

Receiving Water Data

There are no upstream ambient data available for the pollutants of concern for this facility.

Potential Impacts

Baseline Criteria

Under ODEQ (2005) procedures, the RPA for carcinogens would be based on the calculated average concentration and not the geometric mean because the raw data from which to calculate a geometric mean are not available. **Exhibit A-8** summarizes the RPA for baseline criteria for those pollutants detected in the effluent (there will be no RP or monitoring requirements if all observations are nondetect). Coos Bay is estuarine; thus, human health criteria for consumption of organisms only are applicable. Flow data from which to calculate the harmonic mean or 30Q5

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flows needed to calculate dilution are not available, however, the facility's existing permit indicates a dilution factor of 41 (dilution at edge of regulatory mixing zone).

Exhibit A-8. RPA for Baseline Criteria, Coos Bay WWTP #2

Parameter	Calculated Effluent Conc.[1] (µg/L)	Ambient Conc.[2] (µg/L)	Conc. at Edge of Mixing Zone[3] (µg/L)	Human Health Criterion (µg/L)	Reasonable Potential
Arsenic	0.64	0	0.016	0.0175	No
Bis(2-Ethylhexyl) Phthalate	74.9	0	1.82	2.2	No
Chloroform	1.92	0	0.047	15.7	No
Methylene Chloride	0.48	0	0.012	590	No
Mercury[4]	0.021	0	0.00051	0.017	No
Nickel	4.92	0	0.12	100	No
Selenium	1.02	0	0.025	4200	No
Thallium	0.21	0	0.0051	0.47	No
Toluene	9.63	0	0.23	15000	No

1. Represents the calculated average concentration for carcinogens and the calculated maximum concentration for noncarcinogens based on a CV of 0.6 for all pollutants (see Section 3.2).
2. Represents the geometric mean of detected values and zero if data are not available or if all values are nondetect.
3. Dilution based on facility's existing permit (factor = 41).
4. Potential water column criteria based on the revised fish tissue criteria, calculated using EPA default BAFs, trophic level consumption percentages, and water column translator (see Section 4).

As shown in the exhibit, the discharger does not have has RP to exceed baseline criteria for any pollutants. Thus, it is unlikely that the discharger would incur costs.

Revised Criteria

Exhibit A-9 summarizes the RPA for the revised human health criteria for consumption of organisms only for those pollutants detected in the effluent (there will be no RP or monitoring requirements if all observations are nondetect).

Exhibit A-9. RPA for Revised Criteria, Coos Bay WWTP #2

Parameter	Conc. at Edge of Mixing Zone[1] (µg/L)	Human Health Criteria at Alternative FCRs (µg/L)				
		63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
Arsenic	0.016	**0.014***	**0.0080***	**0.0052***	**0.0023***	**0.0015***
Bis(2-Ethylhexyl) Phthalate	1.82	**0.61***	**0.34***	**0.22***	**0.099***	**0.062***
Chloroform	0.047	48.0	27.0	17.0	7.90	4.90
Methylene Chloride	0.012	160	92.0	59.0	27.0	17.0
Mercury[2]	0.00051	0.0047	0.0026	0.0017	0.00076	**0.00048***
Nickel	0.12	470	260	170	77.0	48.0
Selenium	0.025	1200	650	420	190	120
Thallium	0.0051	0.13	0.073	0.047	0.021	0.013
Toluene	0.23	4100	2300	1500	670	420

*Bolded values represent RP equal to "Yes."
FCRs = Fish consumption rates.
1. Dilution based on facility's existing permit (factor = 41).
2. Potential water column criteria based on the revised fish tissue criteria, calculated using EPA default BAFs, trophic level consumption percentages, and water column translator (see Section 4).

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As shown in the exhibit, the discharger would have RP for arsenic, bis(2-ethylhexyl) phthalate, and mercury.

Arsenic

The facility would have RP for arsenic at all of the alternative consumption rates. **Exhibit A-10** shows the projected effluent limits for these consumption rates.

Exhibit A-10. Projected Effluent Limits for Arsenic, Coos Bay WWTP #2

Limit Type	Fish Consumption Rate				
	63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
AMEL (µg/L)	0.57	0.33	0.21	0.094	0.062
MDEL (µg/L)	1.15	0.66	0.43	0.19	0.12

The maximum effluent arsenic concentration is 0.25 µg/L, which is lower than the projected effluent limits for consumption rates of 63.2 gpd and 113 gpd. Thus, the discharger would not likely implement controls for compliance with these revised criteria.

The maximum arsenic concentration is greater than the AMEL for a consumption rate of 175 gpd and the AMEL and MDEL for consumption rates of 389 gpd and 620 gpd. Thus, the discharger may need to implement controls to reduce effluent arsenic concentrations for compliance with these limits. Arsenic and arsenic-containing chemicals are not used in wastewater treatment, and the facility does not have any significant or categorical industrial users. However, drinking water and groundwater infiltration are two potential sources of arsenic to the treatment plant.

The Coos Bay-North Bend Water Board supplies the City with drinking water from its water treatment plant that draws water from Pony Creek. The City detected arsenic twice in drinking water since May 2004 (1.3 µg/L in 2007 and 0.5 µg/L in 2004) (ODHS, 2007b). Thus, it is possible that drinking water is contributing to high arsenic levels in the wastewater effluent. In this case, it is likely that the facility would pursue a variance or request that ODEQ consider granting the facility intake credits.

The facility's permit indicates that the collection system has significant I&I because peak flows are nearly ten times the average dry weather flows. The permit also indicates that the City is addressing the issues with a major revamping of the collection system, but does not state the extent these efforts. Thus, it is uncertain whether these baseline modifications to the collection system would address arsenic levels (there are a number of modifications that can correct I&I issues that would not necessarily reduce arsenic concentrations). If groundwater infiltration is causing the high arsenic effluent levels, the facility may have to implement an I&I reduction program for compliance with the existing criteria.

There would be no compliance costs associated with an intake credit scenario. The one-time cost associated with pursuing a variance could range from $35,000 to $100,000 with minimal costs associated with renewal. If the arsenic effluent levels are the result of infiltration of arsenic-contaminated groundwater, total costs could be $1,850,000 for a comprehensive I&I reduction

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program that includes pipe rehabilitation (source identification is not included because the City has presumably already conducted such a study) for a system with 50 miles of sewer pipes based on the number of miles of sewer pipe for a system of similar size and makeup (approximately $174,000 per year annualized at 7% over 20 years). (Some portion of this cost may be incurred even in the absence of a revised fish consumption rate.) Note that if groundwater infiltration is not the only source of arsenic to the treatment plant, an I&I reduction program alone may not be sufficient for compliance and the discharger would not likely undertake such a program for compliance with toxic criteria alone.

Bis(2-ethylhexyl) phthalate

The discharger would have RP for bis(2-ethylhexyl) phthalate at consumption rates of 63.2 gpd, 113 gpd, 175 gpd, 389 gpd, and 620 gpd. **Exhibit A-11** shows the projected effluent limits for these consumption rates.

Exhibit A-11. Projected Effluent Limits for Bis(2-ethylhexyl) Phthalate, Coos Bay WWTP #2

Limit Type	Fish Consumption Rate				
	63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
AMEL (µg/L)	25	14	9.0	4.1	2.5
MDEL (µg/L)	50	28	18	8.1	5.1

The maximum effluent bis(2-ethylhexyl) phthalate concentration is 55.4 µg/L, which is greater than the projected effluent limits for all the consumption rates. Bis(2-ethylhexyl) phthalate is found mainly in plastics and is used as a plasticizer for polyvinylchloride (PVC) and other polymers, and can be released from plastics manufacturing wastes or through release from plastic goods (Environment Canada, 1994). The facility's permit indicates that it does not have any significant or categorical industrial users and that the only hospital in the area dischargers to the area's other treatment plant. Thus, it is likely that the bis(2-ethylhexyl) phthalate is not the result of any one major source, rather a combination of many sources including the residential sector. High levels of bis(2-ethylhexyl) phthalate in municipal wastewater effluent can also be associated with sampling and/or laboratory analysis conditions (Fairfield-Suisun SD, 2003). If this is the case, cleaner sampling and analysis techniques could reduce the amount of bis(2-ethylhexyl) phthalate measured in the effluent.

Because the bis(2-ethylhexyl) phthalate in the effluent could be the result of sampling error or widespread leaching from PVC piping (that may not be controllable), a P2 program may not be feasible or cost-effective. Thus, the facility may pursue an alternative compliance mechanism such as a variance.

Costs for the facility could be relatively modest for efforts to implement cleaner sampling techniques, or one-time costs of $35,000 to $100,000 for a variance with minimal costs associated with renewal. For consumption rates of 175 gpd and greater, the facility may already pursue a variance for arsenic, and additional study for bis(2-ethylhexyl) phthalate would be included in that effort.

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Mercury

The discharger would have RP for mercury at a consumption rate of 620 gpd. The projected AMEL is 0.02 µg/L and the MDEL is 0.04 µg/L. The maximum effluent concentration of 0.0069 µg/L is less than both limits. Thus, the facility would not likely incur costs.

Summary

Exhibit A-12 provides a summary of the potential range in annual costs associated with the baseline and revised criteria. For the alternative fish consumption rates, the incremental costs represent the any costs above and beyond those that would be needed for compliance with baseline criteria. Under a variance scenario for arsenic and/or bis(2-ethylhexyl) phthalate, incremental costs for all alternative consumption rates could include a one-time expenditure of approximately $35,000 to $100,000.

Exhibit A-12. Summary of Potential Costs, Coos Bay WWTP #2

Alternative	Compliance Scenario	Total Annual Costs	Incremental Annual Costs[1]
Baseline	• None	$0	NA
63.2 gpd	• Cleaner sampling or variance [bis(2-ethylhexyl) phthalate]	$0	$0
113 gpd	• Cleaner sampling or variance [bis(2-ethylhexyl) phthalate]	$0	$0
175 gpd	• Intake credits, variance, or I&I reduction program (arsenic) • Cleaner sampling or variance [bis(2-ethylhexyl) phthalate]	$0 - $174,000	$0 - $174,000
389 gpd	• Intake credits, variance, or I&I reduction program (arsenic) • Cleaner sampling or variance [bis(2-ethylhexyl) phthalate]	$0 - $174,000	$0 - $174,000
620 gpd	• Intake credits, variance, or I&I reduction program (arsenic) • Cleaner sampling or variance [bis(2-ethylhexyl) phthalate]	$0 - $174,000	$0 - $174,000

NA = Not applicable.

1. Annual costs for baseline criteria represent the costs needed for compliance under existing conditions; costs for revised criteria represent the difference between total annual cost and baseline costs (i.e., incremental costs above and beyond those needed for compliance with baseline criteria).

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Eugene-Springfield WWTP

Facility Description

The Metropolitan Wastewater Management Commission (MWMC) operates a wastewater treatment facility located in Eugene, Oregon (NPDES permit number OR0031224). The facility serves the Eugene and Springfield areas, and has an ADWDF of 49 mgd. All flows up to 103 mgd receive secondary treatment. ODEQ classifies the facility as a major discharger. The facility discharges all treated effluent through Outfall 001 into the Willamette River at river mile 178.0. The facility also has 13 other outfalls categorized as emergency overflows.

Treatment Processes

The 2002 NPDES permit for the facility lists current treatment processes as activated sludge with anaerobic digesters, eight aeration basins with coarse or fine bubble diffusers, chlorine disinfection, and dechlorinated with sulfur dioxide. Sludge is processed at two locations: anaerobic digestion takes place at the wastewater treatment facility, consisting of three primary and two secondary anaerobic digesters and sludge from the secondary digesters undergoes further stabilization and drying at the Regional Biosolids Management Facility prior to land application.

Effluent Data and Limits

Exhibit A-13 summarizes monitoring data from September 2003 to September 2006 for those pollutants of concern for which effluent data are available. The facility does not have effluent limits for any toxic pollutants.

Exhibit A-13. Effluent Data Summary, Eugene-Springfield WWTP[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
1,1,2,2-Tetrachloroethane	6	6	5	-	-	-
1,1,2-Trichloroethane	6	6	5	-	-	-
1,1-Dichloroethylene	12	12	5	-	-	-
1,2,4-Trichlorobenzene	6	6	10	-	-	-
1,2-Dichlorobenzene	12	12	10	-	-	-
1,2-Dichloroethane	6	6	5	-	-	-
1,2-Dichloropropane	6	6	5	-	-	-
1,2-Diphenylhydrazine	6	6	10	-	-	-
1,2-Trans-Dichloroethylene	6	6	5	-	-	-
1,3-Dichlorobenzene	12	12	10	-	-	-
1,4-Dichlorobenzene	12	12	10	-	-	-
2,4,6-Trichlorophenol	6	6	10	-	-	-
2,4-Dichlorophenol	6	6	10	-	-	-
2,4-Dimethylphenol	6	6	10	-	-	-
2,4-Dinitrophenol	6	6	25	-	-	-
2,4-Dinitrotoluene	6	6	10	-	-	-
2-Chloronaphthalene	6	6	10	-	-	-

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Exhibit A-13. Effluent Data Summary, Eugene-Springfield WWTP[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
2-Chlorophenol	6	6	10	-	-	-
2-Methyl-4,6-dinitrophenol	6	6	25	-	-	-
3,3'-Dichlorobenzidine	6	6	25	-	-	-
4,4'-DDD	6	6	0.05	-	-	-
4,4'-DDE	6	6	0.05	-	-	-
4,4'-DDT	6	5	0.048	0.08	0.08	0.08
Acenaphthene	6	6	10	-	-	-
Acrolein	6	6	50	-	-	-
Acrylonitrile	6	6	10	-	-	-
Aldrin	6	6	0.05	-	-	-
Alpha-BHC	6	5	0.048	0.068	0.068	0.068
Anthracene	6	6	10	-	-	-
Benzene	6	6	5	-	-	-
Benzidine	6	6	50	-	-	-
Benzo(a) Anthracene	6	6	10	-	-	-
Benzo(a) Pyrene	6	6	10	-	-	-
Benzo(b) Fluoranthene	6	6	10	-	-	-
Benzo(k) Fluoranthene	6	6	10	-	-	-
Beta-BHC	6	6	0.075	-	-	-
Bis(2-chloroethyl) Ether	6	6	10	-	-	-
Bis(2-chloroisopropyl) Ether	6	6	10	-	-	-
Bis(2-Ethylhexyl) Phthalate	6	6	10	-	-	-
Bromoform	6	6	5	-	-	-
Butylbenzyl Phthalate	6	6	10	-	-	-
Carbon Tetrachloride	6	6	5	-	-	-
Chlordane	6	6	1.1	-	-	-
Chlorobenzene	6	6	5	-	-	-
Chlorodibromomethane	6	6	5	-	-	-
Chloroform	6	6	5	-	-	-
Chrysene	6	6	10	-	-	-
Dibenzo(a,h)Anthracene	6	6	10	-	-	-
Dichlorobromomethane	6	6	5	-	-	-
Dieldrin	6	6	0.05	-	-	-
Diethyl phthalate	6	6	10	-	-	-
Dimethyl phthalate	6	6	10	-	-	-
Di-n-Butyl Phthalate	6	6	10	-	-	-
Endosulfan sulfate	6	6	0.05	-	-	-
Endrin	6	6	0.05	-	-	-
Endrin Aldehyde	6	6	0.05	-	-	-
Ethylbenzene	6	6	5	-	-	-
Fluoranthene	6	6	10	-	-	-
Fluorene	6	6	10	-	-	-
gamma-BHC	6	6	0.01	-	-	-
Heptachlor	6	6	0.05	-	-	-

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Exhibit A-13. Effluent Data Summary, Eugene-Springfield WWTP[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
Heptachlor Epoxide	6	6	0.05	-	-	-
Hexachlorobenzene	6	6	10	-	-	-
Hexachlorobutadiene	6	6	10	-	-	-
Hexachlorocyclopentadiene	6	6	10	-	-	-
Hexachloroethane	6	6	10	-	-	-
Ideno(1,2,3-cd)Pyrene	6	6	10	-	-	-
Isophorone	6	6	10	-	-	-
Methylene chloride	6	6	5	-	-	-
Nitrobenzene	6	6	10	-	-	-
N-Nitrosodimethylamine	6	6	25	-	-	-
N-Nitrosodi-N-Propylamine	6	6	10	-	-	-
N-Nitrosodiphenylamine	6	6	25	-	-	-
PCBs[3]	6	6	1.1	-	-	-
Pentachlorophenol	6	6	25	-	-	-
Phenol	6	6	10	-	-	-
Pyrene	6	6	10	-	-	-
Tetrachloroethylene	6	6	5	-	-	-
Toluene	6	6	5	-	-	-
Toxaphene	6	6	2.5	-	-	-
Vinyl chloride	6	6	5	-	-	-

QL = Quantification limit.
1. Represents effluent data from Sept 2003 to Sept 2006.
2. May not match approved QLs because data was collected prior to November 2007 when ODEQ revised applicable QLs.
3. Represents the lowest QL for the 7 congeners sampled (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, and Aroclor 1260).

Receiving Water Data

There are no ambient receiving water data available for this facility. The facility's monitoring data, provided by ODEQ, indicates that the Willamette River 30Q5 flow is 1,675 cubic feet per second (cfs) and the harmonic mean flow is 2,905 cfs during the fish rearing period.

Potential Impacts

Baseline Criteria

Exhibit A-14 summarizes the RPA for baseline criteria for those pollutants detected in the effluent (there will be no RP or monitoring requirements if all observations are nondetect). The Willamette River is a freshwater river; thus, human health criteria for consumption of water and organisms are applicable. ODEQ (2006b) allows 25% of the harmonic mean flow for dilution for carcinogens and 25% of the 30Q5 flow for dilution for noncarcinogens.

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Exhibit A-14. RPA for Baseline Criteria, Eugene-Springfield WWTP

Parameter	Calculated Effluent Conc.[1] (µg/L)	Ambient Conc.[2] (µg/L)	Conc. at Edge of Mixing Zone[3] (µg/L)	Human Health Criterion (µg/L)	Reasonable Potential
4,4'-DDT	0.17	0	0.016	0.000024	**Yes**
alpha-BHC	0.15	0	0.014	0.0026	**Yes**

1. Represents the calculated average concentration for carcinogens and the calculated maximum concentration for noncarcinogens based on a CV of 0.6 for all pollutants (see Section 3.2).
2. Represents the geometric mean of detected values and zero if data are not available or if all values are nondetect.
3. Dilution based on 25% of 30Q5 flow for noncarcinogens (factor = 6.5) and 25% of harmonic mean flow for carcinogens (factor = 10.6).

DDT and BHC

As shown in the exhibit, the facility currently has RP to exceed the baseline criteria for 4,4-DDT and alpha-BHC. DDT is a pesticide that was widely used on agricultural crops to control disease-carrying insects. The United States banned uses of DDT in 1972, except for public health emergencies involving insect diseases and control of body lice (ATSDR, 2002). BHC is a manufactured chemical that exists in eight chemical forms called isomers. Technical-grade BHC was used as an insecticide in the United States and typically contained 10-15% gamma (γ)-BHC as well as the alpha (α), beta (β), delta (δ), and epsilon (ε) forms (ATSDR, 2005). However, technical-grade BHC has not been produced or used in the United States in over 20 years (ATSDR, 2005). Thus, because neither pollutant is actively used nor are there any known sources to a municipal wastewater treatment plant, it is likely that the facility would pursue a variance. Total costs for alternative compliance mechanisms could range from $35,000 to $300,000, with minimal costs associated with renewal.

As part of the variance, ODEQ may require the facility to implement a P2 or source control program to identify the sources of the pollutants (e.g., any commercial/industrial indirect discharges that may have in the past used the chemicals or manufactured pesticides containing the chemicals) because certain sources may be controllable. Annual costs for a P2 program for both DDT and alpha-BHC may be approximately $50,000 ($25,000 + $25,000).

Mercury

Under the baseline Willamette River Basin mercury TMDL, the facility would be required to develop and implement a mercury reduction strategy. Annual P2 program costs for a 49 mgd municipal facility may be approximately $150,000 (see Appendix B for details). As described in Appendix B, P2 costs also potentially include costs for indirect dischargers to implement controls (see Exhibit B-2). Based on information on the discharger's service area, incremental indirect discharger costs may be $48,000 (e.g., there are four universities in the service area). However, because ODEQ does not assign individual wasteload allocations to point source dischargers in the TMDL (point sources as a whole are required to reduce existing load by 26%), it is uncertain whether the facility would incur costs beyond those for a P2 program to meet the wasteload allocation under the baseline TMDL.

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Revised Criteria

Exhibit A-15 summarizes the RPA for the revised human health criteria for consumption of water and organisms for those pollutants detected in the effluent (there will be no RP or monitoring requirements if all observations are nondetect).

Exhibit A-15. RPA for Revised Criteria, Eugene-Springfield WWTP

Parameter	Conc. at Edge of Mixing Zone[1] (µg/L)	Human Health Criteria at Alternative FCRs (µg/L)				
		63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
4,4'-DDT	0.016	**0.000061***	**0.000034***	**0.000022***	**0.0000098***	**0.0000062***
alpha-BHC	0.014	**0.0011***	**0.00067***	**0.00045***	**0.00021***	**0.00013***

*Bolded values represent RP equal to "Yes."
FCRs = Fish consumption rates.
1. Dilution based on 25% of 30Q5 flow for noncarcinogens (factor = 6.5) and 25% of harmonic mean flow for carcinogens (factor = 10.6).

The discharger would have RP for both 4,4-DDT and alpha-BHC at all consumption rates. As described in the baseline analysis, the discharger may pursue variances for these pollutants because neither pollutant is actively used nor are there known sources to a municipal wastewater treatment plant. Under the assumption that the facility would pursue a variance under the baseline, incremental impacts of the revised criteria are unlikely.

Summary

Exhibit A-16 provides a summary of the potential range in annual costs associated with the baseline and revised criteria. For the alternative fish consumption rates, the incremental costs represent the any costs above and beyond those that would be needed for compliance with baseline criteria. In addition, the discharger would also incur one-time expenditures for variances for 4,4'-DDT and alpha-BHC of approximately $35,000 to $300,000.

Exhibit A-16. Summary of Potential Costs, Eugene-Springfield WWTP

Alternative	Compliance Scenario	Total Annual Costs	Incremental Annual Costs[1]
Baseline	• Variance with P2 program for 4,4-DDT and alpha-BHC • P2 program (mercury)	$248,000	NA
63.2 gpd	• Variance with P2 program for 4,4-DDT and alpha-BHC • P2 program (mercury)	$248,000	$0
113 gpd	• Variance with P2 program for 4,4-DDT and alpha-BHC • P2 program (mercury)	$248,000	$0
175 gpd	• Variance with P2 program for 4,4-DDT and alpha-BHC • P2 program (mercury)	$248,000	$0
389 gpd	• Variance with P2 program for 4,4-DDT and alpha-BHC • P2 program (mercury)	$248,000	$0
620 gpd	• Variance with P2 program for 4,4-DDT and alpha-BHC • P2 program (mercury)	$248,000	$0

NA = Not applicable.
1. Annual costs for baseline criteria represent the costs needed for compliance under existing conditions; costs for revised criteria represent the difference between total annual cost and baseline costs (i.e., incremental costs above and beyond those needed for compliance with baseline criteria).

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Kellogg Creek Wastewater Treatment Plant

Facility Description

The Clackamas County Service District's Kellogg Creek Wastewater Treatment Plant (NPDES permit number OR0026221) is located in Milwaukie, Oregon and serves Milwaukie, Happy Valley, Johnson City, and portions of Clackamas, Gladstone, and Damascus. ODEQ classifies this 7.1 mgd (ADWDF) facility as a major discharger. The facility discharges treated effluent into the Willamette River at river mile 18.5.

Treatment Processes

The 2006 NPDES permit for the facility lists current treatment processes as screening and grit removal, primary clarification, aeration basins and secondary clarifiers, and ultraviolet light disinfection. The facility stabilizes sludge from the primary clarifiers using anaerobic digesters and disposes of biosolids by spreading on approved sites.

Effluent Data and Limits

Exhibit A-17 summarizes monitoring data from May 2005 to December 2006 for those pollutants of concern for which effluent data are available. The facility does not have effluent limits for any toxic pollutants.

Exhibit A-17. Effluent Data Summary, Kellogg Creek WWTP[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
1,1,2,2-Tetrachloroethane	1	1	5	-	-	-
1,2,4-Trichlorobenzene	2	2	9.8	-	-	-
1,2-Dichlorobenzene	1	1	5	-	-	-
1,2-Dichloroethane	1	1	5	-	-	-
1,2-Dichloropropane	1	1	5	-	-	-
1,2-Diphenylhydrazine	2	2	9.8	-	-	-
1,2-Trans-Dichloroethylene	1	1	5	-	-	-
1,4-Dichlorobenzene	1	1	5	-	-	-
2,4,6-Trichlorophenol	2	2	9.8	-	-	-
2,4-Dichlorophenol	2	2	9.8	-	-	-
2,4-Dimethylphenol	2	2	9.8	-	-	-
2,4-Dinitrophenol	2	2	25	-	-	-
2,4-Dinitrotoluene	2	2	9.8	-	-	-
2-Chloronaphthalene	2	2	9.8	-	-	-
2-Chlorophenol	2	2	9.8	-	-	-
2-Methyl-4,6-Dinitrophenol	2	2	25	-	-	-
4,4'-DDD	2	2	0.0098	-	-	-
4,4'-DDE	2	2	0.0098	-	-	-
4,4'-DDT	2	2	0.0098	-	-	-
Acenaphthene	2	2	9.8	-	-	-

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Exhibit A-17. Effluent Data Summary, Kellogg Creek WWTP[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
Acrolein	1	1	50	-	-	-
Acrylonitrile	1	1	10	-	-	-
Aldrin	2	2	0.0098	-	-	-
alpha-BHC	2	2	0.0098	-	-	-
Anthracene	2	2	9.8	-	-	-
Arsenic	21	0	0	1.3	0.79	0.60
Benzidine	2	2	49	-	-	-
Benzo(a) Anthracene	2	2	9.8	-	-	-
Benzo(a) Pyrene	2	2	9.8	-	-	-
Benzo(b) Fluoranthene	2	2	9.8	-	-	-
Benzo(k) Fluoranthene	2	2	9.8	-	-	-
Bis(2-Chloroethyl) Ether	2	2	9.8	-	-	-
Bis(2-Chloroisopropyl) Ether	2	2	9.8	-	-	-
Bis(2-Ethylhexyl) Phthalate	2	2	9.8	-	-	-
Bromoform	1	1	5	-	-	-
Carbon Tetrachloride	1	1	5	-	-	-
Chlordane	2	2	0.2	-	-	-
Chlorobenzene	1	1	5	-	-	-
Chloroform	1	1	5	-	-	-
Chrysene	2	2	9.8	-	-	-
Dibenzo(a,h)Anthracene	2	2	9.8	-	-	-
Dichlorobromomethane	1	1	5	-	-	-
Dieldrin	2	2	0.0098	-	-	-
Diethyl Phthalate	2	2	9.8	-	-	-
Dimethyl Phthalate	2	2	9.8	-	-	-
Di-n-Butyl Phthalate	2	2	9.8	-	-	-
Endosulfan Sulfate	2	2	0.0098	-	-	-
Endrin Aldehyde	2	2	0.0098	-	-	-
Ethylbenzene	1	1	5	-	-	-
Fluoranthene	2	2	9.8	-	-	-
Fluorene	2	2	9.8	-	-	-
gamma-BHC	2	2	0.0096	-	-	-
Heptachlor	2	2	0.0098	-	-	-
Heptachlor Epoxide	2	2	0.0098	-	-	-
Hexachlorobenzene	2	2	9.8	-	-	-
Hexachlorobutadiene	2	2	9.8	-	-	-
Hexachlorocyclopentadiene	2	2	9.8	-	-	-
Hexachloroethane	2	2	9.8	-	-	-
Ideno(1,2,3-cd)Pyrene	2	2	9.8	-	-	-
Isophorone	2	2	9.8	-	-	-
Mercury	21	4	0.005	0.013	0.0074	0.0053
Nickel	21	0	0	3.1	1.86	1.4
Nitrobenzene	2	2	9.8	-	-	-
N-Nitrosodimethylamine	2	2	25	-	-	-

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Exhibit A-17. Effluent Data Summary, Kellogg Creek WWTP[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
N-Nitrosodi-n-Propylamine	2	2	9.8	-	-	-
PCBs[3]	2	2	0.98	-	-	-
Pentachlorophenol	2	2	25	-	-	-
Phenol	2	2	9.8	-	-	-
Pyrene	2	2	9.8	-	-	-
Selenium	21	21	2	-	-	-
Tetrachloroethylene	1	1	5	-	-	-
Toxaphene	2	2	0.49	-	-	-
Trichloroethylene	1	1	5	-	-	-
Vinyl Chloride	1	1	5	-	-	-

QL = Quantification limit.
1. Represents effluent data from May 2005 to December 2006.
2. May not match approved QLs because data was collected prior to November 2007 when ODEQ revised applicable QLs.
3. Represents the lowest QL for the 7 congeners sampled (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, and Aroclor 1260).

Receiving Water Data

Exhibit A-18 summarizes data from the Willamette River upstream of the facility from May 2004 to April 2007 for those pollutants of concern for which ambient data are available.

Exhibit A-18. Ambient Data Summary, Kellogg Creek WWTP[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL (µg/L)	Maximum	Geometric Mean	Minimum
1,1,2,2-Tetrachloroethane	2	2	5	-	-	-
1,2,4-Trichlorobenzene	2	2	9.8	-	-	-
1,2-Dichlorobenzene	2	2	5	-	-	-
1,2-Dichloroethane	2	2	5	-	-	-
1,2-Dichloropropane	2	2	5	-	-	-
1,2-Diphenylhydrazine	2	2	9.8	-	-	-
1,2-Trans-Dichloroethylene	2	2	5	-	-	-
1,4-Dichlorobenzene	2	2	5	-	-	-
2,4,6-Trichlorophenol	2	2	9.8	-	-	-
2,4-Dichlorophenol	2	2	9.8	-	-	-
2,4-Dimethylphenol	2	2	9.8	-	-	-
2,4-Dinitrophenol	2	2	25	-	-	-
2,4-Dinitrotoluene	2	2	9.8	-	-	-
2-Chloronaphthalene	2	2	9.8	-	-	-
2-Chlorophenol	2	2	9.8	-	-	-
2-Methyl-4,6-Dinitrophenol	2	2	25	-	-	-
4,4'-DDD	2	2	0.0098	-	-	-
4,4'-DDE	2	2	0.0098	-	-	-
4,4'-DDT	2	2	0.0098	-	-	-
Acenaphthene	2	2	9.8	-	-	-

ED_002991_00017305-00103

Exhibit A-18. Ambient Data Summary, Kellogg Creek WWTP[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL (µg/L)	Maximum	Geometric Mean	Minimum
Acrolein	2	2	50	-	-	-
Acrylonitrile	2	2	10	-	-	-
Aldrin	2	2	0.0098	-	-	-
alpha-BHC	2	2	0.0098	-	-	-
Anthracene	2	2	9.8	-	-	-
Arsenic	4	3	0.5	0.6	0.6	0.6
Benzidine	2	2	49	-	-	-
Benzo(a) Anthracene	2	2	9.8	-	-	-
Benzo(a) Pyrene	2	2	9.8	-	-	-
Benzo(b) Fluoranthene	2	2	9.8	-	-	-
Benzo(k) Fluoranthene	2	2	9.8	-	-	-
Bis(2-Chloroethyl) Ether	2	2	9.8	-	-	-
Bis(2-Chloroisopropyl) Ether	2	2	9.8	-	-	-
Bis(2-Ethylhexyl) Phthalate	2	2	9.8	-	-	-
Bromoform	2	2	5	-	-	-
Carbon Tetrachloride	2	2	5	-	-	-
Chlordane	2	2	0.2	-	-	-
Chlorobenzene	2	2	5	-	-	-
Chloroform	2	2	5	-	-	-
Chrysene	2	2	9.8	-	-	-
Dibenzo(a,h)Anthracene	2	2	9.8	-	-	-
Dichlorobromomethane	2	2	5	-	-	-
Dieldrin	2	2	0.0098	-	-	-
Diethyl Phthalate	2	2	9.8	-	-	-
Dimethyl Phthalate	2	2	9.8	-	-	-
Di-n-Butyl Phthalate	2	2	9.8	-	-	-
Endosulfan Sulfate	2	2	0.0098	-	-	-
Endrin Aldehyde	2	2	0.0098	-	-	-
Ethylbenzene	2	2	5	-	-	-
Fluoranthene	2	2	9.8	-	-	-
Fluorene	2	2	9.8	-	-	-
Heptachlor	2	2	0.0098	-	-	-
Heptachlor Epoxide	2	2	0.0098	-	-	-
Hexachlorobenzene	2	2	9.8	-	-	-
Hexachlorobutadiene	2	2	9.8	-	-	-
Hexachlorocyclopentadiene	2	2	9.8	-	-	-
Hexachloroethane	2	2	9.8	-	-	-
Ideno(1,2,3-cd)Pyrene	2	2	9.8	-	-	-
Isophorone	2	2	9.8	-	-	-
Mercury	4	1	0.005	0.0024	0.0017	0.0009
Nickel	2	0	0	0.70	0.47	0.32
Nitrobenzene	2	2	9.8	-	-	-
N-Nitrosodimethylamine	2	2	25	-	-	-
N-Nitrosodi-n-Propylamine	2	2	9.8	-	-	-

ED_002991_00017305-00104

Exhibit A-18. Ambient Data Summary, Kellogg Creek WWTP[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL (µg/L)	Maximum	Geometric Mean	Minimum
PCBs[2]	2	2	0.98	-	-	-
Pentachlorophenol	2	2	25	-	-	-
Phenol	2	2	9.8	-	-	-
Pyrene	2	2	9.8	-	-	-
Selenium	4	4	2	-	-	-
Tetrachloroethylene	2	2	5	-	-	-
Toxaphene	2	2	0.49	-	-	-
Trichloroethylene	2	2	5	-	-	-
Vinyl Chloride	2	2	5	-	-	-

QL = Quantification limit.
1. Represents ambient data from May 2004 to April 2007.
2. Represents the lowest QL for the 7 congeners sampled (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, and Aroclor 1260).

Potential Impacts

Baseline Criteria

Exhibit A-19 summarizes the RPA for baseline criteria for those pollutants detected in the effluent (there will be no RP or monitoring requirements if all observations are nondetect). The Willamette River is a freshwater river; thus, human health criteria for consumption of water and organisms are applicable. Flow data from which to calculate the harmonic mean or 30Q5 flows are not available; however, the facility's existing permit indicates the dilution factor is 19.9. The Willamette River at river mile 18 is on the state's 303(d) list as impaired for DDT, DDE, dieldrin, dioxin, mercury, PCBs, pentachlorophenol, and PAHs; thus, the facility would not receive dilution for these pollutants.

Exhibit A-19. RPA for Baseline Criteria, Kellogg Creek WWTP

Parameter	Calculated Effluent Conc.[1] (µg/L)	Ambient Conc.[2] (µg/L)	Conc. at Edge of Mixing Zone[3] (µg/L)	Human Health Criterion (µg/L)	Reasonable Potential
Arsenic	1.06	0.6	1.06	0.0022	**Yes**
Mercury[4]	0.018	0.0017	0.018	0.017	**Yes**
Nickel	4.16	0.47	0.66	13.4	No

1. Represents the calculated geometric mean concentration for carcinogens and the calculated maximum concentration for noncarcinogens based on a CV of 0.6 for all pollutants (see Section 3.2).
2. Represents the geometric mean of detected values and zero if data are not available or if all values are nondetect.
3. Dilution based on the facility's existing permit (factor = 19.9).
4. Potential water column criteria based on the revised fish tissue criteria, calculated using EPA default BAFs, trophic level consumption percentages, and water column translator (see Section 4).

As shown in the exhibit, the facility has RP to exceed the baseline criterion for arsenic and mercury because the concentrations at the edge of the regulatory mixing zone are greater than the applicable existing human health criterion.

ED_002991_00017305-00105

Arsenic

Note that although ambient concentrations are greater than the criterion, the Willamette River near the discharge is not on the state's 303(d) list as impaired for arsenic. If ODEQ determines that the ambient concentration represents natural background levels, it would grant dilution in the RPA calculation (ODEQ, 2005). Under this scenario, the concentration at the edge of the mixing zone would be 0.62 µg/L, or approximately 4% above the ambient background concentration. ODEQ (2005) indicates that dischargers that cause less than a 10% increase in downstream receiving water concentrations would not be given numeric effluent limits; rather they would be required to implement narrative BMPs and increased monitoring. The costs of such measures could be comparable to the cost of implementing a mercury P2 program because the facility would likely conduct similar actions and activities. Thus, costs could be approximately $100,000 per year.

If ODEQ determines that the water body is impaired, it would not grant dilution and base effluent limits on achieving the criterion end-of-pipe. However, because the baseline criterion is below the QL, the discharger would only need to reduce effluent levels to the approved QL of 0.05 µg/L (because the criterion is below the QL) for compliance with baseline standards.

Arsenic and arsenic-containing chemicals are not used in wastewater treatment. The facility's permit does not indicate whether there are any significant or categorical industrial users. If the facility determines that one or more of its indirect dischargers is causing or contributing to high arsenic levels in the effluent, it would mostly likely implement a source control program to target the dischargers or impose more stringent pretreatment limits on the dischargers. Without specific information on the types of industrial dischargers that may need controls, it is not possible to estimate pretreatment or P2 costs to indirect dischargers.

Other potential sources of arsenic to the treatment plant are drinking water and groundwater infiltration. The City of Milwaukie's water system relies on seven operating wells and 500,000 gallons of water per day from the Clackamas Water Department (water is from the Clackamas River). Since 1985, arsenic has been detected in the groundwater wells numerous times, ranging from 2 µg/L up to 5.2 µg/L (ODHS, 2007c). These concentrations, while lower than EPA's drinking water maximum contaminant level (MCL) of 10 µg/L, could contribute to arsenic levels above the human health criterion of 0.0022 µg/L. However, the facility would still need to determine if the major effluent source is the influent drinking water or infiltration from groundwater into the sewer system.

There would be no compliance costs associated with an intake credit scenario. The one-time cost associated with pursuing a variance could range from $35,000 to $200,000, with minimal costs associated with renewal. If the arsenic effluent levels are the result of infiltration of arsenic-contaminated groundwater, total costs could be $3,511,000 for a comprehensive I&I reduction program that includes source identification and pipe rehabilitation for a system with 70 miles of sewer pipes (approximately $331,000 per year annualized at 7% over 20 years). Note that if groundwater infiltration is not the only source of arsenic to the treatment plant, an I&I reduction program alone may not be sufficient for compliance and the discharger would not likely undertake such a program for compliance with toxic criteria alone.

ED_002991_00017305-00106

Mercury

Under existing procedures, the applicable AMEL is 0.017 µg/L and the MDEL is 0.034 µg/L (i.e., criterion end-of-pipe because the water body is impaired). The maximum effluent concentration at the facility is 0.013 µg/L, which is lower than both projected limits.

Under the baseline Willamette River Basin mercury TMDL, the facility would be required to develop and implement a mercury reduction strategy. Annual P2 program costs for a 7.1 mgd municipal facility may be approximately $100,000 (see Appendix B for details). As described in Appendix B, P2 costs also potentially include costs for indirect dischargers to implement controls (see Exhibit B-2). Based on information on the discharger's service area, incremental indirect discharger costs may be minimal (e.g., there are no universities in the service area). However, because ODEQ does not assign individual wasteload allocations to point source dischargers in the TMDL (point sources as a whole are required to reduce existing load by 26%), it is uncertain whether the facility would incur costs beyond those for a P2 program to meet the wasteload allocation under the baseline TMDL.

Revised Criteria

Exhibit A-20 summarizes the RPA for the revised human health criteria for consumption of water and organisms for those pollutants detected in the effluent (there will be no RP or monitoring requirements if all observations are nondetect).

Exhibit A-20. RPA for Revised Criteria, Kellogg Creek WWTP

Parameter	Conc. at Edge of Mixing Zone[1] (µg/L)	Human Health Criteria for Alternative FCRs (µg/L)				
		63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
Arsenic	1.06	**0.0083***	**0.0057***	**0.0041***	**0.0021***	**0.0014***
Mercury[2]	0.018	**0.0047***	**0.0026***	**0.0017***	**0.00076***	**0.00048***
Nickel	0.66	280	190	140	69.0	45.0

*Bolded values represent RP equal to "Yes."
FCRs = Fish consumption rates.
1. Dilution based on the facility's existing permit (factor = 19.9).
2. Potential water column criteria based on the revised fish tissue criteria, calculated using EPA default BAFs, trophic level consumption percentages, and water column translator (see Section 4).

As shown in the exhibit, the discharger would have RP for arsenic and mercury based on all alternative fish consumption rates.

Arsenic

The discharger would have RP for arsenic at all fish consumption rates. Thus, because the ambient concentration is greater than the criteria, the discharger would need to reduce discharge concentrations to background (if ODEQ determines that ambient concentrations represent natural levels) or the approved QL of 0.05 µg/L (because the criterion is below the QL) for compliance with revised standards. However, under the baseline, the discharge would need to meet those same levels. Thus, incremental compliance costs would be unlikely.

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Mercury

The discharger would have RP for mercury at all of the revised consumption rates. **Exhibit A-21** shows the AMELs and MDELs for each consumption rate in the absence of a TMDL.

Exhibit A-21. Projected Effluent Limits for Mercury, Kellogg Creek WWTP

Limit Type	Fish Consumption Rate				
	63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
AMEL (µg/L)	0.0047	0.0026	0.0017	0.00076	0.00048
MDEL (µg/L)	0.0094	0.0052	0.0034	0.0015	0.00096

The maximum effluent concentration is greater than all of the AMELs and MDELs. The facility is already required to implement a mercury P2 program under the baseline as part of the Willamette Basin mercury TMDL. It is not clear how ODEQ would adapt the baseline TMDL to attain the revised criteria (e.g., increase point source load reduction requirements; establish individual effluent limits). Thus, it is uncertain whether continued implementation of the baseline P2 program would be sufficient for compliance with the revised criteria/TMDL because there could be some maximum level of effort beyond which a P2 program would not provide additional reductions.

Because there are no proven end-of-pipe treatment technologies that can achieve low mercury levels (e.g., <10 ng/L) on a consistent basis, dischargers may need to pursue a variance (e.g., based on manmade conditions that cannot be remedied) under more stringent TMDL requirements (alternatively, ODEQ may account for this situation in allocating loads under the TMDL). However, it is uncertain at which fish consumption rate the discharger would need a variance. If the discharger pursues a variance for arsenic, these efforts would also cover a variance for mercury. Otherwise, one-time costs associated with pursuing a variance could range from $35,000 to $200,000. As part of a variance ODEQ, could require specific P2 program efforts. For dischargers covered under the Willamette River TMDL for mercury, these activities may already be included in their baseline mercury P2 requirement.

Summary

Exhibit A-22 provides a summary of the potential range in annual costs associated with the baseline and revised criteria. For the alternative fish consumption rates, the incremental costs represent any costs above and beyond those that would be needed for compliance with baseline criteria. Under a variance scenario for arsenic and/or mercury, costs would likely fall within the range shown in the exhibit (e.g., a one-time expenditure of approximately $35,000 to $200,000).

Exhibit A-22. Summary of Potential Costs, Kellogg Creek WWTP

Alternative	Compliance Scenario	Total Annual Costs	Incremental Annual Costs[1]
Baseline	• Intake credits, BMPs, variance, or I&I reduction program (arsenic) • P2 program (mercury)	$100,000 - $431,000	NA

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Exhibit A-22. Summary of Potential Costs, Kellogg Creek WWTP

Alternative	Compliance Scenario	Total Annual Costs	Incremental Annual Costs[1]
63.2 gpd	• Intake credits, BMPs, variance, or I&I reduction program (arsenic) • P2 program possible variance (mercury)	$100,000 - $431,000	$0
113 gpd	• Intake credits, BMPs, variance, or I&I reduction program (arsenic) • P2 program possible variance (mercury)	$100,000 - $431,000	$0
175 gpd	• Intake credits, BMPs, variance, or I&I reduction program (arsenic) • P2 program possible variance (mercury)	$100,000 - $431,000	$0
389 gpd	• Intake credits, BMPs, variance, or I&I reduction program (arsenic) • P2 program possible variance (mercury)	$100,000 - $431,000	$0
620 gpd	• Intake credits, BMPs, variance, or I&I reduction program (arsenic) • P2 program possible variance (mercury)	$100,000 - $431,000	$0

NA = Not applicable.

1. Annual costs for baseline criteria represent the costs needed for compliance under existing conditions; costs for revised criteria represent the difference between total annual cost and baseline costs (i.e., incremental costs above and beyond those needed for compliance with baseline criteria).

ED_002991_00017305-00109

City of McMinnville Water Reclamation Facility

Facility Description

The City of McMinnville Water Reclamation Facility (NPDES permit number OR0034002) is a major facility serving McMinnville, Oregon. The facility has an ADWDF of 5.6 mgd, and discharges treated effluent through Outfall 001 into the South Yamhill River at river mile 0.3 where the 7Q10 flow is 16 cfs. The facility also has 15 other outfalls categorized as emergency overflows.

Treatment Processes

The 2003 NPDES permit for the facility lists current treatment processes as an off-site raw influent pump station and screen, headworks, activated sludge oxidation ditches, secondary clarifiers, tertiary clarifiers, single media filters, UV disinfection, and effluent reaeration. Secondary sludge is thickened with two gravity belt thickeners before undergoing autothermal thermophilic aerobic digestion. The City transfers digested sludge to a 2.8 million gallons biosolids storage tank, and land applies the stored liquid biosolids on local farms during the summer.

Effluent Data and Limits

Exhibit A-23 summarizes monitoring data from June 2004 to March 2007 for those pollutants of concern for which effluent data are available. The facility does not have effluent limits for any toxic pollutants.

Exhibit A-23. Effluent Data Summary, McMinnville WRF[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
1,1,2,2-Tetrachloroethane	5	5	1	-	-	-
1,1,2-Trichloroethane	5	5	1	-	-	-
1,1-Dichloroethylene	5	5	1	-	-	-
1,2,4-Trichlorobenzene	4	4	4.76	-	-	-
1,2-Dichlorobenzene	9	9	4.76	-	-	-
1,2-Dichloroethane	5	5	1	-	-	-
1,2-Dichloropropane	5	5	1	-	-	-
1,2-Diphenylhydrazine	4	4	4.76	-	-	-
1,3-Dichlorobenzene	9	9	4.76	-	-	-
1,4-Dichlorobenzene	9	9	4.76	-	-	-
2,4,6-Trichlorophenol	4	4	4.76	-	-	-
2,4-Dichlorophenol	4	4	4.76	-	-	-
2,4-Dimethylphenol	4	4	9.52	-	-	-
2,4-Dinitrophenol	4	4	23.8	-	-	-
2,4-Dinitrotoluene	4	4	4.76	-	-	-
2-Chloronaphthalene	4	4	4.76	-	-	-
2-Chlorophenol	4	4	4.76	-	-	-

ED_002991_00017305-00110

Exhibit A-23. Effluent Data Summary, McMinnville WRF[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
3,3'-Dichlorobenzidine	4	4	4.76	-	-	-
4,4'-DDD	4	4	0.0952	-	-	-
4,4'-DDE	4	4	0.0952	-	-	-
4,4'-DDT	4	4	0.0952	-	-	-
Acenaphthene	4	4	4.76	-	-	-
Acrolein	5	5	10	-	-	-
Acrylonitrile	5	5	10	-	-	-
Aldrin	4	4	0.0952	-	-	-
alpha-BHC	4	4	0.0952	-	-	-
Anthracene	4	4	4.76	-	-	-
Antimony	8	0	0.02	0.24	0.17	0.12
Arsenic (Inorganic)	23	0	0.075	1.3	0.97	0.52
Benzene	5	5	1	-	-	-
Benzidine	4	4	57.1	-	-	-
Benzo(a) Anthracene	4	4	4.76	-	-	-
Benzo(a) pyrene	4	4	4.76	-	-	-
Benzo(b) Fluoranthene	4	4	4.76	-	-	-
Benzo(k) Fluoranthene	4	4	4.76	-	-	-
Beryllium	4	4	0.06	-	-	-
beta-BHC	4	4	0.0952	-	-	-
Bis(2-Chloroethyl) Ether	4	4	4.76	-	-	-
Bis(2-Chloroisopropyl) Ether	4	4	9.52	-	-	-
Bis(2-Ethylhexyl) Phthalate	4	4	9.52	-	-	-
Bromoform	5	5	1	-	-	-
Butylbenzyl Phthalate	4	4	4.76	-	-	-
Carbon tetrachloride	5	5	1	-	-	-
Chlordane	4	4	0.0952	-	-	-
Chlorobenzene	5	5	1	-	-	-
Chlorodibromomethane	5	5	1	-	-	-
Chloroform	5	5	1	-	-	-
Chrysene	4	4	4.76	-	-	-
Dibenzo(a,h)Anthracene	4	4	4.76	-	-	-
Dichlorobromomethane	5	5	1	-	-	-
Dieldrin	4	4	0.0952	-	-	-
Diethyl Phthalate	4	4	4.76	-	-	-
Dimethyl Phthalate	4	4	4.76	-	-	-
Di-n-Butyl Phthalate	4	4	4.76	-	-	-
Endosulfan sulfate	4	4	0.0952	-	-	-
Endrin	4	4	0.0952	-	-	-
Endrin Aldehyde	4	4	0.0952	-	-	-
Ethylbenzene	5	5	1	-	-	-
Fluoranthene	4	4	4.76	-	-	-
Fluorene	4	4	4.76	-	-	-

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Exhibit A-23. Effluent Data Summary, McMinnville WRF[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
gamma-BHC	4	4	0.0952	-	-	-
Heptachlor	4	4	0.0952	-	-	-
Heptachlor Epoxide	4	4	0.0952	-	-	-
Hexachlorobenzene	4	4	4.76	-	-	-
Hexachlorobutadiene	4	4	9.52	-	-	-
Hexachlorocyclopentadiene	4	4	9.52	-	-	-
Hexachloroethane	4	4	9.52	-	-	-
Ideno(1,2,3-cd)Pyrene	4	4	4.76	-	-	-
Isophorone	4	4	4.76	-	-	-
Mercury	23	0	0.0005	0.011	0.0021	0.0008
Methylene chloride	5	5	5	-	-	-
Nickel	30	0	0.10	1.34	0.73	0.39
Nitrobenzene	4	4	4.76	-	-	-
N-Nitrosodimethylamine	4	4	4.76	-	-	-
N-Nitrosodi-n-Propylamine	4	4	9.52	-	-	-
N-Nitrosodiphenylamine	4	4	4.76	-	-	-
Pentachlorophenol	4	4	9.52	-	-	-
PCBs[3]	3	3	0.472	-	-	-
Phenol	4	4	4.76	-	-	-
Pyrene	4	4	4.76	-	-	-
Selenium	30	21	0.6	0.49	0.37	0.28
Tetrachloroethylene	5	5	1	-	-	-
Thallium	8	8	0.005	-	-	-
Toluene	5	5	1	-	-	-
Toxaphene	4	4	4.76	-	-	-
Trichloroethylene	5	5	1	-	-	-
Vinyl chloride	5	5	1	-	-	-

QL = Quantification limit.
1. Represents effluent data from June 2004 to March 2007.
2. May not match approved QLs because data was collected prior to November 2007 when ODEQ revised applicable QLs.
3. Represents the lowest QL for the 7 congeners sampled (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, and Aroclor 1260).

Receiving Water Data

The harmonic mean receiving water flow for the South Yamhill River is 85.5 cfs, based on daily stream flow measurements from August 2005 through March 2007. There are insufficient data available to calculate the 30Q5 from these measurements for the discharge. However, flow data from a United States Geological Survey (USGS) gauge station 5 miles downstream of the discharge indicates that the ratio of the 7Q10 flow to the 30Q5 flow is 2.37. Assuming a similar flow pattern and ratio, the 30Q5 for the South Yamhill River upstream of the discharge would be 37.9 cfs (16 cfs 7Q10 flow × 2.37).

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Exhibit A-24 summarizes data for the South Yamhill River, approximately 300 yards upstream of the discharge, from August 2005 to October 2006 for those pollutants of concern for which ambient data are available.

Exhibit A-24. Ambient Data Summary, McMinnville WRF[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL (µg/L)	Maximum	Geometric Mean	Minimum
1,1,2,2-Tetrachloroethane	2	2	1	-	-	-
1,1,2-Trichloroethane	2	2	1	-	-	-
1,1-Dichloroethylene	2	2	1	-	-	-
1,2-Dichlorobenzene	2	2	1	-	-	-
1,2-Dichloroethane	2	2	1	-	-	-
1,2-Dichloropropane	2	2	1	-	-	-
1,3-Dichlorobenzene	2	2	1	-	-	-
1,4-Dichlorobenzene	2	2	1	-	-	-
Acrolein	2	2	10	-	-	-
Acrylonitrile	2	2	6	-	-	-
Antimony	4	0	0.02	0.064	0.043	0.037
Arsenic (Inorganic)	9	1	0.75	0.85	0.44	0.24
Benzene	2	2	1	-	-	-
Beryllium	8	8	0.06	-	-	-
Bromoform	2	2	1	-	-	-
Carbon tetrachloride	2	2	1	-	-	-
Chlorobenzene	2	2	1	-	-	-
Chlorodibromomethane	2	2	1	-	-	-
Chloroform	2	2	1	-	-	-
Dichlorobromomethane	2	2	1	-	-	-
Ethylbenzene	2	2	1	-	-	-
Mercury	8	0	0.0005	0.0014	0.00094	0.00065
Methylene chloride	2	2	5	-	-	-
Nickel	20	2	0.04	0.66	0.29	0.045
Selenium	21	13	1.5	0.55	0.39	0.30
Tetrachloroethylene	2	2	1	-	-	-
Thallium	4	4	0.005	-	-	-
Toluene	2	2	1	-	-	-
Trichloroethylene	2	2	1	-	-	-
Vinyl chloride	2	2	1	-	-	-

QL = Quantification limit.
1. Represents ambient data from August 2005 to October 2006.

Potential Impacts

Baseline Criteria

Exhibit A-25 summarizes the RPA for baseline criteria for those pollutants detected in the effluent (there will be no RP or monitoring requirements if all observations are nondetect). The

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South Yamhill River is a freshwater river; thus, human health criteria for consumption of organisms and water are applicable. ODEQ (2006b) allows 25% of the harmonic mean flow for dilution for carcinogens and 25% of the 30Q5 flow for dilution for noncarcinogens.

Exhibit A-25. RPA for Baseline Criteria, McMinnville WRF

Parameter	Calculated Effluent Conc.[1] (µg/L)	Ambient Conc.[2] (µg/L)	Conc. at Edge of Mixing Zone[3] (µg/L)	Human Health Criterion (µg/L)	Reasonable Potential
Antimony	0.46	0.043	0.24	5.6	No
Arsenic	1.04	0.44	1.04	0.0022	**Yes**
Mercury[4]	0.014	0.00094	0.0073	0.017	No
Nickel	1.53	0.29	0.88	13.4	No
Selenium	0.59	0.39	0.49	10	No

1. Represents the calculated geometric mean concentration for carcinogens and the calculated maximum concentration for noncarcinogens based on a CV of 0.6 for all pollutants except arsenic (CV = 0.148) and nickel (CV = 0.42) (see Section 3.2).
2. Represents the geometric mean of detected values and zero if data are not available or if all values are nondetect.
3. Dilution based on 25% of 30Q5 flow for noncarcinogens (factor = 1.1) and 25% of harmonic mean flow for carcinogens (factor = 2.5).
4. Potential water column criteria based on the revised fish tissue criteria, calculated using EPA default BAFs, trophic level consumption percentages, and water column translator (see Section 4).

Arsenic

As shown in the exhibit, the facility has RP to exceed baseline criteria for arsenic because the concentration at the edge of the regulatory mixing zone is greater than the applicable existing human health criterion. Note also that although ambient concentrations are greater than the criterion, the South Yamhill River is not on the state's 303(d) list as impaired for arsenic. Regardless, the facility would be discharging arsenic above allowable levels and, under existing procedures, ODEQ would require the facility to reduce discharge concentrations to background (if ODEQ determines that ambient concentrations represent natural levels) or the approved QL of 0.05 µg/L (because the criterion is below the QL) for compliance with baseline standards.

Inorganic arsenic can enter surface waters through atmospheric deposition (e.g., arsenic released into the air by volcanoes), soil erosion and weathering of arsenic-containing minerals and ores, and commercial or industrial processes, such as metal smelting, wood preserving, and manufacturing of microelectronics and semiconductors (ODEQ, 2006a). Arsenic and arsenic-containing chemicals are not used in wastewater treatment. However, drinking water and groundwater infiltration are two potential sources of arsenic to the treatment plant. McMinnville Water and Light supplies the City with drinking water from two reservoirs: Haskins and McGuire. All arsenic samples (organic plus inorganic) from the reservoirs since 1986 are nondetect below the minimum reporting levels (ODHS, 2007d). The minimum reporting levels are not specified, and the drinking water maximum contaminant level is 10 µg/L, which is higher than current effluent concentrations and human health criteria. Thus, from these data it is not possible to determine if drinking water is contributing to high arsenic levels in the wastewater effluent. However, if the facility determines that drinking water is the source of high arsenic values in the wastewater, it is likely that the facility would pursue a variance or request that ODEQ consider granting the facility intake credits.

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USGS (1998) indicates that arsenic concentrations exceeding EPA's previous maximum contaminant level of 50 µg/L are widespread in groundwater in the Willamette Basin. In addition, the facility has already begun addressing I&I issues. EPA and ODEQ have directed the City to control the sewage overflows into the Yamhill River. The City, with the assistance of consultants, determined that structural defects in sewer pipes and manholes allow unwanted storm water inflow and infiltration to overload the sewage system (City of McMinnville, 2007). The City's experts have estimated that approximately 60% of the infiltration is from private sewer laterals (e.g., broken pipes, roof downspouts, basement drains, or area drains that are connected to the private sewer lateral) (City of McMinnville, 2007). The City is currently requiring that all defective private sewer laterals be replaced to meet the overflow control objective, targeting the areas of town where pipes are repaired and/or replaced first. The City plans to continue the program, moving from one area to another, for the next 10 to 20 years (City of McMinnville, 2007). However, it is not clear if, or when, the overflow reduction goal will be met, and whether meeting this goal would also result in the needed reductions in arsenic.

There would be no compliance costs associated with an intake credit scenario. The one-time cost associated with pursuing a variance could range from $35,000 to $200,000, with minimal costs associated with renewal. If the arsenic effluent levels are the result of infiltration of arsenic-contaminated groundwater, total costs could be relatively minimal if the ongoing I&I study is sufficient to $3,700,000 for an I&I reduction program that includes pipe rehabilitation (source identification is not included because the City has already conducted such a study) for a system with 100 miles of sewer pipes (approximately $349,000 per year annualized at 7% over 20 years).

Mercury

Under the baseline Willamette River Basin mercury TMDL, the facility would be required to develop and implement a mercury reduction strategy. Annual P2 program costs for a 5.6 mgd municipal facility may be approximately $100,000 (see Appendix B for details). As described in Appendix B, P2 costs also potentially include costs for indirect dischargers to implement controls (see Exhibit B-2). Based on information on the discharger's service area, incremental indirect discharger costs may be $12,000 per year (e.g., there is one university in the service area). However, because ODEQ does not assign individual wasteload allocations to point source dischargers in the TMDL (point sources as a whole are required to reduce existing load by 26%), it is uncertain whether the facility would incur costs beyond those for a P2 program to meet the wasteload allocation under the baseline TMDL.

Revised Criteria

Exhibit A-26 summarizes the RPA for the revised human health criteria for consumption of water and organisms for those pollutants detected in the effluent (there will be no RP or monitoring requirements if all observations are nondetect).

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Exhibit A-26. RPA for Revised Criteria, McMinnville WRF

Parameter	Conc. at Edge of Mixing Zone[1] (µg/L)	Human Health Criteria at Alternative FCRs (µg/L)				
		63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
Antimony	0.24	5.40	5.30	5.10	4.70	4.30
Arsenic	1.04	**0.0083***	**0.0057***	**0.0041***	**0.0021***	**0.0014***
Mercury[2]	0.0073	**0.0047***	**0.0026***	**0.0017***	**0.00076***	**0.00048***
Nickel	0.88	280	190	140	69.0	45.0
Selenium	0.49	150	140	120	91.0	70.0

*Bolded values represent RP equal to "Yes."
FCRs = Fish consumption rates.
1. Dilution based on 25% of 30Q5 flow for noncarcinogens (factor = 1.1) and 25% of harmonic mean flow for carcinogens (factor = 2.5).
2. Potential water column criteria based on the revised fish tissue criteria, calculated using EPA default BAFs, trophic level consumption percentages, and water column translator (see Section 4).

As shown in the exhibit, the discharger could have RP for arsenic and mercury based on the alternative fish consumption rates.

Arsenic

The discharger would have RP for arsenic at all fish consumption rates. Thus, because the ambient concentration is greater than the criteria, the discharger would need to reduce discharge concentrations to background (if ODEQ determines that ambient concentrations represent natural levels) or the approved QL of 0.05 µg/L (because the criterion is below the QL) for compliance with revised standards. However, under the baseline, the discharge would need to meet those same levels. Thus, incremental compliance costs would be unlikely.

Mercury

The discharger would have RP for mercury at all the consumption rates. **Exhibit A-27** shows the AMELs and MDELs for each consumption rate. Note that because the background concentration is above the applicable criteria the discharger would receive effluent limits based on criteria end-of-pipe (ODEQ, 2005).

Exhibit A-27. Projected Effluent Limits for Mercury, McMinnville WRF

Limit Type	Fish Consumption Rate				
	63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
AMEL (µg/L)	0.0047	0.0026	0.0017	0.00076	0.00048
MDEL (µg/L)	0.0094	0.0052	0.0034	0.0015	0.00096

The maximum effluent concentration at the facility is 0.011 µg/L, which is greater than all of the projected AMELs and MDELs. The facility is already required to implement a mercury P2 program under the baseline as part of the Willamette Basin mercury TMDL. It is not clear how ODEQ would adapt the baseline TMDL to attain the revised criteria (e.g., increase point source load reduction requirements; establish individual effluent limits). Thus, it is uncertain whether continued implementation of the baseline P2 program would be sufficient for compliance with

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the revised criteria/TMDL because there could be some maximum level of effort beyond which a P2 program would not provide additional reductions.

Because there are no proven end-of-pipe treatment technologies that can achieve low mercury levels (e.g., <10 ng/L) on a consistent basis, dischargers may need to pursue a variance (e.g., based on manmade conditions that cannot be remedied) under more stringent TMDL requirements (alternatively, ODEQ may account for this situation in allocating loads under the TMDL). However, it is uncertain for which consumption rates the discharger would need a variance. If the discharger pursues a variance for arsenic, these efforts would also cover a variance for mercury. Otherwise, one-time costs associated with pursuing a variance could range from $35,000 to $200,000. As part of a variance ODEQ, could require specific P2 program efforts. For dischargers covered under the Willamette River TMDL for mercury, these activities may already be included in their baseline mercury P2 requirement.

Summary

Exhibit A-28 provides a summary of the potential range in annual costs associated with the baseline and revised criteria. For the alternative fish consumption rates, the incremental costs represent any costs above and beyond those that would be needed for compliance with baseline criteria. Under a variance scenario for arsenic and/or mercury, costs could include a one-time expenditure of $35,000 to $200,000.

Exhibit A-28. Summary of Potential Costs, McMinnville WRF

Alternative	Compliance Scenario	Total Annual Costs	Incremental Annual Costs[1]
Baseline	• Intake credits, variance, or I&I reduction program (arsenic) • P2 program (mercury)	$112,000 - $461,000	NA
63.2 gpd	• Intake credits, variance, or I&I reduction program (arsenic) • P2 program, possible variance (mercury)	$112,000 - $461,000	$0
113 gpd	• Intake credits, variance, or I&I reduction program (arsenic) • P2 program, possible variance (mercury)	$112,000 - $461,000	$0
175 gpd	• Intake credits, variance, or I&I reduction program (arsenic) • P2 program, possible variance (mercury)	$112,000 - $461,000	$0
389 gpd	• Intake credits, variance, or I&I reduction program (arsenic) • P2 program, possible variance (mercury)	$112,000 - $461,000	$0
620 gpd	• Intake credits, variance, or I&I reduction program (arsenic) • P2 program, possible variance (mercury)	$112,000 - $461,000	$0

1. Annual costs for baseline criteria represent the costs needed for compliance under existing conditions; costs for revised criteria represent the difference between total annual cost and baseline costs (i.e., incremental costs above and beyond those needed for compliance with baseline criteria).

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City of North Bend Wastewater Treatment Plant

Facility Description

The City of North Bend Waste Water Treatment Plant (NPDES permit number OR0023361) treats wastewater for North Bend, Oregon. The facility treats domestic wastewater from residential and commercial sources for a population of approximately 9,700. ODEQ classifies this 2.2 mgd (ADWDF) as a major discharger. Treated effluent is discharged through outfall 001 into Coos Bay. The facility also has nine other outfalls categorized as emergency overflows.

Treatment Processes

The 2003 NPDES permit for the facility lists current treatment processes as headworks, a primary clarifier, two secondary clarifiers, three aeration basins, and chlorine disinfection. Sludge from the primary and secondary clarifiers is stabilized and land applied as Class B biosolids to beneficial use sites located on the North Bend Airport properties.

Effluent Data and Limits

Exhibit A-29 summarizes monitoring data from January 2006 to December 2006 for those pollutants of concern for which effluent data are available. The facility does not have effluent limits for any toxic pollutants.

Exhibit A-29. Effluent Data Summary, North Bend WWTP[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
1,1,2,2-Tetrachloroethane	3	3	0.5	-	-	-
1,1,2-Trichloroethane	3	3	0.5	-	-	-
1,1-Dichloroethylene	3	3	0.5	-	-	-
1,2,4-Trichlorobenzene	6	6	10	-	-	-
1,2-Dichlorobenzene	6	6	20	-	-	-
1,2-Dichloroethane	3	3	0.5	-	-	-
1,2-Dichloropropane	3	3	0.5	-	-	-
1,2-Trans-Dichloroethylene	3	3	0.5	-	-	-
1,3-Dichlorobenzene	6	6	20	-	-	-
1,4-Dichlorobenzene	6	6	20	-	-	-
2,4,6-Trichlorophenol	3	3	20	-	-	-
2,4-Dichlorophenol	3	3	20	-	-	-
2,4-Dimethylphenol	3	3	20	-	-	-
2,4-Dinitrophenol	3	2	20	35	35	35
2,4-Dinitrotoluene	3	3	10	-	-	-
2-Chloronaphthalene	3	3	10	-	-	-
2-Chlorophenol	3	3	20	-	-	-
2-Methyl-4,6-Dinitrophenol	3	3	20	-	-	-
3,3'-Dichlorobenzidine	3	3	25	-	-	-
4,4'-DDD	3	3	0.04	-	-	-

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Exhibit A-29. Effluent Data Summary, North Bend WWTP[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
4,4'-DDE	3	3	0.04	-	-	-
4,4'-DDT	3	3	0.04	-	-	-
Acenaphthene	3	3	10	-	-	-
Acrolein	3	3	50	-	-	-
Acrylonitrile	3	3	50	-	-	-
Aldrin	3	3	0.02	-	-	-
alpha-BHC	3	3	0.02	-	-	-
Anthracene	3	3	10	-	-	-
Antimony	3	1	0.2	0.74	0.50	0.34
Arsenic	1	0	0	0.72	0.72	0.72
Benzene	3	3	0.5	-	-	-
Benzidine	3	3	10	-	-	-
Benzo(a) Anthracene	3	3	10	-	-	-
Benzo(a) Pyrene	3	3	10	-	-	-
Benzo(b) Fluoranthene	3	3	10	-	-	-
Benzo(k) Fluoranthene	3	3	20	-	-	-
Beryllium	3	3	0.1	-	-	-
beta-BHC	3	3	0.02	-	-	-
Bis(2-Chloroethyl) Ether	3	3	10	-	-	-
Bis(2-Chloroisopropyl) Ether	3	3	10	-	-	-
Bis(2-Ethylhexyl) Phthalate	3	3	10	-	-	-
Bromoform	3	3	0.5	-	-	-
Butylbenzyl Phthalate	3	3	10	-	-	-
Carbon Tetrachloride	3	3	0.5	-	-	-
Chlordane	3	3	0.1	-	-	-
Chlorobenzene	3	3	0.5	-	-	-
Chlorodibromomethane	3	3	0.5	-	-	-
Chloroform	3	0	0	1.7	0.98	0.65
Chrysene	3	3	10	-	-	-
Dibenzo(a,h)Anthracene	3	3	10	-	-	-
Dieldrin	3	3	0.04	-	-	-
Diethyl Phthalate	3	3	10	-	-	-
Dimethyl Phthalate	3	3	10	-	-	-
Di-n-Butyl Phthalate	3	3	10	-	-	-
Endosulfan Sulfate	3	3	0.04	-	-	-
Endrin	3	3	0.04	-	-	-
Endrin Aldehyde	3	3	0.04	-	-	-
Ethylbenzene	3	3	0.5	-	-	-
Fluoranthene	3	3	10	-	-	-
Fluorene	3	3	10	-	-	-
gamma-BHC	3	3	0.02	-	-	-
Heptachlor	3	3	0.02	-	-	-
Heptachlor Epoxide	3	3	0.02	-	-	-
Hexachlorobenzene	3	3	10	-	-	-

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Exhibit A-29. Effluent Data Summary, North Bend WWTP[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
Hexachlorobutadiene	3	3	10	-	-	-
Hexachlorocyclopentadiene	3	3	20	-	-	-
Hexachloroethane	3	3	20	-	-	-
Ideno(1,2,3-cd)Pyrene	3	3	10	-	-	-
Isophorone	3	3	10	-	-	-
Mercury	1	1	0.1	-	-	-
Methylene Chloride	3	3	2	-	-	-
Nickel	3	0	0	5.9	1.92	0.98
Nitrobenzene	3	3	10	-	-	-
N-Nitrosodimethylamine	3	3	10	-	-	-
N-Nitrosodi-n-Propylamine	3	3	10	-	-	-
N-Nitrosodiphenylamine	3	3	10	-	-	-
PCBs[3]	3	3	0.1	-	-	-
Pentachlorophenol	3	3	20	-	-	-
Phenol	3	3	20	-	-	-
Pyrene	3	3	10	-	-	-
Selenium	3	0	0	4.16	1.31	0.63
Tetrachloroethylene	3	3	0.5	-	-	-
Thallium	2	2	0.5	-	-	-
Toluene	3	0	0	1.2	0.87	0.54
Toxaphene	3	3	0.25	-	-	-
Trichloroethylene	3	3	0.5	-	-	-
Vinyl Chloride	3	3	0.5	-	-	-

QL = Quantification limit.
1. Represents effluent data from January 2006 to December 2006.
2. May not match approved QLs because data was collected prior to November 2007 when ODEQ revised applicable QLs.
3. Represents the lowest QL for the 7 congeners sampled (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, and Aroclor 1260).

Receiving Water Data

There are no upstream ambient data available for this facility.

Potential Impacts

Baseline Criteria

Exhibit A-30 summarizes the RPA for baseline criteria for those pollutants detected in the effluent (there will be no RP or monitoring requirements if all observations are nondetect). Coos Bay is estuarine; thus, human health criteria for consumption of organisms only are applicable. The dilution factors are based on the chronic mixing zone factors used in the existing permit because flow data are not available from which to calculate the harmonic mean and 30Q5 flows.

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Exhibit A-30. RPA for Baseline Criteria, North Bend WRF

Parameter	Calculated Effluent Conc.[1] (µg/L)	Ambient Conc.[2] (µg/L)	Conc. at Edge of Mixing Zone[3] (µg/L)	Human Health Criterion (µg/L)	Reasonable Potential
2,4-Dinitrophenol	105	0	1.0	5300	No
Antimony	2.22	0	0.021	640	No
Arsenic	4.46	0	0.042	0.018	**Yes**
Chloroform	2.94	0	0.028	15.7	No
Nickel	17.7	0	0.17	100	No
Selenium	12.5	0	0.12	4200	No
Toluene	3.6	0	0.034	15000	No

1. Represents the calculated geometric mean concentration for carcinogens and the calculated maximum concentration for noncarcinogens based on a CV of 0.6 for all pollutants (see Section 3.2).
2. Represents the geometric mean of detected values and zero if data are not available or if all values are nondetect.
3. Dilution based on chronic mixing zone dilution factors in existing permit (factor = 105).

As shown in the exhibit, the facility has RP to exceed the baseline criterion for arsenic because the concentration at the edge of the regulatory mixing zone is greater than the applicable existing human health criterion. However, the analysis is based on only one data point, resulting in a calculated effluent concentration more than six times greater than the actual effluent concentration. Thus, whether the discharger would have RP with more effluent data is highly uncertain.

If additional effluent data indicate RP, the facility would receive effluent limits. The AMEL would be 1.84 µg/L and the MDEL would be 3.69 µg/L based on the procedures described in Section 4.1.2 (assuming a CV of 0.6). The only effluent value available is less than both projected effluent limits. Thus, it is possible that additional monitoring data could indicate that the facility is in compliance with the projected effluent limits and no costs would be incurred for compliance. However, additional data could also indicate that effluent arsenic concentrations exceed the projected limits, and the discharger may need to reduce discharge concentrations for compliance with baseline standards.

Arsenic and arsenic-containing chemicals are not used in wastewater treatment, and the facility does not serve any significant industrial users. Based on the most conservative dilution factors from the City's mixing zone study, and influent, effluent and biosolids monitoring data, ODEQ (2003) determined that toxic metals are not passing through the treatment facility. However, drinking water and groundwater infiltration are two potential sources of arsenic to the treatment plant.

The Coos Bay-North Bend Water Board supplies the City with drinking water from its water treatment plant that draws water from Pony Creek. The City detected arsenic twice in drinking water since May 2004 (1.3 µg/L in 2007 and 0.5 µg/L in 2004) (ODHS, 2007b). Thus, it is possible that drinking water is contributing to high arsenic levels in the wastewater effluent. In this case, it is likely that the facility would pursue a variance or request that ODEQ consider granting the facility intake credits.

The facility's permit also indicates that it has severe I&I problems and that primary treatment bypass occurs on average about once per month due to heavy rainfall and a high groundwater

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table. If groundwater infiltration is causing the high arsenic effluent levels, the discharger may have to implement an I&I reduction program for compliance with the existing criteria. However, an I&I program that targets overflows may not include the same activities as a program that targets infiltration to reduce arsenic concentrations. For example, overflow detention basins may be used to collect excess flows until capacity is available to treat the water (similar to an equalization basin). Detention basins do not prevent groundwater high in arsenic from entering the system though; only pipe rehabilitation would prevent infiltration.

There would be no compliance costs associated with an intake credit scenario. The one-time cost associated with pursuing a variance could range from $35,000 to $100,000, with minimal costs associated with renewal. If the arsenic effluent levels are the result of infiltration of arsenic-contaminated groundwater, total costs could be $1,850,000 for an I&I reduction program that includes pipe rehabilitation (source identification costs are not included because this would be completed to address the existing I&I issues) for a system with 50 miles of sewer pipes (approximately $174,000 per year annualized at 7% over 20 years). Note that if groundwater infiltration is not the only source of arsenic to the treatment plant, an I&I reduction program alone may not be sufficient for compliance and the discharger would not likely undertake such a program for compliance with toxic criteria alone.

Revised Criteria

Exhibit A-31 summarizes the RPA for the revised human health criteria for consumption of organisms only for those pollutants detected in the effluent (there will be no RP or monitoring requirements if all observations are nondetect).

Exhibit A-31. RPA for Revised Criteria, North Bend WWTP

Parameter	Conc. at Edge of Mixing Zone[1] (µg/L)	Human Health Criteria at Alternative FCRs (µg/L)				
		63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
2,4-Dinitrophenol	1.00	1500	830	530	240	150
Antimony	0.021	180	99.0	64.0	29.0	18.0
Arsenic	0.042	**0.014***	**0.0080***	**0.0052***	**0.0023***	**0.0015***
Chloroform	0.028	48.0	27.0	17.0	7.90	4.90
Nickel	0.17	470	260	170	77.0	48.0
Selenium	0.12	1200	650	420	190	120
Toluene	0.034	4100	2300	1500	670	420

*Bolded values represent RP equal to "Yes."
FCRs = Fish consumption rates.
1. Dilution based on chronic mixing zone dilution factors in existing permit (factor = 105).

As shown in the exhibit, the discharger would have RP for arsenic at all alternative consumption rates. **Exhibit A-32** shows the projected effluent limits for these consumption rates.

Exhibit A-32. Projected Effluent Limits for Arsenic, North Bend WWTP

Limit Type	Fish Consumption Rate				
	63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
AMEL (µg/L)	1.5	0.84	0.55	0.24	0.16
MDEL (µg/L)	3.0	1.7	1.1	0.48	0.32

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As described in the baseline analysis, the discharger may need to reduce effluent concentrations for compliance with baseline criteria, or pursue alternative compliance measures. These are the same compliance scenarios that would apply under all of the potential revised criteria. The baseline I&I reduction program includes a comprehensive study to identify all potential infiltration sources and rehabilitation of those sources. Thus, baseline controls, or alternative actions, should also enable compliance with the revised criteria, and there would be no incremental compliance costs.

Summary

Exhibit A-33 provides a summary of the potential range in annual costs associated with the baseline and revised criteria. For the alternative fish consumption rates, the incremental costs represent the any costs above and beyond those that would be needed for compliance with baseline criteria. Under a variance scenario for arsenic, costs would likely fall within the range shown in the exhibit (e.g., a one-time expenditure of approximately $35,000 to $100,000).

Exhibit A-33. Summary of Potential Costs, North Bend WWTP

Alternative	Compliance Scenario	Total Annual Costs	Incremental Annual Costs[1]
Baseline	• None (in compliance), intake credits, variance, or I&I reduction program (arsenic)	$0 - $174,000	NA
63.2 gpd	• None (in compliance), intake credits, variance, or I&I reduction program (arsenic)	$0 - $174,000	$0
113 gpd	• None (in compliance), intake credits, variance, or I&I reduction program (arsenic)	$0 - $174,000	$0
175 gpd	• None (in compliance), intake credits, variance, or I&I reduction program (arsenic)	$0 - $174,000	$0
389 gpd	• None (in compliance), intake credits, variance, or I&I reduction program (arsenic)	$0 - $174,000	$0
620 gpd	• None (in compliance), intake credits, variance, or I&I reduction program (arsenic)	$0 - $174,000	$0

NA = Not applicable.

1. Annual costs for baseline criteria represent the costs needed for compliance under existing conditions; costs for revised criteria represent the difference between total annual cost and baseline costs (i.e., incremental costs above and beyond those needed for compliance with baseline criteria).

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Portland, Columbia Boulevard WWTP

Facility Description

The City of Portland operates the Columbia Boulevard Wastewater Treatment Plant (NPDES permit number OR0026905) which treats domestic, commercial, and industrial wastewater from the City of Portland, Oregon. The ADWDF for the plant is 100 mgd, while the design peak wet weather flow is 300 mgd. ODEQ classifies the facility as a major discharger. The facility discharges treated municipal wastewater through Outfall 001 and wastewater from its wet weather treatment facility through Outfall 003 to the Columbia River at river mile 105.5. EPA's PCS database indicates that average monthly flows from Outfalls 001 and 003 are 70 mgd and 10 mgd, respectively. The facility also has several outfalls for bypass and overflows.

Treatment Processes

The NPDES permit for the facility indicates that the plant underwent many improvements during the 1990's. Most notable were the disinfection system improvements completed in 1991, modifications to the secondary treatment system completed in 1994, addition of an outfall diffuser in 1995, and replacement of the headworks completed in 1996. The facility hauls most biosolids to Northeastern Oregon for land application, and composts the rest to create a soil amendment for local landscapers.

Effluent Data and Limits

Exhibits A-34 and A-35 summarizes monitoring data for Outfalls 001 and 003 from January 2004 to December 2006 for those pollutants of concern for which effluent data are available. The facility does not have effluent limits for any toxic pollutants.

Exhibit A-34. Effluent Data Summary, City of Portland, Columbia Blvd WWTP, Outfall 001[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
1,1,2,2-Tetrachloroethane	22	22	3	-	-	-
1,1,2-Trichloroethane	22	22	2	-	-	-
1,1-Dichloroethylene	22	22	5	-	-	-
1,2,4-Trichlorobenzene	23	23	5	-	-	-
1,2-Dichlorobenzene	45	45	5	-	-	-
1,2-Dichloroethane	22	22	2	-	-	-
1,2-Dichloropropane	22	22	2	-	-	-
1,3-Dichlorobenzene	45	45	5	-	-	-
1,4-Dichlorobenzene	45	43	5	3.2	2.5	2.0
2,3,7,8-TCDD (Dioxin)	12	0	1.0E-7	5.5E-6	5.0E-6	4.8E-6
2,4,6-Trichlorophenol	23	23	5	-	-	-
2,4-Dichlorophenol	23	23	5	-	-	-
2,4-Dimethylphenol	23	23	10	-	-	-
2,4-Dinitrophenol	23	23	20	-	-	-
2,4-Dinitrotoluene	23	23	5	-	-	-

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Exhibit A-34. Effluent Data Summary, City of Portland, Columbia Blvd WWTP, Outfall 001[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
2-Chloronaphthalene	23	23	5	-	-	-
2-Chlorophenol	23	23	5	-	-	-
2-Methyl-4,6-dinitrophenol	23	23	10	-	-	-
3,3'-Dichlorobenzidine	23	23	5	-	-	-
4,4'-DDD	23	23	0.5	-	-	-
4,4'-DDE	23	23	0.5	-	-	-
4,4'-DDT	23	23	0.962	-	-	-
Acenaphthene	23	23	5	-	-	-
Acrolein	22	22	10	-	-	-
Acrylonitrile	22	22	10	-	-	-
Aldrin	23	23	0.5	-	-	-
Alpha-BHC	23	23	0.5	-	-	-
Anthracene	23	23	5	-	-	-
Arsenic	66	0	0.1	1.71	0.78	0.45
Benzene	22	22	3	-	-	-
Benzidine	23	23	50	-	-	-
Benzo(a) Anthracene	23	23	5	-	-	-
Benzo(a) Pyrene	23	23	5	-	-	-
Benzo(b) Fluoranthene	23	23	5	-	-	-
Benzo(k) Fluoranthene	23	23	5	-	-	-
Beta-BHC	23	23	1	-	-	-
Bis(2-chloroethyl) ether	23	23	5	-	-	-
Bis(2-chloroisopropyl) ether	23	23	10	-	-	-
Bis(2-ethylhexyl) phthalate	23	11	10	10.9	4.28	2.7
Bromoform	22	22	2	-	-	-
Butylbenzyl Phthalate	14	14	10	-	-	-
Carbon tetrachloride	22	22	3	-	-	-
Chlordane	23	23	25	-	-	-
Chlorobenzene	22	22	2	-	-	-
Chloroform	22	12	2	4.6	2.63	2
Chrysene	23	23	5	-	-	-
Dibenzo(a,h)Anthracene	23	23	5	-	-	-
Dichlorobromomethane	44	44	2	-	-	-
Dieldrin	23	23	0.5	-	-	-
Diethyl phthalate	23	22	5	1.2	1.2	1.2
Dimethyl phthalate	23	23	5	-	-	-
Di-n-butyl phthalate	23	22	10	30.6	30.6	30.6
Endosulfan Sulfate	23	23	0.5	-	-	-
Endrin	23	23	0.5	-	-	-
Endrin Aldehyde	23	23	0.5	-	-	-
Ethylbenzene	22	22	2	-	-	-
Fluoranthene	23	23	5	-	-	-
Fluorene	23	23	5	-	-	-
Gamma-BHC	23	23	0.0962	-	-	-

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Exhibit A-34. Effluent Data Summary, City of Portland, Columbia Blvd WWTP, Outfall 001[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
Heptachlor	23	23	0.5	-	-	-
Heptachlor Epoxide	23	23	0.5	-	-	-
Hexachlorobenzene	23	23	5	-	-	-
Hexachlorobutadiene	23	23	10	-	-	-
Hexachlorocyclopentadiene	23	23	10	-	-	-
Hexachloroethane	23	23	10	-	-	-
Ideno(1,2,3-cd)Pyrene	23	23	5	-	-	-
Isophorone	23	23	5	-	-	-
Mercury	66	12	0.01	0.075*	0.013	0.0051
Methylene chloride	22	22	3	-	-	-
Nickel	66	0	0.2	100	4.98	2.12
Nitrobenzene	23	23	5	-	-	-
N-Nitrosodimethylamine	23	23	5	-	-	-
N-Nitrosodi-n-Propylamine	23	23	10	-	-	-
N-Nitrosodiphenylamine	23	23	5	-	-	-
PCBs[3]	161	161	2	-	-	-
Pentachlorophenol	23	23	10	-	-	-
Phenol	23	23	5	-	-	-
Pyrene	23	23	5	-	-	-
Selenium	66	56	0.5	0.98	0.63	0.5
Tetrachloroethylene	22	22	2	-	-	-
Toluene	22	19	2	3.4	3.13	2.9
Toxaphene	23	23	25	-	-	-
Trichloroethylene	22	22	3	-	-	-
Vinyl chloride	22	22	10	-	-	-

QL = Quantification limit.
*Outlier removed because raw data indicates that value is estimated and may not represent actual concentration.
1. Represents effluent data from January 2004 to December 2006.
2. May not match approved QLs because data was collected prior to November 2007 when ODEQ revised applicable QLs.
3. Represents the lowest QL for the 7 congeners sampled (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, and Aroclor 1260).

Exhibit A-35. Effluent Data Summary, City of Portland, Columbia Blvd WWTP, Outfall 003[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
1,1,2,2-Tetrachloroethane	10	10	3	-	-	-
1,1,2-Trichloroethane	10	10	2	-	-	-
1,1-Dichloroethylene	10	10	5	-	-	-
1,2,4-Trichlorobenzene	11	11	5	-	-	-
1,2-Dichlorobenzene	21	21	5	-	-	-
1,2-Dichloroethane	10	10	2	-	-	-
1,2-Dichloropropane	10	10	2	-	-	-
1,3-Dichlorobenzene	21	21	5	-	-	-
1,4-Dichlorobenzene	21	18	5	13.9	5.29	2.6

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Exhibit A-35. Effluent Data Summary, City of Portland, Columbia Blvd WWTP, Outfall 003[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
2,4,6-Trichlorophenol	11	11	5	-	-	-
2,4-Dichlorophenol	11	11	5	-	-	-
2,4-Dimethylphenol	11	11	10	-	-	-
2,4-Dinitrophenol	11	11	20	-	-	-
2,4-Dinitrotoluene	11	11	5	-	-	-
2-Chloronaphthalene	11	11	5	-	-	-
2-Chlorophenol	11	11	5	-	-	-
2-Methyl-4,6-dinitrophenol	11	11	10	-	-	-
3,3'-Dichlorobenzidine	11	11	5	-	-	-
4,4'-DDD	11	11	0.5	-	-	-
4,4'-DDE	11	11	0.5	-	-	-
4,4'-DDT	11	11	0.962	-	-	-
Acenaphthene	11	11	5	-	-	-
Acrolein	10	10	10	-	-	-
Acrylonitrile	10	10	10	-	-	-
Aldrin	11	11	0.5	-	-	-
Alpha-BHC	11	11	0.5	-	-	-
Anthracene	11	11	5	-	-	-
Arsenic	32	0	0.1	4.08	1.26	0.78
Benzene	10	10	3	-	-	-
Benzidine	11	11	50	-	-	-
Benzo(a) Anthracene	11	11	5	-	-	-
Benzo(a) Pyrene	11	11	5	-	-	-
Benzo(b) Fluoranthene	11	11	5	-	-	-
Benzo(k) Fluoranthene	11	11	5	-	-	-
Beta-BHC	11	11	0.5	-	-	-
Bis(2-chloroethyl) ether	11	11	5	-	-	-
Bis(2-chloroisopropyl) ether	11	11	10	-	-	-
Bis(2-ethylhexyl) Phthalate	11	2	10	24.8	15.1	8.66
Bromoform	10	10	2	-	-	-
Butylbenzyl Phthalate	7	6	10	5.8	5.8	5.8
Carbon tetrachloride	10	10	3	-	-	-
Chlordane	11	11	25	-	-	-
Chlorobenzene	10	10	2	-	-	-
Chloroform	10	5	2	9.6	4.7	2.4
Chrysene	11	11	5	-	-	-
Dibenzo(a,h)Anthracene	11	11	5	-	-	-
Dichlorobromomethane	20	20	2	-	-	-
Dieldrin	11	11	0.5	-	-	-
Diethyl phthalate	11	5	5	5.7	2.91	1.33
Dimethyl phthalate	11	11	5	-	-	-
Di-n-butyl phthalate	11	10	10	3.2	3.2	3.2
Endosulfan Sulfate	11	11	0.5	-	-	-
Endrin	11	11	0.5	-	-	-

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Exhibit A-35. Effluent Data Summary, City of Portland, Columbia Blvd WWTP, Outfall 003[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
Endrin Aldehyde	11	11	0.5	-	-	-
Ethylbenzene	10	9	2	4.0	4.0	4.0
Fluoranthene	11	11	5	-	-	-
Fluorene	11	11	5	-	-	-
Gamma-BHC	11	11	0.0962	-	-	-
Heptachlor	11	11	0.5	-	-	-
Heptachlor Epoxide	11	11	0.5	-	-	-
Hexachlorobenzene	11	11	5	-	-	-
Hexachlorobutadiene	11	11	10	-	-	-
Hexachlorocyclopentadiene	11	11	10	-	-	-
Hexachloroethane	11	11	10	-	-	-
Ideno(1,2,3-cd)Pyrene	11	11	5	-	-	-
Isophorone	11	11	5	-	-	-
Mercury	32	0	0.002	0.38	0.040	0.0079
Methylene chloride	10	10	3	-	-	-
Nickel	32	0	0.2	278	5.39	2.28
Nitrobenzene	11	11	5	-	-	-
N-Nitrosodimethylamine	11	11	5	-	-	-
N-Nitrosodi-n-Propylamine	11	11	10	-	-	-
N-Nitrosodiphenylamine	11	11	5	-	-	-
PCBs[3]	77	77	5	-	-	-
Pentachlorophenol	11	11	10	-	-	-
Phenol	11	8	5	6.3	3.02	1.9
Pyrene	11	11	5	-	-	-
Selenium	32	24	0.5	1.58	0.86	0.52
Tetrachloroethylene	10	9	2	4.9	4.9	4.9
Toluene	10	5	2	6.9	4.34	2.5
Toxaphene	11	11	25	-	-	-
Trichloroethylene	10	10	3	-	-	-
Vinyl chloride	10	10	10	-	-	-

QL = Quantification limit.
1. Represents effluent data from January 2004 to December 2006.
2. May not match approved QLs because data was collected prior to November 2007 when ODEQ revised applicable QLs.
3. Represents the lowest QL for the 7 congeners sampled (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, and Aroclor 1260).

Receiving Water Data

There are no upstream ambient data available for this facility.

Potential Impacts

Baseline Criteria

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Exhibits A-36 and A-37 summarize the RPA for baseline criteria for Outfalls 001 and 003 for those pollutants detected in the effluent (there will be no RP or monitoring requirements if all observations are nondetect). The Columbia River is a freshwater river; thus, human health criteria for consumption of organisms and water are applicable. The dilution factor is based on the edge of the regulatory mixing zone factor in the facility's permit. The Columbia River at river mile 105.5 is on the state's 303(d) as impaired for arsenic, DDE, dioxin, PCBs, and PAHs; thus, the facility would not receive dilution in the RP analysis for these pollutants.

Exhibit A-36. RPA for Baseline Criteria, Portland, Columbia Blvd WWTP, Outfall 001

Parameter	Calculated Effluent Conc.[1] (µg/L)	Ambient Conc.[2] (µg/L)	Conc. at Edge of Mixing Zone[3] (µg/L)	Human Health Criterion (µg/L)	Reasonable Potential
1,4-Dichlorobenzene	3.43	0	0.037	63	No
2,3,7,8-TCDD (Dioxin)	5.2E-06	0	5.2E-06	1.3E-08	**Yes**
Arsenic	0.76	0	0.76	0.0022	**Yes**
Bis(2-Ethylhexyl) Phthalate	5.30	0	0.058	1.20	No
Chloroform	3.04	0	0.033	0.19	No
Diethyl Phthalate	1.57	0	0.017	17000	No
Di-n-Butyl Phthalate	39.9	0	0.43	2000	No
Mercury[4]	0.072	0	0.00078	0.017	No
Nickel	93.4	0	1.01	13.4	No
Selenium	0.97	0	0.011	10	No
Toluene	4.50	0	0.049	1300	No

1. Represents the calculated geometric mean concentration for carcinogens and the calculated maximum concentration for noncarcinogens based on a CV of 0.6 for all pollutants except for arsenic (CV = 0.35), bis(2-ethylhexyl) phthalate (CV = 0.47), chloroform (CV = 0.29), mercury (CV = 0.82), nickel (CV = 1.79), and selenium (CV = 0.25) (see Section 3.2).
2. Represents the geometric mean of detected values and zero if data are not available or if all values are nondetect.
3. Dilution based on mixing zone dilution factor in existing permit (factor = 92).
4. Potential water column criteria based on the revised fish tissue criteria, calculated using EPA default BAFs, trophic level consumption percentages, and water column translator (see Section 4).

Exhibit A-37. RPA for Baseline Criteria, Portland, Columbia Blvd WWTP, Outfall 003

Parameter	Calculated Effluent Conc.[1] (µg/L)	Ambient Conc.[2] (µg/L)	Conc. at Edge of Mixing Zone[3] (µg/L)	Human Health Criterion (µg/L)	Reasonable Potential
1,4-Dichlorobenzene	18.7	0	0.20	63	No
Arsenic	1.43	0	1.43	0.0022	**Yes**
Bis(2-Ethylhexyl) Phthalate	25.3	0	0.28	1.20	No
Butylbenzyl Phthalate	11.6	0	0.13	1500	No
Chloroform	8.17	0	0.089	0.19	No
Diethyl Phthalate	9.56	0	0.10	17000	No
Di-n-Butyl Phthalate	5.37	0	0.058	2000	No
Ethylbenzene	6.96	0	0.076	1.4	No
Mercury[4]	0.50	0	0.0054	0.017	No
Nickel	449	0	4.88	13.4	No
Phenol	10.6	0	0.11	3500	No
Selenium	1.87	0	0.020	10	No
Tetrachloroethylene	8.52	0	0.093	0.69	No
Toluene	12.0	0	0.13	1300	No

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Exhibit A-37. RPA for Baseline Criteria, Portland, Columbia Blvd WWTP, Outfall 003

Parameter	Calculated Effluent Conc.[1] (µg/L)	Ambient Conc.[2] (µg/L)	Conc. at Edge of Mixing Zone[3] (µg/L)	Human Health Criterion (µg/L)	Reasonable Potential

1. Represents the calculated geometric mean concentration for carcinogens and the calculated maximum concentration for noncarcinogens based on a CV of 0.6 for all pollutants except for arsenic (CV = 0.43), mercury (CV = 1.10), and nickel (CV = 3.45) (see Section 3.2).
2. Represents the geometric mean of detected values and zero if data are not available or if all values are nondetect.
3. Dilution based on mixing zone dilution factor in existing permit (factor = 92).
4. Potential water column criteria based on the revised fish tissue criteria, calculated using EPA default BAFs, trophic level consumption percentages, and water column translator (see Section 4).

As shown in the exhibits, the facility has RP to exceed the baseline criterion for arsenic at both outfalls, and dioxin at Outfall 001 because the concentration at the edge of the regulatory mixing zone is greater than the applicable existing human health criterion. The Columbia River is also on the state's 303(d) list as impaired for arsenic, and EPA completed a TMDL for dioxin in 1991.

Arsenic

Because of the 303(d) listing, the discharger would have to comply with criteria end-of-pipe (i.e., no dilution) and a waste load allocation under a future TMDL for the Columbia River. If ODEQ determines that ambient background levels represent natural conditions, it may not require the facility to reduce discharge concentrations. However, if the facility is discharging above background concentrations or ODEQ determines that the river must meet the applicable criterion, it may require the facility to reduce effluent arsenic levels for compliance with effluent limits or load allocations under the TMDL.

Arsenic and arsenic-containing chemicals are not used in wastewater treatment. The facility has a large industrial base and regulates 80 significant industrial users and 89 other industrial dischargers to the treatment system. If the facility determines that one or more of its indirect dischargers is causing or contributing to high arsenic levels in the effluent, it would most likely implement a source control program to target the dischargers or impose more stringent pretreatment limits on the dischargers. Without specific information on the types of industrial dischargers that may need controls, it is not possible to estimate pretreatment or P2 costs to indirect dischargers.

The City's primary drinking water source is the Bull Run Watershed; the City also uses groundwater as a supplemental water supply. The City's 2007 water quality report indicates that arsenic was detected in drinking water at 3 µg/L due to the erosion of natural deposits in groundwater aquifers (PWB, 2007). Thus, it is possible that drinking water is contributing to high arsenic levels in the wastewater effluent. In this case, it is likely that the facility would pursue a variance or request that ODEQ consider granting the facility intake credits.

I&I could also be a problem for the City's sewer system. If the facility determines that groundwater infiltration is causing or contributing to the high arsenic effluent levels, the facility may have to implement an I&I reduction program for compliance with the existing criteria.

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There would be no compliance costs associated with an intake credit scenario. The one-time cost associated with pursuing a variance could range from $35,000 to $300,000, with minimal costs associated with renewal. If the arsenic effluent levels are the result of infiltration of arsenic-contaminated groundwater, total costs could be $113,200,000 for an I&I reduction program that includes source identification and pipe rehabilitation for a system with 2,256 miles of sewer pipes (approximately $10,682,000 per year annualized at 7% over 20 years). Note that if groundwater infiltration is not the only source of arsenic to the treatment plant, an I&I reduction program alone may not be sufficient for compliance and the discharger would not likely undertake such a program for compliance with toxic criteria alone.

Dioxin

EPA's 1991 Dioxin TMDL for the Columbia, Snake, and Willamette Rivers does not include wasteload allocations for municipal wastewater treatment facilities (EPA only allocated loads to pulp mills). In addition, the facility's existing permit does not contain an effluent limit for dioxin, only a quarterly dioxin monitoring requirement. Thus, it is unlikely that the facility would install end-of-pipe treatment controls to reduce effluent dioxin levels to the criterion. The facility would either pursue a variance or site-specific criterion. One-time costs of associated with a variance could range from $35,000 to $300,000. However, if the discharger pursues a variance for arsenic, costs to include dioxin in the variance application/analysis for arsenic would be minimal. As part of the variance, ODEQ could require the facility to implement a P2 program to determine if the dioxin is the result of existing indirect dischargers or residual from prior industrial uses. Costs of a P2 program for dioxin could be approximately $50,000 per year.

Revised Criteria

Exhibits A-38 and A-39 summarize the RPA for the revised human health criteria for consumption of water and organisms for Outfalls 001 and 003 for those pollutants detected in the effluent (there will be no RP or monitoring requirements if all observations are nondetect).

Exhibit A-38. RPA for Revised Criteria, Portland, Columbia Blvd WWTP, Outfall 001

Parameter	Conc. at Edge of Mixing Zone[1] (µg/L)	Human Health Criteria at Alternative FCRs (µg/L)				
		63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
1,4-Dichlorobenzene	0.037	34	23	16	7.9	5.1
2,3,7,8-TCDD (Dioxin)	5.2E-06	**1.4E-09***	**7.9E-10***	**5.1E-10***	**2.3E-10***	**1.4E-10***
Arsenic	0.76	**0.0083***	**0.0057***	**0.0041***	**0.0021***	**0.0014***
Bis(2-Ethylhexyl) Phthalate	0.058	0.49	0.30	0.20	0.095	0.061
Chloroform	0.033	5.10	4.70	4.30	3.30	2.70
Diethyl Phthalate	0.017	8,500	5,500	3,800	1,800	1,200
Di-n-Butyl Phthalate	0.43	920	580	400	190	120
Mercury[2]	0.00078	0.0047	0.0026	0.0017	**0.00076***	**0.00048***
Nickel	1.01	280	190	140	69.0	45.0
Selenium	0.011	150	140	120	91.0	70.0
Toluene	0.049	1,000	870	720	450	320

*Bolded values represent RP equal to "Yes."
FCRs = Fish consumption rates.
1. Dilution based on mixing zone dilution factor in existing permit (factor = 92).

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Exhibit A-38. RPA for Revised Criteria, Portland, Columbia Blvd WWTP, Outfall 001

Parameter	Conc. at Edge of Mixing Zone[1] (µg/L)	Human Health Criteria at Alternative FCRs (µg/L)				
		63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd

2. Potential water column criteria based on the revised fish tissue criteria, calculated using EPA default BAFs, trophic level consumption percentages, and water column translator (see Section 4).

Exhibit A-39. RPA for Revised Criteria, Portland, Columbia Blvd WWTP, Outfall 003

Parameter	Conc. at Edge of Mixing Zone[1] (µg/L)	Human Health Criteria at Alternative FCRs (µg/L)				
		63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
1,4-Dichlorobenzene	0.20	34.0	23.0	16.0	7.90	5.10
Arsenic	1.43	**0.0083***	**0.0057***	**0.0041***	**0.0021***	**0.0014***
Bis(2-Ethylhexyl) Phthalate	0.28	0.49	0.30	**0.20***	**0.095***	**0.061***
Butylbenzyl Phthalate	0.13	500	290	190	86.0	54.0
Chloroform	0.089	5.10	4.70	4.30	3.30	2.70
Diethyl Phthalate	0.10	8500	5500	3800	1800	1200
Di-n-Butyl Phthalate	0.058	920	580	400	190	120
Ethylbenzene	0.076	1600	1100	820	420	280
Mercury[2]	0.0054	**0.0047***	**0.0026***	**0.0017***	**0.00076***	**0.00048***
Nickel	4.88	280	190	140	69.0	45.0
Phenol	0.11	20000	19000	19000	17000	15000
Selenium	0.020	150	140	120	91.0	72.0
Tetrachloroethylene	0.093	0.45	0.32	0.24	0.13	**0.084***
Toluene	0.13	1000	870	720	450	320

*Bolded values represent RP equal to "Yes."
FCRs = Fish consumption rates.
1. Dilution based on mixing zone dilution factor in existing permit (factor = 92).
2. Potential water column criteria based on the revised fish tissue criteria, calculated using EPA default BAFs, trophic level consumption percentages, and water column translator (see Section 4).

As shown in the exhibits, the discharger would have RP for arsenic, dioxin, and mercury in Outfall 001, and arsenic, bis(2-ethylhexyl) phthalate, mercury, and tetrachloroethylene in Outfall 003.

Arsenic

The discharger would have RP for arsenic at all fish consumption rates for both outfalls. Thus, because the criteria apply end of pipe (i.e., no dilution because the water body is listed as impaired), the discharger would need to reduce discharge concentrations to background (if ODEQ determines that ambient concentrations represent natural levels) or the approved QL of 0.05 µg/L (because the criterion is below the QL) for compliance with revised standards. However, under the baseline, the discharge would need to meet those same levels. Thus, there would be no incremental compliance costs.

Dioxin

The discharger would have RP for dioxin at all fish consumption rates for Outfall 001. As described under the baseline criteria analysis, the discharger does not have a wasteload allocation under the existing TMDL nor does its existing permit contain an effluent limit for dioxin. Thus,

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under the baseline, the discharger would likely pursue a variance and possibly be required to implement a P2 program. Although the criteria become more stringent under the revised fish consumption rates, it is likely that the discharger would pursue the same actions as it would for compliance with baseline standards. Thus, incremental compliance costs are unlikely.

Bis(2-ethylhexyl) phthalate

The discharger would have RP for bis(2-ethylhexyl) phthalate at consumption rates of 175 gpd, 389 gpd, and 620 gpd for Outfall 003. **Exhibit A-40** shows the projected effluent limits for these consumption rates.

Exhibit A-40. Projected Effluent Limits for Bis(2-ethylhexyl) Phthalate, Portland, Columbia Blvd WWTP, Outfall 003

Limit Type	Fish Consumption Rate				
	63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
AMEL (µg/L)	NA	NA	18	8.7	5.6
MDEL (µg/L)	NA	NA	37	17	11

The maximum effluent bis(2-ethylhexyl) phthalate concentration in Outfall 003 is 24.8 µg/L, which is greater than the projected effluent limits for all the consumption rates. The facility has a large industrial base and regulates 80 significant industrial users and 89 other industrial dischargers to the treatment system. The high bis(2-ethylhexyl) phthalate levels in the effluent could be due to one or more of its indirect dischargers. Regulating these sources through a P2 program could reduce pollutant loadings to the necessary levels. High levels of bis(2-ethylhexyl) phthalate in municipal wastewater effluent can also be associated with sampling and/or laboratory analysis conditions (Fairfield-Suisun SD, 2003). If this is the case, cleaner sampling and analysis techniques could reduce the amount of bis(2-ethylhexyl) phthalate measured in the effluent. Thus, as described in Appendix B, costs for the discharger could be minimal if cleaner sampling techniques result in lower effluent concentrations to approximately $50,000 for a P2 program for bis(2-ethylhexyl) phthalate.

Mercury

The discharger would have RP for mercury at consumption rates of 113 gpd, 175 gpd, 389 gpd, and 620 gpd for Outfall 003 and 620 gpd for Outfall 001. **Exhibit A-41** shows the AMELs and MDELs for each consumption rate.

Exhibit A-41. Projected Effluent Limits for Mercury, Portland, Columbia Blvd WWTP

Limit Type	Fish Consumption Rate				
	63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
Outfall 001					
AMEL (µg/L)	NA	NA	NA	0.07	0.04
MDEL (µg/L)	NA	NA	NA	0.16	0.10
Outfall 003					
AMEL (µg/L)	0.43	0.24	0.16	0.07	0.04
MDEL (µg/L)	1.13	0.62	0.41	0.18	0.12

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The maximum effluent concentration in Outfall 001 is 0.075 µg/L which is greater than the projected limits. The maximum effluent concentration in Outfall 003 is 0.38 µg/L which is greater than the all of the projected limits except those based on a consumption rate of 63.2 gpd. Thus, the facility may need to implement controls to reduce effluent mercury concentrations for compliance with these limits. Since the projected effluent levels are in the range achievable by municipal wastewater treatment plants that have implemented P2, the facility would likely implement a P2 program for compliance with the projected effluent limits. Annual P2 program costs for a 100 mgd municipal facility may be approximately $150,000 (see Appendix B for details). As described in Appendix B, P2 costs also potentially include costs for indirect dischargers to implement controls (see Exhibit B-2). Based on information on the discharger's service area, incremental indirect discharger costs may be $120,000 per year (e.g., there may be as many as 10 universities in the service area).

Tetrachloroethylene

The discharger has RP for tetrachloroethylene at a fish consumption rate of 620 gpd. The projected AMEL would be 7.7 µg/L and the MDEL would be 15.5 µg/L. The maximum effluent concentration is 4.9 µg/L (only one detected value with remaining nondetects less than 2 µg/L), which is lower than both projected limits. Thus, the discharger would likely be in compliance with the revised criteria and would not incur any costs.

Summary

Exhibit A-42 provides a summary of the potential range in annual costs associated with the baseline and revised criteria. For the alternative fish consumption rates, the incremental costs represent the any costs above and beyond those that would be needed for compliance with baseline criteria. Under a variance scenario for dioxin and/or arsenic under the baseline scenario, one-time expenditure costs would range from approximately $35,000 to $300,000.

Exhibit A-42. Summary of Potential Costs, Portland, Columbia Blvd WWTP

Alternative	Compliance Scenario	Total Annual Costs	Incremental Annual Costs[1]
Baseline	• Intake credits, variance, or I&I reduction program (arsenic) • Variance with P2 program (dioxin)	$50,000 - $10,732,000	NA
63.2 gpd	• Intake credits, variance, or I&I reduction program (arsenic) • Variance with P2 program (dioxin)	$50,000 - $10,732,000	$0
113 gpd	• Intake credits, variance, or I&I reduction program (arsenic) • Variance with P2 program (dioxin) • P2 program (mercury)	$320,000 - $11,002,000	$270,000

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Exhibit A-42. Summary of Potential Costs, Portland, Columbia Blvd WWTP

Alternative	Compliance Scenario	Total Annual Costs	Incremental Annual Costs[1]
175 gpd	• Intake credits, variance, or I&I reduction program (arsenic) • Variance with P2 program (dioxin) • Cleaner sampling or P2 program [bis(2-ethylhexyl) phthalate] • P2 program (mercury)	$320,000 - $11,052,000	$270,000 - $320,000
389 gpd	• Intake credits, variance, or I&I reduction program (arsenic) • Variance with P2 program (dioxin) • Cleaner sampling or P2 program [bis(2-ethylhexyl) phthalate] • P2 program (mercury)	$320,000 - $11,052,000	$270,000 - $320,000
620 gpd	• Intake credits, variance, or I&I reduction program (arsenic) • Variance with P2 program (dioxin) • Cleaner sampling or P2 program [bis(2-ethylhexyl) phthalate] • P2 program (mercury)	$320,000 - $11,052,000	$270,000 - $320,000

NA = Not applicable.

1. Annual costs for baseline criteria represent the costs needed for compliance under existing conditions; costs for revised criteria represent the difference between total annual cost and baseline costs (i.e., incremental costs above and beyond those needed for compliance with baseline criteria).

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Rock Creek Advanced Wastewater Treatment Facility

Facility Description

The Rock Creek Advanced Wastewater Treatment Facility (NPDES permit number OR0029777) is located in Hillsboro, Oregon. The plant treats residential, commercial, and light industrial wastewater; wet industry flow, consisting of dilute, high volume wastewater received from local industries year-round from the service area; and sludge, carrier water, and seasonal influent wastewater transfers from the Forest Grove and Hillsboro-Westside WWTPs. The facility is covered under a single watershed-based, integrated municipal permit covering all three other facilities, an MS4, and two industrial storm water permits. The ADWDF for the Rock Creek Wastewater Treatment Plant is 39 mgd. ODEQ classifies the facility as a major discharger. The facility discharges all treated effluent into the Tualatin River at river mile 38. The facility has two other outfalls classified as wet weather outfalls.

Treatment Processes

The 2005 NPDES permit for the facility lists the major treatment processes as headworks, primary clarifiers, activated sludge, effluent filters, and digester complex. The facility thickens primary solids and returns activated sludge prior to anaerobic digestion. The facility dewaters digested biosolids and sends them to land application sites in either the Willamette Valley or the Madison Ranch in eastern Oregon.

Effluent Data and Limits

Exhibit A-43 summarizes monitoring data from February 2004 to March 2007 for those pollutants of concern for which effluent data are available. The facility does not have effluent limits for any toxic pollutants.

Exhibit A-43. Effluent Data Summary, Rock Creek WWTP[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
1,1,2,2-Tetrachloroethane	4	4	5	-	-	-
1,1,2-Trichloroethane	4	4	5	-	-	-
1,2,4-Trichlorobenzene	4	4	11	-	-	-
1,2-Dichlorobenzene	4	4	11	-	-	-
1,2-Dichloroethane	4	4	5	-	-	-
1,2-Dichloropropane	4	4	5	-	-	-
1,2-Diphenylhydrazine	4	4	11	-	-	-
1,3-Dichlorobenzene	4	4	11	-	-	-
1,4-Dichlorobenzene	4	4	11	-	-	-
2,4,6-Trichlorophenol	4	4	11	-	-	-
2,4-Dichlorophenol	4	4	11	-	-	-
2,4-Dimethylphenol	4	4	11	-	-	-
2,4-Dinitrophenol	4	4	27	-	-	-
2,4-Dinitrotoluene	4	4	11	-	-	-

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Exhibit A-43. Effluent Data Summary, Rock Creek WWTP[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
2-Chloronaphthalene	4	4	11	-	-	-
2-Chlorophenol	4	4	11	-	-	-
2-Methyl-4,6-Dinitrophenol	4	4	27	-	-	-
3,3'-Dichlorobenzidine	4	4	27	-	-	-
4,4'-DDD	4	4	0.11	-	-	-
4,4'-DDE	4	4	0.11	-	-	-
4,4'-DDT	4	4	0.11	-	-	-
Acenaphthene	4	4	11	-	-	-
Acrolein	4	4	50	-	-	-
Acrylonitrile	4	4	10	-	-	-
Aldrin	4	4	0.11	-	-	-
alpha-BHC	4	4	0.11	-	-	-
Anthracene	4	4	11	-	-	-
Antimony	42	7	0.2	0.46	0.30	0.11
Arsenic	42	42	4	-	-	-
Benzene	4	4	5	-	-	-
Benzidine	4	4	53	-	-	-
Benzo(a) Anthracene	4	4	11	-	-	-
Benzo(a) Pyrene	4	4	11	-	-	-
Benzo(b) Fluoranthene	4	4	11	-	-	-
Benzo(k) Fluoranthene	4	4	11	-	-	-
Beryllium	42	42	0.16	-	-	-
beta-BHC	4	4	0.16	-	-	-
Bis(2-Chloroethyl) Ether	4	4	11	-	-	-
Bis(2-Chloroisopropyl) Ether	4	4	11	-	-	-
Bis(2-Ethylhexyl) Phthalate	4	4	11	-	-	-
Bromoform	4	4	5	-	-	-
Butylbenzyl Phthalate	4	4	11	-	-	-
Carbon Tetrachloride	4	4	5	-	-	-
Chlordane	4	4	2.1	-	-	-
Chlorobenzene	4	4	5	-	-	-
Chloroform	4	4	5	-	-	-
Chrysene	4	4	11	-	-	-
Dibenzo(a,h)Anthracene	4	4	11	-	-	-
Dieldrin	4	4	0.11	-	-	-
Diethyl Phthalate	4	4	11	-	-	-
Dimethyl Phthalate	4	4	11	-	-	-
Di-n-butyl Phthalate	4	4	11	-	-	-
Endosulfan Sulfate	4	4	0.11	-	-	-
Endrin	4	4	0.11	-	-	-
Endrin Aldehyde	4	4	0.11	-	-	-
Ethylbenzene	4	4	5	-	-	-
Fluoranthene	4	4	11	-	-	-
Fluorene	4	4	11	-	-	-

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Exhibit A-43. Effluent Data Summary, Rock Creek WWTP[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
Gamma-BHC	4	4	0.01	-	-	-
Heptachlor	4	4	0.11	-	-	-
Heptachlor Epoxide	4	4	0.11	-	-	-
Hexachlorobenzene	4	4	11	-	-	-
Hexachlorobutadiene	4	4	11	-	-	-
Hexachlorocyclopentadiene	4	4	11	-	-	-
Hexachloroethane	4	4	11	-	-	-
Ideno(1,2,3-cd)Pyrene	4	4	11	-	-	-
Isophorone	4	4	11	-	-	-
Mercury	28	1	0.0005	0.0051	0.002	0.0006
Methylene Chloride	4	4	5	-	-	-
Nickel	42	0	0	5.42	2.96	1.63
Nitrobenzene	4	4	11	-	-	-
N-Nitrosodimethylamine	4	4	27	-	-	-
N-Nitrosodi-n-Propylamine	8	8	11	-	-	-
PCBs[3]	4	4	1.2	-	-	-
Pentachlorophenol	4	4	27	-	-	-
Phenol	4	4	11	-	-	-
Pyrene	4	4	11	-	-	-
Selenium	0	0	0	-	-	-
Thallium	42	42	0.04	-	-	-
Toluene	4	4	5	-	-	-
Vinyl Chloride	4	4	5	-	-	-

QL = Quantification limit.
1. Represents effluent data from February 2004 to March 2007.
2. May not match approved QLs because data was collected prior to November 2007 when ODEQ revised applicable QLs.
3. Represents the lowest QL for the 7 congeners sampled (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, and Aroclor 1260).

Receiving Water Data

Exhibit A-44 summarizes ambient data 0.44 miles upstream of the facility (at Rood Bridge) from May 2004 to April 2007 for those pollutants of concern for which ambient data are available.

Exhibit A-44. Ambient Data Summary, Rock Creek WWTP[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL (µg/L)	Maximum	Geometric Mean	Minimum
1,1,2,2-Tetrachloroethane	3	3	5	-	-	-
1,1,2-Trichloroethane	3	3	5	-	-	-
1,2,4-Trichlorobenzene	2	2	12	-	-	-
1,2-Dichlorobenzene	3	3	12	-	-	-
1,2-Dichloroethane	3	3	5	-	-	-
1,2-Dichloropropane	3	3	5	-	-	-

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Exhibit A-44. Ambient Data Summary, Rock Creek WWTP[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL (µg/L)	Maximum	Geometric Mean	Minimum
1,2-Diphenylhydrazine	2	2	12	-	-	-
1,3-Dichlorobenzene	3	3	12	-	-	-
1,4-Dichlorobenzene	3	3	12	-	-	-
2,4,6-Trichlorophenol	2	2	12	-	-	-
2,4-Dichlorophenol	2	2	12	-	-	-
2,4-Dimethylphenol	2	2	12	-	-	-
2,4-Dinitrophenol	2	2	28	-	-	-
2,4-Dinitrotoluene	2	2	12	-	-	-
2-Chloronaphthalene	2	2	12	-	-	-
2-Chlorophenol	2	2	12	-	-	-
2-Methyl-4,6-Dinitrophenol	2	2	28	-	-	-
3,3'-Dichlorobenzidine	2	2	28	-	-	-
4,4'-DDD	3	3	0.012	-	-	-
4,4'-DDE	3	3	0.012	-	-	-
4,4'-DDT	3	3	0.012	-	-	-
Acenaphthene	2	2	12	-	-	-
Acrolein	3	3	50	-	-	-
Acrylonitrile	3	3	10	-	-	-
Aldrin	3	3	0.012	-	-	-
alpha-BHC	3	3	0.012	-	-	-
Anthracene	2	2	12	-	-	-
Antimony	33	33	0.102	-	-	-
Arsenic	34	34	2.04	-	-	-
Benzene	3	3	5	-	-	-
Benzidine	2	2	56	-	-	-
Benzo(a) Anthracene	2	2	12	-	-	-
Benzo(a) Pyrene	2	2	12	-	-	-
Benzo(b) Fluoranthene	2	2	12	-	-	-
Benzo(k) Fluoranthene	2	2	12	-	-	-
Beryllium	34	34	0.0808	-	-	-
beta-BHC	3	3	0.017	-	-	-
Bis(2-Chloroethyl) Ether	2	2	12	-	-	-
Bis(2-Chloroisopropyl) Ether	2	2	12	-	-	-
Bis(2-Ethylhexyl) Phthalate	2	2	12	-	-	-
Bromoform	3	3	5	-	-	-
Butylbenzyl Phthalate	2	2	12	-	-	-
Carbon Tetrachloride	3	3	5	-	-	-
Chlordane	3	3	0.23	-	-	-
Chlorobenzene	3	3	5	-	-	-
Chloroform	3	3	5	-	-	-
Chrysene	2	2	12	-	-	-
Dibenzo(a,h)Anthracene	2	2	12	-	-	-
Dieldrin	3	3	0.012	-	-	-
Diethyl Phthalate	2	2	12	-	-	-

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Exhibit A-44. Ambient Data Summary, Rock Creek WWTP[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL (µg/L)	Maximum	Geometric Mean	Minimum
Dimethyl Phthalate	2	2	12	-	-	-
Di-n-butyl Phthalate	2	2	12	-	-	-
Endosulfan Sulfate	3	3	0.012	-	-	-
Endrin	3	3	0.012	-	-	-
Endrin Aldehyde	3	3	0.012	-	-	-
Ethylbenzene	3	3	5	-	-	-
Fluoranthene	2	2	12	-	-	-
Fluorene	2	2	12	-	-	-
Heptachlor	3	3	0.012	-	-	-
Heptachlor Epoxide	3	3	0.012	-	-	-
Hexachlorobenzene	2	2	12	-	-	-
Hexachlorobutadiene	2	2	12	-	-	-
Hexachlorocyclopentadiene	2	2	12	-	-	-
Hexachloroethane	2	2	12	-	-	-
Ideno(1,2,3-cd)Pyrene	2	2	12	-	-	-
Isophorone	2	2	12	-	-	-
Methylene Chloride	3	3	5	-	-	-
Nickel	34	0	0	1.09	0.57	0.35
Nitrobenzene	2	2	12	-	-	-
N-Nitrosodimethylamine	2	2	28	-	-	-
N-Nitrosodi-n-Propylamine	2	2	12	-	-	-
PCBs	3	3	1.2	-	-	-
Pentachlorophenol	2	2	28	-	-	-
Phenol	2	2	12	-	-	-
Pyrene	2	2	12	-	-	-
Selenium	33	31	0.509	0.56	0.53	0.51
Thallium	34	34	0.0204	-	-	-
Toluene	3	3	5	-	-	-
Vinyl Chloride	3	3	5	-	-	-

QL = Quantification limit.
1. Represents ambient data from May 2004 to April 2007.

Potential Impacts

Baseline Criteria

Exhibit A-45 summarizes the RPA for baseline criteria for those pollutants detected in the effluent (there will be no RP or monitoring requirements if all observations are nondetect). The Tualatin River is a freshwater river; thus, human health criteria for consumption of organisms and water are applicable. The dilution factors are based ODEQ estimates of dilution at critical conditions. Fish tissue monitoring data for the Tualatin River at Boones Ferry Road from 1997, about 20 miles downstream from the facility, indicate that mercury tissue concentrations range from 0.11 to 0.74 mg/kg (wet weight). Thus, to be conservative (i.e., err on the side of overestimating costs), we assumed that the facility would not receive dilution for mercury.

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Exhibit A-45. RPA for Baseline Criteria, Rock Creek AWTF

Parameter	Calculated Effluent Conc.[1] (µg/L)	Ambient Conc.[2] (µg/L)	Conc. at Edge of Mixing Zone[3] (µg/L)	Human Health Criterion (µg/L)	Reasonable Potential
Antimony	0.48	0	0.24	5.6	No
Mercury[4]	0.0058	0	0.0058	0.017	No
Nickel	5.68	0.57	3.13	13.4	No

1. Represents the calculated geometric mean concentration for carcinogens and the calculated maximum concentration for noncarcinogens based on a CV of 0.23 for antimony, 0.46 for mercury, and 0.30 for nickel (see Section 3.2).
2. Represents the geometric mean of detected values and zero if data are not available or if all values are nondetect.
3. Dilution based on mixing zone dilution factor in existing RPA spreadsheet (factor = 2).
2. Potential water column criteria based on the revised fish tissue criteria, calculated using EPA default BAFs, trophic level consumption percentages, and water column translator (see Section 4).

The discharger does not have RP for any of the pollutants for which there are detected concentrations.

Under the baseline Willamette River Basin mercury TMDL, the facility would be required to develop and implement a mercury reduction strategy. Annual P2 program costs for a 39 mgd municipal facility may be approximately $150,000 (see Appendix B for details). As described in Appendix B, P2 costs also potentially include costs for indirect dischargers to implement controls (see Exhibit B-2). Based on information on the discharger's service area, incremental indirect discharger costs may be minimal (e.g., there are no universities in the service area). However, because ODEQ does not assign individual wasteload allocations to point source dischargers in the TMDL (point sources as a whole are required to reduce existing load by 26%), it is uncertain whether the facility would incur costs beyond those for a P2 program to meet the wasteload allocation under the baseline TMDL.

Revised Criteria

Exhibit A-46 summarizes the RPA for the revised human health criteria for consumption of water and organisms for those pollutants detected in the effluent (there will be no RP or monitoring requirements if all observations are nondetect).

Exhibit A-46. RPA for Revised Criteria, Rock Creek AWTF

Parameter	Conc. at Edge of Mixing Zone[1] (µg/L)	Human Health Criteria at Alternative FCRs (µg/L)				
		63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
Antimony	0.24	5.40	5.30	5.10	4.70	4.30
Mercury[2]	0.0058	**0.0047***	**0.0026***	**0.0017***	**0.00076***	**0.00048***
Nickel	3.13	280	190	140	69.0	45.0

*Bolded values represent RP equal to "Yes."
FCRs = Fish consumption rates.
1. Dilution based on mixing zone dilution factor in existing RPA spreadsheet (factor = 2).
2. Potential water column criteria based on the revised fish tissue criteria, calculated using EPA default BAFs, trophic level consumption percentages, and water column translator (see Section 4).

As shown in the exhibit, the discharger would have RP for mercury at all alternative fish consumption rates, and would have to comply with effluent limits that represent criteria end-of-

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pipe. The facility is already required to implement a mercury P2 program under the baseline as part of the Willamette Basin mercury TMDL. It is not clear how ODEQ would adapt the baseline TMDL to attain the revised criteria (e.g., increase point source load reduction requirements; establish individual effluent limits). Thus, it is uncertain whether continued implementation of the baseline P2 program would be sufficient for compliance with the revised criteria/TMDL because there could be some maximum level of effort beyond which a P2 program would not provide additional reductions.

Because there are no proven end-of-pipe treatment technologies that can achieve low mercury levels (e.g., <10 ng/L) on a consistent basis, dischargers may need to pursue a variance (e.g., based on manmade conditions that cannot be remedied) under more stringent TMDL requirements (alternatively, ODEQ may account for this situation in allocating loads under the TMDL). However, it is uncertain for which consumption rates the discharger would need a variance. One-time costs associated with pursuing a variance could range from $35,000 to $300,000. As part of a variance ODEQ, could require specific P2 program efforts. For dischargers covered under the Willamette River TMDL for mercury, these activities may already be included in their baseline mercury P2 requirement.

Summary

Exhibit A-47 provides a summary of the potential range in annual costs associated with the baseline and revised criteria. For the alternative fish consumption rates, the incremental costs represent any costs above and beyond those that would be needed for compliance with baseline criteria. Under a variance scenario for mercury under the alternative fish consumption rates, incremental costs could include a one-time expenditure of $35,000 to $300,000.

Exhibit A-47. Summary of Potential Costs, Rock Creek AWTF

Alternative	Compliance Scenario	Total Annual Costs	Incremental Annual Costs[1]
Baseline	• P2 program (mercury)	$150,000	NA
63.2 gpd	• P2 program, possible variance (mercury)	$150,000	$0
113 gpd	• P2 program, possible variance (mercury)	$150,000	$0
175 gpd	• P2 program, possible variance (mercury)	$150,000	$0
389 gpd	• P2 program, possible variance (mercury)	$150,000	$0
620 gpd	• P2 program, possible variance (mercury)	$150,000	$0

NA = Not applicable.

1. Annual costs for baseline criteria represent the costs needed for compliance under existing conditions; costs for revised criteria represent the difference between total annual cost and baseline costs (i.e., incremental costs above and beyond those needed for compliance with baseline criteria).

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City of Salem Willow Lake Wastewater Treatment Plant

Facility Description

The City of Salem, Willow Lake Wastewater Treatment Plant (NPDES permit number OR0026409) treats domestic, commercial, and industrial wastewater from the Salem/Keizer area. The service population is approximately 210,000. The treatment plant is composed of two distinct sets of facilities, referred to as the north plant and the south plant; the two plants can be run in series or parallel. ODEQ classifies this 35 mgd (ADWDF) facility as a major discharger. The facility discharges effluent through a 72-inch outfall to the Willamette River at river mile 78.4.

Treatment Processes

The 2004 NPDES permit for the facility lists current treatment processes at the north plant as headworks, two primary center-feed circular clarifiers, four rock media trickling filters, and a circular center-feed secondary clarifier and chlorine contact tank. The south plant has two primary clarifiers, a pure-oxygen activated sludge process, four secondary clarifiers, a chlorine contact chamber, an additional gravity thickener, and four anaerobic digesters. The facility loads dewatered biosolids, at approximately 19% total solids, into dump trucks for hauling to application sites.

The facility is currently being expanded to treat an additional capacity of 100 mgd. The expansion includes four new circular primary clarifiers, two new gravity thickeners for thickening primary sludge, expanded WAS thickening and biosolids dewatering facility, permanent chlorination and dechlorination facilities, an additional pass on the existing chlorine contact basin, and a new parallel outfall and diffuser structure. These expansions are scheduled to be completed in 2009.

Effluent Data and Limits

Exhibit A-48 summarizes monitoring data from July 2001 to June 2007 for those pollutants of concern for which effluent data are available. The facility does not have effluent limits for any toxic pollutants.

Exhibit A-48. Effluent Data Summary, Salem Willow Lake WWTP[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
1,1,2,2-Tetrachloroethane	2	2	1	-	-	-
1,1,2-Trichloroethane	2	2	1	-	-	-
1,1-Dichloroethylene	2	2	1	-	-	-
1,2,4-Trichlorobenzene	3	3	4.76	-	-	-
1,2-Dichlorobenzene	2	2	1	-	-	-
1,2-Dichloroethane	2	2	1	-	-	-
1,2-Dichloropropane	2	2	1	-	-	-

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Exhibit A-48. Effluent Data Summary, Salem Willow Lake WWTP[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
1,2-Diphenylhydrazine	1	1	4.76	-	-	-
1,2-Trans-Dichloroethylene	2	2	1	-	-	-
1,3-Dichlorobenzene	2	2	1	-	-	-
1,4-Dichlorobenzene	2	1	1	0.56	0.56	0.56
2,4,6-Trichlorophenol	2	2	4.76	-	-	-
2,4-Dichlorophenol	1	1	1.1	-	-	-
2,4-Dimethylphenol	2	2	9.52	-	-	-
2,4-Dinitrophenol	2	2	23.8	-	-	-
2,4-Dinitrotoluene	2	2	4.76	-	-	-
2-Chloronaphthalene	2	2	4.76	-	-	-
2-Chlorophenol	2	2	4.76	-	-	-
2-Methyl-4,6-Dinitrophenol	2	2	9.52	-	-	-
3,3'-Dichlorobenzidine	2	2	4.76	-	-	-
4,4'-DDD	2	2	0.0952	-	-	-
4,4'-DDE	2	2	0.0952	-	-	-
4,4'-DDT	2	2	0.0952	-	-	-
Acenaphthene	2	2	4.76	-	-	-
Acrolein	2	2	10	-	-	-
Acrylonitrile	2	2	6	-	-	-
Aldrin	2	2	0.0952	-	-	-
alpha-BHC	2	2	0.0952	-	-	-
Anthracene	2	2	4.76	-	-	-
Arsenic	38	3	2	11	4.47	1.34
Benzene	2	2	1	-	-	-
Benzidine	2	2	57.1	-	-	-
Benzo(a) Anthracene	2	2	4.76	-	-	-
Benzo(a) Pyrene	2	2	4.76	-	-	-
Benzo(b) Fluoranthene	2	2	4.76	-	-	-
Benzo(k) Fluoranthene	2	2	4.76	-	-	-
Beryllium	1	1	1	-	-	-
beta-BHC	2	2	0.0952	-	-	-
Bis(2-Chloroethyl) Ether	2	2	4.76	-	-	-
Bis(2-Chloroisopropyl) Ether	2	2	9.52	-	-	-
Bis(2-Ethylhexyl) Phthalate	2	1	9.52	13	13	13
Bromoform	2	2	1	-	-	-
Butylbenzyl Phthalate	2	2	4.76	-	-	-
Carbon Tetrachloride	2	2	1	-	-	-
Chlordane	2	2	4.76	-	-	-
Chlorobenzene	2	2	1	-	-	-
Chlorodibromomethane	1	1	0.26	-	-	-
Chloroform	2	2	1	-	-	-
Chrysene	2	2	4.76	-	-	-
Dibenzo(a,h)Anthracene	2	2	4.76	-	-	-
Dichlorobromomethane	1	1	1	-	-	-

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Exhibit A-48. Effluent Data Summary, Salem Willow Lake WWTP[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
Dieldrin	2	2	0.0952	-	-	-
Diethyl Phthalate	2	2	4.76	-	-	-
Dimethyl Phthalate	2	2	4.76	-	-	-
Di-n-Butyl Phthalate	2	2	4.76	-	-	-
Endosulfan Sulfate	2	2	0.0952	-	-	-
Endrin	2	2	0.0952	-	-	-
Endrin Aldehyde	2	2	0.0952	-	-	-
Ethylbenzene	2	2	1	-	-	-
Fluoranthene	2	2	4.76	-	-	-
Fluorene	2	2	4.76	-	-	-
Gamma-BHC	2	2	0.021	-	-	-
Heptachlor	2	2	0.0952	-	-	-
Heptachlor Epoxide	2	2	0.0952	-	-	-
Hexachlorobenzene	2	2	4.76	-	-	-
Hexachlorobutadiene	2	2	9.52	-	-	-
Hexachlorocyclopentadiene	2	2	9.52	-	-	-
Hexachloroethane	2	2	9.52	-	-	-
Ideno(1,2,3-cd)Pyrene	1	1	4.76	-	-	-
Ideno(1,2,3-cd)pyrene	1	1	0.85	-	-	-
Isophorone	2	2	4.76	-	-	-
Mercury	37	21	0.01	0.07	0.015	0.01
Methylene Chloride	2	2	5	-	-	-
Nickel	1	1	2	-	-	-
Nitrobenzene	2	2	4.76	-	-	-
N-Nitrosodimethylamine	2	2	4.76	-	-	-
N-Nitrosodi-n-Propylamine	2	2	9.52	-	-	-
N-Nitrosodiphenylamine	2	2	4.76	-	-	-
PCBs[3]	2	2	0.476	-	-	-
Pentachlorophenol	2	2	9.52	-	-	-
Phenol	2	2	4.76	-	-	-
Pyrene	2	2	4.76	-	-	-
Selenium	1	1	2	-	-	-
Tetrachloroethylene	2	2	1	-	-	-
Thallium	1	1	1	-	-	-
Toluene	2	1	1	0.51	0.51	0.51
Toxaphene	2	2	4.76	-	-	-
Trichloroethylene	1	1	1	-	-	-
Vinyl Chloride	2	2	1	-	-	-

QL = Quantification limit.

1. Represents effluent data from July 2001 to June 2007.
2. May not match approved QLs because data was collected prior to November 2007 when ODEQ revised applicable QLs.
3. Represents the lowest QL for the 7 congeners sampled (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, and Aroclor 1260).

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Receiving Water Data

The harmonic mean receiving water flow for the Willamette River at river mile 84.16 (approximately 6 miles upstream from the facility) is 12,715 cfs, based on daily stream flow measurements from January 1990 through November 2007 from USGS. Using the same stream flow data and EPA's DFlow program, the 30Q5 flow is 6,040 cfs.

Exhibit A-49 summarizes data for the Willamette River at RM 78.4 from May 2006 to June 2007 for those pollutants of concern for which ambient data are available.

Exhibit A-49. Ambient Data Summary, Salem Willow Lake WWTP[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL (µg/L)	Maximum	Geometric Mean	Minimum
1,1,2,2-Tetrachloroethane	2	2	1	-	-	-
1,1,2-Trichloroethane	2	2	1	-	-	-
1,1-Dichloroethylene	2	2	1	-	-	-
1,2,4-Trichlorobenzene	3	3	4.85	-	-	-
1,2-Dichlorobenzene	3	3	1.4	-	-	-
1,2-Dichloroethane	2	2	1	-	-	-
1,2-Dichloropropane	2	2	1	-	-	-
1,2-Diphenylhydrazine	1	1	4.85	-	-	-
1,2-Trans-Dichloroethylene	2	2	1	-	-	-
1,3-Dichlorobenzene	3	3	1.4	-	-	-
1,4-Dichlorobenzene	3	3	1.4	-	-	-
2,4,6-Trichlorophenol	2	2	4.85	-	-	-
2,4-Dichlorophenol	1	1	1	-	-	-
2,4-Dimethylphenol	2	2	9.71	-	-	-
2,4-Dinitrophenol	2	2	24.3	-	-	-
2,4-Dinitrotoluene	2	2	4.85	-	-	-
2-Chloronaphthalene	2	2	4.85	-	-	-
2-Chlorophenol	2	2	4.85	-	-	-
2-Methyl-4,6-Dinitrophenol	2	2	9.71	-	-	-
3,3'-Dichlorobenzidine	2	2	4.85	-	-	-
4,4'-DDD	2	2	0.0971	-	-	-
4,4'-DDE	2	2	0.0971	-	-	-
4,4'-DDT	2	2	0.0971	-	-	-
Acenaphthene	2	2	4.85	-	-	-
Acrolein	2	2	10	-	-	-
Acrylonitrile	2	2	6	-	-	-
Aldrin	2	2	0.0971	-	-	-
alpha-BHC	2	2	0.0971	-	-	-
Anthracene	2	2	4.85	-	-	-
Arsenic	1	1	1	-	-	-
Benzene	2	2	1	-	-	-
Benzidine	2	2	58.3	-	-	-
Benzo(a) Anthracene	2	2	4.85	-	-	-
Benzo(a) Pyrene	2	2	4.85	-	-	-

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Exhibit A-49. Ambient Data Summary, Salem Willow Lake WWTP[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL (µg/L)	Maximum	Geometric Mean	Minimum
Benzo(b) Fluoranthene	2	2	4.85	-	-	-
Benzo(k) Fluoranthene	2	2	4.85	-	-	-
Beryllium	1	1	1	-	-	-
beta-BHC	2	2	0.0971	-	-	-
Bis(2-Chloroethyl) Ether	2	2	4.85	-	-	-
Bis(2-Chloroisopropyl) Ether	2	2	9.71	-	-	-
Bis(2-Ethylhexyl) Phthalate	2	2	9.71	-	-	-
Bromoform	2	2	1	-	-	-
Butylbenzyl Phthalate	2	2	4.85	-	-	-
Carbon Tetrachloride	2	2	1	-	-	-
Chlordane	2	2	4.85	-	-	-
Chlorobenzene	2	2	1	-	-	-
Chloroform	2	2	1	-	-	-
Chrysene	2	2	4.85	-	-	-
Dibenzo(a,h)Anthracene	2	2	4.85	-	-	-
Dichlorobromomethane	2	2	1	-	-	-
Dieldrin	2	2	0.0971	-	-	-
Diethyl Phthalate	2	2	4.85	-	-	-
Dimethyl Phthalate	2	2	4.85	-	-	-
Di-n-Butyl Phthalate	2	2	4.85	-	-	-
Endosulfan Sulfate	2	2	0.0971	-	-	-
Endrin	2	2	0.0971	-	-	-
Endrin Aldehyde	2	2	0.0971	-	-	-
Ethylbenzene	2	2	1	-	-	-
Fluoranthene	2	2	4.85	-	-	-
Fluorene	2	2	4.85	-	-	-
Heptachlor	2	2	0.0971	-	-	-
Heptachlor Epoxide	2	2	0.0971	-	-	-
Hexachlorobenzene	2	2	4.85	-	-	-
Hexachlorobutadiene	2	2	9.71	-	-	-
Hexachlorocyclopentadiene	2	2	9.71	-	-	-
Hexachloroethane	2	2	9.71	-	-	-
Ideno(1,2,3-cd)Pyrene	2	2	4.85	-	-	-
Isophorone	2	2	4.85	-	-	-
Methylene Chloride	2	2	5	-	-	-
Nickel	1	1	2	-	-	-
Nitrobenzene	2	2	4.85	-	-	-
N-Nitrosodimethylamine	2	2	4.85	-	-	-
N-Nitrosodi-n-Propylamine	2	2	9.71	-	-	-
N-Nitrosodiphenylamine	2	2	4.85	-	-	-
PCBs	2	2	0.485	-	-	-
Pentachlorophenol	2	2	9.71	-	-	-
Phenol	2	2	4.85	-	-	-
Pyrene	2	2	4.85	-	-	-

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Exhibit A-49. Ambient Data Summary, Salem Willow Lake WWTP[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL (µg/L)	Maximum	Geometric Mean	Minimum
Selenium	1	1	2	-	-	-
Tetrachloroethylene	2	2	1	-	-	-
Thallium	1	1	1	-	-	-
Toluene	2	2	1	-	-	-
Toxaphene	2	2	4.85	-	-	-
Trichloroethylene	2	2	1	-	-	-
Vinyl Chloride	2	2	1	-	-	-

QL = Quantification limit.
1. Represents ambient data from May 2006 to June 2007.

Potential Impacts

Baseline Criteria

Exhibit A-50 summarizes the RPA for baseline criteria for those pollutants detected in the effluent (there will be no RP or monitoring requirements if all observations are nondetect). The Willamette River is a freshwater river; thus, human health criteria for consumption of organisms and water are applicable. ODEQ (2006b) allows 25% of the harmonic mean flow for dilution for carcinogens and 25% of the 30Q5 flow for dilution for noncarcinogens. The Willamette River at river mile 78.4 is on the state's 303(d) list for dioxin and mercury; thus, the facility would not receive dilution for these pollutants.

Exhibit A-50. RPA for Baseline Criteria, Salem Willow Lake WWTP

Parameter	Calculated Effluent Conc.[1] (µg/L)	Ambient Conc.[2] (µg/L)	Conc. at Edge of Mixing Zone[3] (µg/L)	Human Health Criterion (µg/L)	Reasonable Potential
1,4-Dichlorobenzene	2.12	0	0.074	63	No
Arsenic	4.91	0	0.082	0.0022	**Yes**
Bis(2-Ethylhexyl) Phthalate	49.3	0	0.82	1.2	No
Mercury[4]	0.082	0	0.082	0.017	**Yes**
Toluene	1.94	0	0.067	1300	No

1. Represents the calculated geometric mean concentration for carcinogens and the calculated maximum concentration for noncarcinogens based on a CV of 0.6 for all pollutants except arsenic (CV = 0.47) and mercury (CV = 0.81) (see Section 3.2).
2. Represents the geometric mean of detected values and zero if data are not available or if all values are nondetect.
3. Dilution based on 25% of 30Q5 flow for noncarcinogens (factor = 28.9) and 25% of harmonic mean flow for carcinogens (factor = 60).
4. Potential water column criteria based on the revised fish tissue criteria, calculated using EPA default BAFs, trophic level consumption percentages, and water column translator (see Section 4).

As shown in the exhibit, the facility has RP to exceed the baseline criterion for arsenic and mercury because the concentrations at the edge of the regulatory mixing zone are greater than the applicable existing human health criteria.

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Arsenic

Under existing conditions, the discharger would have to meet an AMEL of 0.026 µg/L and a MDEL of 0.047 µg/L for arsenic. However, because both limits are below the QL of 0.05 µg/L, the discharger would only be required to reduce discharge concentrations to the QL value for compliance with baseline standards.

Inorganic arsenic can enter surface waters through atmospheric deposition (e.g., arsenic released into the air by volcanoes), soil erosion and weathering of arsenic-containing minerals and ores, and commercial or industrial processes, such as metal smelting, wood preserving, and manufacturing of microelectronics and semiconductors (ODEQ, 2006a). Arsenic and arsenic-containing chemicals are not used in wastewater treatment. The facility's permit indicates that it has a total of 27 significant industrial users (SIUs) of which 8 are categorical industrial users (i.e., users subject to EPA's national pretreatment standards). The permit indicates that a significant portion of the facility's industrial load during a portion of the year is from fruit and vegetable packaging operations. If the fruits and vegetables are treated with arsenic-containing pesticides, then any wash water from the packaging operations could contribute to the high effluent arsenic levels. Thus, a source control program that targets the most likely indirect industrial dischargers of arsenic to the plant could reduce arsenic concentrations to the necessary levels. Costs for such a program would depend on the number of arsenic sources and the measures that could be implemented at those sources to reduce arsenic. Without specific information on the types of industrial dischargers that may need controls, it is not possible to estimate pretreatment or P2 costs to indirect dischargers.

The City's drinking water comes from the North Santiam River. Most arsenic samples (organic plus inorganic) from the water body since 1986 are nondetect below the minimum reporting levels, except for 2 detected observations in 1992 (4 µg/L) and 1987 (8 µg/L) (ODHS, 2007e). The minimum reporting levels are not specified, and the drinking water maximum contaminant level is 10 µg/L, which is higher than current effluent concentrations and human health criteria. Thus, from these data it is not possible to determine with any certainty if drinking water is contributing to high arsenic levels in the wastewater effluent. However, if the facility determines that drinking water is the source of high arsenic values in the wastewater, it is likely that the facility would pursue a variance or request that ODEQ consider granting the facility intake credits.

USGS (1998) indicates that arsenic concentrations exceeding EPA's previous maximum contaminant level of 50 µg/L are widespread in groundwater in the Willamette Basin. Infiltration of groundwater with such high levels of arsenic into to the wastewater system could result in increased effluent concentrations. If the facility determines that the source of arsenic in its effluent is groundwater infiltration, an I&I reduction program would likely be necessary for compliance with the existing arsenic criteria.

There would be no compliance costs associated with an intake credit scenario. The one-time cost associated with pursuing a variance could range from $35,000 to $300,000, with minimal costs associated with renewal. If the arsenic effluent levels are the result of infiltration of arsenic-contaminated groundwater, total costs could be $39,100,000 for an I&I reduction program that

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includes source identification and pipe rehabilitation for a sewer system with 780 miles of pipe (approximately $3,693,000 per year annualized at 7% over 20 years). Note that if groundwater infiltration is not the only source of arsenic to the treatment plant, an I&I reduction program alone may not be sufficient for compliance and the discharger would not likely undertake such a program for compliance with toxic criteria alone.

Mercury

Under existing conditions, the discharger would have to meet an AMEL of 0.017 µg/L and a MDEL of 0.039 µg/L for mercury. The maximum effluent concentration is 0.07 µg/L, which is greater than the projected limits. Thus, the facility may need to implement controls to reduce effluent mercury concentrations for compliance with these limits. Under the baseline Willamette River Basin mercury TMDL, the facility would be required to develop and implement a mercury reduction strategy. Annual P2 program costs for a 35 mgd municipal facility may be approximately $150,000 (see Appendix B for details). As described in Appendix B, P2 costs also potentially include costs for indirect dischargers to implement controls (see Exhibit B-2). Based on information on the discharger's service area, incremental indirect discharger costs may be $24,000 (e.g., there are 2 universities in the service area). However, because ODEQ does not assign individual wasteload allocations to point source dischargers in the TMDL (point sources as a whole are required to reduce existing load by 26%), it is uncertain whether the facility would incur costs beyond those for a P2 program to meet the wasteload allocation under the baseline TMDL.

Revised Criteria

Exhibit A-51 summarizes the RPA for the revised human health criteria for consumption of water and organisms for those pollutants detected in the effluent (there will be no RP or monitoring requirements if all observations are nondetect).

Exhibit A-51. RPA for Revised Criteria, Salem Willow Lake WWTP

Parameter	Conc. at Edge of Mixing Zone[1] (µg/L)	Human Health Criteria at Alternative FCRs (µg/L)				
		63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
1,4-Dichlorobenzene	0.074	34.0	23.0	16.0	7.90	5.10
Arsenic	0.082	**0.0083***	**0.0057***	**0.0041***	**0.0021***	**0.0014***
Bis(2-Ethylhexyl) Phthalate	0.82	**0.49***	**0.30***	**0.20***	**0.095***	**0.061***
Mercury[2]	0.082	**0.0047***	**0.0026***	**0.0017***	**0.00076***	**0.00048***
Toluene	0.067	1000	870	720	450	320

*Bolded values represent RP equal to "Yes."
FCRs = Fish consumption rates.
1. Dilution based on 25% of 30Q5 flow for noncarcinogens (factor = 28.9) and 25% of harmonic mean flow for carcinogens (factor = 60).
2. Potential water column criteria based on the revised fish tissue criteria, calculated using EPA default BAFs, trophic level consumption percentages, and water column translator (see Section 4).

As shown in the exhibit, the discharger would have RP for arsenic, bis(2-ethylhexyl) phthalate, and mercury.

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Arsenic

The facility would have RP for arsenic at all of the alternative consumption rates. **Exhibit A-52** shows the projected effluent limits for these consumption rates.

Exhibit A-52. Projected Effluent Limits for Arsenic, Salem Willow Lake WWTP

Limit Type	Fish Consumption Rate				
	63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
AMEL (µg/L)	0.10	0.068	0.049	0.025	0.017
MDEL (µg/L)	0.18	0.12	0.088	0.045	0.030

As described in the baseline analysis, the discharger may need to reduce effluent concentrations for compliance with baseline criteria, or pursue alternative compliance measures. These are the same compliance scenarios that would apply under all of the potential revised criteria. The baseline I&I reduction program includes a comprehensive study to identify all potential infiltration sources and rehabilitation of those sources. Thus, baseline controls, or alternative actions, should also enable compliance with the revised criteria, and there would be no incremental compliance costs.

Bis(2-ethylhexyl) phthalate

The discharger would have RP for bis(2-ethylhexyl) phthalate at all alternative consumption rates. **Exhibit A-53** shows the projected effluent limits for these consumption rates.

Exhibit A-53. Projected Effluent Limits for Bis(2-ethylhexyl) Phthalate, Salem Willow Lake WWTP

Limit Type	Fish Consumption Rate				
	63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
Average Monthly Limit (µg/L)	5.9	3.6	2.4	1.1	0.73
Maximum Daily Limit (µg/L)	12	7.2	4.8	2.3	1.5

The maximum effluent bis(2-ethylhexyl) phthalate concentration is 13 µg/L, which is greater than the projected effluent limits for all the consumption rates. Bis(2-ethylhexyl) phthalate is found mainly in plastics and is used as a plasticizer for polyvinylchloride (PVC) and other polymers. The plasticizer can be released from plastics manufacturing wastes or through release from plastic goods (Environment Canada, 1994). The facility's permit indicates that it has a total of 27 SIUs. The high bis(2-ethylhexyl) phthalate levels in the effluent could be due to one or more of its indirect dischargers. Regulating these sources through a P2 program could reduce pollutant loadings to the necessary levels. High levels of bis(2-ethylhexyl) phthalate in municipal wastewater effluent can also be associated with sampling and/or laboratory analysis conditions (Fairfield-Suisun SD, 2003). If this is the case, cleaner sampling and analysis techniques could reduce the amount of bis(2-ethylhexyl) phthalate measured in the effluent. Thus, as described in Appendix B, costs for the discharger could be minimal if cleaner sampling techniques result in lower effluent concentrations to approximately $50,000 for a P2 program for bis(2-ethylhexyl) phthalate.

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Mercury

The discharger would have RP for mercury at all consumption rates. **Exhibit A-54** shows the projected effluent limits for these consumption rates.

Exhibit A-54. Projected Effluent Limits for Mercury, Salem Willow Lake WWTP

Limit Type	Fish Consumption Rate				
	63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
AMEL (µg/L)	0.0047	0.0026	0.0017	0.00076	0.00048
MDEL (µg/L)	0.011	0.0060	0.0039	0.0018	0.0011

The maximum effluent concentration is greater than all of the AMELs and MDELs. The facility is already required to implement a mercury P2 program under the baseline as part of the Willamette Basin mercury TMDL. It is not clear how ODEQ would adapt the baseline TMDL to attain the revised criteria (e.g., increase point source load reduction requirements; establish individual effluent limits). Thus, it is uncertain whether continued implementation of the baseline P2 program would be sufficient for compliance with the revised criteria/TMDL because there could be some maximum level of effort beyond which a P2 program would not provide additional reductions.

Because there are no proven end-of-pipe treatment technologies that can achieve low mercury levels (e.g., <10 ng/L) on a consistent basis, dischargers may need to pursue a variance (e.g., based on manmade conditions that cannot be remedied) under more stringent TMDL requirements (alternatively, ODEQ may account for this situation in allocating loads under the TMDL). However, it is uncertain at which fish consumption rate the discharger would need a variance. If the discharger pursues a variance for arsenic, these efforts would also cover a variance for mercury. Otherwise, one-time costs associated with pursuing a variance could range from $35,000 to $300,000. As part of a variance ODEQ, could require specific P2 program efforts. For dischargers covered under the Willamette River TMDL for mercury, these activities may already be included in their baseline mercury P2 requirement.

Summary

Exhibit A-55 provides a summary of the potential range in annual costs associated with the baseline and revised criteria. For the alternative fish consumption rates, the incremental costs represent any costs above and beyond those that would be needed for compliance with baseline criteria. Under a variance scenario for arsenic and/or mercury, costs could include a one-time expenditure of $35,000 to $300,000.

Exhibit A-55. Summary of Potential Costs, Salem Willow Lake WWTP

Alternative	Compliance Scenario	Total Annual Costs	Incremental Annual Costs[1]
Baseline	• Intake credits, variance, or I&I reduction program (arsenic) • P2 program (mercury)	$174,000 - $3,867,000	NA

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Exhibit A-55. Summary of Potential Costs, Salem Willow Lake WWTP

Alternative	Compliance Scenario	Total Annual Costs	Incremental Annual Costs[1]
63.2 gpd	• Intake credits, variance, or I&I reduction program (arsenic) • Cleaner sampling or P2 program [bis(2-ethylhexyl) phthalate] • P2 program, possible variance (mercury)	$174,000 - $3,917,000	$0 -$50,000
113 gpd	• Intake credits, variance, or I&I reduction program (arsenic) • Cleaner sampling or P2 program [bis(2-ethylhexyl) phthalate] • P2 program, possible variance (mercury)	$174,000 - $3,917,000	$0 -$50,000
175 gpd	• Intake credits, variance, or I&I reduction program (arsenic) • Cleaner sampling or P2 program [bis(2-ethylhexyl) phthalate] • P2 program, possible variance (mercury)	$174,000 - $3,917,000	$0 -$50,000
389 gpd	• Intake credits, variance, or I&I reduction program (arsenic) • Cleaner sampling or P2 program [bis(2-ethylhexyl) phthalate] • P2 program, possible variance (mercury)	$174,000 - $3,917,000	$0 -$50,000
620 gpd	• Intake credits, variance, or I&I reduction program (arsenic) • Cleaner sampling or P2 program [bis(2-ethylhexyl) phthalate] • P2 program, possible variance (mercury)	$174,000 - $3,917,000	$0 -$50,000

NA = Not applicable.

1. Annual costs for baseline criteria represent the costs needed for compliance under existing conditions; costs for revised criteria represent the difference between total annual cost and baseline costs (i.e., incremental costs above and beyond those needed for compliance with baseline criteria).

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St. Helens-Boise Cascade WWTP

Facility Description

The St. Helens-Boise Cascade Wastewater Treatment Plant (NPDES permit number OR0020834) treats wastewater from St. Helens, Colombia City, and the Boise Cascade Corporation pulp and paper mill. The City of St. Helens shares its NPDES permit with Boise Cascade, which is a fully integrated facility that uses the bleached Kraft pulping process to produce market pulp, tissue and fine papers. Wastewater from the mill is sent to an aerated stabilization basin (ASB), where it is combined with treated municipal wastewater from the St. Helens' WWTP. After secondary treatment in the ASB, the combined pulp mill and municipal wastewater is discharged through Outfall 001 to the Columbia River at river mile 86.9. Boise is responsible for the majority of the effluent. The mill contributes around 29 mgd to the ASB, while the municipal wastewater flow only contributes 1 mgd. There are two other outfalls to the Colombia River, 008 and 009, that are for overflows. Outfalls 007 and 010 are for emergency discharge from the ASB and return mill intake water, and both are outfalls to the Multnomah Channel. Outfalls 002 through 006 are internal monitoring points.

Treatment Processes

The 2004 NPDES permit for the facility lists treatment processes as a primary aerated treatment basin, a chlorine contact chamber for disinfection, and a large aerated stabilization basin (ASB) which provides secondary treatment to the City's wastewater and wastewater from the Boise pulp and paper mill. Wastewater from the mill is treated in a primary clarifier, before being pumped to the ASB.

Effluent Data and Limits

Exhibit A-56 summarizes monitoring data from April 2004 to April 2007 for those pollutants of concern for which effluent data are available. The facility does not have effluent limits for any toxic pollutants.

Exhibit A-56. Effluent Data Summary, St. Helens-Boise Cascade WWTP[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
1,1,2,2-Tetrachloroethane	13	13	6	-	-	-
1,1,2-Trichloroethane	13	13	4	-	-	-
1,1-Dichloroethylene	13	13	10	-	-	-
1,2,4-Trichlorobenzene	13	13	5.56	-	-	-
1,2-Dichlorobenzene	13	13	5.56	-	-	-
1,2-Dichloroethane	13	13	4	-	-	-
1,2-Dichloropropane	13	13	4	-	-	-
1,2-Trans-Dichloroethylene	13	13	6	-	-	-
1,3-Dichlorobenzene	13	13	5.56	-	-	-
1,4-Dichlorobenzene	13	13	5.56	-	-	-
2,3,7,8-TCDD (Dioxin)	13	13	0.00001	-	-	-

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Exhibit A-56. Effluent Data Summary, St. Helens-Boise Cascade WWTP[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
2,4,6-Trichlorophenol	13	13	5.56	-	-	-
2,4-Dichlorophenol	13	13	5.56	-	-	-
2,4-Dimethylphenol	13	13	11.1	-	-	-
2,4-Dinitrophenol	13	13	20	-	-	-
2,4-Dinitrotoluene	13	13	5.56	-	-	-
2-Chloronaphthalene	13	13	5.56	-	-	-
2-Chlorophenol	13	13	5.56	-	-	-
2-Methyl-4,6-Dinitrophenol	13	13	11.1	-	-	-
3,3'-Dichlorobenzidine	13	13	5.56	-	-	-
4,4'-DDD	13	13	1	-	-	-
4,4'-DDE	13	13	1	-	-	-
4,4'-DDT	13	13	1	-	-	-
Acenaphthene	13	13	5.56	-	-	-
Acrolein	13	13	20	-	-	-
Acrylonitrile	13	13	20	-	-	-
Aldrin	13	13	1	-	-	-
alpha-BHC	13	13	1	-	-	-
Antimony	13	0	-	0.82	0.42	0.26
Arsenic	13	0	-	2.28	1.21	0.76
Benzene	13	13	6	-	-	-
Benzidine	13	13	66.7	-	-	-
Benzo(a) Anthracene	13	13	5.56	-	-	-
Benzo(a) Pyrene	13	13	5.56	-	-	-
Benzo(b) Fluoranthene	13	13	5.56	-	-	-
Benzo(k) Fluoranthene	13	13	5.56	-	-	-
Beryllium	13	13	0.1	-	-	-
Bis(2-Chloroethyl) Ether	13	13	5.56	-	-	-
Bis(2-Chloroisopropyl) Ether	13	13	11.1	-	-	-
Bis(2-Ethylhexyl) Phthalate	13	13	11.1	-	-	-
Bromoform	13	13	4	-	-	-
Carbon Tetrachloride	13	13	6	-	-	-
Chlorobenzene	13	13	4	-	-	-
Chloroform	13	13	4	-	-	-
Chrysene	13	13	5.56	-	-	-
Dibenzo(a,h)Anthracene	13	13	5.56	-	-	-
Dichlorobromomethane	13	13	4	-	-	-
Dieldrin	13	13	1	-	-	-
Diethyl Phthalate	13	13	5.56	-	-	-
Dimethyl Phthalate	13	13	5.56	-	-	-
Di-n-Butyl Phthalate	13	12	10	14.7	14.7	14.7
Endosulfan Sulfate	13	13	1	-	-	-
Endrin	13	13	1	-	-	-
Endrin Aldehyde	13	13	1	-	-	-
Ethylbenzene	13	13	4	-	-	-

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Exhibit A-56. Effluent Data Summary, St. Helens-Boise Cascade WWTP[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
Fluoranthene	13	13	5.56	-	-	-
Fluorene	13	13	5.56	-	-	-
Gamma-BHC	13	13	0.1	-	-	-
Heptachlor	13	13	1	-	-	-
Heptachlor Epoxide	13	13	1	-	-	-
Hexachlorobenzene	13	13	5.56	-	-	-
Hexachlorobutadiene	13	13	11.1	-	-	-
Hexachlorocyclopentadiene	13	13	11.1	-	-	-
Hexachloroethane	13	13	11.1	-	-	-
Ideno(1,2,3-cd)Pyrene	13	13	5.56	-	-	-
Isophorone	13	13	10	-	-	-
Mercury	13	5	0.005	0.037	0.015	0.0073
Methylene Chloride	13	13	6	-	-	-
Nickel	13	0	-	16.7	6.99	2.83
Nitrobenzene	13	13	5.56	-	-	-
N-Nitrosodimethylamine	13	13	5.56	-	-	-
N-Nitrosodi-n-Propylamine	13	13	11.1	-	-	-
N-Nitrosodiphenylamine	13	13	5.56	-	-	-
PCBs[3]	13	13	0.556	-	-	-
Pentachlorophenol	13	13	11.1	-	-	-
Phenol	26	26	100	-	-	-
Pyrene	13	13	5.56	-	-	-
Selenium	13	7	0.5	2.35	1.34	0.80
Tetrachloroethylene	13	13	4	-	-	-
Thallium	13	13	0.1	-	-	-
Toluene	13	11	4	7.3	4.10	2.3
Toxaphene	13	13	50	-	-	-
Trichloroethylene	13	13	6	-	-	-
Vinyl Chloride	13	13	20	-	-	-

QL = Quantification limit.
1. Represents effluent data from April 2004 to April 2007.
2. May not match approved QLs because data was collected prior to November 2007 when ODEQ revised applicable QLs.
3. Represents the lowest QL for the 7 congeners sampled (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, and Aroclor 1260).

Receiving Water Data

Through computer modeling of stream flow data in the vicinity of the discharge, CH2MHill (2007) determined that the harmonic mean receiving water flow for the Columbia River at river mile 87 (0.1 miles upstream from the facility) is approximately 186,218 cfs, and the 30Q5 flow is 98,768 cfs.

Exhibit A-57 summarizes monitoring data for the Columbia River at river mile 88.0, 1.1 miles upstream from the outfall location. Samples were taken at a location outside of influence of the

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Outfall 001 mixing zone, from July 2003 to April 2007 for those pollutants of concern for which ambient data are available.

Exhibit A-57. Ambient Data Summary, St. Helens-Boise Cascade WWTP [1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL (µg/L)	Maximum	Geometric Mean	Minimum
Antimony	16	1	0.100	0.16	0.13	0.10
Arsenic	10	0	-	1.06	0.90	0.70
Beryllium	6	5	0.009	0.05	0.05	0.05
Mercury	16	4	0.005	0.013	0.005	0.002
Nickel	6	0	-	2.3	1.45	0.40
Selenium	1	0	-	0.40	0.40	0.40
Thallium	10	10	0.100	-	-	-

QL = Quantification limit.
1. Represents ambient data from July 2003 to April 2007.

Potential Impacts

Baseline Criteria

Exhibit A-58 summarizes the RPA for baseline criteria for those pollutants detected in the effluent (there will be no RP or monitoring requirements if all observations are nondetect). The Columbia River is a freshwater river; thus, human health criteria for consumption of organisms and water are applicable. ODEQ (2006b) allows 25% of the harmonic mean flow for dilution for carcinogens and 25% of the 30Q5 flow for dilution for noncarcinogens. However, to be conservative (i.e., err on the side of higher costs), the dilution factors are based on using only 10% of the river flows. The Columbia River at river mile 86.9 is on the state's 303(d) list as impaired for dioxin, DDT, arsenic, and PCBs; thus, the facility would not receive dilution for these pollutants.

Exhibit A-58. RPA for Baseline Criteria, St. Helens-Boise Cascade WWTP

Parameter	Calculated Effluent Conc.[1] (µg/L)	Ambient Conc.[2] (µg/L)	Conc. at Edge of Mixing Zone[3] (µg/L)	Human Health Criterion (µg/L)	Reasonable Potential
Antimony	1.11	0.13	0.13	5.6	No
Arsenic	1.69	0.90	1.69	0.0022	**Yes**
Di-n-Butyl Phthalate	23.2	0	0.11	2000	No
Mercury[4]	0.058	0.005	0.0052	0.017	No
Nickel	25.4	1.45	1.56	13.4	No
Selenium	3.71	0.4	0.42	10	No
Toluene	11.5	0	0.054	1300	No

1. Represents the calculated geometric mean concentration for carcinogens and the calculated maximum concentration for noncarcinogens based on a CV of 0.6 for all pollutants except antimony (CV = 0.385), arsenic (CV = 0.42) and nickel (CV = 0.546) (see Section 3.2).
2. Represents the geometric mean of detected values and zero if data are not available or if all values are nondetect.
3. Dilution based on 10% of 30Q5 flow for noncarcinogens (factor = 214) and 10% of harmonic mean flow for carcinogens (factor = 404).
4. Potential water column criteria based on the revised fish tissue criteria, calculated using EPA default BAFs, trophic level

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Exhibit A-58. RPA for Baseline Criteria, St. Helens-Boise Cascade WWTP

Parameter	Calculated Effluent Conc.[1] (µg/L)	Ambient Conc.[2] (µg/L)	Conc. at Edge of Mixing Zone[3] (µg/L)	Human Health Criterion (µg/L)	Reasonable Potential

consumption percentages, and water column translator (see Section 4).

As shown in the exhibit, the facility has RP to exceed the baseline criterion for arsenic because the concentration at the edge of the regulatory mixing zone is greater than the applicable existing human health criterion. Note also that although ambient concentrations are greater than the criterion, the Willamette River near the discharge is not on the state's 303(d) list as impaired for arsenic. If ODEQ determines that the ambient concentration represents natural background levels, it would grant dilution in the RPA calculation (ODEQ, 2005). Under this scenario, the concentration at the edge of the mixing zone would be approximately 0.2% above the ambient background concentration. ODEQ (2005) indicates that dischargers that cause less than a 10% increase in downstream receiving water concentrations would not be given numeric effluent limits; rather they would be required to implement narrative BMPs (e.g., improve internal process control) and increased monitoring. The costs of such measures could be comparable to the cost of implementing an industrial mercury P2 program because the facility would likely conduct similar actions and activities. Thus, costs could be approximately $25,000 per year.

If ODEQ determines that the water body is impaired, it would not grant dilution and base effluent limits on achieving the criterion end-of-pipe. However, because the baseline criterion is below the QL, the discharger would only need to reduce effluent levels to the QL of 0.05 µg/L (because the criterion is below the QL) for compliance with baseline standards.

Arsenic and arsenic-containing chemicals are not used in wastewater treatment. However, the City's drinking water comes from the groundwater wells. The majority of the water is extracted from two wells on the banks of the Columbia River and treated at the City's new membrane filtration water treatment facility (St. Helens Water Department, 2006). In the summer groundwater from a well located near Scappoose Bay Marina is used to meet peak demands (St. Helens Water Department, 2006). This water is not treated at the water treatment plant. USGS (1998) indicates that arsenic concentrations exceeding EPA's previous maximum contaminant level of 50 µg/L are widespread in groundwater in the Willamette Basin. However, most arsenic samples (organic plus inorganic) from the wells since 1986 are nondetect below the minimum reporting levels, except for 1 detected observation in 1993 (3 µg/L) (ODHS, 2007f). The minimum reporting levels are not specified, and the drinking water maximum contaminant level is 10 µg/L, which is higher than current effluent concentrations and human health criteria. Use of groundwater with high levels of arsenic could result in increased effluent concentrations as a result of use of drinking water at the Boise Cascade pulp mill.

There would be no compliance costs associated with an intake credit scenario. The one-time cost associated with pursuing a variance could range from $35,000 to $300,000, with minimal costs associated with renewal.

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Revised Criteria

Exhibit A-59 summarizes the RPA for the revised human health criteria for consumption of water and organisms for those pollutants detected in the effluent (there will be no RP or monitoring requirements if all observations are nondetect).

Exhibit A-59. RPA for Revised Criteria, St. Helens-Boise Cascade WWTP

Parameter	Conc. at Edge of Mixing Zone[1] (µg/L)	Human Health Criteria at Alternative FCRs (µg/L)				
		63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
Antimony	0.13	5.40	5.30	5.10	4.70	4.30
Arsenic	1.69	**0.0083***	**0.0057***	**0.0041***	**0.0021***	**0.0014***
Di-n-Butyl Phthalate	0.11	920	580	400	190	120
Mercury[2]	0.0052	**0.0047***	**0.0026***	**0.0017***	**0.00076***	**0.00048***
Nickel	1.56	280	190	140	69.0	45.0
Selenium	0.42	150	140	120	91.0	70.0
Toluene	0.054	1000	870	720	450	320

*Bolded values represent RP equal to "Yes."
FCRs = Fish consumption rates.
1. Dilution based on 10% of 30Q5 flow for noncarcinogens (factor = 214) and 10% of harmonic mean flow for carcinogens (factor = 404).
2. Potential water column criteria based on the revised fish tissue criteria, calculated using EPA default BAFs, trophic level consumption percentages, and water column translator (see Section 4).

As shown in the exhibit, the discharger could have RP for arsenic and mercury based on the alternative fish consumption rates.

Arsenic

The discharger would have RP for arsenic at all fish consumption rates. Thus, because the ambient concentration is greater than the criteria, the discharger would need to reduce discharge concentrations to background (if ODEQ determines that ambient concentrations represent natural levels) or the approved QL of 0.05 µg/L (because the criterion is below the QL) for compliance with revised standards. However, under the baseline, the discharge would need to meet those same levels. Thus, incremental compliance costs would be unlikely.

Mercury

The discharger would have RP for mercury at all fish consumption rates. **Exhibit A-60** shows the AMELs and MDELs for each consumption rate. Note that at the alternative consumption rates the ambient background concentration (0.005 µg/L) is greater than the applicable criteria so the discharger would not receive dilution in calculating effluent limits.

Exhibit A-60. Projected Effluent Limits for Mercury, St. Helens-Boise Cascade WWTP

Limit Type	Fish Consumption Rate				
	63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
AMEL (µg/L)	0.0047	0.0026	0.0017	0.00076	0.00048
MDEL (µg/L)	0.0094	0.0052	0.0034	0.0015	0.00096

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The maximum effluent concentration at the facility is 0.037 µg/L, which is greater than the AMEL and MDEL for all consumption rates. Thus, the facility may need to implement controls to reduce effluent mercury concentrations for compliance with these limits. As described above, only about 1 mgd of the 30 mgd effluent is municipal wastewater. The remaining is pulp mill effluent. Because mercury monitoring data are not available for each waste stream, we assumed that both facilities would need to implement mercury control measures for compliance with the revised effluent limits.

Because there are no proven end-of-pipe treatment technologies that can achieve low mercury levels (e.g., <10 ng/L) on a consistent basis, the municipal wastewater treatment plant would likely implement a P2 program for compliance with the projected effluent limits. Annual P2 program costs for a 1 mgd municipal facility may be approximately $50,000 (see Appendix B for details). As described in Appendix B, P2 costs also potentially include costs for indirect dischargers to implement controls (see Exhibit B-2). Based on information on the discharger's service area, incremental indirect discharger costs may be minimal (e.g., there are no universities in the service area).

The pulp mill would need to implement a P2 program to identify the sources of mercury and determine the most cost-effective measures for reducing mercury from those sources. Annual P2 program costs for an industrial facility may be approximately $25,000 (see Appendix B for details). Thus, total annual mercury control costs for this discharger are $75,000 ($50,000 + $25,000). Note that a municipality is likely to have many more potential sources of mercury to target and control than an industrial facility so P2 costs are greater for the municipal portion of the facility even though the flow is less.

Note there could be some maximum level of effort beyond which a P2 program would not provide additional reductions and the facility may need to pursue a variance (e.g., based on manmade conditions that cannot be remedied). However, it is uncertain for which consumption rates the discharger would need a variance. If the discharger pursues a variance for arsenic, these efforts would also cover a variance for mercury. Otherwise, one-time costs associated with pursuing a variance could range from $35,000 to $300,000. As part of a variance ODEQ, could require specific P2 program efforts.

Summary

Exhibit A-61 provides a summary of the potential range in annual costs associated with the baseline and revised criteria. For the alternative fish consumption rates, the incremental costs represent any costs above and beyond those that would be needed for compliance with baseline criteria. Under a variance scenario for arsenic and/or mercury, costs could include a one-time expenditure of approximately $35,000 to $300,000.

Exhibit A-61. Summary of Potential Costs, St. Helen-Boise Cascade WWTP

Alternative	Compliance Scenario	Total Annual Costs	Incremental Annual Costs[1]
Baseline	• Intake credits, BMPs, or variance (arsenic)	$0 - $25,000	NA
63.2 gpd	• Intake credits, BMPs, or variance (arsenic) • P2 program, possible variance (mercury)	$75,000 - $100,000	$75,000

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Exhibit A-61. Summary of Potential Costs, St. Helen-Boise Cascade WWTP

Alternative	Compliance Scenario	Total Annual Costs	Incremental Annual Costs[1]
113 gpd	• Intake credits, BMPs, or variance (arsenic) • P2 program, possible variance (mercury)	$75,000 - $100,000	$75,000
175 gpd	• Intake credits, BMPs, or variance (arsenic) • P2 program, possible variance (mercury)	$75,000 - $100,000	$75,000
389 gpd	• Intake credits, BMPs, or variance (arsenic) • P2 program, possible variance (mercury)	$75,000 - $100,000	$75,000
620 gpd	• Intake credits, BMPs, or variance (arsenic) • P2 program, possible variance (mercury)	$75,000 - $100,000	$75,000

NA = Not applicable.

1. Annual costs for baseline criteria represent the costs needed for compliance under existing conditions; costs for revised criteria represent the difference between total annual cost and baseline costs (i.e., incremental costs above and beyond those needed for compliance with baseline criteria).

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Tri-City Service District

Facility Description

The Tri-City Service District operates an activated biosolids sewage plant in Oregon City, Oregon (NPDES permit number OR0031259) and serves the cities of Gladstone, Oregon City, and West Linn. ODEQ classifies the facility as a major discharger, with an ADWDF of 8.4 mgd. The facility discharges treated effluent through Outfall 001 into the Willamette River at river mile 0.2. The facility also has four other outfalls categorized as emergency overflows.

Treatment Processes

The major treatment processes at the facility are activated sludge, secondary treatment, and chlorine disinfection; sludge is anaerobically digested.

Effluent Data and Limits

Exhibit A-62 summarizes monitoring data from May 2005 to December 2006 for those pollutants of concern for which effluent data are available. The facility does not have effluent limits for any toxic pollutants.

Exhibit A-62. Effluent Data Summary, Tri-City Service District[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
1,1,2,2-Tetrachloroethane	2	2	5	-	-	-
1,2,4-Trichlorobenzene	2	2	10	-	-	-
1,2-Dichlorobenzene	2	2	5	-	-	-
1,2-Dichloroethane	2	2	5	-	-	-
1,2-Dichloropropane	2	2	5	-	-	-
1,2-Diphenylhydrazine	2	2	10	-	-	-
1,2-Trans-Dichloroethylene	2	2	5	-	-	-
1,4-Dichlorobenzene	4	4	5	-	-	-
2,4,6-Trichlorophenol	2	2	10	-	-	-
2,4-Dichlorophenol	2	2	25	-	-	-
2,4-Dimethylphenol	2	2	10	-	-	-
2,4-Dinitrophenol	2	2	25	-	-	-
2,4-Dinitrotoluene	2	2	10	-	-	-
2-Chloronaphthalene	2	2	10	-	-	-
2-Chlorophenol	2	2	10	-	-	-
2-Methyl-4,6-Dinitrophenol	2	2	25	-	-	-
4,4'-DDD	2	2	0.01	-	-	-
4,4'-DDE	2	2	0.01	-	-	-
4,4'-DDT	2	2	0.01	-	-	-
Acenaphthene	2	2	10	-	-	-
Acrolein	2	2	50	-	-	-
Acrylonitrile	2	2	10	-	-	-

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Exhibit A-62. Effluent Data Summary, Tri-City Service District[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
Aldrin	2	2	0.01	-	-	-
alpha-BHC	2	2	0.013	-	-	-
Anthracene	2	2	10	-	-	-
Arsenic	21	11	0.5	1	0.44	0.12
Benzidine	2	2	50	-	-	-
Benzo(a) Anthracene	2	2	10	-	-	-
Benzo(a) Pyrene	2	2	10	-	-	-
Benzo(b) Fluoranthene	2	2	10	-	-	-
Benzo(k) Fluoranthene	2	2	10	-	-	-
Bis(2-Chloroethyl) Ether	2	2	10	-	-	-
Bis(2-Chloroisopropyl) Ether	2	2	10	-	-	-
Bis(2-Ethylhexyl) Phthalate	2	2	10	-	-	-
Bromoform	2	2	5	-	-	-
Carbon Tetrachloride	2	2	5	-	-	-
Chlordane	2	2	0.2	-	-	-
Chlorobenzene	2	2	5	-	-	-
Chloroform	2	2	5	-	-	-
Chrysene	2	2	10	-	-	-
Dibenzo(a,h)Anthracene	2	2	10	-	-	-
Dichlorobromomethane	2	2	5	-	-	-
Dieldrin	2	2	0.01	-	-	-
Diethyl Phthalate	2	2	10	-	-	-
Dimethyl Phthalate	2	2	10	-	-	-
Di-n-Butyl Phthalate	2	2	10	-	-	-
Endosulfan Sulfate	2	2	0.01	-	-	-
Endrin Aldehyde	2	2	0.01	-	-	-
Ethylbenzene	2	2	5	-	-	-
Fluoranthene	2	2	10	-	-	-
Fluorene	2	2	10	-	-	-
Gamma-BHC	2	2	0.01	-	-	-
Heptachlor	2	2	0.01	-	-	-
Heptachlor Epoxide	2	2	0.01	-	-	-
Hexachlorobenzene	2	2	10	-	-	-
Hexachlorobutadiene	2	2	10	-	-	-
Hexachlorocyclopentadiene	2	2	10	-	-	-
Hexachloroethane	2	2	10	-	-	-
Ideno(1,2,3-cd)Pyrene	2	2	10	-	-	-
Isophorone	2	2	10	-	-	-
Mercury	21	6	0.05	0.020	0.0073	0.0039
Nickel	21	0	0	2.1	1.61	1.1
Nitrobenzene	2	2	10	-	-	-
N-Nitrosodimethylamine	2	2	25	-	-	-
N-Nitrosodi-n-Propylamine	2	2	10	-	-	-
PCBs[3]	1	1	0.97	-	-	-

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Exhibit A-62. Effluent Data Summary, Tri-City Service District[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
Pentachlorophenol	2	2	25	-	-	-
Phenol	2	2	10	-	-	-
Pyrene	2	2	10	-	-	-
Selenium	21	21	2	-	-	-
Tetrachloroethylene	2	2	5	-	-	-
Toxaphene	2	2	0.5	-	-	-
Trichloroethylene	2	2	5	-	-	-
Vinyl Chloride	2	2	5	-	-	-

QL = Quantification limit.
1. Represents effluent data from May 2005 to December 2006.
2. May not match approved QLs because data was collected prior to November 2007 when ODEQ revised applicable QLs.
3. Represents the lowest QL for the 7 congeners sampled (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, and Aroclor 1260).

Receiving Water Data

Exhibit A-63 summarizes data from the Willamette River upstream of the facility from November 2002 to December 2006 for those pollutants of concern for which ambient data are available.

Exhibit A-63. Ambient Data Summary, Tri-City Service District[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL (µg/L)	Maximum	Geometric Mean	Minimum
1,1,2,2-Tetrachloroethane	2	2	5	-	-	-
1,2,4-Trichlorobenzene	2	2	11	-	-	-
1,2-Dichlorobenzene	2	2	5	-	-	-
1,2-Dichloroethane	2	2	5	-	-	-
1,2-Dichloropropane	2	2	5	-	-	-
1,2-Diphenylhydrazine	2	2	11	-	-	-
1,2-Trans-Dichloroethylene	2	2	5	-	-	-
1,4-Dichlorobenzene	4	4	5	-	-	-
2,4,6-Trichlorophenol	2	2	11	-	-	-
2,4-Dichlorophenol	2	2	11	-	-	-
2,4-Dimethylphenol	2	2	11	-	-	-
2,4-Dinitrophenol	2	2	25	-	-	-
2,4-Dinitrotoluene	2	2	11	-	-	-
2-Chloronaphthalene	2	2	11	-	-	-
2-Chlorophenol	2	2	11	-	-	-
2-Methyl-4,6-Dinitrophenol	2	2	27	-	-	-
4,4'-DDD	2	2	0.011	-	-	-
4,4'-DDE	2	2	0.011	-	-	-
4,4'-DDT	2	2	0.011	-	-	-
Acenaphthene	2	2	11	-	-	-
Acrolein	2	2	50	-	-	-

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Exhibit A-63. Ambient Data Summary, Tri-City Service District[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL (µg/L)	Maximum	Geometric Mean	Minimum
Acrylonitrile	2	2	10	-	-	-
Aldrin	2	2	0.011	-	-	-
alpha-BHC	2	2	0.011	-	-	-
Anthracene	2	2	11	-	-	-
Arsenic	4	3	0.5	0.5	0.5	0.5
Benzidine	2	2	53	-	-	-
Benzo(a) Anthracene	2	2	11	-	-	-
Benzo(a) Pyrene	2	2	11	-	-	-
Benzo(b) Fluoranthene	2	2	11	-	-	-
Benzo(k) Fluoranthene	2	2	11	-	-	-
Bis(2-Chloroethyl) Ether	2	2	11	-	-	-
Bis(2-Chloroisopropyl) Ether	2	2	11	-	-	-
Bis(2-Ethylhexyl) Phthalate	2	2	11	-	-	-
Bromoform	2	2	5	-	-	-
Carbon Tetrachloride	2	2	5	-	-	-
Chlordane	2	2	0.22	-	-	-
Chlorobenzene	2	2	5	-	-	-
Chloroform	2	2	5	-	-	-
Chrysene	2	2	11	-	-	-
Dibenzo(a,h)Anthracene	2	2	11	-	-	-
Dichlorobromomethane	2	2	5	-	-	-
Dieldrin	2	2	0.011	-	-	-
Diethyl Phthalate	2	2	11	-	-	-
Dimethyl Phthalate	2	2	11	-	-	-
Di-n-Butyl Phthalate	2	2	11	-	-	-
Endosulfan Sulfate	2	2	0.011	-	-	-
Endrin Aldehyde	2	2	0.011	-	-	-
Ethylbenzene	2	2	5	-	-	-
Fluoranthene	2	2	11	-	-	-
Fluorene	2	2	11	-	-	-
Heptachlor	2	2	0.011	-	-	-
Heptachlor Epoxide	2	2	0.011	-	-	-
Hexachlorobenzene	2	2	11	-	-	-
Hexachlorobutadiene	2	2	11	-	-	-
Hexachlorocyclopentadiene	2	2	11	-	-	-
Hexachloroethane	2	2	11	-	-	-
Ideno(1,2,3-cd)Pyrene	2	2	11	-	-	-
Isophorone	2	2	11	-	-	-
Mercury	4	1	0.005	0.0025	0.0019	0.0011
Nickel	4	0	0	0.70	0.54	0.35
Nitrobenzene	2	2	11	-	-	-
N-Nitrosodimethylamine	2	2	27	-	-	-
N-Nitrosodi-n-Propylamine	2	2	11	-	-	-
PCBs	2	2	1.1	-	-	-

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Exhibit A-63. Ambient Data Summary, Tri-City Service District[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL (µg/L)	Maximum	Geometric Mean	Minimum
Pentachlorophenol	2	2	27	-	-	-
Phenol	2	2	11	-	-	-
Pyrene	2	2	11	-	-	-
Selenium	4	4	2	-	-	-
Tetrachloroethylene	2	2	5	-	-	-
Toxaphene	2	2	0.53	-	-	-
Trichloroethylene	2	2	5	-	-	-
Vinyl Chloride	2	2	5	-	-	-

"-" = not applicable.
QL = Quantification limit.
1. Represents ambient data from Nov 2002 to December 2006.
2. Represents the lowest QL for the 7 congeners sampled (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, and Aroclor 1260).

Potential Impacts

Baseline Criteria

Exhibit A-64 summarizes the RPA for baseline criteria for those pollutants detected in the effluent (there will be no RP or monitoring requirements if all observations are nondetect). The Willamette River is a freshwater river; thus, human health criteria for consumption of organisms and water are applicable. There are no data available from which to determine the 30Q5 and harmonic means flows for the Willamette River upstream of the facility, and the facility's existing permit does not specify any dilution factors. Therefore, we assumed that there is no dilution for this facility (i.e., dilution factor equals 1). Note, even if dilution factors were available, the discharger would not receive dilution for DDT, DDE, dieldrin, dioxin, mercury, PCBs, pentachlorophenol, or PAHs because the Willamette River at river mile 0.2 is on the state's 303(d) list as impaired for these pollutants.

Exhibit A-64. RPA for Baseline Criteria, Tri-City Service District

Parameter	Calculated Effluent Conc.[1] (µg/L)	Ambient Conc.[2] (µg/L)	Conc. at Edge of Mixing Zone[3] (µg/L)	Human Health Criterion (µg/L)	Reasonable Potential
Arsenic	0.60	0.5	0.60	0.0022	**Yes**
Mercury[4]	0.026	0.0019	0.026	0.017	**Yes**
Nickel	2.33	0.54	2.33	13.4	No
Selenium	0.0097	0	0.0097	10	No

1. Represents the calculated geometric mean concentration for carcinogens and the calculated maximum concentration for noncarcinogens based on a CV of 0.6 for all pollutants except arsenic (CV = 0.63), mercury (CV = 0.50), and nickel (CV = 0.20) (see Section 3.2).
2. Represents the geometric mean of detected values and zero if data are not available or if all values are nondetect.
3. Assumes no dilution (factor = 1).
4. Potential water column criteria based on the revised fish tissue criteria, calculated using EPA default BAFs, trophic level consumption percentages, and water column translator (see Section 4).

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As shown in the exhibit, the facility has RP to exceed the baseline criterion for arsenic and mercury because the concentrations at the edge of the regulatory mixing zone are greater than the applicable existing human health criteria.

Arsenic

Note that although ambient concentrations are greater than the criterion, the Willamette River near the discharge is not on the state's 303(d) list as impaired for arsenic. Regardless, the facility would be discharging arsenic above allowable levels and would be required to reduce discharge concentrations to background (if ambient concentrations are determined to represent natural levels) or the approved QL of 0.05 µg/L (because the criterion is below the QL) for compliance with baseline standards.

Arsenic and arsenic-containing chemicals are not used in wastewater treatment. The facility's permit does not indicate whether there are any significant or categorical dischargers to the treatment plant. However, if the facility determines that one or more of its indirect dischargers is causing or contributing to high arsenic levels in the effluent, it would most likely implement a source control program to target the dischargers or impose more stringent pretreatment limits on the dischargers. Without specific information on the types of industrial dischargers that may need controls, it is not possible to estimate pretreatment or P2 costs to indirect dischargers.

The facility's drinking water comes from the Clackamas River. Most arsenic samples (organic plus inorganic) from the water body since 1986 are nondetect below the minimum reporting levels, except for 2 detected observations in 1987 (5 µg/L) and 1989 (6 µg/L) (ODHS, 2007g). The minimum reporting levels are not specified, and the drinking water maximum contaminant level is 10 µg/L, which is higher than current effluent concentrations and human health criteria. Thus, from these data it is not possible to determine with any certainty if drinking water is contributing to high arsenic levels in the wastewater effluent. However, if the facility determines that drinking water is the source of high arsenic values in the wastewater, it is likely that the facility would pursue a variance or request that ODEQ consider granting the facility intake credits.

USGS (1998) indicates that arsenic concentrations exceeding EPA's previous maximum contaminant level of 50 µg/L are widespread in groundwater in the Willamette Basin. Infiltration of groundwater with such high levels of arsenic into to the wastewater system could result in increased effluent concentrations. If the facility determines that the source of arsenic in its effluent is groundwater infiltration, an I&I reduction program may be necessary for compliance with the existing arsenic criteria.

There would be no compliance costs associated with an intake credit scenario. The one-time cost associated with pursuing a variance could range from $35,000 to $200,000, with minimal costs associated with renewal. If the arsenic effluent levels are the result of infiltration of arsenic-contaminated groundwater, total costs could be $10,900,000 for an I&I reduction program that includes source identification and pipe rehabilitation for a sewer system with approximately 218 miles of pipe (approximately $1,032,000 per year annualized at 7% over 20 years). Note that if groundwater infiltration is not the only source of arsenic to the treatment plant, an I&I reduction

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program alone may not be sufficient for compliance and the discharger would not likely undertake such a program for compliance with toxic criteria alone.

Mercury

Under existing condition, the AMEL would be 0.017 µg/L and the MDEL would be 0.031 µg/L (i.e., criterion end-of-pipe because the water body is impaired). The maximum effluent concentration at the facility is 0.02 µg/L, which is greater than the projected limits. Thus, the facility may need to implement controls to reduce effluent mercury concentrations for compliance with these limits. Since the projected effluent levels are in the range achievable by municipal wastewater treatment plants that have implemented P2, the facility would likely implement a P2 program for compliance with the projected effluent limits. In addition, under the baseline Willamette River Basin mercury TMDL, the facility would be required to develop and implement a mercury reduction strategy. However, because ODEQ does not assign individual wasteload allocations to point source dischargers in the TMDL (point sources as a whole are required to reduce existing load by 26%), it is uncertain whether the facility would incur costs beyond those for a P2 program to meet the wasteload allocation under the baseline TMDL.

Annual P2 program costs for an 8.4 mgd municipal facility may be approximately $100,000 (see Appendix B for details). As described in Appendix B, P2 costs also potentially include costs for indirect dischargers to implement controls (see Exhibit B-2). Based on information on the discharger's service area, incremental indirect discharger costs may be minimal (e.g., there are no universities in the service area).

Revised Criteria

Exhibit A-65 summarizes the RPA for the revised human health criteria for consumption of water and organisms for those pollutants detected in the effluent (there will be no RP or monitoring requirements if all observations are nondetect).

Exhibit A-65 RPA for Revised Criteria, Tri-City Service District

Parameter	Conc. at Edge of Mixing Zone[1] (µg/L)	Human Health Criteria at Alternative FCRs (µg/L)				
		63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
Arsenic	0.60	**0.0083***	**0.0057***	**0.0041***	**0.0021***	**0.0014***
Mercury[2]	0.026	**0.0047***	**0.0026***	**0.0017***	**0.00076***	**0.00048***
Nickel	2.33	280	190	140	69.0	45.0
Selenium	0.0097	150	140	120	91.0	70.0

*Bolded values represent RP equal to "Yes."
FCRs = Fish consumption rates.
1. Assumes no dilution (factor = 1).
2. Potential water column criteria based on the revised fish tissue criteria, calculated using EPA default BAFs, trophic level consumption percentages, and water column translator (see Section 4).

As shown in the exhibit, the discharger could have RP for arsenic and mercury based on the alternative fish consumption rates.

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Arsenic

The discharger would have RP for arsenic at all fish consumption rates. Thus, because the ambient concentration is greater than the criteria, the discharger would need to reduce discharge concentrations to background (if ODEQ determines that ambient concentrations represent natural levels) or the approved QL of 0.05 µg/L (because the criterion is below the QL) for compliance with revised standards. However, under the baseline, the discharge would need to meet those same levels. Thus, incremental compliance costs are unlikely.

Mercury

The discharger would have RP for mercury at all of the revised consumption rates. **Exhibit A-66** shows the AMELs and MDELs for each consumption rate.

Exhibit A-66. Projected Effluent Limits for Mercury, Tri-City Service District

Limit Type	Fish Consumption Rate				
	63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
Average Monthly Limit (µg/L)	0.0047	0.0026	0.0017	0.00076	0.00048
Maximum Daily Limit (µg/L)	0.0087	0.0048	0.0031	0.0014	0.00089

The maximum effluent concentration is greater than all of the AMELs and MDELs. The facility is already required to implement a mercury P2 program under the baseline as part of the Willamette Basin mercury TMDL. It is not clear how ODEQ would adapt the baseline TMDL to attain the revised criteria (e.g., increase point source load reduction requirements; establish individual effluent limits). Thus, it is uncertain whether continued implementation of the baseline P2 program would be sufficient for compliance with the revised criteria/TMDL because there could be some maximum level of effort beyond which a P2 program would not provide additional reductions.

Because there are no proven end-of-pipe treatment technologies that can achieve low mercury levels (e.g., <10 ng/L) on a consistent basis, dischargers may need to pursue a variance (e.g., based on manmade conditions that cannot be remedied) under more stringent TMDL requirements (alternatively, ODEQ may account for this situation in allocating loads under the TMDL). However, it is uncertain at which fish consumption rate the discharger would need a variance. If the discharger pursues a variance for arsenic, these efforts would also cover a variance for mercury. Otherwise, one-time costs associated with pursuing a variance could range from $35,000 to $200,000. As part of a variance ODEQ, could require specific P2 program efforts. For dischargers covered under the Willamette River TMDL for mercury, these activities may already be included in their baseline mercury P2 requirement.

Summary

Exhibit A-67 provides a summary of the potential range in annual costs associated with the baseline and revised criteria. For the alternative fish consumption rates, the incremental costs represent any costs above and beyond those that would be needed for compliance with baseline

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criteria. Under a variance scenario for arsenic and/or mercury, costs could include a one-time expenditure of $35,000 to $200,000.

Exhibit A-67. Summary of Potential Costs, Tri-City Service District

Alternative	Compliance Scenario	Total Annual Costs	Incremental Annual Costs[1]
Baseline	• Intake credits, variance, or I&I reduction program (arsenic) • P2 program (mercury)	$100,000 - $1,132,000	NA
63.2 gpd	• Intake credits, variance, or I&I reduction program (arsenic) • P2 program, possible variance (mercury)	$100,000 - $1,132,000	$0
113 gpd	• Intake credits, variance, or I&I reduction program (arsenic) • P2 program, possible variance (mercury)	$100,000 - $1,132,000	$0
175 gpd	• Intake credits, variance, or I&I reduction program (arsenic) • P2 program, possible variance (mercury)	$100,000 - $1,132,000	$0
389 gpd	• Intake credits, variance, or I&I reduction program (arsenic) • P2 program, possible variance (mercury)	$100,000 - $1,132,000	$0
620 gpd	• Intake credits, variance, or I&I reduction program (arsenic) • P2 program, possible variance (mercury)	$100,000 - $1,132,000	$0

NA = Not applicable.

1. Annual costs for baseline criteria represent the costs needed for compliance under existing conditions; costs for revised criteria represent the difference between total annual cost and baseline costs (i.e., incremental costs above and beyond those needed for compliance with baseline criteria).

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Woodburn Wastewater Treatment Plant

Facility Description

The Woodburn Wastewater Treatment Plant (NPDES permit number OR0020001) is an advanced secondary wastewater treatment facility located near Woodburn, Oregon. The treatment facility serves the entire City of Woodburn, with the exception of some isolated residences. ODEQ classifies the discharger as a major municipal, with an ADWDF of 3.33 mgd. Treated wastewater flows through Outfalls 001A and 001B into the Pudding River at river mile 21.4. Reclaimed wastewater at Outfall 002 is distributed on land for dissipation by evapotranspiration and controlled seepage. There are three other outflows used for emergency overflows.

Treatment Processes

The 2004 NPDES permit for the facility lists current treatment processes as headworks with screening and degritting, primary clarification, anoxic selector activated sludge secondary treatment and clarification, effluent filtration, and ultraviolet disinfection. Treated wastewater is discharged to either the Pudding River (outfall 001) or a poplar tree plantation (outfall 002). Sludge is anaerobically digested, stored in facultative sludge lagoons, and land applied on the poplar plantation.

Effluent Data and Limits

Exhibit A-68 summarizes monitoring data from June 2003 to March 2006 for those pollutants of concern for which effluent data are available. The facility does not have effluent limits for any toxic pollutants.

Exhibit A-68. Effluent Data Summary, Woodburn WWTP[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
1,1,2,2-Tetrachloroethane	2	2	0.5	-	-	-
1,1,2-Trichloroethane	4	4	0.5	-	-	-
1,1-Dichloroethylene	2	2	0.5	-	-	-
1,2,4-Trichlorobenzene	2	2	6.3	-	-	-
1,2-Dichlorobenzene	4	4	6.3	-	-	-
1,2-Dichloroethane	2	2	0.5	-	-	-
1,2-Dichloropropane	2	2	0.5	-	-	-
1,2-Diphenylhydrazine	2	2	6.3	-	-	-
1,3-Dichlorobenzene	4	4	6.3	-	-	-
1,4-Dichlorobenzene	4	4	6.3	-	-	-
2,4,6-Trichlorophenol	2	2	4.4	-	-	-
2,4-Dichlorophenol	2	2	4.4	-	-	-
2,4-Dimethylphenol	2	2	4.4	-	-	-
2,4-Dinitrophenol	2	2	4.4	-	-	-
2,4-Dinitrotoluene	2	2	12.6	-	-	-

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Exhibit A-68. Effluent Data Summary, Woodburn WWTP[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
2-Chloronaphthalene	2	2	6.3	-	-	-
2-Chlorophenol	2	2	4.4	-	-	-
3,3'-Dichlorobenzidine	2	2	12.6	-	-	-
4,4'-DDD	2	2	20	-	-	-
4,4'-DDE	2	2	10	-	-	-
4,4'-DDT	2	2	20	-	-	-
Acenaphthene	2	2	6.3	-	-	-
Acrolein	2	2	100	-	-	-
Acrylonitrile	2	2	10	-	-	-
Aldrin	2	2	10	-	-	-
Alpha-BHC	2	2	5	-	-	-
Anthracene	2	2	6.3	-	-	-
Antimony	2	2	200	-	-	-
Arsenic	8	1	10	6.78	4.12	2.82
Benzene	2	2	0.5	-	-	-
Benzidine	2	2	7.4	-	-	-
Benzo(a) Anthracene	2	2	6.3	-	-	-
Benzo(a) Pyrene	2	2	6.3	-	-	-
Benzo(b) Fluoranthene	2	2	6.3	-	-	-
Benzo(k) Fluoranthene	2	2	6.3	-	-	-
Beryllium	2	2	10	-	-	-
Beta-BHC	2	2	10	-	-	-
Bis(2-Chloroethyl) Ether	2	2	6.3	-	-	-
Bis(2-Chloroisopropyl) Ether	2	2	6.3	-	-	-
Bis(2-Ethylhexyl) Phthalate	2	0	0	17.9	17.9	17.9
Bromoform	2	2	0.5	-	-	-
Butylbenzyl Phthalate	2	2	6.3	-	-	-
Carbon Tetrachloride	2	2	0.5	-	-	-
Chlordane	2	2	10	-	-	-
Chlorobenzene	2	2	0.5	-	-	-
Chlorodibromomethane	2	2	0.5	-	-	-
Chloroform	2	2	0.5	-	-	-
Chrysene	2	2	6.3	-	-	-
Dibenzo(a,h)Anthracene	2	2	6.3	-	-	-
Dieldrin	2	2	10	-	-	-
Diethyl Phthalate	2	2	6.3	-	-	-
Dimethyl Phthalate	2	2	6.3	-	-	-
Di-N-Butyl Phthalate	2	2	6.3	-	-	-
Endosulfan Sulfate	2	2	20	-	-	-
Endrin	2	2	10	-	-	-
Endrin Aldehyde	2	2	25	-	-	-
Ethylbenzene	2	2	0.5	-	-	-
Fluoranthene	2	2	6.3	-	-	-
Fluorene	2	2	6.3	-	-	-

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Exhibit A-68. Effluent Data Summary, Woodburn WWTP[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
Gamma-BHC	2	2	4.4	-	-	-
Heptachlor	2	2	10	-	-	-
Heptachlor Epoxide	2	2	10	-	-	-
Hexachlorobenzene	2	2	6.3	-	-	-
Hexachlorobutadiene	2	2	6.3	-	-	-
Hexachlorocyclopentadiene	2	2	31.5	-	-	-
Hexachloroethane	2	2	6.3	-	-	-
Ideno(1,2,3-cd)Pyrene	2	2	6.3	-	-	-
Isophorone	2	2	6.3	-	-	-
Mercury[3]	2	2	0.01	-	-	-
Methyl Bromide	2	2	0.5	-	-	-
Methylene Chloride	2	2	0.5	-	-	-
Nickel	5	0	0	0.89	0.21	0.026
Nitrobenzene	2	2	6.3	-	-	-
N-Nitrosodimethylamine	2	2	6.3	-	-	-
N-Nitrosodi-n-Propylamine	2	2	6.3	-	-	-
N-Nitrosodiphenylamine	2	2	6.3	-	-	-
PCBs[4]	2	2	0.25	-	-	-
Pentachlorophenol	2	2	22	-	-	-
Phenol	2	2	4.4	-	-	-
Pyrene	2	2	6.3	-	-	-
Selenium	5	3	100	0.43	0.39	0.36
Tetrachloroethylene	2	2	0.5	-	-	-
Thallium	2	2	200	-	-	-
Toluene	2	2	0.5	-	-	-
Toxaphene	2	2	200	-	-	-
Trichloroethylene	2	2	0.5	-	-	-
Vinyl Chloride	2	2	0.5	-	-	-

QL = Quantification limit.
1. Represents effluent data from February 1999 to March 2006.
2. May not match approved QLs because data was collected prior to November 2007 when ODEQ revised applicable QLs.
3. Represents data analyzed using Method 1631 only because the facility's current permit requires special monitoring of mercury using clean analytical methods.
4. Represents the lowest QL for the 7 congeners sampled (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, and Aroclor 1260).

Receiving Water Data

Exhibit A-69 summarizes data for the Pudding River above the mixing zone from April 2005 to April 2006 for those pollutants of concern for which ambient data are available.

Exhibit A-69. Ambient Data Summary, City of Woodburn WWTP[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL (µg/L)	Maximum	Geometric Mean	Minimum

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Exhibit A-69. Ambient Data Summary, City of Woodburn WWTP[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL (µg/L)	Maximum	Geometric Mean	Minimum
Arsenic	2	0	-	0.46	0.14	0.042
Mercury	3	0	-	0.00196	0.0017	0.00139
Nickel	2	0	-	0.34	0.11	0.036
Selenium	2	2	0.6	-	-	-

QL = Quantification limit.
1. Represents ambient data from April 2005 to April 2006.

Potential Impacts

Baseline (Revised) Criteria

Exhibit A-70 summarizes the RPA for baseline criteria for those pollutants detected in the effluent (there will be no RP or monitoring requirements if all observations are nondetect). The Pudding River is a freshwater river; thus, human health criteria for consumption of organisms and water are applicable. Based on the chronic mixing zone factors in the facility's existing permit, the dilution factor is 1.2. The Pudding River at river mile 21.4 is on the state's 303(d) list for DDT; thus the facility would not receive dilution for this pollutant.

Exhibit A-70. RPA for Baseline Criteria, Woodburn WWTP

Parameter	Calculated Effluent Conc.[1] (µg/L)	Ambient Conc.[2] (µg/L)	Conc. at Edge of Mixing Zone[3] (µg/L)	Human Health Criterion (µg/L)	Reasonable Potential
Arsenic	7.82	0.14	7.82	0.0022	**Yes**
Bis(2-Ethylhexyl) Phthalate	67.9	0.0	42.5	1.2	**Yes**
Nickel	2.07	0.11	1.33	13.4	No
Selenium	1.0	0.0	0.63	10	No

1. Represents the calculated geometric mean concentration for carcinogens and the calculated maximum concentration for noncarcinogens based on a CV of 0.6 for all pollutants (see Section 3.2).
2. Represents the geometric mean of detected values and zero if data are not available or if all values are nondetect.
3. Dilution based on chronic mixing zone factor in facility's existing permit (factor = 1.2).

As shown in the exhibit, the facility has RP to exceed the baseline criteria for arsenic and bis(2-ethylhexyl) phthalate because the concentrations at the edge of the regulatory mixing zone are greater than the applicable existing human health criteria.

Arsenic

Although ambient concentrations are greater than the criterion, the Pudding River is not on the state's 303(d) list as impaired for arsenic. Regardless, the facility would be discharging above allowable levels and would be required to reduce discharge concentrations to background (if ambient concentrations are determined to represent natural levels) or the approved QL of 0.05 µg/L (because the criterion is below the QL).

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Arsenic and arsenic-containing chemicals are not used in wastewater treatment. The City's drinking water comes from six groundwater wells. The 2005 drinking water quality report indicates that arsenic concentrations in drinking water range from 5 µg/L to 12 µg/L (Woodburn Public Works, 2005). Use of this groundwater enters the sanitary sewer system and becomes influent water to the wastewater treatment plant. Because the source of arsenic to the wastewater treatment facility is likely the City's drinking water, the facility would likely pursue intake credits or a variance. There would be no compliance costs associated with an intake credit scenario. The one-time cost associated with pursuing a variance could range from $35,000 to $100,000, with minimal costs associated with renewal.

Bis(2-Ethylhexyl) Phthalate

Under existing procedures, the applicable AMEL is 1.9 µg/L and the MDEL is 3.8 µg/L. Bis-(2-ethylhexyl) phthalate is found mainly in plastics and is used as a plasticizer for polyvinylchloride (PVC) and other polymers. The plasticizer can be released from plastics manufacturing wastes or through release from plastic goods (Environment Canada, 1994). The facility's permit indicates that it has one categorical industrial user and 3 significant industrial users, the exact types of which are not specified. If additional testing indicates that bis(2-ethylhexyl) phthalate is the result of indirect industrial dischargers the facility would need to impose more stringent pretreatment limits or implement source controls to prevent bis(2-ethylhexyl) phthalate from entering the treatment plant.

High levels of bis(2-ethylhexyl) phthalate in municipal wastewater effluent can also be associated with sampling and/or laboratory analysis conditions (Fairfield-Suisun SD, 2003). If this is the case, cleaner sampling and analysis techniques could reduce the amount of bis(2-ethylhexyl) phthalate measured in the effluent.

Therefore, costs for the facility could be minimal if cleaner sampling techniques result in lower effluent concentrations to approximately $50,000 for a source control program that targets indirect industrial dischargers of bis(2-ethylhexyl) phthalate.

Mercury

Under the baseline Willamette River Basin mercury TMDL, the facility would be required to develop and implement a mercury reduction strategy. Thus, even though all effluent values are nondetect and there is no RP, the facility would still incur P2 program costs under the baseline. Annual P2 program costs for a 3.3 mgd municipal facility may be approximately $100,000 (see Appendix B for details). As described in Appendix B, P2 costs also potentially include costs for indirect dischargers to implement controls (see Exhibit B-2). Based on information on the discharger's service area, incremental indirect discharger costs may be minimal (e.g., there are no universities in the service area). However, because ODEQ does not assign individual wasteload allocations to point source dischargers in the TMDL (point sources as a whole are required to reduce existing load by 26%), it is uncertain whether the facility would incur costs beyond those for a P2 program to meet the wasteload allocation under the baseline TMDL.

ED_002991_00017305-00175

Revised Criteria

Exhibit A-71 summarizes the RPA for the revised human health criteria for consumption of water and organisms for those pollutants detected in the effluent (there will be no RP or monitoring requirements if all observations are nondetect).

Exhibit A-71. RPA for Revised Criteria, Woodburn WWTP

Parameter	Conc. at Edge of Mixing Zone[1] (µg/L)	Human Health Criteria at Alternative FCRs (µg/L)				
		63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
Arsenic	7.82	**0.0083***	**0.0057***	**0.0041***	**0.0021***	**0.0014***
Bis(2-Ethylhexyl) Phthalate	42.5	**0.49***	**0.30***	**0.20***	**0.095***	**0.061***
Nickel	1.33	280	190	140	69.0	45.0
Selenium	0.63	150	140	120	91.0	70.0

*Bolded values represent RP equal to "Yes."
FCRs = Fish consumption rates.
1. Dilution based on chronic mixing zone factor in facility's existing permit (factor = 1.2).

As shown in the exhibit, the discharger could have RP for arsenic and bis(2-ethylhexyl) phthalate based on the alternative fish consumption rates.

Arsenic

The discharger would have RP for arsenic at all fish consumption rates. Thus, because the ambient concentration is greater than the criteria, the discharger would need to reduce discharge concentrations to background (if ODEQ determines that ambient concentrations represent natural levels) or the approved QL of 0.05 µg/L (because the criterion is below the QL) for compliance with revised standards. However, under the baseline, the discharge would need to meet those same levels. Thus, incremental compliance costs are unlikely.

Bis(2-ethylhexyl) Phthalate

The discharger would have RP for bis(2-ethylhexyl) phthalate at all fish consumption rates. **Exhibit A-72** shows the projected effluent limits for these consumption rates.

Exhibit A-72. Projected Effluent Limits for Bis(2-ethylhexyl) Phthalate, Woodburn WWTP

Limit Type	Fish Consumption Rate				
	63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
AMEL (µg/L)	0.78	0.48	0.32	0.15	0.098
MDEL (µg/L)	1.6	0.96	0.64	0.30	0.20

Based on existing effluent data, the discharger would need to reduce effluent bis(2-ethylhexyl) phthalate concentrations for compliance with the projected limits shown in the exhibit. The current approved QL for bis(2-ethylhexyl) phthalate is 1 µg/L. Therefore, the discharger would only have to reduce concentrations to below the QL for compliance with the projected limits; controls for these consumption rates would not differ.

ED_002991_00017305-00176

As described in the baseline analysis, the discharger would either switch to cleaner sampling techniques or implement a P2 program for compliance with baseline limits. The baseline P2 program includes source identification and implementation of control measures for those sources. It is uncertain the magnitude of reductions achievable through a P2 program because the specific sources have not yet been identified. However, given that bis(2-ethylhexyl) phthalate is widespread throughout a municipal collection system, the City would likely target any controllable source as part of compliance with baseline standards, and that those actions would also result in compliance with the revised criteria (i.e., effluent levels below the QL). Thus, incremental compliance costs are unlikely.

Summary

Exhibit A-73 provides a summary of the incremental impacts associated with the revised criteria in comparison to the impacts associated with baseline criteria. For each fish consumption rate the incremental impacts represent the controls and costs above and beyond those needed for compliance with baseline criteria. Under a variance scenario for arsenic, one-time expenditures could range from $35,000 to $100,000.

Exhibit A-73. Summary of Potential Costs, Woodburn WWTP

Alternative	Compliance Scenario	Total Annual Costs	Incremental Annual Costs[1]
Baseline	• Intake credits or a variance (arsenic) • Cleaner sampling or P2 program [bis(2-ethylhexyl) phthalate] • P2 program (mercury)	$100,000 - $150,000	NA
63.2 gpd	• Intake credits or a variance (arsenic) • Cleaner sampling or P2 program [bis(2-ethylhexyl) phthalate] • P2 program (mercury)	$100,000 - $150,000	$0
113 gpd	• Intake credits or a variance (arsenic) • Cleaner sampling or P2 program [bis(2-ethylhexyl) phthalate] • P2 program (mercury)	$100,000 - $150,000	$0
175 gpd	• Intake credits or a variance (arsenic) • Cleaner sampling or P2 program [bis(2-ethylhexyl) phthalate] • P2 program (mercury)	$100,000 - $150,000	$0
389 gpd	• Intake credits or a variance (arsenic) • Cleaner sampling or P2 program [bis(2-ethylhexyl) phthalate] • P2 program (mercury)	$100,000 - $150,000	$0
620 gpd	• Intake credits or a variance (arsenic) • Cleaner sampling or P2 program [bis(2-ethylhexyl) phthalate] • P2 program (mercury)	$100,000 - $150,000	$0

NA = Not applicable.

1. Annual costs for baseline criteria represent the costs needed for compliance under existing conditions; costs for revised criteria represent the difference between total annual cost and baseline costs (i.e., incremental costs above and beyond those needed for compliance with baseline criteria).

ED_002991_00017305-00177

City of Shady Cove Wastewater Treatment Plant

Facility Description

The City of Shady Grove Wastewater Treatment Plant (NPDES permit number OR0030660) treats wastewater generated from homes and businesses in the City of Shady Cove. Two homes outside the city limits are also connected to the collection system because of failed septic systems. The plant opened in 1980 and is located on the west bank of the Rogue River about 1.5 miles southwest of town. Classified by ODEQ as a minor municipal, the ADWDF is 0.45 mgd. Treated wastewater flows through a 6-inch Parshall flume and is discharged through Outfall 001 to the Rogue River year-round at river mile 143.1. Outfall 002 is for emergency overflows to be discharged into the Rogue River.

Treatment Processes

The 2002 NPDES permit for the facility lists current treatment processes as preliminary screening, two aeration basins, two secondary clarifiers, two sand filters, and a chlorine contact chamber for disinfection. Waste secondary sludge is pumped to the aerobic digesters with surface aeration. After digestion, sludge is dewatered by a vertical screw thickener. The thickened sludge is discharged to a paved and covered drying bed.

Effluent Data and Limits

There are no effluent data available for the pollutants of concern because minor facilities are not currently required to monitor for toxic pollutants. Also, the facility does not have effluent limits for any toxic pollutants in its current permit.

Receiving Water Data

There are no upstream ambient data available for this facility.

Potential Impacts

The facility discharges less than 0.5 mgd of treated effluent to the Rogue River. The dilution factor at the edge of the mixing zone is 161.4 to 1 during critical low flow conditions for aquatic life; human health dilution factors are likely to be of similar magnitude. Thus, given such a large dilution factor and the fact that by definition minor facilities do not discharge toxic pollutants in toxic amounts, it is unlikely that the facility would have RP to cause or contribute to exceedances of the baseline criteria or the revised criteria based on alternative fish consumption rates. It is also unlikely that ODEQ would require toxic pollutant monitoring as a result of the revised criteria.

ED_002991_00017305-00178

Blue Heron Paper Company, Oregon City

Facility Description

The Blue Heron Paper Company is a paper mill located along the east bank of the Willamette River in Oregon City, Oregon (NPDES permit number OR0000566). The facility manufactures newsprint and other similar types of papers from a mixture of recycled newspapers and magazines, wood chips, and purchased pulp. ODEQ classifies the facility as a major discharger. Wastewater from the facility is generated in five primary areas: the paper machine process, the deinking process, filter plant backwash, the steam plant, and the bleach plant. Wastewater from the process, steam plant, and bleach plant, along with any storm water runoff is treated and discharged through outfall 001. Wastewater from the filter plant is discharged through outfall 002. Outfalls 003, 004, and 005 are rarely used and handle only small discharges of miscellaneous wastewater. The facility's permit indicates that total flows from the facility total 9.7 mgd.

Treatment Processes

The 2006 NPDES permit for the facility indicates that the process wastewater is sent to a primary clarifier for primary sedimentation. The primary clarifier solids are dewatered and used as bedding for dairy cattle or land applied. Effluent from the primary clarifier is sent to an aerated stabilization basin before being discharged to the Willamette River.

Effluent Data and Limits

Exhibit A-74 summarizes monitoring data from May of 2004 for those pollutants of concern for which effluent data are available. The facility does not have effluent limits for any toxic pollutants.

Exhibit A-74. Effluent Data Summary, Blue Heron Paper Company[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
1,1,2,2-Tetrachloroethane	1	1	2	-	-	-
1,1,2-Trichloroethane	1	1	2	-	-	-
1,1-Dichloroethylene	1	1	2	-	-	-
1,2-Dichlorobenzene	1	1	2	-	-	-
1,2-Dichloropropane	1	1	2	-	-	-
1,2-Diphenylhydrazine	1	1	9.62	-	-	-
1,2-Trans-Dichloroethylene	1	1	2	-	-	-
1,3-Dichlorobenzene	1	1	2	-	-	-
1,4-Dichlorobenzene	1	1	2	-	-	-
2,3,7,8-TCDD (Dioxin)	1	1	9.5E-06	-	-	-
2,4-Dichlorophenol	1	1	9.62	-	-	-
2,4-Dimethylphenol	1	1	19.2	-	-	-
2,4-Dinitrophenol	1	1	48.1	-	-	-
2,4-Dinitrotoluene	1	1	9.62	-	-	-

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Exhibit A-74. Effluent Data Summary, Blue Heron Paper Company[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
2-Chloronaphthalene	1	1	9.62	-	-	-
2-Chlorophenol	1	1	9.62	-	-	-
2-Methyl-4,6-Dinitrophenol	1	1	19.2	-	-	-
3,3'-Dichlorobenzidine	1	1	9.62	-	-	-
4,4'-DDD	1	1	0.1	-	-	-
4,4'-DDE	1	1	0.1	-	-	-
4,4'-DDT	1	1	0.5	-	-	-
Acenaphthene	1	1	9.62	-	-	-
Aldrin	1	1	0.1	-	-	-
alpha-BHC	1	1	0.1	-	-	-
Anthracene	1	1	9.62	-	-	-
Antimony	1	1	1	-	-	-
Arsenic	1	1	1	-	-	-
Benzene	1	1	2	-	-	-
Benzidine	1	1	115	-	-	-
Benzo(a) Anthracene	1	1	9.62	-	-	-
Benzo(a) Pyrene	1	1	9.62	-	-	-
Benzo(b) Fluoranthene	1	1	9.62	-	-	-
Benzo(k) Fluoranthene	1	1	9.62	-	-	-
Beryllium	1	1	1	-	-	-
beta-BHC	1	1	0.1	-	-	-
Bis(2-Chloroethyl) Ether	1	1	9.62	-	-	-
Bis(2-Chloroisopropyl) Ether	1	1	19.2	-	-	-
Bis(2-Ethylhexyl) Phthalate	1	1	19.2	-	-	-
Bromoform	1	1	2	-	-	-
Carbon Tetrachloride	1	1	2	-	-	-
Chlorobenzene	1	1	2	-	-	-
Chloroform	1	1	2	-	-	-
Chrysene	1	1	9.62	-	-	-
Dibenzo(a,h)Anthracene	1	1	9.62	-	-	-
Dichlorobromomethane	1	1	2	-	-	-
Dieldrin	1	1	0.1	-	-	-
Diethyl Phthalate	1	1	9.62	-	-	-
Dimethyl Phthalate	1	1	9.62	-	-	-
Di-n-Butyl Phthalate	1	1	9.62	-	-	-
Endosulfan Sulfate	1	1	0.1	-	-	-
Endrin	1	1	0.1	-	-	-
Endrin Aldehyde	1	1	0.1	-	-	-
Ethylbenzene	1	1	2	-	-	-
Fluoranthene	1	1	9.62	-	-	-
Fluorene	1	1	9.62	-	-	-
Gamma-BHC	1	1	0.1	-	-	-
Heptachlor	1	1	0.1	-	-	-
Heptachlor Epoxide	1	1	0.1	-	-	-

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Exhibit A-74. Effluent Data Summary, Blue Heron Paper Company[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
Hexachlorobenzene	1	1	9.62	-	-	-
Hexachlorobutadiene	1	1	19.2	-	-	-
Hexachlorocyclopentadiene	1	1	19.2	-	-	-
Hexachloroethane	1	1	19.2	-	-	-
Ideno(1,2,3-cd)Pyrene	1	1	9.62	-	-	-
Isophorone	1	1	9.62	-	-	-
Mercury	4	0	-	0.20	0.017	0.0013
Methylene Chloride	1	1	5	-	-	-
Nitrobenzene	1	1	9.62	-	-	-
N-Nitrosodimethylamine	1	1	9.62	-	-	-
N-Nitrosodi-n-Propylamine	1	1	19.2	-	-	-
N-Nitrosodiphenylamine	1	1	9.62	-	-	-
PCBs[3]	1	1	0.5	-	-	-
Pentachlorophenol	1	1	19.2	-	-	-
Phenol	1	1	9.62	-	-	-
Pyrene	1	1	9.62	-	-	-
Tetrachloroethylene	1	1	2	-	-	-
Toluene	1	1	2	-	-	-
Toxaphene	1	1	5	-	-	-
Trichloroethylene	1	1	2	-	-	-
Vinyl Chloride	1	1	2	-	-	-

QL = Quantification limit.
1. Represents effluent data from May 2004.
2. May not match approved QLs because data was collected prior to November 2007 when ODEQ revised applicable QLs.
3. Represents the lowest QL for the 7 congeners sampled (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, and Aroclor 1260).

Receiving Water Data

There are no upstream ambient data available for this facility.

Potential Impacts

Baseline Criteria

Exhibit A-75 summarizes the RPA for baseline criteria for those pollutants detected in the effluent (there will be no RP or monitoring requirements if all observations are nondetect). The Willamette River is a freshwater river; thus, human health criteria for consumption of organisms and water are applicable. The Willamette River at river mile 27 (near the discharge) is on the state's 303(d) list as impaired for 4,4'-DDT, 4,4'-DDE, dieldrin, dioxin, mercury, and PCBs; thus, the facility would not receive dilution for these pollutants.

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Exhibit A-75. RPA for Baseline Criteria, Blue Heron Paper Company

Parameter	Calculated Effluent Conc.[1] (µg/L)	Ambient Conc.[2] (µg/L)	Conc. at Edge of Mixing Zone[3] (µg/L)	Human Health Criterion (µg/L)	Reasonable Potential
Mercury	0.52	0	0.52	0.017	**Yes**

1. Represents the calculated geometric mean concentration for carcinogens and the calculated maximum concentration for noncarcinogens based on a CV of 0.6 for all pollutants (see Section 3.2).
2. Represents the geometric mean of detected values and zero if data are not available or if all values are nondetect.
3. The facility' does not receive dilution for mercury because the river is already impaired.

As shown in the exhibit, the facility has RP to exceed the baseline criterion for mercury because the concentration at the edge of the regulatory mixing zone is greater than the applicable existing human health criterion.

Under existing conditions, the AMEL is 0.017 µg/L and the MDEL is 0.034 µg/L (i.e., based on criterion end-of-pipe because the water body is impaired). The maximum effluent concentration at the facility is 0.20 µg/L, which is greater than the projected limits. Thus, the discharger may need to implement controls to reduce effluent mercury concentrations for compliance with these limits. A mercury P2 program would enable the discharger to identify the sources of mercury and determine the most cost-effective measures for reducing mercury from those sources. In addition, under the baseline Willamette River Basin mercury TMDL, the facility would be required to develop and implement a mercury reduction strategy. However, because ODEQ does not assign individual wasteload allocations to point source dischargers in the TMDL (point sources as a whole are required to reduce existing load by 26%), it is uncertain whether the facility would incur costs beyond those for a P2 program to meet the wasteload allocation under the baseline TMDL.

Annual P2 program costs for an industrial facility may be approximately $25,000 (see Appendix B for details).

Revised Criteria

Exhibit A-76 summarizes the RPA for the revised human health criteria for consumption of water and organisms for those pollutants detected in the effluent (there will be no RP or monitoring requirements if all observations are nondetect).

Exhibit A-76. RPA for Revised Criteria, Blue Heron Paper Company

Parameter	Conc. at Edge of Mixing Zone[1] (µg/L)	Human Health Criteria (µg/L)				
		63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
Mercury[2]	0.52	**0.0047***	**0.0026***	**0.0017***	**0.00076***	**0.00048***

*Bolded values represent RP equal to "Yes."
1. Dilution based on values used in the facility's draft 2007 permit for human health pollutants (carcinogen factor = 143; noncarcinogens factor = 72).
2. Potential water column criteria based on the revised fish tissue criteria, calculated using EPA default BAFs, trophic level consumption percentages, and water column translator (see Section 4).

As shown in the exhibit, the discharger would have RP for mercury at all consumption rates. **Exhibit A-77** shows the AMELs and MDELs for each consumption rate. Note that because the

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Willamette River is on the 303(d) list for mercury, the discharger would receive effluent limits based on criteria end-of-pipe.

Exhibit A-77. Projected Effluent Limits for Mercury, Blue Heron Paper Company

Limit Type	Fish Consumption Rate				
	63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
Average Monthly Limit (μg/L)	0.0047	0.0026	0.0017	0.00076	0.00048
Maximum Daily Limit (μg/L)	0.0094	0.0052	0.0034	0.0015	0.00096

The maximum effluent concentration is greater than all of the AMELs and MDELs. The facility is already required to implement a mercury P2 program under the baseline as part of the Willamette Basin mercury TMDL. It is not clear how ODEQ would adapt the baseline TMDL to attain the revised criteria (e.g., increase point source load reduction requirements; establish individual effluent limits). Thus, it is uncertain whether continued implementation of the baseline P2 program would be sufficient for compliance with the revised criteria/TMDL because there could be some maximum level of effort beyond which a P2 program would not provide additional reductions.

Because there are no proven end-of-pipe treatment technologies that can achieve low mercury levels (e.g., <10 ng/L) on a consistent basis, dischargers may need to pursue a variance (e.g., based on manmade conditions that cannot be remedied) under more stringent TMDL requirements (alternatively, ODEQ may account for this situation in allocating loads under the TMDL). However, it is uncertain at which fish consumption rate the discharger would need a variance. One-time costs associated with pursuing a variance could range from $35,000 to $100,000. As part of a variance ODEQ, could require specific P2 program efforts. For dischargers covered under the Willamette River TMDL for mercury, these activities may already be included in their baseline mercury P2 requirement.

Summary

Exhibit A-78 provides a summary of the potential range in annual costs associated with the baseline and revised criteria. For the alternative fish consumption rates, the incremental costs represent any costs above and beyond those that would be needed for compliance with baseline criteria. Under a variance scenario for mercury under the alternative fish consumption rates, incremental costs could include a one-time expenditure of $35,000 to $100,000.

Exhibit A-78. Summary of Potential Costs, Blue Heron Paper Company

Alternative	Compliance Scenario	Total Annual Costs	Incremental Annual Costs[1]
Baseline	• P2 program (mercury)	$25,000	NA
63.2 gpd	• P2 program, possible variance (mercury)	$25,000	$0
113 gpd	• P2 program, possible variance (mercury)	$25,000	$0
175 gpd	• P2 program, possible variance (mercury)	$25,000	$0
389 gpd	• P2 program, possible variance (mercury)	$25,000	$0
620 gpd	• P2 program, possible variance (mercury)	$25,000	$0

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Exhibit A-78. Summary of Potential Costs, Blue Heron Paper Company

Alternative	Compliance Scenario	Total Annual Costs	Incremental Annual Costs[1]

NA = Not applicable.

1. Annual costs for baseline criteria represent the costs needed for compliance under existing conditions; costs for revised criteria represent the difference between total annual cost and baseline costs (i.e., incremental costs above and beyond those needed for compliance with baseline criteria).

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Heinz Food Company

Facility Description

The Heinz Food Company (NPDES number OR0002402) is located in Ontario, Oregon, and processes raw vegetables into frozen products. The facility primarily processes potatoes into consumer products including french fries, batter fries, Tater Tots, and hash browns. In a single day, the facility washes, sorts, peels, blanches, and cuts about 3.5 million pounds of raw potatoes, which are then further processed into frozen products. Depending on the product, the potato may also be dried, battered, and fried. Finished products are bagged, cased, and transferred to an adjacent cold storage warehouse. The facility generates about 3.4 mgd of wastewater primarily from wet processes that wash, sort, blanch, cut, and transfer potatoes and during clean-up and equipment sanitation. Wastewater is discharged to the Snake River at river mile 371.

Treatment Processes

The 2003 permit for the facility indicates that before discharge to the wastewater system, potato wash water is routed through settling basins to remove silt, and raw starch is separated and recovered from potato white water (pump and cutting water). The wastewater treatment system consists of headworks, primary clarification, activated sludge, and sludge dewatering. The facility employs extensive recycling/reuse of water for conservation and to minimize the quantity of wastewater that must be discharged; recycled water is treated by a sand filter and sodium hypochlorite disinfection.

Effluent Data and Limits

There are no data available for this facility; ODEQ has not required the facility to conduct a priority pollutant scan.

Receiving Water Data

There are no upstream ambient data available for this facility.

Potential Impacts

The 2003 permit evaluation indicates that, with the exception of chlorine and ammonia, toxic substances in amounts which may be harmful to aquatic life are either not present in the discharge or are present in small quantities that are within water quality standards. Thus, given this finding and the fact that ODEQ does not require the facility to monitor for priority pollutants, it is unlikely that the discharger would incur costs for compliance with baseline or revised criteria.

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Pope and Talbot Inc, Hasley

Facility Description

The Pope and Talbot, Hasley Mill (NPDES permit number OR0001074) is an integrated Kraft process pulp mill located in Hasley, Oregon. The facility produces bleached and unbleached pulp from Douglas fir wood chips. The plant consists of a pulp mill, chlorine dioxide generator, power and recovery, recausticizing process, water treatment, and wastewater treatment. ODEQ classifies the facility as a major discharger. Effluent from the facility is discharged into the Willamette River at river mile 147.7. Effluent flow data from EPA's PCS database indicate that average monthly flow from the facility is 10.3 mgd.

Treatment Processes

The draft 2007 NPDES permit for the facility indicates that the wastewater generated during the pulp production process is treated by primary clarification followed by biological treatment in two large aerated stabilization basins (ASB). The clarifier has a diameter of 200 feet and can hold approximately 2.8 million gallons. Solids from the primary clarifier are beneficially applied to nearby agricultural fields. The two aeration basins are operated in series and each has a capacity of 113 million gallons and a detention time of about 10 days. Following the aeration basins, the treated effluent is sent to a secondary settling pond with a size of 150 square feet.

Effluent Data and Limits

Exhibit A-79 summarizes monitoring data for those pollutants of concern for which effluent data are available (the sampling date for the data is unknown). The facility has load-based limits for dioxin of 0.3 mg/day as an annual average and 0.41 mg/day as a 3-day maximum in its draft 2007 permit.

Exhibit A-79. Effluent Data Summary, Pope and Talbot, Hasley[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
1,1,2,2-Tetrachloroethane	1	1	5	-	-	-
1,1,2-Trichloroethane	1	1	5	-	-	-
1,1-Dichloroethylene	1	1	5	-	-	-
1,2,4-Trichlorobenzene	1	1	9.5	-	-	-
1,2-Dichlorobenzene	1	1	9.5	-	-	-
1,2-Dichloropropane	1	1	5	-	-	-
1,2-Trans-Dichloroethylene	1	1	5	-	-	-
1,3-Dichlorobenzene	1	1	9.5	-	-	-
1,3-Dichloropropene	1	1	5	-	-	-
1,4-Dichlorobenzene	1	1	9.5	-	-	-
2,3,7,8-TCDD (Dioxin)	1	1	0.01	-	-	-
2,4,6-Trichlorophenol	1	1	9.5	-	-	-
2,4-Dichlorophenol	1	1	9.5	-	-	-
2,4-Dimethylphenol	1	1	9.5	-	-	-

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Exhibit A-79. Effluent Data Summary, Pope and Talbot, Hasley[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
2,4-Dinitrophenol	1	1	24	-	-	-
2-Chloronaphthalene	1	1	9.5	-	-	-
2-Chlorophenol	1	1	9.5	-	-	-
3,3'-Dichlorobenzidine	1	1	24	-	-	-
4,4'-DDD	1	1	0.048	-	-	-
4,4'-DDE	1	1	0.048	-	-	-
4,4'-DDT	1	1	0.059	-	-	-
Acenaphthene	1	1	9.5	-	-	-
Acrolein	1	1	50	-	-	-
Aldrin	1	1	0.048	-	-	-
alpha-BHC	1	1	0.048	-	-	-
Anthracene	2	2	9.5	-	-	-
Antimony	1	0	0	0.51	0.51	0.51
Arsenic	1	0	0	1.8	1.8	1.8
Benzene	1	1	5	-	-	-
Benzidine	1	1	48	-	-	-
Benzo(a) Anthracene	1	1	9.5	-	-	-
Benzo(a) Pyrene	1	1	9.5	-	-	-
Beryllium	1	1	0.02	-	-	-
beta-BHC	1	1	0.048	-	-	-
Bis(2-Chloroethyl) Ether	1	1	9.5	-	-	-
Bis(2-Chloroisopropyl) Ether	1	1	9.5	-	-	-
Bis(2-Ethylhexyl) Phthalate	1	1	9.5	-	-	-
Bromoform	1	1	5	-	-	-
Carbon Tetrachloride	1	1	5	-	-	-
Chlordane	1	1	0.96	-	-	-
Chlorobenzene	1	1	5	-	-	-
Chlorodibromomethane	1	1	5	-	-	-
Chloroform	1	1	5	-	-	-
Chrysene	1	1	9.5	-	-	-
Dichlorobromomethane	1	1	5	-	-	-
Dieldrin	1	1	0.048	-	-	-
Diethyl Phthalate	1	1	9.5	-	-	-
Dimethyl Phthalate	1	1	9.5	-	-	-
Di-n-Butyl Phthalate	1	1	9.5	-	-	-
Endrin	1	1	0.048	-	-	-
Endrin Aldehyde	1	1	0.048	-	-	-
Ethylbenzene	1	1	5	-	-	-
Fluoranthene	2	2	9.5	-	-	-
Fluorene	1	1	9.5	-	-	-
Gamma-BHC	1	1	0.048	-	-	-
Heptachlor	1	1	0.084	-	-	-
Hexachlorobenzene	1	1	9.5	-	-	-
Hexachlorobutadiene	1	1	9.5	-	-	-

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Exhibit A-79. Effluent Data Summary, Pope and Talbot, Hasley[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
Hexachlorocyclopentadiene	1	1	9.5	-	-	-
Hexachloroethane	1	1	9.5	-	-	-
Ideno(1,2,3-cd)Pyrene	1	1	9.5	-	-	-
Isophorone	1	1	9.5	-	-	-
Mercury	1	0	0	0.0073	0.0073	0.0073
Methyl Bromide	1	1	5	-	-	-
Methylene Chloride	1	1	5	-	-	-
Nickel	1	0	0	7.8	7.8	7.8
Nitrobenzene	1	1	9.5	-	-	-
N-Nitrosodi-n-Propylamine	1	1	9.5	-	-	-
N-Nitrosodiphenylamine	1	1	9.5	-	-	-
PCBs[3]	1	1	0.096	-	-	-
Pentachlorophenol	1	1	24	-	-	-
Phenol	1	1	9.5	-	-	-
Pyrene	1	1	9.5	-	-	-
Selenium	1	1	1	-	-	-
Tetrachloroethylene	1	1	5	-	-	-
Thallium	1	1	0.02	-	-	-
Toluene	1	1	5	-	-	-
Toxaphene	1	1	2.4	-	-	-
Trichloroethylene	1	1	5	-	-	-
Vinyl Chloride	2	2	10	-	-	-

QL = Quantification limit.
1. Represents effluent data for the facility (sampling date for data is unknown).
2. May not match approved QLs because data was collected prior to November 2007 when ODEQ revised applicable QLs.
3. Represents the lowest QL for the 7 congeners sampled (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, and Aroclor 1260).

Receiving Water Data

There are no upstream ambient data available for this facility.

Potential Impacts

Baseline Criteria

Exhibit A-80 summarizes the RPA for baseline criteria for those pollutants detected in the effluent (there will be no RP or monitoring requirements if all observations are nondetect). The Willamette River is a freshwater river; thus, human health criteria for consumption of organisms and water are applicable. The dilution factors are based on values provided in the facility's draft 2007 permit for human health pollutants. The Willamette River at river mile 147.7 is on the state's 303(d) list as impaired for dioxin and mercury; thus, the facility would not receive dilution for these pollutants.

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Exhibit A-80. RPA for Baseline Criteria, Pope and Talbot, Hasley

Parameter	Calculated Effluent Conc.[1] (µg/L)	Ambient Conc.[2] (µg/L)	Conc. at Edge of Mixing Zone[3] (µg/L)	Human Health Criterion (µg/L)	Reasonable Potential
Antimony	3.16	0	0.044	5.6	No
Arsenic	11.2	0	0.078	0.0022	**Yes**
Mercury	0.045	0	0.045	0.017	**Yes**
Nickel	48.3	0	0.67	13.4	No

1. Represents the calculated geometric mean concentration for carcinogens and the calculated maximum concentration for noncarcinogens based on a CV of 0.6 for all pollutants (see Section 3.2).
2. Represents the geometric mean of detected values and zero if data are not available or if all values are nondetect.
3. Dilution based on values used in the facility's draft 2007 permit for human health pollutants (carcinogen factor = 143; noncarcinogens factor = 72).

As shown in the exhibit, the facility has RP to exceed the baseline criterion for arsenic and mercury because the concentrations at the edge of the regulatory mixing zone are greater than the applicable existing human health criteria.

Arsenic

The facility's draft 2007 permit indicates that ODEQ does not consider it to be a significant contributor of arsenic according to ODEQ (2005) criteria, and the draft permit only requires additional arsenic testing using ultra clean methods to obtain lower detection limits. Thus, it is possible that the facility would not incur costs associated with baseline criteria.

However, if the draft permit does not represent actual baseline (final permit) requirements, the facility may be required to reduce discharge concentrations to projected effluent limits of 0.31 µg/L (AMEL) and 0.63 µg/L (MDEL). As mentioned above, the facility produces bleached and unbleached pulp from Douglas fir wood chips and does not use arsenic and arsenic-containing chemicals in the manufacturing process. Thus, the arsenic in the facility's effluent may be coming from an external source such as drinking water.

The facility operates a drinking water treatment plant that draws water from the Willamette River. Most arsenic samples (organic plus inorganic) from the surface waters since 1980 are nondetect below the minimum reporting levels; there was 1 detected value of 6 µg/L in 1983 (ODHS, 2007h). The minimum reporting levels are not specified, and the drinking water maximum contaminant level is 10 µg/L, which is higher than current wastewater effluent concentrations and human health criteria. Although it is not possible to determine from these data with any certainty whether drinking water is contributing to high arsenic levels in the wastewater effluent, drinking water is a potential source. There would be no compliance costs associated with an intake credit scenario. The one-time cost associated with pursuing a variance could range from $35,000 to $100,000, with minimal costs associated with renewal.

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Mercury

Under existing conditions, the AMEL is 0.017 µg/L and the MDEL is 0.034 µg/L (i.e., based on criterion end-of-pipe because the water body is impaired). The maximum effluent concentration at the facility is 0.0073 µg/L, which is less than the projected limits.

Under the baseline Willamette River Basin mercury TMDL, the facility would be required to develop and implement a mercury reduction strategy. Annual P2 program costs for an industrial facility may be approximately $25,000 (see Appendix B for details). However, because ODEQ does not assign individual wasteload allocations to point source dischargers in the TMDL (point sources as a whole are required to reduce existing load by 26%), it is uncertain whether the facility would incur costs beyond those for a P2 program to meet the wasteload allocation under the baseline TMDL.

Revised Criteria

Exhibit A-81 summarizes the RPA for the revised human health criteria for consumption of water and organisms for those pollutants detected in the effluent (there will be no RP or monitoring requirements if all observations are nondetect).

Exhibit A-81. RPA for Revised Criteria, Pope and Talbot, Hasley

Parameter	Conc. at Edge of Mixing Zone[1] (µg/L)	Human Health Criteria at Alternative FCRs (µg/L)				
		63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
Antimony	0.044	5.40	5.30	5.10	4.70	4.30
Arsenic	0.078	**0.0083***	**0.0057***	**0.0041***	**0.0021***	**0.0014***
Mercury[2]	0.045	**0.0047***	**0.0026***	**0.0017***	**0.00076***	**0.00048***
Nickel	0.67	280	190	140	69.0	45.0

*Bolded values represent RP equal to "Yes."
FCRs = Fish consumption rates.
1. Dilution based on values used in the facility's draft 2007 permit for human health pollutants (carcinogen factor = 143; noncarcinogens factor = 72).
2. Potential water column criteria based on the revised fish tissue criteria, calculated using EPA default BAFs, trophic level consumption percentages, and water column translator (see Section 4).

As shown in the exhibit, the discharger could have RP for arsenic and mercury based on the alternative fish consumption rates.

Arsenic

The discharger would have RP for arsenic at all fish consumption rates. **Exhibit A-82** shows the projected effluent limits for these consumption rates.

Exhibit A-82. Projected Effluent Limits for Arsenic, Pope and Talbot, Hasley

Limit Type	Fish Consumption Rate				
	63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
AMEL (µg/L)	1.2	0.82	0.59	0.30	0.20
MDEL (µg/L)	2.4	1.6	1.2	0.60	0.40

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The maximum effluent concentration is greater than all the projected effluent limits. As described in the baseline analysis, the discharger would likely pursue a variance or intake credits for compliance because arsenic is likely coming from an external source such as drinking water. The discharger would likely pursue the same actions for compliance with the revised criteria. Thus, incremental compliance costs are unlikely.

Mercury

The discharger would have RP for mercury at all consumption rates. **Exhibit A-83** shows the AMELs and MDELs for each consumption rate. Note that because the Willamette River is on the 303(d) list for mercury, the discharger would receive effluent limits based on criteria end-of-pipe.

Exhibit A-83. Projected Effluent Limits for Mercury, Pope and Talbot, Hasley

Limit Type	Fish Consumption Rate				
	63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
AMEL (µg/L)	0.0047	0.0026	0.0017	0.00076	0.00048
MDEL (µg/L)	0.0094	0.0052	0.0034	0.0015	0.00096

The maximum effluent concentration is greater than all the projected limits. The facility is already required to implement a mercury P2 program under the baseline as part of the Willamette Basin mercury TMDL. It is not clear how ODEQ would adapt the baseline TMDL to attain the revised criteria (e.g., increase point source load reduction requirements; establish individual effluent limits). Thus, it is uncertain whether continued implementation of the baseline P2 program would be sufficient for compliance with the revised criteria/TMDL because there could be some maximum level of effort beyond which a P2 program would not provide additional reductions.

Because there are no proven end-of-pipe treatment technologies that can achieve low mercury levels (e.g., <10 ng/L) on a consistent basis, dischargers may need to pursue a variance (e.g., based on manmade conditions that cannot be remedied) under more stringent TMDL requirements (alternatively, ODEQ may account for this situation in allocating loads under the TMDL). However, it is uncertain at which fish consumption rate the discharger would need a variance. If the discharger pursues a variance for arsenic, these efforts would also cover a variance for mercury. Otherwise, one-time costs associated with pursuing a variance could range from $35,000 to $200,000. As part of a variance ODEQ, could require specific P2 program efforts. For dischargers covered under the Willamette River TMDL for mercury, these activities may already be included in their baseline mercury P2 requirement.

Summary

Exhibit A-84 provides a summary of the potential range in annual costs associated with the baseline and revised criteria. For the alternative fish consumption rates, the incremental costs represent any costs above and beyond those that would be needed for compliance with baseline

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criteria. Under a variance scenario for arsenic and/or mercury, costs could include a one-time expenditure of approximately $35,000 to $200,000.

Exhibit A-84. Summary of Potential Costs, Pope and Talbot, Hasley

Alternative	Compliance Scenario	Total Annual Costs	Incremental Annual Costs[1]
Baseline	• Intake credits or variance (arsenic) • P2 program (mercury)	$25,000	NA
63.2 gpd	• Intake credits or variance (arsenic) • P2 program, possible variance (mercury)	$25,000	$0
113 gpd	• Intake credits or variance (arsenic) • P2 program, possible variance (mercury)	$25,000	$0
175 gpd	• Intake credits or variance (arsenic) • P2 program, possible variance (mercury)	$25,000	$0
389 gpd	• Intake credits or variance (arsenic) • P2 program, possible variance (mercury)	$25,000	$0
620 gpd	• Intake credits or variance (arsenic) • P2 program, possible variance (mercury)	$25,000	$0

NA = Not applicable.

1. Annual costs for baseline criteria represent the costs needed for compliance under existing conditions; costs for revised criteria represent the difference between total annual cost and baseline costs (i.e., incremental costs above and beyond those needed for compliance with baseline criteria).

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Reynolds Metals Company, Troutdale

Facility Description

The Reynolds Metals Company owns a facility in Troutdale, Oregon (NPDES permit number OR0000060) that was used for primary aluminum production. The plant was originally constructed in 1941 to produce aluminum for the U.S. government's wartime operations. The company purchased the plant from the government in 1949 and operated it until 2000 when production was suspended. In 2002, the company announced that the facility would be permanently closed and dismantled. As a result of past waste handling practices at the facility, several waste disposal areas, soils, and groundwater are contaminated. The site is currently on EPA's Superfund National Priorities List (NPL). The primary contaminants identified in the soils at the site include fluoride, cyanide, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs). The groundwater beneath the site contains a significant fluoride plume. Groundwater from deep production wells (average flow of 2.37 mgd) and shallow, focused extraction wells (average flow of 0.17 mgd) provide the majority of the discharge at Outfall 001. Deep production well water combines with contaminated, focused extraction well flows. Wastewater is discharged into the south ditch of the facility and from there is it discharged directly to the Columbia River at river mile 120.

Treatment Processes

The draft 2007 NPDES permit for the facility indicates that wastewater comes from pumped groundwater from deep production wells, shallow focused extraction wells, and small quantities of treated miscellaneous waste streams (e.g., laboratory sample analysis wastewater, sample basin water, monitoring well purge water, shallow groundwater and surface water pumped from dewatering activities for construction of subsurface infrastructure during property redevelopment, and occasional draw-down of groundwater in Company Lake). The permit does not specify the treatment processes, if any, that are associated with each source of wastewater.

Effluent Data and Limits

Toxicity testing for the draft 2007 permit indicates that only trace amounts of aluminum and nondetects for PAHs characterize groundwater pumped from the deep and shallow extraction wells at the facility. The draft permit does not specify monitoring results for any other toxic pollutants.

Receiving Water Data

There are no upstream ambient data available for this facility.

Potential Impacts

The facility's 2007 fact sheet indicates that all sampling data for PAHs are nondetect for groundwater pumped from the deep and shallow extraction wells. ODEQ's analysis indicates

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that there is no RP to cause acute or chronic toxicity outside the assigned mixing zone. The 2007 fact sheet also indicates that the facility does not have RP for any of the pollutants for which the Columbia River is impaired: aldrin, DDE, arsenic, and dioxin. Dioxin is typically a contact product of chlorine interacting with biological material, and the facility no longer uses chlorine for disinfection. Aldrin, DDE, and arsenic are not associated with groundwater. Thus, ODEQ concludes that based on permitted facility operations, there is no RP for any of these pollutants to be present in the treated groundwater discharged to the Columbia River. Therefore, it is unlikely that the facility would incur costs associated with meeting baseline or revised criteria.

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Boise Cascade, Elgin

Facility Description

Boise Building Solutions Manufacturing, LLC (BBSM) operates a stud mill and plywood manufacturing plant in Elgin, Oregon (NPDES permit number OR0002411). The facility includes a log storage yard (wet deck), veneer block vats and peeler, veneer lamination and dryer, saw mill, planer, boiler, lumber drying kilns, and product storage. ODEQ classifies the discharger as a minor industrial. The facility discharges process and nonprocess wastewaters, tile drain wastewater, and industrial storm water. Process wastewater includes veneer block sprinkling return flow, veneer dryer cleanup and deluge water, plywood press pit water (groundwater), kiln waters, filter backflush water, dry electrostatic precipitator (DESP) cleanup water, ash storage area runoff water, heavy equipment wash pad water, vat waters, and regenerative catalytic/thermal oxidizer (RCO-1) cleanup water. The facility discharges industrial storm water, boiler condensate, and fire system flush water through Outfall 001 and tile drain wastewater (groundwater collected from beneath the log yard) through Outfall 003 to Phillips Creek. Outfalls 001 and 003 are approximately located at river mile 1 on Phillips Creek.

Treatment Processes

The 2005 NPDES permit for the facility indicates that the commingled process and nonprocess wastewater and storm water flow by gravity to the Frog Pond. An emergency gravity overflow/bypass vault and basin is adjacent to the Frog Pond. From the Frog Pond, combined flows are pumped to a 3-acre settling pond/open water wetland (SP/OWW), which overflows to a 15-acre Process Water Storage Pond (PWSP). The SP/OWW consists of two cells. The first cell is lined with 60-mil high-density polyethylene liner and includes an oil skimmer system. The second cell provides additional primary treatment. PWSP capacity is approximately 51 million gallons. PWSP wastewater is irrigated on land application sites, sprinkled on decked logs or veneer blocks for log quality control, or it is applied to roads and other unpaved areas for dust suppression.

Effluent Data and Limits

The facility's permit evaluation report indicates that tile drain wastewater has elevated concentrations of iron, manganese and zinc, lacks appreciable oxygen and has very low turbidity; industrial storm water has elevated TSS. However, there are no data available for the toxic pollutants of concern.

Receiving Water Data

There are no upstream ambient data available for this facility.

Potential Impacts

Although there are no data available for the pollutants of concern, the draft revised permit indicates that the facility has RP for iron, manganese, and zinc. Instead of establishing WQBELs for which an exceedance would indicate noncompliance, the permit contains "benchmarks" that

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trigger action plans. If a similar approach is used for baseline and revised criteria, some level of costs associated with developing action plans could be incurred for those pollutants with RP that exceed established benchmarks. However, without effluent data or indication of basis for benchmark values, we cannot estimate potential costs.

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Oregon Steel Mills

Facility Description

Oregon Steel Mills (NPDES number OR0000451) is located in Portland, Oregon and operates a steel plate manufacturing plant. ODEQ classifies the discharger as a minor industrial discharge. The facility manufactures carbon steel slabs, coils, and plates from recycled scrap metal, raw metals, and additives. Primary facilities at the site include scrap processing, a steel melt shop that includes slab casting and scarfing, plate rolling, plate coiling, surface processing, and a cut-to-length facility. Support facilities include those associated with maintenance, utilities, oxygen production, wastewater treatment, slab storage, and transport of materials and products. The facility operates two central wastewater treatment systems (melt shop contact water and plant service water treatment systems). Effluent from these onsite water treatment units is primarily recycled onsite for process manufacturing reuse, however, a portion is discharged to the Willamette River at river mile 2.4. Various onsite waters are discharged to the City of Portland sanitary sewer system: sanitary waters, diluted laboratory wash water, some process treated water, and oil/water separator effluent.

Treatment Processes

The 2003 permit modification for the facility indicates that wastewater from manufacturing activities is directed to a large pond, where it is treated by a bank of sand filters and reused. As water is reused, the dissolved solids level in the water increases, so that periodically, the facility must discharges a portion of the wastewater from the pond and add make-up water from the City of Portland public water supply and/or from the Willamette River.

Effluent Data and Limits

Exhibit A-85 summarizes monitoring data for those pollutants of concern for which effluent data are available from August 2007. The facility does not have effluent limits for any of the pollutants of concern.

Exhibit A-85. Effluent Data Summary, Oregon Steel Mills[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
1,1,2,2-Tetrachloroethane	1	1	5	-	-	-
1,1,2-Trichloroethane	1	1	5	-	-	-
1,1-Dichloroethylene	1	1	5	-	-	-
1,2,4-Trichlorobenzene	1	1	9.6	-	-	-
1,2-Dichlorobenzene	1	1	5	-	-	-
1,2-Dichloroethane	1	1	5	-	-	-
1,2-Dichloropropane	1	1	5	-	-	-
1,2-Diphenylhydrazine	1	1	9.6	-	-	-
1,2-Trans-Dichloroethylene	1	1	5	-	-	-
1,3-Dichlorobenzene	1	1	5	-	-	-
1,3-Dichloropropene	1	1	5	-	-	-

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Exhibit A-85. Effluent Data Summary, Oregon Steel Mills[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
1,4-Dichlorobenzene	1	1	5	-	-	-
2,4,6-Trichlorophenol	1	1	9.6	-	-	-
2,4-Dichlorophenol	1	1	9.6	-	-	-
2,4-Dimethylphenol	1	1	9.6	-	-	-
2,4-Dinitrophenol	1	1	9.6	-	-	-
2,4-Dinitrotoluene	1	1	24	-	-	-
2-Chloronaphthalene	1	1	-	-	-	-
2-Chlorophenol	1	1	9.6	-	-	-
3,3'-Dichlorobenzidine	1	1	24	-	-	-
4,4'-DDD	1	1	-	-	-	-
4,4'-DDE	1	1	-	-	-	-
4,4'-DDT	1	1	-	-	-	-
Acenaphthene	1	1	9.6	-	-	-
Acrolein	1	1	50	-	-	-
Acrylonitrile	1	1	10	-	-	-
Aldrin	1	1	-	-	-	-
alpha-BHC	1	1	-	-	-	-
Anthracene	1	1	9.6	-	-	-
Antimony	1	0	0.05	2.04	2.04	2.04
Arsenic	1	0	0.5	3.8	3.8	3.8
Benzene	1	1	5	-	-	-
Benzidine	1	1	9.6	-	-	-
Benzo(a) Anthracene	1	1	9.6	-	-	-
Benzo(a) Pyrene	1	1	9.6	-	-	-
Benzo(b) Fluoranthene	1	1	9.6	-	-	-
Benzo(k) Fluoranthene	1	1	9.6	-	-	-
Beryllium	1	1	-	-	-	-
beta-BHC	1	1	-	-	-	-
Bis(2-Chloroethyl) Ether	1	1	9.6	-	-	-
Bis(2-Chloroisopropyl) Ether	1	1	9.6	-	-	-
Bis(2-Ethylhexyl) Phthalate	1	1	9.6	-	-	-
Bromoform	1	1	5	-	-	-
Butylbenzyl Phthalate	1	1	9.6	-	-	-
Carbon Tetrachloride	1	1	5	-	-	-
Chlordane	1	1	-	-	-	-
Chlorobenzene	1	1	-	-	-	-
Chlorodibromomethane	1	1	5	-	-	-
Chloroform	1	1	5	-	-	-
Chrysene	1	1	9.6	-	-	-
Dibenzo(a,h)Anthracene	1	1	9.6	-	-	-
Dichlorobromomethane	1	1	5	-	-	-
Dieldrin	1	1	-	-	-	-
Diethyl Phthalate	1	1	9.6	-	-	-
Dimethyl Phthalate	1	1	9.6	-	-	-

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Exhibit A-85. Effluent Data Summary, Oregon Steel Mills[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL[2] (µg/L)	Maximum	Geometric Mean	Minimum
Di-n-Butyl Phthalate	1	1	9.6	-	-	-
Endosulfan Sulfate	1	1	-	-	-	-
Endrin	1	1	-	-	-	-
Endrin Aldehyde	1	1	-	-	-	-
Ethylbenzene	1	1	5	-	-	-
Fluoranthene	1	1	9.6	-	-	-
Fluorene	1	1	9.6	-	-	-
Heptachlor	1	1	-	-	-	-
Heptachlor Epoxide	1	1	-	-	-	-
Hexachlorobenzene	1	1	9.6	-	-	-
Hexachlorobutadiene	1	1	9.6	-	-	-
Hexachlorocyclopentadiene	1	1	9.6	-	-	-
Hexachloroethane	1	1	9.6	-	-	-
Ideno(1,2,3-cd)Pyrene	1	1	9.6	-	-	-
Isophorone	1	1	9.6	-	-	-
Mercury	1	1	0.0005	-	-	-
Methyl Bromide	1	1	-	-	-	-
Methylene Chloride	1	1	5	-	-	-
Nickel	1	0	0.2	46.5	46.5	46.5
Nitrobenzene	1	1	9.6	-	-	-
N-Nitrosodimethylamine	1	1	24	-	-	-
N-Nitrosodi-n-Propylamine	1	1	9.6	-	-	-
N-Nitrosodiphenylamine	1	1	9.6	-	-	-
PCBs	1	1	-	-	-	-
Pentachlorophenol	1	1	25	-	-	-
Phenol	1	1	9.6	-	-	-
Pyrene	1	1	9.6	-	-	-
Selenium	1	1	-	-	-	-
Tetrachloroethylene	1	1	5	-	-	-
Thallium	1	1	0.02	-	-	-
Toluene	1	1	5	-	-	-
Toxaphene	1	1	-	-	-	-
Trichloroethylene	1	1	5	-	-	-
Vinyl Chloride	1	1	5	-	-	-

QL = Quantification limit.

1. Represents effluent data for the facility from August 2007.
2. May not match approved QLs because data was collected prior to November 2007 when ODEQ revised applicable QLs.

Receiving Water Data

Exhibit A-86 summarizes data for the Willamette River above the mixing zone for those pollutants of concern for which ambient data are available from the facility's draft RPA analysis spreadsheet provided by ODEQ.

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Exhibit A-86. Ambient Data Summary, Oregon Steel Mills[1]

Pollutant	Number of Observations			Summary of Detected Values (µg/L)		
	Total	Nondetect	QL (µg/L)	Maximum	Geometric Mean	Minimum
Arsenic	2	0	-	0.46	0.14	0.042
Nickel	2	0	-	0.34	0.11	0.036
Selenium	2	2	0.6	-	-	-

QL = Quantification limit.
1. Represents ambient data from April 2005 to April 2006.

Potential Impacts

Baseline Criteria

Exhibit A-87 summarizes the RPA for baseline criteria for those pollutants detected in the effluent (there will be no RP or monitoring requirements if all observations are nondetect). The Willamette River is a freshwater river; thus, human health criteria for consumption of organisms and water are applicable. The dilution factors are based on stream and effluent flows provided in the facility's permit, assuming only 25% of the stream flow is allowed for dilution. The Willamette River at river mile 2.4 is on the state's 303(d) list as impaired for DDT, DDE, dieldrin, dioxin, mercury, PCBs, pentachlorophenol, and PAHs. Also, the ambient background concentration for arsenic is above the applicable criterion. Thus, the facility would not receive dilution for these pollutants.

Exhibit A-87. RPA for Baseline Criteria, Oregon Steel Mills

Parameter	Calculated Effluent Conc.[1] (µg/L)	Ambient Conc.[2] (µg/L)	Conc. at Edge of Mixing Zone[3] (µg/L)	Human Health Criterion (µg/L)	Reasonable Potential
Antimony	12.6	0	0.0087	5.6	No
Arsenic	23.5	0.70	23.5	0.0022	**Yes**
Nickel	288.2	0.93	1.13	13.4	No

1. Represents the calculated geometric mean concentration for carcinogens and the calculated maximum concentration for noncarcinogens based on a CV of 0.6 for all pollutants (see Section 3.2).
2. Represents the geometric mean of detected values and zero if data are not available or if all values are nondetect.
3. Dilution based on effluent and stream flows specified in the facility's permit for human health pollutants (carcinogen factor = 3,478; noncarcinogens factor = 1,455).

As shown in the exhibit, the facility has RP to exceed the baseline criterion for arsenic because the concentration at the edge of the regulatory mixing zone is greater than the applicable existing human health criterion.

There is only one data point from which to determine compliance with the baseline arsenic criterion. Additional data would be needed to characterize the effluent and determine the need for WQBELs. If additional data indicate compliance with the baseline criterion, the discharger would not incur compliance costs. However, if additional data indicate effluent arsenic concentrations above necessary levels, the discharger could incur compliance costs.

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The ambient background concentration for arsenic is above the applicable criterion, indicating that the stream may be impaired. If ODEQ determines that the ambient concentration represents natural background levels, it would grant dilution in the RPA calculation (ODEQ, 2005). Under this scenario, the concentration at the edge of the mixing zone would be 0.71 µg/L, or approximately 1% above the ambient background concentration. ODEQ (2005) indicates that dischargers that cause less than a 10% increase in downstream receiving water concentrations would not be given numeric effluent limits; rather they would be required to implement narrative BMPs and increased monitoring.

If ODEQ determines that the water body is impaired, it would not grant dilution and base effluent limits on achieving the criterion end-of-pipe. However, because the baseline criterion is below the QL, the discharger would only need to reduce effluent levels to the QL. The permit application indicates that dust from the electric arc furnace unit contains arsenic, among other heavy metals, and that the discharger sends this dust to a baghouse for dust removal and ships the dust offsite to a permitted landfill. IDEM (2002) indicates that releases from baghouse units are common, particularly during loading of trucks. Any dust that escapes from the baghouse onto the surrounding area could be taken up during storm events and collected in surrounding catch basins. The permit evaluation report indicates some portion of the wastewater discharged to the Willamette contains storm water from catch basins surrounding these baghouses. BMPs to reduce dust leaks or other potential onsite arsenic sources would likely enable compliance with the baseline criterion. Costs for implementation of such BMPs are likely to be similar to those for an industrial P2 program for mercury ($25,000).

Thus, costs could range from zero if additional data indicate compliance to $25,000 per year if BMPs are needed to control onsite arsenic sources. The costs to implement narrative BMPs and increased monitoring under a scenario of dilution and no numeric effluent limits would likely fall within this range.

Revised Criteria

Exhibit A-88 summarizes the RPA for the revised human health criteria for consumption of water and organisms for those pollutants detected in the effluent (there will be no RP or monitoring requirements if all observations are nondetect).

Exhibit A-88. RPA for Revised Criteria, Oregon Steel Mills

Parameter	Conc. at Edge of Mixing Zone[1] (µg/L)	Human Health Criteria at Alternative FCRs (µg/L)				
		63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
Antimony	0.0087	5.40	5.30	5.10	4.70	4.30
Arsenic	23.5	**0.0083***	**0.0057***	**0.0041***	**0.0021***	**0.0014***
Nickel	1.13	280	190	140	69.0	45.0

*Bolded values represent RP equal to "Yes."
FCRs = Fish consumption rates.
1. Dilution based on effluent and stream flows specified in the facility's permit for human health pollutants (carcinogen factor = 3,478; noncarcinogens factor = 1,455).

The discharger would have RP for arsenic at all fish consumption rates. Thus, because the ambient concentration is greater than the criteria, the discharger would need to reduce discharge

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concentrations to background (if ODEQ determines that ambient concentrations represent natural levels) or the approved QL of 0.05 µg/L (because the criterion is below the QL) for compliance with revised standards. However, under the baseline, the discharge would need to meet those same levels. Thus, incremental compliance costs are unlikely.

Summary

Exhibit A-89 provides a summary of the potential range in annual costs associated with the baseline and revised criteria. For the alternative fish consumption rates, the incremental costs represent any costs above and beyond those that would be needed for compliance with baseline criteria.

Exhibit A-89. Summary of Potential Costs, Oregon Steel Mills

Alternative	Compliance Scenario	Total Annual Costs	Incremental Annual Costs[1]
Baseline	• None or BMPs (arsenic)	$0 - $25,000	NA
63.2 gpd	• None or BMPs (arsenic)	$0 - $25,000	$0
113 gpd	• None or BMPs (arsenic)	$0 - $25,000	$0
175 gpd	• None or BMPs (arsenic)	$0 - $25,000	$0
389 gpd	• None or BMPs (arsenic)	$0 - $25,000	$0
620 gpd	• None or BMPs (arsenic)	$0 - $25,000	$0

NA = Not applicable.

1. Annual costs for baseline criteria represent the costs needed for compliance under existing conditions; costs for revised criteria represent the difference between total annual cost and baseline costs (i.e., incremental costs above and beyond those needed for compliance with baseline criteria).

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Appendix B. Pollution Prevention Programs and Costs

Pollution prevention (P2) is the most cost-effective approach to reducing pollutants in waste water. P2 strategies focus on reducing the pollutant at the source where it is more concentrated and may be more easily controlled, rather than treating larger volumes of wastewater once diluted. Because of the cost-effectiveness of source controls, and the lack of cost effectiveness and demonstrated performance from end-of-pipe controls for pollutants like mercury, P2 is a key strategy for compliance with very low effluent limitations.

B.1 Municipal Mercury P2

A number of municipalities have developed P2 programs that provide a basis for estimating program components and costs. The costs to municipalities, industries, businesses, and households associated with a municipal P2 program for mercury will vary greatly based on a number of factors including the concentration of mercury in the treatment plant effluent, the community size and makeup, the extent of P2 efforts already underway, and the knowledge and experience of the municipality in this area. Municipalities would most likely target dentists, hospitals, medical facilities, educational institutions (primarily universities and high schools), households, and industries to reduce mercury discharges to the treatment plant. Program components could include:

- Sampling and analysis – to characterize mercury at the facility and track treatment effectiveness
- Program development – for source identification, materials development, program implementation, and management
- Conducting site visits and holding workshops
- Supplying mercury-free product replacements
- Advertising – to promote and inform the community of various activities and events taking place
- Website development – to provide the community with additional resources and serve as another means of promoting P2 activities.

Sampling and Analysis

As part of the sampling and analysis task, municipalities should characterize mercury inputs to the treatment plant and track program effectiveness. Characterization involves measuring mercury influent, effluent, and sludge concentrations to produce a better understanding of the load entering the plant and treatment process removal efficiency. This enables the discharger to determine how much of the resulting effluent mercury loading is due to treatment performance and removal efficiencies, and how much is the result of industrial, commercial, institutional, or residential discharges. Dischargers should address any in plant sources or issues in addition to focusing efforts on potential influent sources.

Although municipalities may sample frequently at the start of the program, they may reduce this frequency over the life of the program after developing an understanding of mercury behavior within the plant. Therefore, on average, municipalities would likely sample on a monthly basis using Method 1631, which requires clean sampling techniques and allows for the determination

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of mercury at a minimum level of 0.5 ng/L. Assuming one sample at each sampling point (influent, effluent, and biosolids) per month, municipalities would collect 36 samples per year (12 months × 3 samples per month).

Costs associated with sampling include the time required to take the sample and analytical costs. It typically takes about 1 hour, on average, to collect each sample and prepare the shipment (e.g., complete the chain of custody form, wrap the bottles, and draft the shipping label) (Morris, 2006). The average labor rate for a wastewater treatment plant operator in Oregon, including employer benefits is $29 per hour [escalated from 2006 dollars to 2007 dollars using Bureau of Labor Statistics (BLS) employment cost index] (BLS, 2006; 2007a; 2007b). Thus, costs would be about $29 per sample (1 hour per sample at an hourly wage rate of about $29). Laboratory analytical costs would be an additional $150 per sample (CAS, 2007; NRC, 2007; Test America, 2007). Therefore, total sampling costs may be approximately $180 per sample ($29 for operator labor + $150 for laboratory analysis = $180), or approximately $6,500 per year for 36 samples.

Program Development

P2 program development involves identifying potential mercury sources, determining appropriate or cost-effective measures for targeting those sources, developing materials, implementing the program, and managing and assessing progress/effectiveness of the program.

There are a large number of potential sources of mercury to any POTW, but there are few data on these sources from which to accurately predict the mercury load measured at the headworks of a facility. Nevertheless, several municipal dischargers have attempted to quantify their mercury sources. For example, the WLSSD estimates that 44% of influent mercury is from commercial business (e.g., hospitals, dentists, universities), 34% is unknown, 14% is residential, and 8% is from permitted industrial users. Some facilities in California have taken the characterization a step further and estimated the loads from individual commercial sources.

The Palo Alto Regional Water Quality Control Plant (RWQCP) in California estimates that residential and human waste not related to amalgam fillings accounts for 32% of its influent mercury load, the water supply accounts for 22%, human waste attributable to amalgam fillings accounts for 20%, dental offices account for 9%, and permitted industries account for 6% (EIP Associates, 1999). The East Bay Municipal Utilities District (EBMUD) in California estimates that 34% of their influent mercury load is from dental offices, 20% from the residential sector, 12% from inflow and infiltration, 11% from known commercial dischargers, and 10% from hospitals and medical facilities (EBMUD, 2004). Both of these dischargers estimated the source loadings from a combination of available monitoring studies and actual sampling efforts. Therefore, to reduce costs, facilities could use information collected and developed from other POTWs to identify potential sources of mercury, as well as to roughly estimate influent mercury contributions from those sources. Note, however, that the only way to truly characterize influent loads would be through site-specific sampling.

Determining which P2 efforts to pursue requires evaluation of the contribution to total mercury loadings, relative magnitude of loading, feasibility of control, and effectiveness of proposed efforts. Source control efforts could be implemented through existing pretreatment programs.

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P2 practices could include BMPs, production/process changes at industrial facilities, and public outreach and education programs targeting local businesses (e.g., dentists, hospitals, and laboratories), consumers, and schools.

Currently, most municipal facilities initially target dental offices and the residential sector through public outreach efforts. Municipalities can develop and distribute materials for dental offices that outline BMPs they can implement to reduce the amount of mercury discharged to the POTW. They may also encourage dentists to install amalgam separators, which often remove over 95% of amalgam particles prior to discharge. For example, the Central Contra Costa Sanitary District (CCCSD) developed a brochure for dentists that describes the mercury problem in the area, the role that dentists play in this problem, and measures that dentists can take to reduce their mercury contributions (CCCSD, 2005). Developing brochures may not be necessary for smaller facilities if there are relatively few dental offices in the service area. For example, the Mt. View SD was able to conduct site visits to each of the four dental offices in their area, and use a checklist developed by the Bay Area Pollution Prevention Group (BAPPG) to guide the visit and recommend actions each dentist could take to reduce mercury discharges (Engler, 2005).

The most common activities targeting the residential sector include distributing educational material in the form of brochures or billing inserts, or organizing events to collect mercury-containing equipment or products and ensure that they are properly disposed of or recycled. Some municipalities offer a mercury-free alternative in exchange for the mercury-containing one. Collection events held at easily accessible places such as schools, community centers, and grocery stores are more successful than events held at the facility. For example, the Palo Alto RWQCB collected about 2,000 mercury thermometers over a couple of years by relying on individuals to bring their thermometers to the treatment plant at their convenience. However, once the City decided to hold events at a scheduled date and time within the community, they were able to double the number of thermometers collected in a much shorter time period (Bobel, 2005).

Other potentially significant sources of mercury to a POTW are hospitals and medical facilities and educational institutions. Most of the mercury from these sources can be found in equipment such as thermometers, manometers, and blood pressure cuffs and chemical reagents. Municipalities may develop materials or conduct workshops aimed at encouraging these facilities to conduct an inventory of mercury-containing equipment, switch to mercury-free alternative equipment, and implement BMPs that prevent releases of mercury from the equipment. For example, WLSSD worked with the St Mary's-Duluth Health System to identify the major sources of mercury within the system and replace the source with mercury-free alternatives.

EBMUD, under a grant from EPA, partnered with the University of California, Berkeley to develop a mercury reduction program for educational institutions. Under the program, EBMUD replaced mercury-containing laboratory equipment with mercury-free alternatives, collected elemental mercury, worked with specific departments on campus to replace any additional mercury-containing devices, and developed a template based on these experiences for use at other institutions (EBMUD, 2007). In 2007, EBMUD worked with two local school districts and

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one university to collect and properly dispose of 112 pounds of mercury waste and replace equipment with nonmercury alternatives (e.g., thermometers and some laboratory devices).

Public outreach and education activities, however, do no always result in noticeable reductions in mercury loads to the POTW. For example, collection programs are aimed at reducing the overall load to the environment, and not only the load to the wastewater treatment plant, since many of the products collected may not directly affect the plant's influent mercury load (e.g., fluorescent bulbs and thermostats). Also participation rates for implementing suggested BMPs or control measures are often low for commercial and institutional dischargers because there are no regulatory requirements. To increase participation rates and make voluntary efforts more successful, municipalities could offer indirect dischargers assistance with residuals disposal, or make it clear that if voluntary programs fail, mandatory programs that include noncompliance liability risk (i.e., fines) will follow.

An increasing number of municipalities are implementing nonvoluntary measures such as limits/requirements in pretreatment permits or sewer use ordinances that require implementation of specific treatment controls and/or BMPs to obtain more measurable reductions in mercury loadings. For example, the Palo Alto RWQCP implemented a sewer use ordinance that requires all dental offices to install approved amalgam separators by March 31, 2005, and provide certification to the facility that they had done so. The facility also requires dentists to implement BMPs that:

- Prohibit rinsing chairside traps, vacuum screens, or amalgam separator equipment in a sink or other sanitary sewer connection
- Require staff to be trained in the proper handling and disposal of amalgam materials and fixer-containing solutions
- Prohibit the use of bleach or other chlorine containing disinfectants to clean the vacuum line system
- Prohibit the use of bulk liquid mercury; only precapsulated dental amalgam is permitted
- Require that amalgam waste be stored in accordance with recycler or hauler instructions.

The Palo Alto RWQCP developed its program in cooperation with the Mid-Peninsula Dental Society, the California Dental Association, and other stakeholders. The City also coordinated the program's work plan and implementation with the City of San Francisco and the EBMUD.

Similarly, the EBMUD regulates its indirect dischargers through permits. The permits for dental facilities require all dentists to install an ISO 11143 standard amalgam separator by June 30, 2005, and recommend implementation of specific BMPs. Dental facilities must also submit a report self-certifying installation of the separator and implementation of recommended BMPs.

Costs of program development vary based on the level of effort and size of the service area. The Palo Alto RWQCP (design flow of 38 mgd) has a P2 program sector of its environmental compliance division that includes 4 staff. The staff works on various tasks and outreach efforts for a number of different pollutants including mercury. The program director estimates that approximately one quarter of these 4 staff members' time is spent working on mercury-related tasks, resulting in average annual labor costs, including benefits, of approximately $85,000 per year (Bobel, 2005). Similarly, at EBMUD (design flow of 79.6 mgd), one staff member spends

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about 80% of her time on new mercury P2 tasks (Mena, 2005). Employee labor is used to identify potential source sectors, develop and evaluate alternative P2 strategies, develop outreach and education materials, request and draft changes to sewer use ordinances, schedule and organize collection events, conduct educational workshops for specific source sectors, maintain contact information for facilities within each sector, and put together annual program status reports. Thus, these estimates of 1 full-time equivalent (FTE) staff position (or approximately $85,000/year) are likely to be representative of costs for program development for large facilities (e.g., flows greater than 20 mgd).

Medium (e.g., between 5 mgd and 20 mgd) and small (e.g., between 1 mgd and 5 mgd) facilities have smaller service areas, and thus, fewer sources to identify and target. Smaller facilities are also more likely to partner with large facilities that have already established P2 programs or organizations such as the Department of Health Services or ODEQ to reduce costs. Therefore, in-house labor requirements for medium and small facilities will most likely be less than those of a larger facility.

For example, an employee of the San Mateo WWTP in California (design flow of 13.6 mgd) estimates that in-house labor for mercury P2-related tasks equals about 0.1 FTE. The level of effort is low because the City does not have a formal P2 program for mercury, and relies heavily on partnerships with the Department of Health and other larger P2 organizations (e.g., a county-wide storm water P2 program) to develop the outreach and educational information needed to target local businesses and residents (San Mateo Public Works, 2005). The City anticipates that more in-house labor will be needed in the coming years as the program is expanded to target dentists and other potential source sectors (San Mateo Public Works, 2005). Similarly, the P2 coordinator at Mt. View Sanitation District (average flow of 2 mgd) only spends about one week per year on mercury-related P2 tasks. However, most of the sources in the service area have already been targeted and the facility has developed numerous partnerships with other organizations, making the district's P2 program for mercury virtually self-sustaining (Engler, 2005). If the district began additional activities such as fluorescent light bulb collection events or regulatory requirements for dentists, additional in-house labor would be needed (Engler, 2005).

Thus, given the San Mateo and Mt. View estimates, medium-sized facilities could require as much as two-thirds of the effort of large facilities (approximately $56,000 or 0.67 FTE per year), and small facilities could require as much as one-third of the effort (approximately 0.33 FTE or $28,000 per year).

Site Visits and Workshops

Municipal facilities may also supplement their own employee labor with expertise from outside the municipality (e.g., consultants). For example, the Palo Alto RWQCP spends about $30,000 per year on a private consultant to help them develop outreach materials and conduct mercury education workshops and seminars at schools throughout their service area (Bobel, 2005). Workshops can be used to provide target groups with sector-specific information on mercury sources, effective BMPs, and sources for alternative equipment. The need for additional assistance varies depending on the number of different sources of mercury to the plant and the size of the service area.

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The Palo Alto RWQCP also hires a consultant to visit various sources and advise them on BMPs for reducing mercury or ensure that they are complying with sewer use ordinance requirements. Palo Alto spends about $20,000 a year on this off-site consultant work (Bobel, 2005). Site-visits are useful to determine what BMPs, if any, are in place or could be employed at a particular site to reduce mercury discharges. Sources of mercury are usually easy to identify at dental offices. However, mercury sources at hospitals, medical centers, secondary schools, and universities are harder to identify because of the larger discharge volume and greater number of potential sources, and may require a greater amount of time.

Based on information from Palo Alto, large facilities may spend about $30,000 per year on tasks related to program maintenance and material development performed by persons not directly employed by the municipality, and $20,000 per year on site visits. Medium and smaller facilities, due to the nature and size of their service areas would not have to spend as much. For example, in 2006, San Mateo plans to spend about $20,000 on consultants to target dentists and conduct site visits (San Mateo Public Works, 2005). The facility may also need assistance in developing materials for those sources it has not yet targeted (e.g., hospitals). Therefore, medium facilities could spend about $30,000 per year on additional assistance, or roughly 60% as much as a large facility, and small facilities could spend about $15,000 per year, or about 30% as much as a large facility.

Mercury-Free Products

Municipalities may need funds to provide mercury-free products to the public or commercial sectors. For example, many localities hold collection events in which residents turn in mercury thermometers for recycling and receive either a free electronic thermometer or a coupon towards purchasing one. For example, ODEQ provides free digital thermometers at collection events to citizens turning in a mercury containing thermometer and supplies local governments with free digital thermometers (ODEQ, 2007). Also, in 2005 and 2006, ODEQ, with grant assistance from EPA, worked with dairy and agricultural organizations to replace and properly dispose of mercury manometers used in dairy farm milking operations with mercury-free digital vacuum gauges (ODEQ, 2007). ODEQ also initiated a program with Portland General Electric, the Thermostat Recycling Corporation, and the Product Stewardship Institute through which participants receive $4 rebate coupons for each mercury-containing thermostat returned to a participating wholesaler for recycling.

However, municipalities may also need to provide secondary schools or hospitals with mercury-free equipment to replace all or part of their mercury-containing equipment. The Minnesota Pollution Prevention Agency (MPPA) works with schools to eliminate mercury. The school often conducts the mercury inventory with guidance from the MPPA. Then, MPPA gives the school a limited amount of free mercury-free equipment (including 40 laboratory thermometers, 2 digital fever thermometers, a blood pressure unit, and a digital barometer), lines up a proper recycling facility, and covers the mercury recycling costs. Total average costs are about $400 per school (Butler, 2002).

Costs vary based on the number of exchange/collection events and the volume of equipment collected. Because ODEQ already provides municipalities assistance with exchange and

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collection events for thermometers, thermostats, and dairy equipment, it is likely that only schools would need to be targeted for mercury-free product exchanges. Therefore, based on service area sizes, small facilities may replace mercury-containing equipment at 1 school ($400); medium facilities may replace mercury-containing equipment at 2 schools (2 × $400 = $800); and large facilities may replace mercury-containing equipment at 3 schools (3 × $400 = $1,200), assuming costs associated with replacing mercury equipment at schools are about $400 per school. Note that over time, the facility will replace most mercury-containing equipment in schools. However, these costs would likely still be incurred annually because facilities would just refocus their efforts on other source sectors (e.g., hospitals, medical centers, and laboratories).

Advertising

Developing public service announcements (PSAs) and a website promoting mercury P2 efforts are relatively low-cost methods for distributing information. The PSA cost is for the time spent to prepare audio PSAs for radio broadcast use. For example, the price charged by Hispanic Radio Network to produce a Spanish or English PSA under a General Services Agreement for the federal government (GSA contract GS-23F-0307M) is $200. Due to a large service area, large facilities could need a number of messages targeting different sources in different languages annually. Since medium and small facilities have fewer sources to target, they may need fewer announcements.

Website

Small municipalities would likely target primarily residential customers with a mercury P2 website (e.g., post collection event dates and times, links to mercury fact sheets). However, larger municipalities may also target commercial and industrial dischargers. The cost of a website depends on its function, number of pages, and security requirements. Websites with less than 10 pages and no animation or custom graphics typically cost less than $1,000 (Numatek, 2007). Due to the nature of P2 programs and the need to adapt efforts based on sampling and outreach results, frequent maintenance would be needed to keep the websites up to date. However, over the life of a program, website development and maintenance might average approximately $1,000 per year. These costs do not include the cost of the website itself. Rather, facilities would likely add information on the P2 program to a preexisting website run by the municipality or sewer district.

Total Municipal P2 Costs

Exhibit B-1 summarizes potential program components and costs for different size facilities, based on the experiences of communities that have already implemented such programs. Actual costs may be higher or lower than shown.

Exhibit B-1. Potential Annual P2 Program Costs for Municipal Facilities (2007$)

Component	Small (1-5 mgd)	Medium (5-20 mgd)	Large (> 20 mgd)
Sampling and Analysis	$6,500	$6,500	$6,500
Program Development	$28,000	$56,700	$85,000
Site Visits and Workshops	$15,000	$30,000	$50,000

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Exhibit B-1. Potential Annual P2 Program Costs for Municipal Facilities (2007$)

Component	Small (1-5 mgd)	Medium (5-20 mgd)	Large (> 20 mgd)
Mercury-Free Products	$400	$800	$1,200
Advertising	$400	$800	$1,200
Website Development	$1000	$1,000	$1,000
Total	$51,000	$96,000	$145,000

Costs may be greater in the startup period than costs in subsequent years as the program becomes more established; the estimates represent average annual program expenditures. Facilities will likely initially target the largest or most known sources of mercury to the treatment plant, such as dentists and hospitals, and then move on to other potential sources such as automobile service stations and secondary schools. The estimates for conducting site visits and workshops reflect this sequential targeting of an equal number of sources in a given year.

Indirect Dischargers

In addition to the cost of developing a P2 program, municipalities may require indirect dischargers to the sewer system to implement source controls. Municipalities would likely target dentists, hospitals and medical centers, secondary schools, universities, and industrial facilities. However, the program may not address all of these sectors immediately (i.e., in certain sectors, implementation of controls may not occur for several years).

Dental Offices

The Oregon Senate recently passed Senate Bill 704 requiring dentists who place or remove dental amalgam and other mercury-containing materials to be certified in compliance with ODA's BMPs. Senate Bill 704 took effect January 8, 2008. The law also requires these dentists to install amalgam separators. However, those certified in compliance with ODA's BMPs have until 2011 to install separators (ODA, 2007). Thus, costs for these actions are attributable to the bill (and not compliance with baseline or revised human health criteria).

Hospitals and Medical Centers

P2 measures for hospitals and medical centers include BMPs such as eliminating the use and handling of mercury-containing products and equipment through the modification of purchasing practices. Mercury-free substitutes are available for most mercury-containing chemicals and equipment. Although mercury-free products may currently be more expensive than those containing mercury, there are savings associated with eliminating the costs of hazardous waste training, storage and disposal, clean up, and potential noncompliance, and potential health risks to staff, patients, and visitors. In the case of electronic thermometers, the mercury-free alternative also has time-saving benefits since an electronic thermometer gives a quicker temperature reading than a mercury thermometer (Pollution Probe, 1996). For example, comparison of a mercury-containing sphygmomanometer to a mercury-free aneroid sphygmomanometer shows that once staff training, spill cleanup, and administrative costs are taken into account, the mercury-free alternative is actually more cost effective (Pollution Probe, 1996).

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The potential cost savings from using mercury-free equipment can be substantial. For example, the University of Minnesota-Duluth reports that phasing out mercury has significantly reduced costs due to hazardous spill cleanups (Second Nature, 2003). The average wage rate of spill team members is about $100 per hour, and it takes on average about 6 hours to clean up a spill (California DHS, 2000). Spill kits range in costs from $15 to $200. Using mercury also requires administrative costs to keep procedures up to date and staff trained. The Butterworth hospital in Grand Rapids, Michigan spent over $3,000 per mercury spill for clean up for several spills between 1993 and 1995 (Pollution Probe, 1996). In 1998, Kaiser-Permanente, which owns and operates 30 hospitals and 360 clinics, began a mercury minimization policy aimed at switching to mercury-free thermometers and sphygmomanometers, and proper disposal of fluorescent lamps, through a contract with a recycler. Kaiser-Permanente predicted that elimination of mercury thermometers and sphygmomanometers would result in cost reductions of about $550,000 over the next 10 years across the system. These cost savings would also offset the cost of the recycling program (Tellus Institute, 2000).

Therefore, implementing P2 activities is not likely to impose incremental costs on hospitals and medical centers.

Laboratories

P2 measures for laboratories that may reduce the amount of mercury released to the environment as a result of daily operations are similar to those implemented by hospitals and medical centers. In addition to replacing mercury containing equipment (e.g., manometers and thermometers) and chemicals containing mercury with mercury-free alternatives, laboratories can also work to minimize the amount of waste generated during experiments and testing procedures. The University of Minnesota-Duluth has instituted micro-scale projects in undergraduate labs that dramatically reduced the quantities of possible mercury-containing chemicals used, purchased, and discarded (Second Nature, 2003). Laboratories in hospitals that have replaced their mercury-containing chemicals with mercury-free alternatives found that costs of mercury-free chemicals are about the same as costs of chemicals containing mercury (Pollution Probe, 1996).

There may be instances, however, in which mercury-free alternatives do not exist. A 250-employee laboratory in Massachusetts uses thimerosal as a bacteriostat/fungistat in many clinical tests. The facility is permitted to discharge up to 1 µg/L under the Massachusetts Water Resources Authority (MWRA) pretreatment program. The laboratory determined that thimerosal could not be readily replaced, so the laboratory employed source reduction techniques (e.g., collecting waste streams for hazardous waste disposal, reducing the amount of reagent used) to reduce their mercury concentrations by 90%. The 90% reduction was not great enough for compliance with the pretreatment standard, and the facility had to install treatment using silver-impregnated granular activated carbon with flow equalization to reduce mercury to the required levels (Massachusetts OTA, 1995). However, since this case study, manufacturers have been working to create more alternatives for mercury-containing chemicals.

Because there is a cost savings associated with a decrease in mercury spill clean ups costs, and costs for mercury free alternatives are often about the same as costs of mercury-containing chemicals, implementing P2 programs is not likely to impose incremental costs on laboratories.

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Universities and Secondary Schools

There are a number of BMPs schools can implement to reduce mercury in their wastewater:

- Educate students, teachers and administrators about the health hazards and environmental fate of mercury (e.g., see the Mercury in Schools Pollution Prevention project, located at http://www.mercuryinschools.uwex.edu)
- Promote proper management and recycling of mercury and mercury-containing products (e.g., educate teachers and maintenance personnel on items that may contain mercury such as thermometers and laboratory chemicals, and proper disposal techniques)
- Eliminate the use of mercury wherever possible and promote the use of alternative products that do not contain mercury (e.g., schools may have mercury-containing thermostats, barometers, thermometers, and wall switches that can easily be replaced with mercury-free alternatives)
- Clean out plumbing (e.g., mercury builds up in plumbing over the years resulting in a constant mercury discharge even after the use of mercury is eliminated).

Universities and secondary schools would most likely take an inventory of mercury and mercury containing equipment in each building, and replace each item with a mercury-free alternative, as well as set up an educational program for professors, teachers, maintenance personnel, and students on the health effects of mercury, its environmental fate, and proper handling and clean up procedures.

The EBMUD initiated a mercury reduction program with the University of California at Berkeley (UCB) through grant funding from EPA. The program focused on identifying all mercury-containing equipment and chemicals through the campus and replacing them with mercury-free alternatives. Another main component of the program focused on outreach and education targeting professors, students, and school administrators. EBMUD also developed a template to guide other institutions on implementation of a successful mercury reduction program. UC Berkeley spent about $36,000 from 2002 through 2005 on the program (an average of $12,000 per year) for mercury waste disposal and recycling ($6,000) and program development and implementation ($30,000). However, if other universities use the template developed as part of the program development and implementation, costs would be much less.

P2 program implementation costs for secondary schools are most likely minimal because the municipality conducting the program generally conducts the mercury equipment inventory and arranges for equipment replacement and disposal (already accounted for in the direct costs). For example, schools are not charged to participate in the MPPA's Mercury Free Zone program. In addition, this Agency offers free lab and medical equipment to replace the schools' mercury-containing equipment and arranges for proper mercury disposal at a recycling facility (Butler, 2002). The Oregon Association of Clean Water Agencies (ACWA), in conjunction with ODEQ, also developed a pilot program for two local school districts to eliminate the use of mercury in schools. ODEQ spent approximately $27,800 of staff time inventorying 5 schools for mercury equipment and chemicals, and an additional $6,000 on mercury replacement and disposal. All of these costs were covered by donations, City of Corvallis, City of Eugene, ACWA, and CWA 319 Nonpoint Source Grants from ODEQ (Oregon ACWA, 2005).

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Based on the above examples, it is likely that municipalities will conduct mercury inventories and supply mercury-free equipment for secondary schools. Therefore, the costs to secondary schools would be minimal.

Exhibit B-2 summarizes the estimated annual average costs to facilities in the various sectors.

Exhibit B-2. Summary of Potential Annual Indirect Costs Associated with Mercury P2 Programs

Sector	Annual Cost
Dentists	None attributable to rule; SB 704 requires dentists to implement BMPs and amalgam separators
Hospitals and Medical Centers	Potential cost savings
Laboratories	Potential cost savings
Universities	$12,000 per year per university in initial years (based on experience of one California university)
Secondary Schools	Minimal; inventory and mercury replacement accounted for in direct costs

B.2 Industrial Mercury P2

There is little information available on the cost of P2 programs for industrial facilities because facilities typically do not account for pollutant-specific P2 costs as a budget item that can be verified apart from other source control costs. For example, one industrial facility spends between $5 and $6 million a year on waste minimization and P2 activities for a variety of pollutants and media (e.g., air, water, solid wastes), but only a small portion of that is related to mercury (Barrett, 2005). In addition, P2 activities for industrial dischargers vary greatly based on facility type, volume of wastewater discharged, existing wastewater treatment processes (if any), and the manufacturing processes and chemicals potentially responsible for mercury loads. For example, a facility that uses chlorine for disinfection or to prevent scaling may find that the type of chlorine used is contaminated with mercury. Reducing effluent mercury concentrations could be as simple as switching to mercury-free chlorine. However, the identification of sources and solutions may not be as straightforward at another type of industrial facility, especially those with multiple internal waste streams and industrial processes. Despite these differences though, it can be assumed that most industrial facilities will implement the basic components of a P2 program, including process analysis and process modifications.

During process analysis the discharger would identify pollutant uses and quantities within the facility (i.e., inventory facility), identify pollutant use and potential contamination in process streams, and identify P2 options for reducing the pollutant at the plant (e.g., on-going management of pollutants, recycling, and product and raw material substitutions). After the process analysis step, the facility would need to implement the identified P2 options and make any necessary process modifications.

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We estimated the costs to identify potential pollutant sources and sample process waste streams assuming a two-month study, or approximately 320 hours. The hourly wage in Oregon for an environmental engineer is approximately $50 including employer benefits [escalated from 2006 dollars to 2007 dollars using BLS employment cost index] (BLS, 2006; 2007c; 2007d).[9] This results in study costs of approximately $16,000 (320 × $50).

As discussed above, analytical costs for measuring mercury using Method 1631 may be approximately $180 per sample. We assumed that industrial facilities would sample at 4 points within the treatment process (e.g., influent, effluent, and 2 internal points) monthly, resulting in analytical costs of approximately $8,600 (4 × 12 × 180). Thus, total process analysis for industrial facilities would be approximately $25,000 ($16,000 + $8,600).

Process analysis costs will likely only be incurred during the first year. However, because process modifications are highly site-specific, we assumed that facilities would continue to incur the process analysis cost of $25,000 per year to cover any process modifications such as replacing mercury-containing equipment at the end of its useful life, product substitution, switching chemical manufacturers, or installing treatment on internal waste stream where mercury is most concentrated.

B.3 Bis(2-ethylhexyl) Phthalate

Bis(2-ethylhexyl) phthalate is found mainly in plastics and is used as a plasticizer for polyvinylchloride (PVC) and other polymers. The plasticizers can be released from plastics manufacturing wastes or through release from plastic goods (Environment Canada, 1994). Hospitals use a number of products that contain bis(2-ethylhexyl) phthalate such as gloves, tubing, flexible bags (e.g., intravenous, nutritional, blood, collection and specimen), rigid containers, respiratory equipment (e.g., masks and oxygen tents), and packaging (Malcolm Pirnie, 2005). High levels of bis(2-ethylhexyl) phthalate in municipal wastewater effluent can also be associated with sampling and/or laboratory analysis conditions (Fairfield-Suisun SD, 2003). If this is the case, cleaner sampling and analysis techniques could reduce the amount of bis(2-ethylhexyl) phthalate measured in the effluent. Therefore, facilities would likely need to conduct additional monitoring to determine potential sources of the pollutant.

If additional testing indicates that bis(2-ethylhexyl) phthalate is the result of industrial or commercial dischargers, the facility would need to develop more stringent pretreatment standards or implement source controls to prevent bis(2-ethylhexyl) phthalate from entering the treatment plant. However, example costs of such programs at other wastewater treatment plants are unavailable. In fact, it is not certain whether any municipal wastewater treatment plants have actually been required to reduce effluent levels of bis(2-ethylhexyl) phthalate. For example,

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[9] BLS (2006) describes an environmental engineer (standard occupations classification 17-2081) as one that can "design, plan, or perform engineering duties in the prevention, control, and remediation of environmental health hazards utilizing various engineering disciplines" and "work may include waste treatment, site remediation, or pollution control technology."

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several dischargers in California found that switching to cleaner analytical methods resulted in reductions in detected effluent concentrations, thus eliminating the need for permit limits (Fairfield Suisun, 2003; EBMUD, 2003). In Phoenix, the City began the process for developing local limits, but after finding no controllable sources, abandoned the efforts. Since that time, and without implementing specific actions targeting bis(2-ethylhexyl) phthalate, effluent concentrations have decreased to below detected levels.

As described above (see Section B.1) mercury P2 program costs may range from about $50,000 for a small facility (1 mgd to 5 mgd) to $150,000 for a large, major facility (>20 mgd). There are not as many controllable sources under a bis(2-ethylhexyl) phthalate source program as there are under a mercury P2 program. Thus, we assumed that source program costs for bis(2-ethylhexyl) phthalate would be approximately $50,000 per year, although costs could be higher or lower depending on factors including discharger experience with the pollutant and P2 efforts, existing monitoring and controls, and sources to the treatment plant.

B.4 Pesticides

The main pesticides of concern for the municipal sample facilities are 4,4-DDT and alpha-BHC. DDT is a pesticide that was widely used on agricultural crops to control insects. The United States banned uses of DDT in 1972, except for public health emergencies involving insect diseases and control of body lice (ATSDR, 2002). BHC is a manufactured chemical that exists in eight chemical forms called isomers. Technical-grade BHC was used as an insecticide in the United States and typically contained 10-15% gamma (γ)-BHC as well as the alpha (α), beta (β), delta (δ), and epsilon (ε) forms (ATSDR, 2005). However, technical-grade BHC has not been produced or used in the United States in over 20 years (ATSDR, 2005).

P2 or source control programs to identify potential sources of the pollutants (e.g., any commercial/industrial indirect discharges that may have in the past used the chemicals or manufactured pesticides containing the chemicals or storm water discharges to the sanitary sewer system) would likely include monitoring and assessment, and local limits development and implementation, if appropriate. Monitoring would enable the municipality to determine the magnitude of the influent load and calculate the appropriate pretreatment limits for each potential source. However, example costs of such programs at other wastewater treatment plants are unavailable.

As described above (see Section B.1) mercury P2 program costs may range from about $50,000 for a small facility (1 mgd to 5 mgd) to $150,000 for a large, major facility (>20 mgd). These pesticides are no longer in use or production in the United States and there are much fewer controllable sources than there are under a mercury P2 program. Thus, we assumed that source program costs for legacy pesticides would be approximately $25,000 per year, although costs could be higher or lower depending on factors including discharger experience with the pollutant and P2 efforts, existing monitoring and controls, and sources to the treatment plant.

B.5 Dioxin

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Dioxin (2,3,7,8-TCDD) may form during chlorination by wastewater treatment plants or in the manufacture of certain organic chemicals (ATSDR, 1999). Industry only intentionally manufactures the chemical for research. The City of Palo Alto RWQCP has implemented a dioxin P2 program since 1997. The municipality identified laundry and shower graywater, storm water inflow, human and food waste, and toilet paper as the largest conveyances of dioxin to the treatment plant. There is a difference between the sources of dioxins and the conveyances by which they reach a treatment plant. Palo Alto identified the sources of dioxin as chlorinated chemical manufacturing, organochlorine pesticide manufacturing, motor vehicles, residential wood burning, incineration, historic activities, and paper bleaching (Palo Alto, 1997). However, the City predicts that implementation of all the control strategies identified in their plan to reduce dioxin from these conveyances only has the potential to reduce the load to the treatment plant by a relatively small percentage (Palo Alto, 1997). Therefore, a municipal P2 program for dioxin may not result in compliance with effluent limits end-of-pipe, at least not immediately.

Costs for a dioxin P2 program would include monitoring and source assessment and program development and implementation. Monitoring would enable the municipality to determine whether the dioxin is coming from chemicals used within the treatment process (e.g., chlorine) or influent sources to the treatment plant. If the dioxin is the result of treatment chemicals, the solution could be as simple as switching chemical brands. If the dioxin is from discharges to the treatment plant, the facility would need to identify the likely sources, determine feasible and cost-effective control measures, and work with dischargers to implement those measures. As described above (see Section B.1) mercury P2 program costs may range from about $50,000 for a minor facility (1 mgd to 5 mgd) to $150,000 for a large, major facility (>20 mgd). There are not as many controllable sources under a dioxin P2 program as there are under a mercury P2 program. Thus, we assumed that P2 program costs for dioxin would be approximately $50,000 per year, although costs could be higher or lower depending on factors including discharger experience with dioxin and P2 efforts, existing monitoring and controls, and sources to the treatment plant.

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Appendix C. End-of-Pipe Treatment Controls and Costs

There are numerous end-of-pipe treatment technologies that could be used to reduce toxic pollutants in wastewater effluents. However, in general there is a lack of performance data available to show that advanced treatment technologies will result in the effluent levels necessary for compliance with the baseline and revised criteria.

C.1 Reverse Osmosis

Theoretically, reverse osmosis (RO) can remove nearly all inorganic contaminants from water, (NDWC, 1997), as well as viruses and most organic contaminants, including some pesticides. The process removes contaminants from water using a semipermeable membrane that permits water, and not dissolved compounds, to pass through its pores. The contaminated water is subjected to high pressures that force pure water through the membrane, leaving pollutants behind in a brine solution (NDWC, 1997).

Properly operated RO units can achieve 96% removal of arsenic (III), arsenic (IV), barium, cadmium, chromium (III), chromium (VI), fluoride, lead, mercury, nitrite, selenium (IV), selenium (VI), and silver. Multiple RO units operated in series, however, are capable of nondetectable or almost 100% removal rates (NDWC, 1997).[10] RO has several advantages, including:

- Removal of nearly all contaminant ions and most other dissolved contaminants
- Relatively insensitive to flow and total dissolved solids levels
- Also removes bacteria and particulates (NDWC, 1997).

However, despite these claims there are no full scale performance data available from wastewater treatment plants discharging to surface waters that indicate that such removals are possible at these facilities on a consistent basis. This may be due to the fact that few, if any, facilities have been required to reduce toxic pollutants to such low levels through the use of end-of-pipe treatment. The use of RO for treating wastewater is limited, and therefore performance data are scarce. Because removal efficiencies are less than optimal when treating influents with low contaminant concentrations, performance testing using influent concentrations in the ppb (µg/L) or ppt (ng/L) range should be conducted on various types of wastewater to ensure that RO is capable of producing the appropriate effluent range.

Even if the necessary pollutant levels are achievable with RO, it is important to consider the potential disadvantages and limitations of this technology, including:

- High capital and operating (including energy) costs (which increase with decreasing desired effluent concentrations)
- Management and disposal of residuals (brine and media) is potentially costly and problematic

[10] It was not clear how many data points or studies on which the percent removals are based. Also, NDWC (1997) does not indicate whether the percent removals represent single or dual stage RO processes.

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- Expensive pretreatment may be required to maintain the high treatment efficiency levels needed to achieve extremely low levels of pollutants (e.g., carbon prefilter for the reduction of chlorine, which can damage some types of chlorine sensitive RO membranes, sediment prefilter to ensure that fine suspended materials do not clog the membrane)
- Membranes are prone to fouling (NDWC, 1997)
- May not be feasible for treatment of large flows
- Does not remove pollutants from the environment, rather transfers them to another medium (pollutants are concentrated in the reject discharge or brine).

The most limiting of these disadvantages, especially for larger systems, is the management and disposal of residuals. Most RO systems reject about 10% to 25% of influent water as a concentrated brine solution (U.S. EPA, 1996). For a 10 mgd facility running 2 RO units in series, this translates into disposal of about 2 mgd to 4.5 mgd of residual waste; this brine contains the contaminants removed from the wastewater, and must be treated prior to disposal. The more feasible residual disposal options for wastewater treatment plants include:

- Land disposal (e.g., evaporation pond, underground injection)
- Treatment (e.g., brine concentrator, thermal evaporation) (Metcalf and Eddy, 2003).

The first option requires that the waste be classified as nonhazardous. Otherwise, the brine must be disposed of as a hazardous waste, which can be extremely costly, especially for larger volumes. The land disposal option also may require a large amount of land (U.S. EPA, 2002), and if evaporation ponds are the only land disposal option, precipitation rates cannot be greater than evaporation rates. The treatment through controlled evaporation is feasible, although operating and maintenance costs may be extremely high. This approach is usually only employed where no other alternatives are available (Metcalf and Eddy, 2003).

In addition, these disposal options do not guarantee that the pollutants in the residuals will not be re-released into the environment. The pollutant is simply transferred from the effluent to a residual brine that must be disposed of in some manner. If the brine is evaporated (either through an evaporation pond or flash/thermal evaporator), the pollutant could evaporate to the atmosphere and be redeposited into rivers and lakes.

Since no wastewater treatment plants in the country have installed RO to remove toxics to very low levels for discharges to surface waters, there is no information on installed costs. Nor is information available from similar industrial applications. U.S. EPA's Office of Groundwater and Drinking Water is developing detailed models for estimating compliance costs associated with drinking water regulations. Adjusting the input parameters to reflect average wastewater conditions, the RO model may provide an indication of potential costs for wastewater applications. **Exhibit C-1** shows these wastewater input parameters. The total costs for RO include microfiltration pretreatment (essential to prevent fouling of the RO membranes for wastewater applications; generated by a separate cost model), two RO units in series (likely needed to achieve the low levels under the revised criteria), equalization basins to handle recycle flows from backwashing and chemical cleaning, and residuals management (brine concentrator followed by evaporation ponds).

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Exhibit C-1. Input Parameters for Microfiltration Pretreatment and Reverse Osmosis Cost Models for Wastewaters

Component	Input Value
Microfiltration	
Temperature	20°C
Membrane flux	26 gal/ft^2/day
Chemical-enhanced backwash interval	15 minutes
Clean-in-place interval	30 days
Reverse Osmosis	
Total dissolved solids	490 mg/L
Hardness	100 mg/L
Alkalinity	120 mg/L
Calcium	34 mg/L
Magnesium	3.6 mg/L
Sodium	110 mg/L
Barium	50 µg/L
HCO_3	145 mg/L
Chloride	45 mg/L
SO_4	150 mg/L
pH	8.0
Temperature	20° C
First-pass RO recovery	90%
First-pass RO flux	12 gal/ft^2/day
Second-pass RO recovery	85%
Second-pass RO flux	20 gal/ft^2/day
Clean-in-place interval	2 months (1st pass); 12 months (2nd pass)
Residuals Management	
Precipitation rate (Eastern OR)[1]	32 cm/year
Pan evaporation rate (Eastern OR)[2]	134 cm/yr

1. Based on values from http://ocs.orst.edu/page_links/comparative_climate/oregon/or.jpg.
2. Represents median of the evaporation rates measured at stations in climate zones 6, 7, 8, and 9 from http://ocs.orst.edu/page_links/comparative_climate/oregon/oregon.html converted to lake evaporation rates assuming a safety factor of 0.7.

Scaling is a concern in RO operation; the scaling potential may limit the water recovery percentage of each RO unit. The less water that is recovered from each unit, the greater volume of residual brine that needs treatment and disposal, thus increasing capital and operating costs. If the concentration of barium or sulfate is higher than shown in the exhibit, or if silica is present, water recovery could be limited.

Certain RO membranes are intolerant of free chlorine, and most microfiltration membranes have limited chlorine tolerance. Thus, prior to microfiltration, the wastewater should be dechlorinated if chlorine is used in previous treatment units. Note that dechlorination may result in an increase in sulfate ions, which, as mentioned above, could contribute to the scaling potential of the RO membranes. Costs may be higher than shown to account for these factors.

Exhibit C-2 summarizes capital and O&M costs for four size categories. Annual costs represent capital costs annualized at 7% over 20 years plus O&M costs.

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Exhibit C-2. Summary of Estimated Costs for Reverse Osmosis

Component	5 mgd	10 mgd	25 mgd	50 mgd
Capital Costs				
Microfiltration	$6,820,000	$11,560,000	$22,650,000	$39,740,000
Equalization Basin	$3,580,000	$7,150,000	$18,250,000	$36,230,000
Reverse Osmosis	$18,800,000	$32,440,000	$79,350,000	$159,860,000
Residuals Management	$11,190,000	$18,390,000	$39,970,000	$75,900,000
Total	$40,390,000	$69,550,000	$160,220,000	$311,720,000
O&M Costs[2]				
Microfiltration	$338,000	$627,000	$1,520,000	$2,930,000
Reverse Osmosis	$1,410,000	$2,560,000	$5,890,000	$11,020,000
Residuals Management	$1,550,000	$2,850,000	$6,780,000	$13,300,000
Total	$3,290,000	$6,040,000	$14,190,000	$27,250,000
Annual Costs				
Annual Capital plus O&M	$7,110,000	$12,600,000	$29,310,000	$56,670,000

1. Includes costs for brine concentrator and evaporation pond.
2. Includes costs for labor, materials, chemicals, energy, and solids disposal, where applicable.

Capital costs include brine concentration followed by evaporation ponds to handle the residual brine from the RO units. While this option may be feasible in Eastern Oregon where precipitation rates are less than evaporation rates, it is likely infeasible in Western Oregon where precipitation exceeds evaporation. More costly options such as thermal evaporation may be necessary, which could greatly increase O&M costs.

The cost effectiveness (cost per pound of pollutant reduced) of achieving incremental load reductions under the revised criteria with RO is very low. For example, **Exhibit C-3** shows the cost effectiveness of reducing mercury from baseline criteria (0.017 µg/L) to the potential revised criteria for each consumption rate based on the total annual RO costs for each flow category in Exhibit C-2.

Exhibit C-3. Cost Effectiveness of Reverse Osmosis for Reducing Mercury to Revised Criteria

Scenario	5 mgd		10 mgd		25 mgd		50 mgd	
	LR[1] (lb/yr)	C-E ($ million/lb)	LR[1] (lb/yr)	C-E ($ million/lb)	LR[1] (lb/yr)	C-E ($ million/lb)	LR[1] (lb/yr)	C-E ($ million/lb)
63.2 gpd	0.19	$40.0	0.37	$33.7	0.94	$31.3	1.87	$30.3
113 gpd	0.22	$32.4	0.44	$28.7	1.10	$26.7	2.19	$25.9
175 gpd	0.23	$30.5	0.47	$27.1	1.16	$25.2	2.33	$24.3
389 gpd	0.25	$28.8	0.49	$25.5	1.24	$23.7	2.47	$22.9
620 gpd	0.25	$28.3	0.50	$25.1	1.26	$23.3	2.51	$22.5

C-E = Cost effectiveness
gpd = grams per day
LR = Load reduction
mgd = million gallons per day
1. Load reductions calculated by multiplying the difference in concentration between the baseline (0.017 µg/L) and revised criterion (0.0047 µg/L for 63.2 gpd; 0.0026 µg/L for 113 gpd; 0.0017 µg/L for 175 gpd; 0.00076 µg/L for 389 gpd; 0.00048 µg/L for 620 gpd) by the flow, days per year (365), and a conversion factor (0.00834).

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C.2 Selective Sorbents

There are a number of sorbents designed to remove dissolved and ionic forms of pollutants from wastewater. Most of these sorbents rely on adsorption and chemical bonding of ions through chelation and/or ion exchange. Adsorptive technologies work best when waste streams are pretreated to remove suspended and dissolved solids to enhance pollutant removal and eliminate competing ions.

Selective resins are typically used in packed columns, similar to ion exchange. The ion exchange process consists of four operations: service, backwash, regeneration, and rinse (U.S. EPA, 1997). In the service step, the resin is contacted with the influent water. The resin is considered spent once it can no longer remove the desired amount of pollutant. Next, the backwash step is initiated to expand the bed and to remove fines that may be clogging the packed bed. The spent resin is regenerated using a concentrated solution of the original exchange ion, reversing the exchange process. Lastly, the rinse step removes excess regeneration solution before the column is brought back online for the next service cycle (U.S. EPA, 1997). Note that some sorbents cannot be regenerated, and once they are spent (i.e., there is no more capacity to adsorb mercury), they are disposed of and replaced with fresh media. Advantages of a selective sorbent packed column process include:

- Theoretically achieves extremely low effluent levels, under certain conditions (e.g., a number of columns in series, extensive pretreatment)
- Contaminants can be recovered from most resins upon regeneration.

Use of selective sorbents also has disadvantages:

- Management and disposal of spent media or regenerated brine can be costly
- Effluent quality may be highly variable (depending on sorbent loading)
- To achieve low pollutant levels in wastewater, extensive pretreatment may be necessary
- May need multiple units in series for desired effluent quality, which increases costs.

Mercury

For mercury, historically, the use of sorbent resins has been limited to anion resins applied to industrial wastewater containing inorganic mercury with high concentrations of chloride. The chloride produces negatively charged mercury chloride complexes that are attracted to the positively charged resin. Cationic resins containing thiol groups can also be used to remove mercury because they have a high selectivity for mercury (U.S. EPA, 1997). Another resin that can be used to remove mercury is a chelating resin, which, when attached to a complexing group, can bond negatively charged metal ions to form a ring (or chelate) (U.S. EPA, 1997).

Limited performance data on selective adsorbent resins indicate that mercury can be removed to ng/L levels. Few studies have used analytical methods sensitive enough to measure below 200 ng/L. However, studies conducted at two U.S. Department of Energy (DOE) sites used clean analytical methods (e.g., Method 1631), and focused on the removal of mercury from mg/L levels to low ng/L levels (Klasson, et al., 1999, 2000; TN & Associates 1998).

Klasson et al. (1999) treated wastewater from the Oak Ridge National Laboratory (ORNL) with various selective sorbents to reduce effluent mercury concentrations. For a portion of the

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wastewater, treatment prior to entering the sorbent columns consisted of dual media filtration, air stripping, and granular activated carbon; the remaining water was treated with precipitation, flocculation, and settling. The waste streams were combined prior to entering the sorptive media columns. Influent mercury to the columns ranged from 40 to 625 ng/L. Overall, the thiol-based sorbents such as Keyle:X and SIR-200 performed the best. The Keyle:X resin produced effluent levels below 19 ng/L about 50% of the time when the water was chlorinated prior to entering the column to oxidize the mercury to a more treatable form. The removal efficiency of the selective resins was not specified; however, the report indicates that efficiencies vary considerably over time, most likely the result of changes in the speciation of the mercury in the wastewater (Klasson, et al., 2000).

None of the tested sorbents at the second DOE site, the Y-12 Plant, reduced mercury concentrations to less than 12 ng/L from an average influent concentration of about 1,100 ng/L. Three sorbents, SIR-200, Keyle:X, and GT-73 reduced mercury concentrations to less than 51 ng/L at flow rates of 0.3 bed volumes per minute to 1 bed volume per minute (TN & Associates, 1998). Removal efficiencies were approximately 95%, on average.

Although the sorbents tested above were capable of reducing mercury concentrations significantly, they did not demonstrate the ability to produce effluents that would comply with the any of the potential effluent limits on a consistent basis. However, influent concentrations at both sites were greater than typical conventional treatment effluents described in Section 2. Thus, reducing influent concentrations could potentially reduce achievable effluent concentrations as long as the diluted influent concentration does not in turn reduce removal efficiencies.

For selective sorbents though, removal efficiencies may not be affected by influent concentrations because at both sites, lower influent concentrations resulted in lower effluent concentrations, and the removal efficiency was not dependent on the number of bed volumes treated or the sorbent loading rate (Klasson, et al., 2000). Therefore, effluent concentrations could decrease as influent concentrations decrease (e.g., through source control efforts or operating columns in series), although this result would need to be substantiated with further testing of waters with lower concentrations.

Arsenic

Most of the research on the removal of arsenic from aqueous solution has been related to drinking water treatment, and the available data on arsenic in wastewater is extremely limited. The drinking water MCL is 10 µg/L, which is four orders of magnitude greater than the baseline water quality criterion for consumption of water and organisms for arsenic. As such, the studies on drinking water only aim to reduce arsenic levels below the MCL. For example, EPA (2000) indicates that ion exchange can reduce influent arsenic source water concentrations ranging from 45 µg/L to 60 µg/L down to below 5 µg/L. However, as shown in Appendix A, most of the dischargers are already discharging at concentrations less than 2 µg/L. Thus, it is uncertain whether ion exchange could reduce arsenic concentrations by the same percentage given lower influent concentrations. That is, there are no data available to show that lowering the influent concentration does not also lower the percent reduction achievable.

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C.3 Chemical Precipitation

Chemical precipitation involves the addition of chemicals to alter the physical state of dissolved and suspended solids and facilitate their removal by sedimentation (Metcalf and Eddy, 2003). Common precipitants for removal of heavy metals such as mercury and arsenic include hydroxide and sulfide, although carbonate can also be used in certain circumstances (Metcalf and Eddy, 2003). In practice, the minimum achievable effluent concentration depends not only on the precipitant used and the operating pH, but also the nature and concentration of organic matter and temperatures (Metcalf and Eddy, 2003).

Mercury

Mercury may be present in three forms in wastewater: elemental mercury (Hg^0), ionic mercury (Hg^{+2}, usually present as complexes and chelates with ligands), and organic (e.g., methylmercury). These species of mercury may bind to particulate matter in the wastewater to form physical agglomerates containing mercury that more readily settle out (MASCO, 1997). Particulate mercury is often the predominant form in wastewater streams (MASCO, 1997). However, in order to achieve mercury levels in the low ng/L range, the dissolved and elemental forms of mercury, as well as particulate mercury may need to be removed.

The removal of mercury from wastewater to ng/L levels may be achieved using chemical precipitation and adsorption. Ionic mercury readily combines with phosphate or sulfide to precipitate as mercury phosphates or sulfides. When mercury is precipitated as sulfide, high mercury residuals are often observed due to reduction of mercury to elemental mercury, which has a solubility in water of about 25 mg/L (much greater than potential effluent limits). Once in the elemental form, the mercury will not form the insoluble sulfide. Therefore, this residual mercury must by oxidized to the ionic form and retreated with sulfide to achieve low residual concentrations (West General, 2004). Such a conversion can be done through the addition of an oxidant such as chlorine. [This process is similar to the addition of chlorine to enhance performance of the Keyle:X resin tested at the DOE site discussed above. The chlorine oxidizes mercury to a more readily adsorbed form (Klasson et al., 2000).]

Exhibit C-1 shows the solubility of mercury sulfide in water. The solubility curve for mercuric sulfide in the exhibit shows that very low levels of mercury (less than 2 pg/L, or 0.002 ng/L) remain in the water when mercury is precipitated as sulfide.

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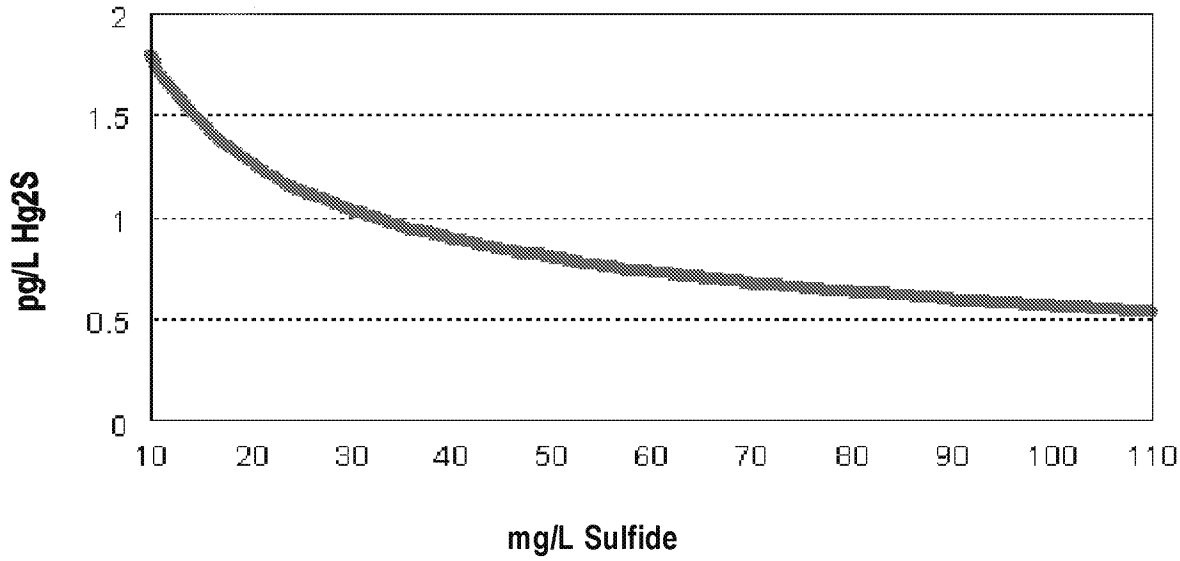
Exhibit C-1. Solubility of Mercury (I) Sulfide in Water



Source: West General (2004)

Dischargers may choose to add sulfide in the form of iron sulfide or hydrogen sulfide to precipitate the mercury. Adding iron sulfide is more favorable than adding hydrogen sulfide because the generation, handling, and application of hydrogen sulfide may be challenging due to its highly toxic nature. Iron sulfide should be added in mg/L doses (e.g., 1 to 2 mg/L), concentrations much greater than the µg/L mercury concentrations found in effluent waters.

Once these sulfide precipitates are formed, additional treatment is needed because a portion of the precipitate is composed of fine particles that have such a high surface area to mass ratio that they do not settle out (U.S. EPA, 1980). U.S. EPA (1997) indicates that only levels in the µg/L range can be achieved with precipitation alone.

The most efficient way to remove this trace level solid mercurous sulfide is to attach it to a nonleaching media such as activated alumina. Activated alumina adsorption is a physical/chemical process by which ions in solution are removed by the available adsorption sites on an oxide surface. Activated alumina is used primarily in packed beds where feed water is passed continuously through one or more beds (U.S. EPA, 2000). The precipitate adsorbs onto the activated alumina as the wastewater passes through it, thus reducing the mercury concentration of the final effluent. Note that, although the chemistry of the process indicates that mercury will be effectively reduced, bench- and pilot-scale testing would be necessary to confirm that the necessary levels can be met for a particular wastewater and to determine the operating conditions required for optimal performance.

Precipitation and subsequent treatment is also not without disadvantages and limitations. The addition of sulfides to wastewater may generate toxic sulfide residual levels. Extensive testing would need to be conducted to ensure minimal residual levels. Otherwise the excess sulfides would have to be removed prior to discharge. Another concern associated with the addition of sulfides is the formation of hydrogen sulfide gas. If the pH of the wastewater is low, hydrogen

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sulfide gas may be produced, causing air toxicity and odor problems (U.S. EPA, 1980). Control of sulfide dose or enclosing and vacuum evacuating vessels may be necessary to prevent this problem.

The oxidation of elemental mercury may also cause problems. The use of chlorine or ozone to oxidize mercury could result in the formation of harmful by-products such as trihalomethanes, haloacetic acids, aldehydes, and carboxylic acids.

Lastly, the limited performance data available for mercury precipitation followed by activated alumina presents a significant limitation. Although in theory this process should remove mercury to the proposed criterion, actual performance on different wastewater types has not been demonstrated. The effects that factors such as flow rate, competing contaminants, residuals production, and by-product formation have on the process and design requirements would need to be investigated before facilities are likely to install such a process for compliance with revised permit limits.

Arsenic

Chemical precipitation is generally more effective for arsenic(V) than arsenic(III) (U.S. EPA, 2000). Thus, to achieve low effluent levels, oxidation of arsenic(III) to arsenic(V) is necessary. Few wastewater treatment plants specifically aim to reduce arsenic levels. However, in drinking water treatment, iron and aluminum salts are widely used, with iron salts being more common because they are generally more effective for removing arsenic(III). Removal of arsenic occurs through chemical adsorption and coprecipitation during the formation of ferric hydroxides. Hering et al. (1996, as cited in U.S. EPA, 2000) observed "complete" removal of arsenic(V) at pH of 7.0 and coagulant dose above 5 mg/L ferric chloride. However, use of such high coagulant doses also increases the amount of sludge that must be disposed of. Low effluent levels will only likely be achieved with filtration or adsorption after chemical precipitation to remove colloidal arsenic.

C.5 Granular Activated Carbon

GAC has been used successfully in advanced treatment of municipal and industrial wastewater for years. GAC is primarily used to adsorb refractory organics, such as 4,4'-DDT, alpha-BHC, dioxin, and bis(2-ethylhexyl) phthalate, as well as residual amounts of inorganics such as nitrogen, sulfides, and heavy metals (Metcalf and Eddy, 2003). However, water-soluble compounds and small molecules are not adsorbed well (NAVFAC, 2008).

GAC adsorption occurs when pollutant molecules adhere to the internal walls of pores in carbon particles produced by thermal activation (U.S. EPA, 2000). At municipal wastewater treatment plants, GAC is usually installed prior to disinfection, but after filtration (or some other type of pretreatment) that removes suspended solids in order to prevent fouling and maximize the time before breakthrough occurs (i.e., the point at which the contaminant is no longer absorbed).

Advantages of GAC include the following:

- Proven, reliable technology for removing dissolved organics
- Low space requirements

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- Easy to incorporate into existing systems (U.S. EPA, 2000).

However, GAC is not without its disadvantages, including:

- Under certain conditions, hydrogen sulfide may be generated from bacterial growth, creating odor and corrosion problems
- Wet GAC is highly corrosive and abrasive
- Requires pretreated wastewater with low suspended solids, and little variations in pH, temperature, and flow rate (U.S. EPA, 2000)
- Spent carbon may be a hazardous waste
- Spent carbon must be regenerated or disposed of and the adsorbed contaminants must be destroyed, often by incineration (possibly re-releasing contaminants into the environment; organic contaminants are usually thermally degraded)
- The presence of multiple contaminants can affect the process performance due to competitive adsorption of different classes of compounds; bench tests may be conducted to estimate carbon usage for mixtures
- Some common chlorinated contaminants are weakly sorbed, resulting in low GAC capacity
- Type and pore size of the carbon, as well as the operating temperature, must be carefully selected to optimize contaminant removal (NAVFAC, 2008).

There are no studies demonstrating GAC organics removal at wastewater treatment plants, although there are several plants throughout the country using GAC either to supplement secondary treatment or to enhance phosphorus removal. Unfortunately, there are no effluent data for toxic pollutants in EPA's PCS database for these facilities. GAC has been used for a number of groundwater cleanup operations. However, the removal rates vary based on the specific contaminant, quality of the source water, and operating parameters of the GAC unit (e.g., single versus dual stage).

Although GAC can remove low concentrations of certain metals, it has not been widely used for this purpose possibly due to the fact that spent carbon used for metals removal can be difficult to regenerate and may require treatment and/or disposal as a hazardous waste (U.S. EPA, 1991). Also, traditional types of GAC have low adsorption capacity for mercury. Sulfur-impregnated GAC can be used to increase the adsorption capacity for mercury because the sulfur chemically reacts with the mercury to form mercuric sulfide (HgS), a tightly bonded and highly insoluble compound (Grieco, 2007). Use of this type of GAC for mercury removal at wastewater treatment plants discharging to surface waters has not been demonstrated on a full scale. Performance data from groundwater cleanup operations indicate that dual stage sulfur-impregnated GAC can reduce mercury from 1,500 ng/L to 80 ng/L after the first stage, and from 80 ng/L to 2.5 ng/L after the second stage (Grieco, 2007). The major disadvantage to this type of GAC it that it cannot be regenerated, so once its capacity is exhausted it must be replaced with new media, which can be costly; Grieco (2007) estimates unit costs to be approximately $200 per cubic foot, compared to approximately $34 to $52 per cubic foot for typical GAC media that can be regenerated (Calgon Carbon Corporation, 2002; Arce Systems, Inc., 2002; Environtrol, 2003; updated to 2006 dollars using ENR CCI).

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Estimates from one vendor indicate that annual costs for a GAC system designed to remove PCBs may range from about $17,000 to $26,000 per mgd, depending on flow (Sherbondy, 2004). To remove DDT, the pH of the system may need to be adjusted, increasing annual costs to about $19,000 to $31,000 per mgd (Sherbondy, 2004). These costs do not include components such as pretreatment, residual disposal, process piping, site work, pilot studies, administrative fees, and contingencies. In addition, more than one GAC unit in series may be necessary to reduce certain pollutants to the required levels. The costs may also vary considerably based on source water quality and influent contaminant concentration.

C.6 Advanced Oxidation Processes

Advanced oxidation processes can be used to reduce the concentration of organic contaminants such as 4,4'-DDT, alpha-BHC, and dioxin in wastewater. Advanced oxidation processes such as UV light coupled with ozone and/or hydrogen peroxide, UV light coupled with titanium dioxide, and sonochemical degradation destroy organic contaminants through the production of hydroxyl radicals which react with organics to break them down into non-toxic compounds such as carbon dioxide and water.

UV Oxidation

UV oxidation involves the use of UV light coupled with one, or a combination of, chemical and physical agents that break up existing bonds, take away electrons, or elevate the energy level of electrons in organic compounds to create new bonds. Examples of agents commonly used in this process include ozone, hydrogen peroxide, titanium dioxide, iron, and other oxidizing compounds. The oxidizing agents produce free radicals which also react with organic compounds destroying them (Rahuman et al., 2000).

The most common UV oxidation processes involve the use of UV light paired with a catalyst (e.g., titanium dioxide) or strong oxidizer (e.g., ozone, hydrogen peroxide). In UV oxidation, organic chemicals are oxidized by various mechanisms, including direct reaction with oxidizers, UV photolysis, and the synergistic action of UV light (FRTR, 2002). If complete mineralization is achieved, the final products of oxidation are carbon dioxide, water, and salts. Oxidation of organic compounds using only a strong oxidizer does not always completely oxidize the contaminants, resulting in the presence of intermediate oxidation products. These intermediate products may be as toxic as or even more toxic than the original compound. Therefore, these oxidizing agents are paired with UV light to enhance the completion of the oxidation reactions, eliminating harmful byproducts (Munter, 2001).

UV oxidation using a catalyst generates electrons into the conduction band of the catalyst and produces valence band holes at the surface of the catalyst. Electron accepting species such as oxygen are reduced by the electrons in the conduction band, and water molecules or hydroxyl ions are oxidized at the holes. This process produces two hydroxyl radicals that rapidly break down and mineralize organic contaminants (Powell, 2000). A number of properties such as the surface state of the semiconductor, the flat-band potential, and the dissociation of the organic contaminant are strongly dependent on pH. The optimal pH value varies with the contaminant of concern and wastewater type (Munter, 2001). Therefore, pilot testing to determine optimal operating conditions would be necessary to confirm performance.

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Advantages to UV oxidation include:

- Destroys, not removes, contaminants (there is no need to dispose of residuals)
- Also provides disinfection
- Can be used over a wide range of influent concentrations and flow rates (e.g., 1 to 1,000 gpm)
- Can be configured as batch or continuous process, depending on flow (FRTR, 2002; Kidman and Tsuji, 1991).

UV oxidation forms hydroxyl radicals that can potentially react with almost any organic chemical present in the wastewater. Therefore, to ensure that pollutants are completely destroyed there must be a sufficient amount of radicals, especially if other competing organic chemicals are present. However, overdosing with oxidizers such as ozone may actually decrease the destruction efficiency due to ozone absorption of the UV light. Therefore, careful planning and testing would be necessary to determine the optimal operating parameters.

Disadvantages associated with UV oxidation may include:

- Pretreatment to lower suspended solids concentrations and turbidity to provide for good transmission of UV light and minimize reactor and lamp maintenance
- Free radical scavengers can inhibit destruction efficiency (e.g., excessive dosages of oxidizers could become scavengers)
- Fouling of UV quartz sleeve as a result of material deposition from temperature and UV light exposure, or as a result of compounds in the source water reacting with the sleeve surface
- Handling and storage of oxidizers may require special safety precautions (FRTR, 2002)
- Use of ozone or hydrogen peroxide may result in the formation of harmful byproducts that would need to be removed prior to discharge.

U.S. EPA (1998) indicates that UV oxidation with hydrogen peroxide or ozone can remove 86% to 99.9% of VOCs from contaminated groundwater, and over 99% of semivolatile organic contaminants from contaminated groundwater, depending on the specific pollutant and treatment unit. However, most of the effluent concentrations were still above the baseline and revised criteria, and it is unclear whether performance levels would remain the same for treatment of municipal and industrial wastewater. Thus, additional full-scale testing is likely needed to determine the feasibility of UV oxidation for municipal and industrial wastewater.

Potential costs for UV oxidation differ depending on whether the process is coupled with ozone, hydrogen peroxide, or titanium dioxide catalyst. The major difference between the two processes is that UV oxidation with ozone or hydrogen peroxide requires the generation and handling of ozone and hydrogen peroxide onsite, whereas UV/titanium dioxide oxidation does not require the handling of any hazardous chemicals. Also, with UV oxidation with titanium dioxide, if the more efficient powder form of titanium dioxide is used, a mechanism for recovering the catalyst is necessary. Both processes will have relatively high energy costs due to the use of UV light. **Exhibit C-5** provides a qualitative comparison of operating costs for the various UV oxidation systems.

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Exhibit C-5. Comparison of Operating Costs for Various UV Oxidation Processes

Process	Cost of Oxidant	Cost of UV
UV/Ozone	High	Medium
UV/Hydrogen Peroxide	Medium	High
UV/Titanium Dioxide	Very Low	Medium to High

Source: Munter (2001).

Note, however, that the efficiency of each process is strongly dependent on the specific compounds targeted (Munter, 2001). Preliminary bench testing should be conducted to determine the appropriate oxidation process for removal of the target pollutants from a particular type of wastewater.

FRTR (2002) indicates that costs for UV oxidation systems using ozone and/or hydrogen peroxide for the treatment of contaminated groundwater are generally between $36,000 and $3,650,000 per mgd. Costs may be slightly greater for wastewater treatment due to increases in the variability of water quality as well as additional pretreatment requirements (e.g., filtration). The major operating cost for the ozone/hydrogen peroxide system is the cost of electricity for generating the chemicals (Munter, 2001).

Hand et al. (1995) estimated that annual costs for a 1 mgd UV oxidation system using titanium dioxide range from approximately $139,000 to $433,000 per mgd. Note that these costs were developed when this technology was still fairly new, therefore, actual costs may be lower due to advances in the technology or an increase in the number of manufacturers.

Factors that may influence the cost of UV oxidation include:

- Types and concentration of contaminants - affect oxidizer selection, oxidizer dose, UV light intensity, and contact time
- Influent concentration (i.e., destruction efficiency required)
- Flow
- Pretreatment and post treatment requirements (FRTR, 2002).

Neither of the cost estimates above includes pre- or post-treatment costs. For low effluent levels in wastewater, pretreatment is necessary to ensure that the UV rays effectively reach and destroy the compounds; suspended solids and other contaminants may reduce the destruction efficiency of UV oxidation. Sand or dual media filtration should be sufficient for this purpose, however, the exact type of treatment necessary will be site-specific and depend on influent water quality.

Sonochemical Degradation

The two main mechanisms for sonochemical degradation of pollutants are thermal reaction inside cavitating bubbles and radical chemistry (Destaillants et al., 2001).

Sonochemical degradation involves the use of ultrasound to create micron size gas cavities in water. These cavities collapse, generating a localized zone of high temperature (about 5,000°C) and pressure (greater than 100 atm). This process is called acoustic cavitation. Any organic molecules diffused in these gas bubbles before they collapse are rapidly hydrolyzed or oxidized to less toxic molecules such as carbon dioxide, water, and hydrochloric acid (Bruce, 2004).

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Cavitation is influenced by vapor pressure, surface tension, and hydrophobicity (Price, et al., 2004). As sound intensity increases, higher temperatures and pressures exist within the bubble interior, which increases the decomposition rate of pollutants (Hua and Zhang, 2000).

In addition to the direct high temperature and pressure destruction of organic molecules within these localized zones, the thermolysis of water to release radical species (e.g., •H, •OH, and HOO•) and hydrogen peroxide is an important mechanism for the organic chemical destruction. These free radicals attack organic compounds present in water, comprising another mechanism of sonochemistry (Hua and Zhang, 2000). Free radical formation is also enhanced with increased sound intensities, thus, further increasing decomposition rates (Hua and Zhang, 2000).

Most studies on sonochemical degradation have been performed using frequencies of 20-25 kHz. However, reaction rates may vary significantly with variations in frequencies (Price et al., 2004). For example, frequencies dictate the type of cavitation that takes place. Under low frequencies transient cavitation occurs in which bubbles undergo only a few oscillations before collapse. A larger concentration of radicals will be formed on each individual bubble collapse during this type of cavitation because bubbles collapse from a larger radius and thus, contain more water vapor. At high frequencies, a bubble undergoes hundreds or thousands of oscillations, known as stable cavitation. Under stable cavitation more collapse events occur per unit time, which may increase the overall rate of radical production (Price et al., 2004). It is also important to note that at higher frequencies, cavitation is produced in the liquid phase far from the surface of the transducer, thus protecting it from erosion cause by bubble implosion (Destaillants et al., 2001). However, these situations have only been tested in laboratories and not on larger, full-scale reactors.

Destaillants et al. (2001) investigated how laboratory conditions translate into larger-scale operation. They found that react rates for the nonvolatile contaminants tested increased by factors of 2 to 5. Destaillants et al. (2001) also found that while the reaction rates for one non-volatile contaminant only varied by about 15% for various flow rates, reaction rates for another varied by more than 50% depending on flow rate. In addition, degradation rates may also vary with reactor size and configuration, temperature, and influent contaminant concentration (Destaillants et al., 2001). Therefore, extensive testing is important to determine the optimal operating frequency for destruction in a particular type of wastewater, as well as to determine if any harmful byproducts are formed during sonochemical oxidation.

There are many engineering and scientific issues that still need to be resolved before the technology can be used on a commercial scale. These issues include scaling up bench test to full scale processes, variation of the sound field in reactors, and effects of source water quality associated with sonochemical degradation. The general lack of full scale operating data prohibits determinations of the technology's effectiveness for any particular pollutant or group of pollutants.

Also, cost information for this technology is not available. However, since the main mechanism involved in sonochemical degradation is the same mechanism that destroys pollutants in UV oxidation (i.e., radical chemistry), it is not likely that sonochemical degradation would be used in

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place of UV oxidation, especially given the limited performance data for sonochemical degradation.

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Appendix D. Variance Procedures Based on Adverse Economic Impacts

This appendix describes the analysis of the potential for compliance costs to result in substantial and widespread economic and social impacts pursuant to EPA (1995) guidance.

D.1 Analysis for Public Sector Entities

Public sector entities will evaluate whether the compliance costs associated with WQBELs will impose a substantial financial impact (estimate change in household sewer bills resulting from the compliance costs; evaluate financial health of the community), and whether such an impact would have widespread adverse economic and social impact.

Substantial Impacts

The analysis of whether compliance costs would impose a substantial financial impact involves the following steps.

Verify Project Costs

The first step of an economic analysis of a publicly financed project is to evaluate the appropriateness and the cost-effectiveness of the proposed project. Public entities should consider a broad range of discharge management options including pollution prevention, end-of-pipe treatment, and upgrades or additions to existing treatment. Specific types of pollution prevention activities that should be considered are (EPA, 1995):

- public education
- change in raw materials
- substitution of process chemicals
- change in process
- water recycling and reuse
- pretreatment requirements.

EPA (1995) provides worksheets to summarize general information regarding the proposed pollution control project.

Calculate Annualized Cost per Household

Since capital costs will be paid over several years, annualized costs are used to evaluate the economic burden to the community. The capital portion of project costs is financed by issuing a municipal debt instrument such as a general obligation bond or a revenue bond. Local governments may also finance capital costs using bank loans or state infrastructure loans (e.g., State Revolving Fund loans). State and federal grant funding may also be available for technology upgrades or other treatment options. EPA (1995) also provides a worksheet for calculating the total annualized cost of the project.

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To assess the burden that pollution control costs are expected to have on households, an average annualized pollution control cost per household is calculated for all households in the community that would bear project costs. To evaluate substantial impacts, therefore, applicants should determine which households will actually pay for pollution control, as well as what proportion of the costs will be borne by households. These apportioned project costs are then added to existing pollution control costs paid by households. EPA (1995) provides worksheets for calculating the cost per household.

Municipal Preliminary Screener

Whether or not the community is expected to incur "substantial" economic impacts due to the pollution control project is determined by jointly considering the results of two tests. The first test is a "screener" to establish whether the community can clearly pay for the project without incurring any substantial impacts. The Municipal Preliminary Screener, or MPS, is the total annual pollution control costs per household (existing costs plus those attributable to the proposed project) as a percentage of MHI. EPA (1995) provides a worksheet for calculating and evaluating the MPS.

If the MPS value is less than 1.0, there is little potential for substantial impacts and the analysis can conclude with a determination of no substantial impact. Communities are expected to incur mid-range impacts when the ratio of total annual compliance costs to MHI is between 1.0% and 2.0%. If the average annual cost per household exceeds 2.0%, then the project may place an unreasonable financial burden on many of the households within the community. In either case, applicants move on to the Secondary Test to demonstrate substantial impacts.

Secondary Test

The Secondary Test, which provides indication of the community's ability to obtain financing and the socioeconomic health of the community, consists of six indicators for the community:

- Debt Indicators
  - Bond Rating - a measure of a jurisdiction's ability to repay its debt
  - Overall Net Debt as a Percent of Full Market Value of Taxable Property - a measure of debt burden on residents within the jurisdiction
- Socioeconomic Indicators
  - Unemployment Rate - a measure of the economic health of the jurisdiction
  - MHI - a measure of the income of the jurisdiction
- Financial Management Indicators
  - Property Tax Revenue as a Percent of Full Market Value of Taxable Property - a measure of the capacity to support debt based on the wealth of the jurisdiction
  - Property Tax Collection Rate - a measure of the strength of the local government administration, and of the jurisdiction's acceptance of property tax rates.

Exhibit D-1 summarizes the indicators, and the scoring of the values following EPA (1995) guidance. EPA (1995) provides worksheets for calculating the secondary score.

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Exhibit D-1. Secondary Indicators

Indicator	Evaluation		
	Weak (score of 1 point)	Mid-Range (score of 2 points)	Strong (score of 3 points)
Bond Rating	Below BBB (Standard and Poor's) Below Baa (Moody's)	BBB (Standard and Poor's) Baa (Moody's)	Above BBB (Standard and Poor's) Above Baa (Moody's)
Overall Net Debt as Percent of Full Market Value of Taxable Property	Above 5%	2% - 5%	Below 2%
Unemployment	More than 1% above National average	National average	More than 1% below National average
MHI	More than 10% below State median	State median	More than 10% above State median
Property Tax Revenues as a Percent of Full Market Value of Taxable Property	Above 4%	2% - 4%	Below 2%
Property Tax Collection	Below 94%	94% - 98%	Above 98%

Source: See U.S. EPA (1995), Table 2-1.

Applicants then jointly evaluate results of the MPS and Secondary Test. **Exhibit D-2** summarizes the scoring. An "X" in the matrix indicates that the impact is likely to be substantial. Similarly, the "✓" indicates that the impact is not likely to be substantial. Finally, the "?" symbol in the exhibit indicates that the impact is unclear. For results falling into either the "X" or "?" category, applicants proceed to determine whether the impacts would also be widespread. EPA (1995) provides further discussion of evaluating the results.

Exhibit D-2. Substantial Impacts Matrix

Secondary Score	Municipal Preliminary Screener		
	Less than 1.0%	Between 1.0% and 2.0%	Greater than 2.0%
Less than 1.5	?	X	X
Between 1.5 and 2.5	✓	?	X
Greater than 2.5	✓	✓	?

Source: See EPA (1995), Table 2-2.

Widespread Impacts

The financial impacts of undertaking pollution controls could potentially cause far-reaching and serious socioeconomic impacts. Conversely, adverse financial impacts experienced by the affected entities may be offset by the expenditures on pollution controls to attain water quality standards, since these expenditures do not vanish from the community but become business revenues and household incomes. Therefore, applicants must examine the estimated change in socioeconomic conditions that would result from compliance (EPA, 1995).

At a minimum, the analysis must (EPA, 1995):

- define the affected community (the geographic area where project costs pass through to the local economy)
- consider the baseline economic health of the community

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- evaluate how the proposed project will affect the socioeconomic well-being of the community.

For municipal control projects, the affected community is most often the immediate municipality. There are, however, exceptions where the affected community includes individuals and areas outside the immediate community. For example, if business activity in the region is concentrated in a nearby community and not in the immediate community, then the nearby community may also be affected by loss of income in the immediate community and should be included in the analysis. If business activity of the region is concentrated in the immediate community, then outlying communities dependent upon the immediate municipality for employment, goods, and services should also be included in the analysis.

To demonstrate that there will be widespread impacts, EPA (1995) recommends evaluating changes in the following indicators:

- MHI
- community unemployment rate
- overall net debt as a percent of full market value of taxable property
- property values
- percent of households below poverty line
- community development potential.

The first step in estimating the change in these indicators is to identify their precompliance values. Evaluation of baseline socioeconomic conditions is important because the extent to which estimated changes can be interpreted as significant depends on the health of the community before compliance. For example, if a community is in a weak condition before compliance but the evaluation of widespread impacts suggests that all of the indicators listed above will remain virtually unchanged, then widespread impacts have not been demonstrated. Alternatively, if the community is very healthy, the estimated change in the indicators listed above would have to be very large in order for widespread impacts to occur. Note that expenditures for pollution controls also become increased household and business incomes (costs to one sector become revenues to another). EPA (1995) provides a worksheet for applicants to qualitatively describe estimated changes.

D.2 Analysis for Private Sector Entities

Private sector entities will evaluate whether the compliance costs associated with WQBELs (variances from technology-based standards are not available) will impose a substantial financial impact on the company (estimate impact of costs on profitability, liquidity, solvency, and leverage; compare to industry benchmarks; establish that the company would be forced to curtail operations or shut down), and whether such an impact would have widespread adverse economic and social impact (the loss of employment and incomes would have a widespread impact on the community).

Substantial Impacts

To evaluate whether compliance costs will be substantial, private sector entities will verify project costs and calculate the annual cost of the pollution control project, and then conduct a

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financial impact analysis. Considerations for verifying project costs and calculating annual costs are similar to those described above for public sector entities. EPA (1995) provides a worksheet for calculating the annualized cost of pollution control.[11]

The purpose of the financial impact analysis is to assess the extent to which existing or planned activities and employment will be reduced as a result of meeting water quality standards. There are four tests divided into a primary measure and three secondary measures of financial impacts:

- Primary Measure
  - Profit—how much will profits decline due to pollution control expenditures?
- Secondary Measures
  - Liquidity—how easily can an entity pay its short-term bills?
  - Solvency—how easily can an entity pay its fixed and long-term bills?
  - Leverage—how much money can the entity borrow?

Each type of test measures a different aspect of a discharger's financial health. The primary measure evaluates the extent to which an applicant's profit rate will change, and compares the profit level to typical profits in that industry. The secondary measures provide additional information about specific impacts that the discharger would bear if required to comply with WQBELs. Profit and solvency ratios are calculated both with and without the additional compliance costs (taking into consideration the entity's ability, if any, to increase its prices to cover part or all of the costs). Comparing these ratios to each other and to industry benchmarks provides a measure of the impact on the entity. EPA (1995) provides worksheets for evaluating the primary and secondary measures.

Widespread Impacts

Applicants that demonstrate that pollution control costs would have a substantial financial impact proceed to evaluate whether such an impact would have a widespread impact on the surrounding community. The steps in the analysis are identical to those described above for public sector entities.

D.3 References

United States Environmental Protection Agency (U.S. EPA). 1995. Interim Economic Guidance for Water Quality Standards. EPA 823-B-95-002. March.

[11] Note, however, that entities that pay corporate income taxes may be able to deduct interest payments from their taxes.

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Appendix E. BMPs and Unit Costs for Nonpoint Sources

As discussed above, some level of incremental controls may be needed for runoff and erosion control from agricultural and forest lands, urban areas, and abandoned mine sites. This section provides a description of potential controls and associated unit costs, where available.

E.1 Agricultural and Forest Lands

To control or reduce erosion and runoff of mercury-containing soils from agricultural and forest lands as part of the Willamette Basin Mercury TMDL, ODEQ recommends the implementation of sediment/erosion BMPs (ODEQ, 2006a). However, implementation of these BMPs is already required under existing state and federal regulations and plans. For example, the Forest Practice Act and Agricultural Water Quality Management Area Plans require implementation of BMPs to minimize soil erosion and prevent runoff or use of products that contain harmful pollutants (ODEQ, 2006b). Thus, an incremental level of control would only be required if implementation to meet existing water quality standards would not also achieve compliance with the revised criteria.

Exhibit E-1 shows various practices that can be adopted to control soil/sediment erosion.

Exhibit E-1. Erosion Control Practices

Practice	Description
Protective cover	Plant cover (as well as other covers such as mulch, bark dust, rock, and concrete) protects soils from erosion.
Barriers	Barriers slow wind and water and trap eroded soils. Barriers include grass strips in a field crop, silt fences around a construction site, or a windbreak.
Reduce slope length and steepness	In general, plants can protect slopes that are less than 50% (2:1 gradient or 2 foot run for every 1 foot drop), mulches protect slopes less than 33 percent (3:1 gradient), and erosion control structures like terraces may be needed for slopes more than 50 %.
Buffers	Trees, shrubs, and/or grass slow water speed, filter pollutants, and trap sediment. Grass filter strips are effective on slopes less than 10 percent. Contour buffer strips combine contour farming (see below) with strips of permanent grass. A ratio of cultivated to buffer strip width between 4:1 to 9:1 is best. Riparian buffers are tree, shrub, and/or grass strips that protect streams, ditches, lakes, and ponds and may be 35 to 300 feet wide, based on site conditions and your goals.
Conservation tillage	Reduce the amount of tillage and leave at least 30% cover from crop residue after harvest and during winter months. Soil loss is reduced by 50% compared to bare soil.
Contour farming	Run rows "on the level" around the hill rather than up and down the slope. Crop rows form hundreds of small dams that slow water and reduce soil loss up to 50% compared to farming up and down a slope. Cover crops temporarily protect the soil until the main crop is planted.

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Exhibit E-1. Erosion Control Practices

Practice	Description
Crop rotation	Changes crops each year in a certain order. A rotation that includes grasses, legumes, or small grains will break pest cycles and reduce erosion compared to continuous row crops that may build up pest populations and leave soil open to erosion.
Erosion control structure	Drop water safely to a lower elevation. Rock, metal, or concrete structures prevent the soil from forming gullies.
Grassed waterway	A natural or constructed drainage way is graded and shaped to form a smooth, concave channel. This area is seeded to suitable vegetation. Runoff water that flows down the drainage way flows across the grass rather than tearing away soil and forming a gully. An outlet is often installed at the base of the drainage way to stabilize the waterway.
Pasture management	Balance livestock numbers, forage, and water. Pastures with at least 70% plant cover have little erosion and produce more forage. Set aside area where animals are held to protect pastures when soils are wet or plants are recovering from grazing.
Terraces	Long, low dikes of earth that follow the contour of the hill. They break long slopes into shorter runs, slow runoff, and trap sediment. If terraces aren't practical, consider planting 1-foot strips of stiff, perennial plants that are perpendicular to the slope of the land with the same spacing as terraces.

Source: Washington County SWCD (1999)

Many of these BMPs that control the erosion of toxic-containing sediments also reduce stream temperatures and nutrient loads. For example, riparian buffers increase shade cover for streams, cooling instream temperatures. As described in the exhibit, buffers also slow runoff (reducing erosion), filter pollutants, and trap sediments. In the Stillaguamish River Fecal Coliform, Dissolved Oxygen, pH, Mercury, and Temperature TMDL, the Washington Department of Ecology (Ecology) indicates that the key to controlling mercury is to control suspended solids levels. However, the implementation plan does not identify specific actions to reduce mercury levels, rather Ecology indicates that mercury reductions will occur as part of efforts to improve temperatures through control of sediment (Ecology, 2007). Thus, it is possible that controls being implemented for compliance with baseline standards for nontoxic pollutants could result in compliance with the revised criteria.

In addition, if incremental controls are necessary, the USDA's National Resources Conservation Service (NRCS) provides technical assistance and funding opportunities to agricultural landowners with the mission to conserve, maintain, or improve natural resources. NRCS' Environmental Quality Incentives Program (EQIP) is a voluntary conservation program that provides assistance to agricultural producers in a manner that promotes agricultural production and environmental quality as compatible goals (NRCS, 2007a). Through EQIP, farmers and ranchers receive financial and technical assistance to implement structural and management conservation practices that optimize environmental benefits on working agricultural land. As part of EQIP, NRCS develops cost estimates for various BMPs in Oregon that may be available for funding assistance. Thus, the cost of additional BMPs that may be needed under the revised criteria would likely be similar to the NRCS estimates.

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E.2 Mining

In the Willamette Basin mercury TMDL, DEQ does not specify the measures necessary to cleanup mines, only that it will continue efforts to remediate abandoned mine sites to minimize the flow of mercury into adjacent water bodies (ODEQ, 2006a). The Horse Heaven Mine is an abandoned mercury mine, located in the east-central portion of Jefferson County. Potential remedial actions to address the presence of mercury and arsenic in contaminated soils and groundwater may include:

- Excavation and on-site entombment and capping of contaminated soils
- Collection, entombment and capping of solid waste mining debris on-site
- Re-grading of tailings to mitigate mass wasting and off-site migration
- Abatement and mitigation of physical hazards represented by extant mine portals.

However, the cost of assessment and cleanup at abandoned mines varies widely.

For example, elevated levels of mercury have been detected in soil at Bonanza Mine in Douglas County. ODEQ has spent about $500,000 to investigate the site and remove the most contaminated soil around one area of contamination. Black Butte Mine has been identified as a major contributor of mercury to the Cottage Grove Watershed. Although the mine is now abandoned, remnants from past mining activity are still readily visible. Site features include: 1) remnants of mining equipment including two mercury-extraction furnaces, tramway, and ore crusher; 2) tailings piles; and 3) mine openings (adits and stopes). Through 2004, ODEQ spent about $50,000 from Oregon's Orphan Site Account for environmental investigation of the site.

E.3 Municipal Storm Water

In the Willamette Basin TMDL, DEQ requires all MS4s to address mercury through modifications to existing storm water management plans (SWMP), and all other areas to develop SWMPs for mercury (ODEQ, 2006a). In general, dischargers are required to control pollutants to the maximum extent practicable (MEP) through their SWMPs. As described in Section 2.2.2, ODEQ interprets the MEP requirement to require all controls that are reasonable and available. In some areas this level of control may be necessary for compliance with baseline standards, in which case additional controls for compliance with revised criteria would not be required because all reasonable and available controls are already being implemented. In other areas, however, MEP controls may not be fully implemented and some incremental level of control may be necessary for compliance with the revised criteria. Thus, for any situation in which storm water sources are specifically required to control toxic pollutants to levels that are lower than what would be necessary under the baseline, potential compliance actions could include:

- increased or additional nonstructural BMPs – institutional, education, or pollution prevention practices designed to limit generation of runoff or reduce the pollutants load of runoff
- structural controls – engineered and constructed systems designed to provide water quantity or quality control.

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Nonstructural BMPs

Nonstructural BMPs can be effective in controlling pollution at the source, which in turn can reduce or eliminate the need for costly end-of-pipe treatment or structural controls. Examples include expanding an existing outreach and education program to a larger or new target audience, refocusing source control efforts on pollutants and sources of concern, increasing program compliance efforts, and increasing frequency, duration, or efficiency of maintenance practices such as street sweeping.

Street sweeping programs reduce the amount of debris and particulates that enter surface waters. The effectiveness of street sweeping depends on the type and operation of the equipment, sweeping frequency and number of passes, and climate (FHWA, 2002). Thus, increasing the frequency of sweeping or changing the type of sweeper used may result in decreases in pollutant loads. Incremental costs for more extensive sweeping would depend on a municipality's current sweeping practices and the extent of the increase needed to reduce toxic loadings (e.g., the incremental curb miles and whether new sweepers need to be purchased).

For example, most municipalities use mechanical/brush model sweepers (Minton, 2007). These models are generally only half as effective as vacuum sweepers which are much more effective at removing fine sediments, silts and clays where much of the pollution resides. There are two types of vacuum sweepers: wet and dry. The dry vacuum sweepers remove a greater percentage of small particulates and sediments than the wet vacuum sweepers. Thus, depending on the load reductions needed, switching to either a wet or dry vacuum sweeper could increase pollutant load reductions to surface waters.

Structural Controls

There are a variety of structural means to control the quantity and quality of storm water runoff including infiltration systems, detention systems, retention systems, constructed wetlands, filtration systems, and vegetated systems. The cost for any particular structure depends on the type of control, the quantity of water treated, and site-specific factors such as land cost.

Infiltration systems capture runoff and allow it to infiltrate into the ground. These systems provide both water quality and quantity control. Typically, these systems infiltrate water into the ground relatively rapidly (from a few hours up to 72 hours). However, the primary drawback of infiltration systems is that they are not appropriate in areas where groundwater is used as a drinking water source. Additional constraints include identifying sites with appropriate soils and risk of failure due to clogging. **Exhibit E-2** summarizes the different types of infiltration systems.

Exhibit E-2. Summary of Storm Water Infiltration Systems

System Type	Description
Infiltration basin	Large capacity of infiltration systems. Basins should be designed to drain within 72 hours in order to prevent mosquito breeding and possible odor. Removes pollutant and helps restore or maintain predevelopment hydrology.

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Exhibit E-2. Summary of Storm Water Infiltration Systems

System Type	Description
Porous pavement systems	Include porous asphalt, porous concrete, modular perforated concrete block, cobble pavers with porous joints or gaps or reinforced/stabilized turf. Only effective in areas not exposed to high volumes of traffic, heavy equipment, and high amounts of sediments in runoff. Appropriate for driveways/streets in residential areas and parking areas in commercial areas.
Infiltration trenches and wells	Typically designed to capture only a small volume of water (appropriate to capture first flush of a runoff event).

Source: U.S. EPA (1999).

Detention systems capture runoff and temporarily retain it for later release. Detention systems do not retain a significant permanent pool of water between runoff events. These systems provide quantity and quality control; however, resuspension of particulate matter often occurs. **Exhibit E-3** summarizes the different types of detention systems.

Exhibit E-3. Summary of Storm Water Detention Systems

System Type	Description
Detention basin	Primary purpose is quantity control. Typically designed to empty within 24 hours of a runoff event. Limited quality control through gravity setting of suspended solids. Earthen basins achieve high levels of quality control by allowing some infiltration (however, ground water is then a risk of contamination).
Underground vaults, pipes, and tanks	Same primary purpose as basins – storage to limit downstream effects due to high peak flow rates. Limit quality control.

Source: U.S. EPA (1999).

Retention systems capture runoff and retain it until it is displaced by the next runoff event, and maintain a significant permanent pool volume of water between runoff events. The most common retention system is a retention pond (wet pond). The primary pollutant removal mechanism is sedimentation. These systems can also benefit from added biological and biochemical pollutant removal mechanisms provided by aquatic plants and microorganisms. Compared to detention systems, resuspension is less likely due to the presence of a permanent pool of water. The primary constraint to these systems is the need for a perennial flow to sustain the permanent pool. Furthermore, these systems typically require more land than other controls (U.S. EPA, 1999).

Constructed wetland systems are similar to retention and detention systems, except that a major portion of the water surface area (for pond systems) or bottom (for meadow-type systems) contains wetland vegetation. These systems can be effective in both quantity and quality control, but, as with natural wetlands, are relatively delicate and require a water balance to sustain the aquatic vegetation. Sedimentation can especially reduce the effectiveness of the system. Pollutant removal in wetlands can occur through a number of mechanisms including sedimentation, filtration, volatilization, adsorption, absorption, microbial decomposition, and plant uptake. Pretreatment of runoff may be necessary for these systems (U.S. EPA, 1999).

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Filtration systems use some combination of a granular filtration media remove constituents found in runoff such as sand, soil, organic material, carbon, or membranes. Often these systems treat only the first half inch to inch of runoff, and are common at small sites such as parking lots and developments, in areas with high pollution potential such as industrial areas, or in highly urbanized areas where land availability or costs preclude the use of other controls (U.S. EPA, 1999). **Exhibit E-4** summarizes the different types of filtration systems.

Exhibit E-4. Summary of Storm Water Filtration Systems

System Type	Description
Surface sand filter	Most common system is the Austin sand filter. Runoff first enters a sedimentation basin where coarse particles are removed by gravity settling. The filter bed consists of sand with a gravel and perforated pipe under-drain system to capture the treated water.
Underground vault sand filter	Common systems are the D.C. sand filter and the Delaware sand filter. Basic design premise is the same as the surface sand filter.
Biofiltration/bioretention systems	Designed to mimic the functions of a natural forest ecosystem for treating storm water runoff. Variation of surface sand filter where sand filtration media is replaced with a planted soil bed. Pollutants are removed by a number of processes including adsorption, filtration, volatilization, ion exchange, and decomposition.

Source: U.S. EPA (1999).

Vegetated systems (biofilters) such as swales and filter strips are designed to convey and treat either shallow flow (swales) or sheetflow (filter strips) runoff. Open channel vegetated systems are alternatives to the traditional curb-and-gutter and storm sewer conveyance systems. By conveying storm water runoff in vegetated systems treatment, storage, and infiltration can be provided prior to discharge to the storm sewer system (U.S. EPA, 1999). **Exhibit E-5** summarizes the different types of vegetated systems.

Exhibit E-5. Summary of Storm Water Vegetated Systems

System Type	Description
Grass filter strips	Densely vegetated, uniformly graded areas that intercept sheet runoff from impervious surfaces such as parking lots, highways, and rooftops. Designed to trap sediments, to partially infiltrate runoff, and to reduce the velocity of the runoff. Frequently used as a pretreatment system prior to storm water being treated by BMPs such as filters or bioretention systems.
Vegetated swales	Broad, shallow channels with a dense stand of vegetation covering the side slopes and channel bottom. Designed to slowly convey storm water runoff, and in the process trap pollutants, promote infiltration, and reduce flow velocities. Swales can be either wet or dry.

Source: U.S. EPA (1999).

The performance of BMPs can vary considerably based on differences in the design criteria and performance standards. Factors that influence performance and design include size of the drainage area, the level of watershed imperviousness, duration and volume of runoff, and the

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land use of contributing drainage areas. Ranges for pollutant removal for various controls are summarized in **Exhibit E-6**.

Exhibit E-6. Potential Pollutant Removal Efficiencies for Structural Storm Water Controls

BMP Type	Suspended Solids	Metals
Infiltration basin[1]	50% - 80%	50% - 80%
Infiltration trenches[1]	50% - 80%	50% - 80%
Porous pavement[1]	65% - 100%	65% - 100%
Detention basins	30% - 65%	15% - 45%
Retention basins	50% - 80%	50% - 80%
Constructed wetlands	50% - 80%	50% - 80%
Surface sand filters[2]	50% - 80%	50% - 80%
Other media filters[2]	65% - 100%	50% - 80%
Vegetated filter strips	50% - 80%	30% - 65%
Grassed swales	30% - 65%	15% - 45%

Source: U.S. EPA (1999); Caltrans (2004).
1. Removal is considered to be 100% when the water is infiltrated and not discharged to surface waters.
2. Filters must be placed off-line to assure continued functioning; only provide treatment based on a design storm.

The cost of constructing storm water controls depends on site conditions and drainage area. Furthermore, there are often economies of scale, making it difficult to develop a unit construction cost. As described below, U.S. EPA (1999) and the Caltrans (2001) provide cost estimates for various controls.

EPA's Engineering and Analysis Division (EAD) reviewed and summarized the available information related to expected costs of storm water controls (U.S. EPA, 1999). EAD identified only three studies that systematically evaluated the construction costs associated with structural controls since 1985. EAD used these studies to develop construction costs for specified drainage size and percent impervious cover (**Exhibit E-7**).

Exhibit E-7. Estimated Costs of Storm Water Controls in the U.S.

BMP Type	Typical Construction Cost ($/Control)	Drainage Size (Acre)	Approximate Unit Cost ($/acre)
35% Impervious Cover (Residential)			
Retention Basin	$136,500	50	$2,730
Wetland	$170,500	50	$3,410
Grass Swale	$5,000	5	$1,000
Filter Strip	$0-$12,500	5	$0-$2,500
65% Impervious Cover (Commercial)			
Infiltration Trench	$61,500	5	$12,300
Infiltration Basin	$20,500	5	$4,100
Sand Filter[1]	$47,500-$95,500	5	$9,500-$19,100
Bioretention	$82,000	5	$16,400

Source: U.S. EPA (1999); escalated from 1997 dollars to 2007 dollars using the Environmental News Record (ENR) Construction Cost Index (CCI) and round to the near $500.
1. Range accounts for design variations.

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In addition to capital costs, additional costs include design, contingency, and permitting costs; land costs; and operation and maintenance (O&M) costs. EPA (1999) estimated that the design, contingency, and permitting costs equal approximately 25%-32% of the base construction costs. Land costs are extremely variable. For example, little or no land acquisition may be needed for a particular storm water control resulting in low or zero additional costs. However, if land acquisition is needed for the construction of a storm water control, the cost could potentially outweigh the design and construction costs combined.

EPA (1999) indicates that most studies estimate O&M costs as a fraction of base construction costs. O&M costs vary across controls and may also vary based on site and region specific parameters. Potential O&M costs are presented in **Exhibit E-8**.

Exhibit E-8. Potential Annual O&M Costs for Storm Water Controls

Control Type	Percent of Construction Cost
Infiltration basin	1%-10%
Infiltration trenches	5%-20%
Detention basins	<1%
Retention basins	3%-6%
Constructed wetlands	2%-6%
Surface sand filters	11%-13%
Bioretention	5%-7%
Vegetated filter strips	$320/acre (maintained)
Grassed swales	5%-7%

Source: U.S. EPA (1999).

The Portland Bureau of Environmental Services (BES) has also conducted a number of demonstration projects aimed at reducing the volume of storm water and pollutant loadings entering its combined sewer system. The project BMPs provide runoff volume control and water quality benefits, while improving the existing landscape:

- Storm water planters – vegetative landscaping added to parking garages and lots that capture and infiltrate runoff from paved surfaces; adds attractive green space to urban areas
- Curb extensions – landscaped add-ons to existing curbs designed to capture runoff from streets and side walks; can increase pedestrian safety
- Pervious pavers – use of paving blocks (rather than impervious asphalt) that allow storm water infiltration
- Landscape infiltration basin – landscaped basin and captures storm water
- Ecoroof - cover roof top with vegetation to absorb/retain storm water; roofscaping covers and protects the waterproofing and structural components of a roof, which extends the life of a conventional roof.

Exhibit E-10 provides a summary of various storm water BMP demonstration projects implemented throughout Portland. Portland BES and EPA grants funded some part of most of the projects.

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Exhibit E-10. Portland-Area Storm Water BMP Demonstration Projects

BMP Description	Total Project Cost	Impervious Area Treated (sf)	Unit Cost ($/sf)	Benefit
NE Fremont Street - curb extension	$16,400	4,500	$3.64	Reduces peak flows and retains storm water volumes to reduce CSOs
SE Ankeny - 2 curb extensions	$11,946	7,300	$1.64	Reduces peak flows and retains storm water volumes to reduce CSOs
NE Siskiyou - 2 curb extensions	$17,000	9,300	$1.83	Reduces peak flow from 25-yr storm by 88%
SW 12th Avenue - 4 consecutive planters	$34,850	7,500	$4.65	Reduces peak flow from a 25-yr storm by 70%
ReBuilding Center - 2 planters with pervious parking lot	$108,232	35,000	$2.79	Treats >870,000 gallons/year of storm water onsite
Mississippi Commons - planters for building complex	$42,105	25,000	$1.68	Treats 500,000 gallons/year of storm water onsite
Liberty Centre Parking Garage - 2 planters	$75,530	36,155	$2.10	Treats most storm water from area
East Holladay Park - new pervious pavers parking lot	$165,000	5,225	$31.58	Complete onsite storm water treatment
Multnomah Building - ecoroof	$179,807	11,900	$15.11	Substantial reduction in runoff from the roof; extends roof life.
Hamilton West Apartments - ecoroof	$127,500	8,400	$15.18	Manages about 768,000 gallons of potential storm water; extends roof life.
Oregon Natural Resources Council - pervious pavers; infiltration basin	$76,731	5,750	$6.00	Complete onsite storm water treatment
Barrington Square Apartments - infiltration basins and mini soakage trenches	$54,200	16,585	$3.25	Removes >350,000 gallons/year of runoff
Page 19 LLC – smaller parking lot, gravel courtyard, infiltration basin, and landscape areas	$37,080	10,000	$3.80	Treats most storm water from area
Natural Resource Program Eastside Field Office - swales, infiltration basin, and vegetated filter	$55,183	14,000	$3.94	Removes >314,000 gallons/year of runoff from the sewer
Reed College Apartments - soakage trench	$33,042	12,000	$2.75	Removes >269,000 gallon/year of runoff from the sewer
Wattles Boys and Girls Club - infiltration facilities/basins, subsurface sand filter; and 2 planters	$56,581	21,000	$2.60	Removes >314,000 gallons/year of runoff from the sewer

Sources: Portland BES (2006; 2005a; 2005b; 2005c; 2004a; 2004b; 2003a; 2003b; 2002a; 2002b; 2002c; 2002d; 2002e; 2002f; 2001; 1999). Costs in project year dollars
CSO = combined sewer overflow
sf = square feet

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Appendix F. Sample Facility Results and Statewide Extrapolation

This appendix provides a summary of the sample facility results and shows the extrapolation of statewide costs.

F.1 Baseline Criteria

Exhibit F-1 summarizes the potential compliance costs to the sample facilities associated with the baseline criteria scenario.

Exhibit F-1. Potential Total Annual Compliance Costs for Sample Facilities: Baseline Criteria (millions 2007$)

Facility Name	Discharger Category	Total Baseline Costs with I&I	Total Baseline Costs without I&I
Certainty Sample			
Eugene/Springfield WPCF	Major Municipal	$0.25	$0.25
Portland Columbia Blvd WWTP	Major Municipal	$0.050 - $10.7	$0.050
Salem Willow Lake WWTP	Major Municipal	$0.17 - $3.87	$0.17
St Helen-Boise WWTP	Major Municipal[1]	$0 - $0.025	$0 - $0.025
Oregon Steel Mills	Minor Industrial	$0 - $0.025	$0 - $0.025
Random Sample			
Astoria WWTP	Major Municipal	$0 - $0.40	$0
Brookings WWTP	Major Municipal	$0	$0
Coos Bay WWTP #2	Major Municipal	$0	$0
Kellogg Creek WWTP	Major Municipal	$0.10 - $0.43	$0.10
McMinnville WRF	Major Municipal	$0.11 - $0.46	$0.11
North Bend WWTP	Major Municipal	$0 - $0.17	$0
Rock Creek WWTP	Major Municipal	$0.15	$0.15
Tri-City S. D.	Major Municipal	$0.10 - $1.13	$0.10
Woodburn WWTP	Major Municipal	$0.10 - $0.15	$0.10 - $0.15
Blue Heron Paper	Major Industrial	$0.025	$0.025
Heinz Food	Major Industrial	$0	$0
Pope and Talbot	Major Industrial	$0.025	$0.025
Reynolds Metals	Major Industrial	$0	$0
Shady Cove WWTP	Minor Municipal	$0	$0
Boise Cascade, Elgin Mill	Minor Industrial	$0	$0

1. Dominated by industrial flow.

Exhibits F-2 and **F-3** show the extrapolation of the random sample results, and addition to the certainty sample results with and without I&I costs for reducing arsenic in municipal sewer systems, respectively, for the baseline scenario. There are no costs for either of the minor facilities in the random sample, as well as no data; expansion of this sample is unlikely to change this result due to the lack of monitoring requirements for toxic pollutants for these facilities.

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Exhibit F-2. Potential Annual Statewide Baseline Compliance Costs: Includes I&I Costs (millions of 2007$)

Category	Sample			Statewide	Extrapolated Annual Cost
	Total Annual Cost	Number of Facilities	Average Cost per Facility	Number of Facilities[1]	
Certainty Sample					
Multiple[2]	$0.47 - $14.9	5	NA	5	$0.47 - $14.9
Random Sample					
Major Municipals	$0.56 - $2.90	9	$0.062 - $0.32	45	$2.81 - $14.5
Major Industrials	$0.050	4	$0.013	27	$0.34
Total	$1.08 - $17.8	18	NA	77	$3.62 - $29.7

Note: Detail may not add to totals due to rounding.
NA = not applicable
1. Random sample results extrapolated to total number in category less number in certainty sample.
2. Large flow municipals (one of which is dominated by industrial flow) plus one minor industrial.

Exhibit F-3. Potential Annual Statewide Baseline Compliance Costs: Excludes I&I Costs (millions of 2007$)[1]

Category	Sample			Statewide	Extrapolated Annual Cost
	Total Annual Cost	Number of Facilities	Average Cost per Facility	Number of Facilities[1]	
Certainty Sample					
Multiple[2]	$0.47 - $0.52	5	NA	5	$0.47 - $0.52
Random Sample					
Major Municipals	$0.56 - $0.61	9	$0.062 - $0.068	45	$2.81 - $3.06
Major Industrials	$0.050	4	$0.013	27	$0.34
Total	$1.08 - $1.23	18	NA	77	$3.62 - $3.92

Note: Detail may not add to totals due to rounding.
NA = not applicable
1. Random sample results extrapolated to total number in category less number in certainty sample.
2. Large flow municipals (one of which is dominated by industrial flow) plus one minor industrial.

F.2 Revised Criteria

Exhibits F-4 and F-5 summarize the potential incremental (i.e., costs above and beyond those needed for compliance with current regulations) compliance costs to the sample facilities, with and without I&I costs to control arsenic in municipal sewer systems, respectively, associated with the revised criteria scenarios that incorporate alternative fish consumption rates.

Exhibit F-4. Potential Annual Incremental Compliance Costs for Sample Facilities: Revised Criteria (millions 2007$)

Facility Name	Incremental Costs of Alternative Fish Consumption Rate Scenarios				
	63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
Certainty Sample					
Eugene/Springfield WPCF	$0	$0	$0	$0	$0
Portland Columbia Blvd WWTP	$0	$0.27	$0.27 - $0.32	$0.27 - $0.32	$0.27 - $0.32
Salem Willow Lake WWTP	$0 - $0.050	$0 - $0.050	$0 - $0.050	$0 - $0.050	$0 - $0.050

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Exhibit F-4. Potential Annual Incremental Compliance Costs for Sample Facilities: Revised Criteria (millions 2007$)

Facility Name	Incremental Costs of Alternative Fish Consumption Rate Scenarios				
	63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
St Helen-Boise WWTP	$0.075	$0.075	$0.075	$0.075	$0.075
Oregon Steel Mills	$0	$0	$0	$0	$0
Major Municipals					
Astoria WWTP	$0	$0	$0	$0.10	$0.10
Brookings WWTP	$0	$0	$0	$0	$0
Coos Bay WWTP #2	$0	$0	$0 - $0.17	$0 - $0.17	$0 - $0.17
Kellogg Creek WWTP	$0	$0	$0	$0	$0
McMinnville WRF	$0	$0	$0	$0	$0
North Bend WWTP	$0	$0	$0	$0	$0
Rock Creek WWTP	$0	$0	$0	$0	$0
Tri-City S. D.	$0	$0	$0	$0	$0
Woodburn WWTP	$0	$0	$0	$0	$0
Major Industrials					
Blue Heron Paper	$0	$0	$0	$0	$0
Heinz Food	$0	$0	$0	$0	$0
Pope and Talbot	$0	$0	$0	$0	$0
Reynolds Metals	$0	$0	$0	$0	$0
Minors					
Shady Cove WWTP	$0	$0	$0	$0	$0
Boise Cascade, Elgin Mill	$0	$0	$0	$0	$0

Exhibit F-5. Potential Annual Incremental Compliance Costs for Sample Facilities Excluding I&I Costs: Revised Criteria (millions 2007$)

Facility Name	Incremental Costs of Alternative Fish Consumption Rate Scenarios				
	63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
Certainty Sample					
Eugene/Springfield WPCF	$0	$0	$0	$0	$0
Portland Columbia Blvd WWTP	$0	$0.27	$0.27 - $0.32	$0.27 - $0.32	$0.27 - $0.32
Salem Willow Lake WWTP	$0 - $0.050	$0 - $0.050	$0 - $0.050	$0 - $0.050	$0 - $0.050
St Helen-Boise WWTP	$0.075	$0.075	$0.075	$0.075	$0.075
Oregon Steel Mills	$0	$0	$0	$0	$0
Major Municipals					
Astoria WWTP	$0	$0	$0	$0.10	$0.10
Brookings WWTP	$0	$0	$0	$0	$0
Coos Bay WWTP #2	$0	$0	$0	$0	$0
Kellogg Creek WWTP	$0	$0	$0	$0	$0
McMinnville WRF	$0	$0	$0	$0	$0
North Bend WWTP	$0	$0	$0	$0	$0
Rock Creek WWTP	$0	$0	$0	$0	$0
Tri-City S. D.	$0	$0	$0	$0	$0
Woodburn WWTP	$0	$0	$0	$0	$0
Major Industrials					

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Exhibit F-5. Potential Annual Incremental Compliance Costs for Sample Facilities Excluding I&I Costs: Revised Criteria (millions 2007$)

Facility Name	Incremental Costs of Alternative Fish Consumption Rate Scenarios				
	63.2 gpd	113 gpd	175 gpd	389 gpd	620 gpd
Blue Heron Paper	$0	$0	$0	$0	$0
Heinz Food	$0	$0	$0	$0	$0
Pope and Talbot	$0	$0	$0	$0	$0
Reynolds Metals	$0	$0	$0	$0	$0
Minors					
Shady Cove WWTP	$0	$0	$0	$0	$0
Boise Cascade, Elgin Mill	$0	$0	$0	$0	$0

Exhibits F-6 and F-7 show the extrapolation of the incremental compliance costs for the random sample, and addition to the certainty sample results, for the revised criteria scenarios, with and without I&I costs to control arsenic in municipal sewer systems, respectively. Again, there are no costs for the minor facilities in the random sample (and no data); expansion of this sample is not likely to change this result due to a lack of monitoring requirements for toxic pollutants for these facilities.

Exhibit F-6. Potential Annual Incremental Statewide Compliance Costs: Including I&I Costs (millions of 2007$)[1]

Category	Sample			Statewide	Extrapolated Annual Cost
	Total Annual Cost	Number of Facilities	Average Cost per Facility	Number of Facilities[2]	
63.2 gpd					
Certainty Sample[3]	$0.075 - $0.13	5	NA	5	$0.075 - $0.13
Major Municipals	$0	9	$0	45	$0
Major Industrials	$0	4	$0	27	$0
Total	$0.075 - $0.13	18	NA	77	$0.075 - $0.13
113 gpd					
Certainty Sample[3]	$0.35 - $0.40	5	NA	5	$0.35 - $0.40
Major Municipals	$0	9	$0	45	$0
Major Industrials	$0	4	$0	27	$0
Total	$0. 35 - $0.40	18	NA	77	$0.35 - $0.40
175 gpd					
Certainty Sample[3]	$0.35 - $0.45	5	NA	5	$0.35 - $0.45
Major Municipals	$0 - $0.17	9	$0 - $0.019	45	$0 - $0.87
Major Industrials	$0	4	$0	27	$0
Total	$0.35 - $0.62	18	NA	77	$0.35 - $1.32
389 and 620 gpd					
Certainty Sample[3]	$0.35 - $0.45	5	NA	5	$0.35 - $0.45
Major Municipals	$0.10 - $0.27	9	$0.011 - $0.030	45	$0.50 - $1.37
Major Industrials	$0	4	$0	27	$0
Total	$0.45 - $0.72	18	NA	77	$0.85 - $1.82

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NA = not applicable
1. Represents the annual costs of compliance above and beyond those needed for compliance with baseline criteria.
2. Random sample results extrapolated to total number in category less number in certainty sample.
3. Large flow municipals (one of which is dominated by industrial flow) plus one minor industrial.

Exhibit F-7. Potential Annual Incremental Statewide Compliance Costs: Excluding I&I Costs (millions of 2007$)[1]

Category	Sample			Statewide	Extrapolated Annual Cost
	Total Annual Cost	Number of Facilities	Average Cost per Facility	Number of Facilities[2]	
63.2 gpd					
Certainty Sample[3]	$0.075 - $0.13	5	NA	5	$0.075 - $0.13
Major Municipals	$0	9	$0	45	$0
Major Industrials	$0	4	$0	27	$0
Total	$0.075 - $0.13	18	NA	77	$0.075 - $0.13
113 gpd					
Certainty Sample[3]	$0.35 - $0.40	5	NA	5	$0.35 - $0.40
Major Municipals	$0	9	$0	45	$0
Major Industrials	$0	4	$0	27	$0
Total	$0. 35 - $0.40	18	NA	77	$0.35 - $0.40
175 gpd					
Certainty Sample[3]	$0.35 - $0.45	5	NA	5	$0.35 - $0.45
Major Municipals	$0	9	$0	45	$0
Major Industrials	$0	4	$0	27	$0
Total	$0.35 - $0.45	18	NA	77	$0.35 - $0.45
389 and 620 gpd					
Certainty Sample[3]	$0.35 - $0.45	5	NA	5	$0.35 - $0.45
Major Municipals	$0.10	9	$0.011	45	$0.50
Major Industrials	$0	4	$0	27	$0
Total	$0.45 - $0.55	18	NA	77	$0.85 - $0.95

NA = not applicable
1. Represents the annual costs of compliance above and beyond those needed for compliance with baseline criteria.
2. Random sample results extrapolated to total number in category less number in certainty sample.
3. Large flow municipals (one of which is dominated by industrial flow) plus one minor industrial.

F.5 Variance Costs

Exhibit F-8 summarizes the potential one-time baseline and incremental (i.e., costs above and beyond those needed for compliance with current regulations) variance costs to the sample facilities.

Exhibit F-8. Potential Baseline and Incremental One-Time Variance Costs for Sample Facilities (millions 2007$)

Facility Name	Discharger Category	Baseline Costs	Incremental Costs of Revised Criteria
Certainty Sample			
Eugene/Springfield WPCF	Major Municipal	$0.035 - $0.30	$0
Portland Columbia Blvd WWTP	Major Municipal	$0.035 - $0.30	$0

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Exhibit F-8. Potential Baseline and Incremental One-Time Variance Costs for Sample Facilities (millions 2007$)

Facility Name	Discharger Category	Baseline Costs	Incremental Costs of Revised Criteria
Salem Willow Lake WWTP	Major Municipal	$0.035 - $0.30	$0
St Helen-Boise WWTP	Major Municipal[1]	$0.035 - $0.30	$0
Oregon Steel Mills	Minor Industrial	$0	$0
Random Sample			
Astoria WWTP	Major Municipal	$0.035 - $0.10	$0
Brookings WWTP	Major Municipal	$0	$0
Coos Bay WWTP #2	Major Municipal	$0	$0.035 - $0.10
Kellogg Creek WWTP	Major Municipal	$0.035 - $0.20	$0
McMinnville WRF	Major Municipal	$0.035 - $0.20	$0
North Bend WWTP	Major Municipal	$0.035 - $0.10	$0
Rock Creek WWTP	Major Municipal	$0	$0.035 - $0.30
Tri-City S. D.	Major Municipal	$0.035 - $0.20	$0
Woodburn WWTP	Major Municipal	$0.035 - $0.10	$0
Blue Heron Paper	Major Industrial	$0	$0.035 - $0.10
Heinz Food	Major Industrial	$0	$0
Pope and Talbot	Major Industrial	$0.035 - $0.20	$0
Reynolds Metals	Major Industrial	$0	$0
Shady Cove WWTP	Minor Municipal	$0	$0
Boise Cascade, Elgin Mill	Minor Industrial	$0	$0

1. Dominated by industrial flow.

Exhibit F-9 shows the extrapolation of the baseline and incremental one-time variance costs for the random sample facilities, and addition to the certainty sample results. There are no costs associated with the minor facilities in the random sample (and no data); expansion of this sample is not likely to change this result due to a lack of monitoring requirements for toxic pollutants for these facilities.

Exhibit F-9. Potential Baseline and Incremental Statewide One-Time Variance Costs (millions of 2007$)

Category	Sample			Statewide	Extrapolated One-Time Cost
	Total One-Time Cost	Number of Facilities	Average Cost per Facility	Number of Facilities[1]	
Baseline Criteria					
Certainty Sample[2]	$0.14 - $1.20	5	NA	5	$0.14 - $1.20
Major Municipals	$0.21 - $0.90	9	$0.023 - $0.10	45	$1.05 - $4.50
Major Industrials	$0.035 - $0.20	4	$0.009 - $0.050	27	$0.24 - $1.35
Total	$0.39 - $2.30	18	NA	77	$1.43 - $7.05
Revised Criteria (Incremental)[3]					
Certainty Sample[2]	$0	5	NA	5	$0
Major Municipals	$0.070 - $0.40	9	$0.008 - $0.044	45	$0.35 - $2.0
Major Industrials	$0.035 - $0.10	4	$0.009 - $0.025	27	$0.24 - $0.68
Total	$0.11 - $0.50	18	NA	77	$0.59 - $2.68

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NA = not applicable
1. Random sample results extrapolated to total number in category less number in certainty sample.
2. Large flow municipals (one of which is dominated by industrial flow) plus one minor industrial.
3. Represents the annual costs of compliance above and beyond those needed for compliance with baseline criteria.

Extrapolating the potential number of variance applications for the sample facilities, ODEQ may need to review approximately 40 requests under the baseline, and an additional 16 under the revised criteria. Assuming a cost of $3,900 per review, baseline costs could be approximately $159,000, with incremental costs of approximately $65,000 under the revised criteria.

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