Columbia Slough Sediment Program
2006 Annual Report

1. Columbia Slough Sediment Program Background

Since 1993, the City of Portland, Bureau of Environmental Services (BES) and the State Department of Environmental Quality (DEQ) have studied the Columbia Slough watershed and have implemented actions to improve sediment quality. Early studies and subsequent follow-up investigations indicate widespread, low-level contamination throughout the Slough's sediments with a few isolated areas of higher contamination. Routine dredging or capping actions alone will not be effective at reducing risks associated with this widespread contamination because the Slough is shallow and the contamination is ubiquitous.

DEQ and the City devised a cleanup approach for the Columbia Slough which was documented in a Record of Decision (ROD) issued in July 2005. The approach consists of three primary elements:

1. Source control – Implementing actions that address the sources of contamination to reduce contaminant inputs. Addressing the sources of contamination is important because it will prevent recontamination of remediated sediments and allow natural recovery processes to effectively reduce existing contamination in the Slough

2. "Hot spot" cleanup – Dredging sediments that are contaminated at levels that exceed the general pervasive level of contamination throughout the Slough

3. Long-term monitoring – Evaluating the effectiveness of the actions taken and identify areas where more focused attention is necessary

An initial broad-scale sampling event was conducted in 1994/1995, results of which were documented in the Screening Level Risk Assessment (SLRA) for the Slough. Several smaller studies have been completed in the interim and provided the foundation for development of the remedial approach. A Feasibility Study for the Slough was completed in 2004 and the ROD signed in July 2005. Implementation of the ROD was officially initiated in 2006; however, many aspects of the remedial approach were already in progress. These actions were pulled into the framework established in the ROD.

In 2006, BES and DEQ signed an Intergovernmental Agreement (IGA) forming a partnership to jointly implement the remedial approach for sediment contamination in the Columbia Slough. The IGA establishes a workplan for both BES and DEQ to reduce releases of contaminants to the Slough to protective levels and conduct long-term monitoring of various parameters to assess progress.

BES and DEQ will implement programs and actions in a watershed, or geographic, approach. With a watershed approach, the actions mimic the natural soil, vegetation, and hydrologic functions of a watershed. The actions are targeted at the source of the problem rather than the symptoms, and they are multi-objective. The watershed approach also incorporates adaptive

management principals in that the sediment program will be modified based on data collected to optimize the actions to improve Columbia Slough watershed health.

The overall goal of the ROD and IGA is to reduce contaminant levels in the Slough sediment to concentrations that are protective of human health and the environment. Actions specified in the IGA to achieve this goal include:

- Controlling the sources of pollution to reduce the amount of contaminants reaching the slough
- Long-term monitoring of watershed conditions to determine long-term trends
- Updating the public and providing opportunities for the public to provide input
- Modifying actions as warranted based on the data collected (adaptive management)

Source control actions and priorities are specified in a Watershed Action Plan which was finalized in October 2006. Source control activities include:

- Conducting in-depth investigations to identify and control sources of contamination and recommend remedial actions and future monitoring
- Constructing water quality facilities, such as swales, planters, rain gardens, and eco-roofs to treat stormwater before it is discharged to the slough
- Ensuring best management practices (BMPs) at private businesses and industries are implemented to reduce input from widespread sources of contamination
- Providing technical assistance to businesses that use or manage hazardous substances to help them reduce contaminant input to stormwater runoff
- Educating students and adults who live and/or work in the Slough watershed
- Increasing vegetation in drainage areas to increase soil stability and stormwater infiltration

This second Annual Report covers fiscal year 2007 (July 1, 2006 – June 30, 2007). The purpose of this report is to provide an update on the progress BES and DEQ are making in implementing the IGA and improving watershed health and to identify activities planned for the upcoming year.

Section 1 provides background information about the program. Section 2 describes the accomplishments for the year. Section 3 describes the actions planned for the next fiscal year (July 1, 2007 – June 30, 2008).

Many of the reports referenced are available on-line at either the BES or DEQ web site:
www.portlandonline.com/bes
http://www.deq.state.or.us/wmc/cu/NWR/ColumbiaSlough/index.htm.

Watershed Action Plan

In 2006, BES and DEQ completed the *Columbia Slough Sediment Watershed Action Plan* (the Plan) (found on line at: http://www.portlandonline.com/bes/index.cfm?c=eeage).

The Plan describes the actions that will be implemented to reduce sources of contamination to the Slough to protective levels so that natural recovery processes will be effective. The Plan recognizes on-going efforts and describes an approach for prioritizing areas in the watershed for

more focused efforts. The Plan provides a framework for ultimately addressing all sources of contamination to the Slough. The Plan includes a prioritization of storm sewer basins within the Slough Watershed so that comprehensive source control can be implemented sequentially beginning with the areas of greatest concern to Slough sediment.

BES identified five areas of the Slough watershed, described below, for targeted actions. These Target Areas were selected based on the amount of total suspended solids (TSS) discharged from the Municipal Separated Storm Sewer System (MS4), the presence of elevated levels of contamination in slough sediments, and opportunities for partnerships when implementing actions.

Interstate 5 to Martin Luther King Jr. Blvd.
This stretch of the Lower Slough is located between NE Bayard and NE MLK and receives drainage from an area of approximately 187 acres. This is a Target Area because of the quantity of TSS being discharged into this area, the elevated levels of contamination in the sediment, and the presence of three former CSO outfalls.

Marx-Whitaker Slough
Marx-Whitaker Slough is a one-mile side-channel of the main Slough. It is located between NE 118th and NE 129th , and receives drainage from an area of approximately 434 acres. This reach is a Target Area because of the quantity of TSS reaching this slough (five outfalls within this Area rated high in total TSS discharged) and the elevated level of contamination in the sediment. There are clear sources of TSS (the agricultural fields and high traffic roads) where actions will be targeted.

Buffalo Slough
Buffalo Slough is a one-mile side-channel of the Middle Slough. It is located between NE 33rd and NE 42nd, and it receives drainage from an area of approximately 42 acres. This reach is a Target Area because of the quantity of TSS discharged into the reach in the past and because it has elevated levels of contamination.

Cully Neighborhood
This area, from NE 42nd to NE 82nd, is adjacent to the Cully neighborhood in northeast Portland. BES will focus on two outfalls, OF 77 and OF 77a, which are located near NE 69th , the drainage area is approximately 103 acres. This is a Target Area because of the quantity of TSS being discharged from the two outfalls.

St Johns Landfill
The St Johns Landfill is located in the Lower Slough near Rivergate north of Columbia Blvd. and drains an area of approximately 208 acres. This Target Area is a priority because of the quantity of TSS being discharged from two outfalls. Also, opportunities exist for collaboration with DEQ-required investigations at the landfill and other contaminated sites in this section of the Slough.

2. Fiscal Year 2007 Actions Accomplished

2.1 Target Areas

Activities in FY2007 primarily focused on the I-5 to MLK and Marx-Whitaker Target Areas which were identified as the highest priority areas in the Watershed Action Plan. As outlined in the schedule provided in the WAP, comprehensive plans for source investigation/control activities will be developed sequentially for each Target Area over the next 5 years.

I-5 to MLK Target Area

A source investigation was conducted for outfall (OF) 59, a former CSO outfall. Outfall 59 discharges to the Slough at approximately NE Bayard. The investigation focused on identifying sources of chromium, lead, nickel, silver, and thallium. No distinct sources of metals were found, although several potential sources were identified. A draft report on this investigation was completed in June 2007.

A workplan is being developed for Outfalls 61, 61a, 62 and 62a. These outfalls discharge to the Slough near I-5. Stormwater from I-5 discharges from outfall 61a. BES reviewed available records to identify current and past businesses to identify potential pollutants. BES conducted site visits and reviewed aerial photos and other data to identify areas that may be contaminated. BES also inspected facilities to review permits, stormwater management plans, and review BMP implementation with facility owners and managers.

Marx-Whitaker Target Area

Portland Parks and Recreation (PP&R) owns 15 acres of land at NE 122nd and NE Shaver. This land was farmed for many years, and erosion from this property contributed significant quantities of sediment to Marx-Whitaker Slough. PP&R is no longer leasing their property for farming purposes. PP&R planted a cover crop of grass which will significantly reduce, and possibly eliminate, erosion and sedimentation from their property.

Buffalo Slough Target Area

A characterization of current conditions of Buffalo Slough was initiated. The goal of the characterization is to fully understand the current conditions of Buffalo Slough, to identify new management approaches that may be needed to improve conditions, and to develop an approach which may be used in other areas of the city to characterize a sub-watershed.

Phase 1 of the characterization brings together all existing data about Buffalo Slough such as water quality, sediment quality, precipitation, and land use.

Cully Neighborhood Target Area

The Portland Department of Transportation initiated a study which will identify green street sites along Cully Ave. near Killingsworth. PDOT issued an RFP to hire a consultant team which will develop green street options. This is a long-term project, and BES will participate.

St. Johns Landfill
Metro continued to work with DEQ on the investigation and risk assessment associated with the landfill.

2.2 Site Cleanup

Specific Site Actions

Significant progress has been made on investigation and cleanup of sites in each section of the Slough Watershed. Highlights for FY07 are summarized below by Slough segment.

Lower Slough

There are currently 23 active cleanup sites in the Lower Columbia Slough watershed. At most sites the initial phases of investigation on the upland portions of the properties have been conducted. At some sites, sampling has been completed in the Slough itself. Highlights include the following:

- A supplemental remedial investigation work plan was approved for the Merit Oil/Fuel Processors Inc facility located at 4150 N Suttle Rd. The plan includes additional sediment, groundwater, and surface water sampling to evaluate groundwater/surface water interactions. A plan for upland soil data gap sampling is pending.
- The risk assessment and hot spot evaluation was revised for the Pacific Meat site, located at 2701 N Newark St. A focused feasibility study evaluating cleanup options is being finalized. Cleanup will address pond sediments, groundwater, and surface soil with PCB contamination; soil stockpiles contaminated with metals, PAHs, and PCBs; and contaminated Slough sediments.

Installing mini-piezometers near St. Johns Landfill

- Monitoring wells and injection wells for in-situ treatment of groundwater were installed at the Breunig Property (former south parcel of the Larsen Property) located at 10145 N. Portland Rd.
- A Record of Decision was issued for bank, sediment, and upland cleanup at the Pacific Carbide and Alloys facility located at 9901 N. Hurst Ave. Pacific Carbide and Alloys, Inc. has applied for a Solid Waste Letter of Authorization for disposal of approximately 45,000 cubic yards of lime waste at the Tigard Sand and Gravel facility.
- A risk assessment was completed for the Hanson Pipe and Products Inc. site, located at 755 NE Columbia Boulevard. Unacceptable risk was found based on elevated soil contaminant concentrations around a crane pad area.
- Sediment pore water was sampled at the Union Carbide site, located at 11020 N Byrgard St., to complete the evaluation of possible groundwater contamination impacts on the Slough. Union Carbide is finalizing reports on the results of this study which indicate that groundwater from the site is not adversely impacting the Slough.
- A draft agreement is under review for a potential multi-party funded sediment investigation in the Slough in the vicinity of the I-5 crossing of the Columbia Slough. This is area is the Outfall 59 to MLK Blvd. Target Area in the Watershed Action Plan. Responsible parties for

the following sites are participating in the negotiations: Blasen Family LTD/BTS Container Service (1601 N. Columbia Blvd), Dynea Overlays/Simpson Timber Co. (2301 N. Columbia Blvd.), Macadam Aluminum and Bronze (north of Columbia Blvd., just west of I5), Wastech (701 Hunt St.), and Precision Equipment (8440 N. Kerby Ave.).

Middle Slough

There are currently ten active cleanup sites in the Middle Columbia Slough. The Baron Blakeslee/Honeywell site (5920 NE 87th Ave.), Cadet Manufacturing site (6225 NE 105th Ave.), and Portland Air National Guard site (Portland Airport) are in the process of conducting and evaluating groundwater cleanup actions. Final documentation associated with contamination at the former wrecking yards site (10201 NE Airport Way) is being prepared by the Port of Portland. The investigation results for these projects indicate that current and historical impacts to the Slough above baseline concentrations are unlikely and no sediment sampling has occurred or is planned at this time.

Whitaker Slough

This tributary to the main stem of the Middle Slough has six active cleanup projects including those in the vicinity of Johnson Lake which is connected to Whitaker Slough. Phase 1 of the cleanup of sediment, shoreline, and upland portions of the NuWay Oil site was completed in the Fall 2006 under DEQ's Orphan site program. Planning for completion of Phase 1 is in progress.

A workplan for sediment assessment is being prepared for the Portland Willamette Company site (6800 NE 59th Ave.).

An upland groundwater evaluation was completed at Johnson Lake by Owens-Illinois, and a sediment and upland soil cleanup proposal is being prepared for public comment.

Farm land at NE 122nd

The City of Portland Parks and Recreation and Bureau of Environmental Services are working with agricultural property owners where stormwater runoff is affecting the upper portion of Whitaker Slough, or Marx-Whitaker Sub-basin, to reduce runoff of pesticide-contaminated stormwater and evaluate options for addressing contaminated sediment. Fifteen acres of agricultural land will no longer be farmed. The property will be planted with grass to eliminate erosion. This is a target area identified in the Watershed Action Plan.

Peninsula Drainage Canal
DEQ provided a level 1 No Further Action (NFA) determination for this short segment of the Slough which is the dividing point between the Lower and Middle Slough. No sites have been identified along this segment as contributing contamination to the sediments and additional options for source control appear to be limited. Contamination detected in the sediment generally falls within the baseline range established for the Slough but some contaminants exceed risk-based concentrations. Long-term monitoring for the Slough will continue to include this segment and is anticipated to show declining concentrations of contaminants as source control efforts in other portions of the watershed take effect and sediments recover naturally through deposition of clean sediments and degradation of contaminants.

Buffalo Slough
There are currently no active cleanup projects in Buffalo Slough. DEQ is evaluating sediment data in this segment to identify areas where baseline concentrations are exceeded and site discovery efforts, and eventually sediment cleanup actions, are warranted. Buffalo Slough is a in the Watershed Action Plan.

Upper Slough
There are active cleanup projects in the Upper Slough. Two of these, Reynolds Metals (5100 NE Sundial Rd., Troutdale) and Boeing (19000 NE Sandy Blvd.) are in active phases of groundwater cleanup that are not expected to impact Columbia Slough sediments.

Investigations were completed at the Spada North and South site (185th Ave., south of Marine Drive) and monitoring associated with storm water management was completed.

2.3 Site Investigation and Cleanup Tools Development

DEQ has developed a Geographic Work Plan to provide guidelines to Project Managers working on sites in the Columbia Slough watershed to ensure the investigation and cleanup actions are completed consistently, efficiently, and effectively. Recent activities include:

- Columbia Slough Sediment Screening Levels – DEQ created a spreadsheet that provides screening levels for Columbia Slough sediment and allows for calculation of site-specific screening levels where data supporting this is available. The spreadsheet includes screening levels pertinent to evaluating the potential for upland sources to adversely impact Slough sediments (and thus lays the foundation for source control evaluations) as well as screening levels that can be used to assess sediment areas of concern adjacent to a particular site.
- Investigation/Cleanup Guidelines – DEQ prepared a detailed outline for a guidance that will provide Project Managers and Responsible Parties working on sediment sites in the Columbia Slough a framework for assessing the extent of sediment contamination associated with a particular site and evaluating the need for source control measures. DEQ is considering expanding the scope of the document for state-wide use.
- Slough Segment Plan – DEQ prepared a proposal for assessing sediment investigation and cleanup liability associated with a particular section of the Slough where multiple sources of contamination appear to be contributing to contamination which exceeds sediment screening levels. This proposal is currently being developed for the Outfall 59 to MLK Jr. Blvd. Target Area identified in the Watershed Action Plan and will provide parties with an option of

contributing to a sediment cleanup fund rather than conducting a sediment investigation themselves.

2.4 Site Discovery

DEQ's Northwest Region (NWR) Site Assessment Program did not perform any focused site discovery efforts within the Columbia Slough over the past year.

2.5 NPDES Permits

DEQ issues NPDES permits to businesses and industries in the Slough watershed. BES has a Memorandum of Agreement to administer the 1200-COLS permits for those facilities within the City of Portland. DEQ retains oversight for the other general and individual permits as well as the 1200-COLS permits issued to facilities outside the City, the Portland International Airport, Oregon Air National Guard, the St Johns Landfill, and the City's leaf compost facility and wastewater treatment plant. There are currently 173 general NPDES permits within the Columbia Slough watershed:

- 1200-COLS permits (industrial storm water): 140
- 1700-A permits (wash water): 2
- 1200-C permits (construction storm water): 23
- 100-J permits (non-contact cooling water): 8

The COLS permit is unique to the Slough and has benchmarks, not limits, for stormwater discharges. Benchmarks are guideline concentrations designed to assist the permittee in determining whether their Stormwater Pollution Control Plan is reducing pollutant concentrations. DEQ does not take direct enforcement action on benchmarks. Instead, permittees are required to submit Action Plans to identify Best Management Practices (BMPs) to meet benchmarks. If the benchmark is not met after the fourth year of their 1200-COLS permit, then the DEQ will revoke the facility's coverage under the general permit and require them to apply for an individual permit.

City oversight of stormwater discharges to the Columbia Slough included the following activities over the past year:

- A total of 85 facilities that discharge stormwater to the MS4 were inspected. Of these, 66 were permitted and 19 were non-permitted facilities
- A total of 71 facilities that do not discharge to the MS4 were inspected. Of these, 49 were permitted and 22 were non-permitted facilities

2.6 Industrial Process Water

There are currently five individual NPDES permits on the Columbia Slough: Dynea Overlays, Portland Meadows, Portland Water Bureau Groundwater Pump Station, and two Port of Portland permits for the Airport – one for construction dewatering and one for deicing and anti-icing activities. Only one significant issue arose during the year. The Port of Portland failed to meet discharge limits established in their permit covering deicing and anti-icing. The Port and DEQ

recently signed a Mutual Agreement and Order (MAO) which sets out a schedule for the Port to build additional infrastructure to manage the deicing and anti-icing discharge. The Port submitted a conceptual design report in March 2007 in accordance with the MAO.

2.7 Hazardous Waste Technical Assistance

No technical assistance outreach efforts were conducted in the Slough watershed over the past year.

2.8 Long-term Monitoring

The Columbia Slough Watershed Long-Term Monitoring Plan (LTMP) was significantly reorganized. The LTMP describes monitoring that BES will conduct in the Slough watershed over the next ten years and more. This is a dynamic plan, and as technology and monitoring approaches change, the LTMP can also be changed. The following sections highlight monitoring efforts that the LTMP covers. The LTMP can be accessed on line at www.portlandonline.com

Fish Tissue Monitoring

Catching fish in the Slough for 2005 sampling

Fish tissue sampling will be conducted every ten years to assess the level of contamination in fish from the slough. The first broad-scale fish tissue sampling event was conducted in 1995. During the second event, conducted during the summer of 2005, BES collected 48 adult carp (*Cyprinus carpio*) for whole- body fish tissue analysis of contaminants of interest (COI). The fish were analyzed for low-level polychlorinated biphenyls (PCBs), organochlorine pesticides, polyaromatic hydrocarbons, and metals. Comparison of 2006 to 1994 data suggest that many key contaminants, such as DDT, chlordane and dieldrin, have decreased. Geographically, fish tissue show slight differences in contaminant levels for metals and moderate differences for pesticides and PCBs. Fish in Peninsula Drainage Canal and Buffalo Slough tend to have the lowest levels of contaminants relative to other areas of the Slough. Contaminant levels in Slough fish still exceed threshold levels for the protection of human health. The full *Columbia Slough Fish Tissue Analysis, 2005 Sampling Event* report can be found at http://www.portlandonline.com/bes/index.cfm?c=44908&

Sediment Monitoring

Sediment sampling will also be conducted every ten years to assess the level of contamination in slough sediments. In summer 2006, sediment samples were collected at 78 sites by BES field crews. The samples were collected at all major Slough reaches including: Lower, Middle, and Upper Sloughs, Buffalo Slough, Whitaker Slough, North Slough, Wapato Wetlands, Peninsula Drainage Canal, Big Four Corners, and Marx-Whitaker Slough.

A broad range of analytes were assessed, including: PCB aroclors, persistent pesticides (such as DDTs, aldrin, dieldrin, chlordane, heptachlor, and heptachlor epoxide), heavy metals (chromium, cadmium, cobalt, lead, copper, zinc, mercury, arsenic and nickel), total petroleum hydrocarbons, and PAHs. These analytes have been previously identified as COIs in the SLRA and as part of other investigations in the Slough. Sediment pH and redox potential, acid volatile sulfides, total organic carbon (TOC), and grain size were also analyzed.

Sediment samples were analyzed at the BES Water Pollution Control Lab and BES' contract laboratory (Test America in Beaverton, Oregon). Low-level organics analyses were performed by Battelle in Duxbury, Massachusetts. A report is not yet prepared, but is expected to be available in fall 2008.

Water Quality Monitoring

Water quality samples were taken at ten sites throughout the Columbia Slough. Continuous, 15-minute, samples were taken for temperature, pH, conductivity and dissolved oxygen. Grab samples were taken monthly for the following analytes, and the flow and depth at which the sample was collected was documented:

BOD-5	Mercury
Chlorophyll a	Nickel (total and dissolved)
Conductivity (specific)	Nitrogen (ammonia, nitrate and total Kjeldah)
Copper (total and dissolved)	PH
Direction and velocity of flow	Phosphorus (total and ortho phosphate)
Dissolved oxygen	Secchi disc
E. coli	Temperature
Hardness (total)	Total suspended solids
Lead (total and dissolved)	Zinc (total and dissolved)

Table 1 lists water quality sample sites and the type of samples taken (continuous, grab or both)

Sampling Site	Location	Continuous	Grab
GRF	Bridge roughly 500ft east of Fairview Lake weir		X
FVL	Fairview Lake Weir	X	
AWB	NE Airport Way Bridge		X
158	NE 158th Ave. Bridge	X	X
92B	NE 92nd Ave. Bridge (main stem)	X	X
47S	NE 47th Ave. Bridge (south arm)		X
21B	NE 21st Ave Bridge (main stem)	X	X
VNB	N Vancouver St Bridge	X	X
PED	Columbia Blvd Wastewater Treatment Plan Pedestrian Bridge		X
SJB	St. John's Landfill Bridge	X	X
SJB	St. John's Landfill Bridge	X	X

Table 2 summarizes results of the monitoring program

Analyte	Regulation	Results
BOD - 5	TMDL	Samples at all sites met the standard
Chlorophyll a	TMDL OAR-41-150(1)(b)	Many samples did not meet the standards, particularly in Lower Slough. Chlorophyll a has been increasing in the Lower Slough since 2003. Increases may be related to the change in sample collection method that occurred in July 2000, but this has not been verified.
Conductivity - specific		A preliminary investigation was conducted. The Willamette River has specific conductance close to 100 µS/cm; the Slough has specific conductance close to 200 µS/cm.
Copper	OAR 340 Table20	Samples at all sites met the standard
Copper, dissolved		Samples at all sites met the standard
Dissolved oxygen	TMDL OAR 340 - 41-445	Lower Slough samples have shown major DO depressions during winter months. The low DO in winter may be due to de-icing agents used at the airport and discharged to the Slough. Upper Slough samples have shown DO depressions during summer months which are due to the decomposition of algae and plants.
E. coli	TMDL	Some samples did not meet the standards, particularly in the Upper and Middle Slough. Possible sources of E. coli include large avian populations in adjacent wetlands, pump stations, old cesspools/septic systems, and illicit discharge.
Hardness		
Lead	TMDL	A few samples did not meet the standard
Lead, dissolved	TMDL	Samples at all sites met the standard
Nitrogen - nitrate	OAR 340 Table20	Samples at all sites met the standard for drinking water, however nitrogen is abundantly available for plants. In Upper Slough, results were higher in winter months. Lower Slough shows a downward trend.
Nitrogen – ammonia		Not yet investigated
Nitrogen - Kjeldahl		Not yet investigated
pH	TMDL	Sites in the Upper and particularly the Lower Slough have high pH during the spring and summer, likely due to eutrophication.

Phosphorus - ortho phosphate (dissolved)	EPA 1986	Some sites in the middle and upper slough did not meet the standard. Orthophosphates may accumulate because algal and macrophyte growth is limited due to turbidity, or due to algal decomposition and the subsequent release of orthophosphates back into the water column.
Phosphorus - total	TMDL	Some total phosphorus samples did not meet the standard, primarily in August and September. Samples taken in the Middle Slough met the standard more frequently.
Temperature	TMDL	Most sites do not meet the 18 degree C standard for 7-day average of daily maximum temperature from June – August.
Total Suspended Solids(TSS)	NPDES 1200-COLS	Samples taken in the Upper and Lower Slough generally do not meet the standard; though tend to be lower in the winter and late spring. Samples taken in the Middle Slough generally met the standard.
Zinc	OAR 340 Table20	Samples at all sites met the standard
Zinc, dissolved	OAR 340 Table20	Samples at all sites met the standard

Stormwater Monitoring

Plans were developed for sampling stormwater being discharged from MS4 outfalls to Marx-Whitaker Slough. The sampling will occur in winter 2007.

BMP Effectiveness Monitoring

BMP effectiveness monitoring was conducted at two constructed wetlands. Sediment samples were collected in the forebay of the NE 138th Ave water quality facility and in the underground vault and the first pond of the Whitaker Ponds facility. The samples are being analyzed and the data have not yet been reported.

Sediment and Fish Tissue Monitoring Using Semi-permeable Membrane Devices (SPMDs)

SPMDs are an innovative approach to assessing water column concentrations of various hydrophobic organic compounds of concern in the Columbia Slough, including polycyclic aromatic hydrocarbons, (PAHs), organochlorine (OC) compounds, and polychlorinated biphenols (PCBs).

Location of SPMD sample sites in the Lower Slough

Following the successful study of Buffalo Slough in 2003/04 using SPMDs, a second

study was initiated in 2007 in the Lower Slough. The purpose of this study is to determine what the source of contamination is in the Slough—water column or sediments. Two SPMDs were deployed at seven locations in the lower Slough in May and August 2006. One SPMD was set resting on the sediments, and the other was set in the water column. After 28 days, the SPMDs were collected and sent to the University of Texas lab for analysis. A report is being prepared and will be available in 2008.

Threatened and Endangered Species Monitoring

Working with Ducks Unlimited, BES monitors salmonid species use of Ramsey Refuge in the Lower Slough. Use of the refuge by salmonids has steadily risen since it was constructed in 2005. Juvenile salmonids were observed in the Lower Slough and North Slough in the fall (November), winter (February), and spring (March).

Ramsey Refuge in the Lower Slough
Photo by Don Kangas

24" Steelhead Trout, caught July 2006 in Ramsey Refuge

2.9 Innovative Stormwater Management

The Portland City Council approved a Green Streets policy. The policy will encourage the use of innovative stormwater management facilities such as green streets, planters, swales, and rain gardens to be used throughout the city including the Slough watershed.

BES constructs on-site innovative stormwater management facilities as a way to treat stormwater before it is discharged to the MS4. A curb extension stormwater planter was proposed for NE 131st and NE Shaver, and a meeting with the surrounding neighbors was

Green street at NE Freemont and NE 131st

conducted. Neighbors had concerns about traffic and the curb extension, so this project was placed on-hold while other projects in the area progress.

BES formed a partnership with the Columbia Slough Watershed Council to test a stormwater retrofit at Whitaker Ponds as a visible demonstration of residential-scale stormwater retrofit options at a frequently-visited education center. The rain garden will manage 650 square feet of roof; and two additional downspout disconnections will manage an additional 100 square feet of rooftop.

Design of the NE 92nd Avenue water quality facility continued. The facility will treat stormwater from 53 acres of mixed-use drainage (commercial, industrial, and residential development and Columbia Boulevard, a high-volume road).

BES unveiled the Clean Rivers Rewards Program. Through this program, homeowners throughout the city can receive a discount on the stormwater fee if they implement actions which will keep stormwater runoff on their property.

BES provided Stewardship grant ranging from $600 to $5000 to support stormwater management projects and outreach activities implemented by volunteers.

- Verde/Hacienda CDC: 33 volunteers installed bioswales and native plant gardens during environmental job training for low-income individuals. The bioswales manage 1800 sq ft of impervious area.
- Reynolds After School Environmentalists: 147 volunteers provided education for at-risk students.
- The Other Portland: Art & Ecology in the 5th Quadrant: 50 volunteers exhibited art works focused on watershed health issues. The Columbia Slough was the focus of many of the art installations.
- St Andrew Catholic Church: volunteers planted native vegetation around parking lot bioswales.
- Revegetation: three revegetation projects were conducted by citizens, and 1,166 native plants were planted.

BES ensures that Operation and Maintenance (O&M) plans for private stormwater facilities are followed. A total of 67 private stormwater facilities, primarily drywells, swales, and infiltration basins, were constructed in the Slough Watershed. During the year, BES inspected eight facilities.

2.10 Vegetation

Revegetation and Stewardship

The City planted over 26,000 trees and shrubs throughout the Slough watershed. BES has three revegetation and street tree planting programs:

- Through partnerships with businesses and other private landowners, the BES Watershed Revegetation Program plants native vegetation on both public and private properties. Funding comes from landowners, grants, and BES funds. A total of 19,882 trees and 6,938

shrubs were planted on 27,290 linear feet of stream bank and 33.7 acres. The Watershed Revegetation Program has planted and currently manages 426.1 acres of habitat restoration sites and 93,129 feet of stream bank in the Slough watershed.

- Through a contract with BES, Friends of Trees planted 500 trees primarily in tree-deficient areas of the Slough watershed.
- Through a partnership with SOLV, stewardship volunteers conducted vegetation maintenance at Wilkes Creek which is one of two tributaries to the Slough. A total of 87 volunteers planted 150 native plants and removed 8,300 pounds of blackberry and morning glory and 20 pounds of trash.

Urban Forest Management Plan Action Plan

The City of Portland, under the leadership of Portland Parks and Rec., developed an Action Plan to implement the Urban Forest Management Plan (UFMP). The Action Plan establishes objectives and actions which the city will undertake to improve and protect the city's urban forest canopy. The actions range from education and outreach to reviewing and modifying codes, planting trees throughout the city, and monitoring. The Action Plan will be implemented city-wide including the Slough watershed.

2.11 Education

BES provides environmental education to students at 46 schools in the Slough watershed. Instruction includes the following activities:

- In-class, hands-on education on stormwater and other environmental issues and the "soak-it-up" program – 258 students.
- Field trips around the Slough watershed where students measure water quality and conduct macroinvertebrate sampling — 1,622 students
- Restoration including removing invasive vegetation and planting native vegetation at Whitaker Ponds and Johnson Lake — 797 students
- Jet boat and canoe tours to study CSOs, stormwater, and preventing pollution — 182 students
- Watershed Awareness program focusing on identifying and preventing non-point sources of pollution — 431 students
- In-class and field activities for two new audiences – residents of the recently constructed New Columbia neighborhood and Rosa Parks Elementary School, which serves the largest Section 8 housing project in the city.
- Developed a six-week curriculum on restoration site design and plant monitoring. The curriculum was completed by a Park Rose High School junior science class.

Students at Whitaker Ponds Learning Center gazebo

- Organized an internship program for a Park Rose High School senior environmental studies class. Met with internship sponsors, developed site profiles, and created evaluation paperwork.
- Assisted with leading canoe tours and nature hikes for 210 students during the CSWC Canoe Week.
- Supported Reynolds Middle School, a Community Watershed Grant recipient, during restoration activities. Worked with nearly 60 students planting native plants and managing non-native invasive vegetation.
- Acted as a camp leader during the New Columbia Spring Break Camp organized by the Urban League and BES. Accompanied a highly diverse group of 7-15 students during a weeklong program focused on watershed issues and activities.
- Developed and installed a rain garden and interpretive sign at Whitaker Ponds. This facility is a publicly accessible and highly visible residential rain garden. Interpretation is provided in Spanish and English.

Education and outreach is also provided for adults on how to recognize and prevent pollution:

- Co-sponsored and participated in numerous community events, including Slough 101, Wetlands 101, Groundwater 101, Explorando El Columbia Slough, Canoe the Slough, Columbia Slough Small Craft Regatta, Adventure in the Well Field, Corps of Rediscovery, three Soup on the Slough, two watershed cycling events, four Great Blue Heron week events, two Wild in the City events, and five neighborhood association picnics and gatherings in which stormwater was a topic of instruction. The total attendance was approximately 1,885 persons.

Annual Corps of Rediscovery tour of the Slough

- Participated in training 15 “Eyes on the Slough” volunteer monitors. Monitors paddle each reach of the Columbia Slough monthly and report on water quality and landscape conditions.

The City of Portland Water Bureau provides outreach to residents and businesses and one-on-one technical assistance to businesses to help them comply with requirements of the Columbia South Shore Well Field Wellhead Protection Program. The Water Bureau also conducted outreach events for the general public. The Water Bureau also participated with Metro at their Hazardous Materials Round-Up at the Parkrose K-Mart (in the wellhead protection area). Over 600 people properly disposed of household hazardous materials.

In partnership with the Columbia Corridor Association (CCA), the Water Bureau conducted presentations and workshops and published articles in the CCA newsletter on complying with

well head protection area regulations. The Water Bureau also provided 26 businesses with free technical assistance on how to comply with program requirements and fielded dozens of calls on program, and they gave away free spill response signs, 30 spill kits, one secondary containment pallet, and three drain covers.

The Water Bureau continued to provide oversight to ensure that commercial and industrial facilities comply with program requirements under the Columbia South Shore Well Field Wellhead Protection Program. A total of 145 inspections were conducted of regulated businesses under the program. Six violations were identified, most related to reporting requirements.

2.12 Maintenance

The City of Portland Office of Transportation, Maintenance Operations maintains the city's public stormwater infrastructure to prevent contaminated sediment from reaching the slough:

- 357 inlets were inspected and 57 were cleaned
- 408 sedimentation and sump manholes were cleaned
- 589 linear feet of culverts were cleaned and 194 feet of ditches were cleaned
- 43 public surface water quality facilities were inspected, each was inspected twice. Of these, ten were cleaned and five were repaired
- 21 inlets and 16 inlet leads (766 linear feet) were repaired or constructed (inlet leads are the pipe segments from the inlet to the manhole)

Maintenance Operations sweeps streets to remove debris and reduce the amount of TSS in runoff. Arterials are swept 12 times a year and residential streets are swept four to six times a year. A total of 327 miles of road in the Columbia Slough Watershed were swept during the year (some roads may have been swept more than once).

Maintenance Inspection Program
The City has an inspection program to ensure that stormwater management facilities constructed on private property are operated and maintained in accordance with City requirements. The facilities are built as part of new development requirements under the City's Stormwater Management Manual. All sites are inspected at least once per five year cycle for industrial, commercial, and multi-family properties. Single family residences are addressed through public outreach and education.

The MIP received new O&M agreements that included plans to construct 67 private stormwater management facilities in the slough watershed. The facilities constructed include sedimentation manholes, soakage trenches, dry wells, swales, and infiltration and flow-through planters. Eight facilities were inspected.

2.13 Spill Response and Illegal Connections

The BES Spill Response Hotline received 1,300 calls during the day and 438 after-hours complaint calls. The calls are tracked on a citywide basis only. The calls include complaints

about pollution, spills, sanitary sewer overflows, dye tests, and seepage discharges. BES and the Portland Water Bureau installed signs in the Columbia South Shore to protect the well-head protection area from spills. The signs list the BES spill response hotline number and read: "TO REPORT SPILLS CALL (503) 823-7180."

BES conducted 114 inspections of stormwater discharge pipes during summer (dry weather) to identify illegal connections and illicit discharges. Discharges from two outfalls (70 and 104b) discovered were traced to the source. BES staff notified the property owners of the problem and ensured the discharge was stopped.

2.14 Enforcement, Zoning, and Regulations

Regulatory Improvement Code Amendment Process (RICAP)
In the last year, the City adopted the second code change package under the Regulatory Improvement Code Amendment Process (RICAP). Through RICAP, which is lead by the Bureau of Development Services, city bureaus review city codes and make recommendations for improvements. Through RICAP, environmental regulations were clarified to state that activities exempt from environmental regulations must still meet other city regulations such as Title 10, Erosion Control. In addition, a review of zoning, special district, and other City codes was conducted to identify opportunities to improve water quality through the RICAP process.

Green Streets Policy
The Portland City Council approved a Green Streets policy by resolution. The policy promotes the use of green streets to manage stormwater, enhance neighborhood livability, improve the function of the right of way, provide habitat corridors, and promote connectivity between Portland neighborhoods. By adopting the policy, more stormwater will be managed appropriately which will improve watershed health.

Stormwater Management Manual
BES implements the City of Portland *Stormwater Management Manual* which requires new and re-development projects to manage stormwater runoff on-site when 500 square feet or more of impervious surface is created. By implementing the manual, the quantity of stormwater and pollutants reaching the Slough are reduced. A process was initiated to review the City's flow control and water quality standards for the next revision to the manual which will occur in 2010. In addition, typical details and specifications were developed for vegetated facilities in the public right-of-way. The details and specifications will make it easier to construct stormwater facilities that manage street runoff.

Erosion Control
There were 1,207 active private construction permits subject to erosion control inspection in the Slough watershed. These construction sites are required to maintain proper erosion control to prevent TSS from reaching the slough. A total of 2,247 inspections were conducted. In addition, the City maintains a 24-hour erosion control response hotline.

2.15 Other Actions

Terrestrial Ecology Enhancement Strategy
One of the priority actions listed in the Portland Watershed Management Plan was development of a Terrestrial Ecology Enhancement Strategy (TEES). In 2006, an advisory group was formed to help the City develop the strategy. The TEES will set priorities for land conservation and acquisition, restoration efforts, technical assistance, and community education and stewardship activities. The strategy will also include guidance to bureaus that can enhance upland wildlife habitat and terrestrial biological communities. Major activities included:

- Compiling lists of habitat types, wildlife and plant species in the City, and identifying "special status" habitat types and species
- Identifying key limiting factors
- Identifying key management issues and potential strategies and actions to address them
- Discussing all technical information with the advisory group

Salmon Safe Parks
Portland Parks and Recreation (PP&R) examined maintenance activities as part of annual compliance requirements for continued Salmon Safe certification for all parks within Portland, including in the Slough watershed. PP&R analyzed the integrated pest management enhancement project, studying alternatives to pesticides, and trials of pesticide-free parks.

3. Future Actions Fiscal Year 2008

3.1 Target Areas

The Watershed Action Plan identifies the actions that will be implemented in the Columbia Slough watershed to reduce contaminant inputs to the Slough to levels that will be protect human health and the environment. Actions planned for the next fiscal year in each Target Area include:

Interstate 5 to Martin Luther King Jr. Blvd.
Actions will include completing the two draft source investigations for outfall 59 and outfalls 61, 62, and 62a. The reports will provide recommendations for future monitoring, outreach, inspections and on-the-ground actions that BES or others may implement. BES will begin implementing the recommendations and will identify sites for green streets along high traffic streets such as I-5 and Columbia Blvd.

Marx-Whitaker Slough
Potential actions include conducting an investigation to identify sources of sediment and contamination, controlling erosion from agricultural fields, and constructing green streets to manage stormwater from high traffic streets such as NE Shaver, NE 122nd, and Sandy Blvd. A Source Investigation Report will be drafted.

Buffalo Slough

Work on the Buffalo Slough characterization will continue. In the next phase an analysis of the data will be described and performed. A report will be prepared that describes the results of the analysis, the conditions of Buffalo Slough, additional data that is needed, and management options that are needed, if any, to improve conditions of Buffalo Slough.

Cully Neighborhood

Potential actions include conducting an investigation to identify the sources of sediment and contamination and constructing green streets to manage stormwater from high traffic roads such as Columbia Blvd.

Target Area 5: St Johns Landfill

Potential actions include coordinating sediment sampling and analysis with Metro and conducting an investigation to identify sources of contamination.

3.2 Site Cleanup

Specific Site Actions

Significant investigation/cleanup actions anticipated over the upcoming year are highlighted below:

- Johnson Lake cleanup will be proposed for public comment. Anticipated actions will likely include sediment removal from a portion of the lake, soil excavation in an upland drainage area, and containment in an upland area that will be re-contoured in conjunction with construction of a stormwater management swale.
- Pacific Carbide remedial action to address the upland lime waste piles is expected to take place in the summer and early fall 2007. The remedy will include removal of both the northern and southern lime piles with off-site disposal. The Slough bank and in-water sediment will be addressed in 2008.
- NuWay Oil completion of Phase 2 of the cleanup remedy is scheduled for the August 2007. Phase 2 includes construction of the upland cap and revegetation of the property. Some follow-up monitoring, including groundwater monitoring, will be conducted following implementation.
- Pacific Meat ROD is anticipated for sediment and upland areas at the site. Implementation of cleanup in upland areas is likely to be initiated.
- Dynea No Further Action determination for the upland area of the site is expected to be issued.
- Hanson Pipe and Products Inc. streamlined feasibility study will be completed.

3.3 Site Investigation and Cleanup Tools Development

DEQ plans to further develop the Slough Segment Plan option which allows multiple to contribute to a sediment clean up fund rather than conducting a sediment investigation themselves. Negotiations on proposed settlements with five parties located in the initial target segment area are ongoing, and if successful, will lead to a DEQ-managed in-water sediment RI/FS beginning in 2008 and a sediment cleanup plan for that area in 2009.

3.4 Site Discovery

DEQ Site Discovery efforts will be coordinated with City source investigations for the Target Areas identified in the Plan. NWR Site Assessment will be increasing discovery and assessment efforts in targeted segments of the Columbia Slough with a primary focus in the Lower Slough.

3.5 NPDES Permits

BES will continue to inspect all permitted industries once per year, and conduct stormwater sampling as needed. BES will also continue inspecting non-permitted industries discharging to the MS4 and evaluating the need to permit these industries. BES will continue to locate and map non-City outfalls in the Columbia Slough and Willamette River Watersheds.

3.6 Industrial Process Water

Industrial process water activities in the Slough will focus primarily on completing the design of the airport de-icing and anti-icing discharge management. The final design of the system to address this discharge is to be completed by June 30, 2008.

3.7 Hazardous Waste Technical Assistance

Hazardous waste technical assistance will be coordinated with City source investigations for the Target Areas identified in the Watershed Action Plan, where the various activities associated with this work are described. Next year resources will be focused on the MLK/I-5 Target Area.

3.8 Long-term Monitoring

Fish Tissue

No fish tissue sampling is planned for the next fiscal year.

Sediment Sampling

A draft report will be prepared describing the evaluation of the temporal and spatial differences using the results of the 2006 sampling event. The report will include an evaluation of any correlations between sediment and fish tissue data.

Water Quality

Water quality sampling will continue as in past years. Water quality samples (continuous and grab samples) will be taken for temperature, pH, conductivity and dissolved oxygen. Grab

samples will be taken monthly for the following analytes, as well as the flow and depth at which the sample is collected:

• Chlorophyll a • BOD-5 • Conductivity (specific) • Copper (total and dissolved) • Direction and velocity of flow • Dissolved oxygen • E. coli • Hardness (total) • Lead (total and dissolved)	• Mercury • Nickel (total and dissolved) • Nitrogen (ammonia, nitrate and total Kjeldah) • PH • Phosphorus (total and ortho phosphate) • Secchi disc • Temperature • Total suspended solids • Zinc (total and dissolved)

Stormwater Monitoring

Stormwater from four outfalls in Marx-Whitaker Slough will be sampled at least once during the winter. Analytes include metals, pesticides, PAHs, PCBs, and total petroleum hydrocarbons.

BMP Effectiveness Monitoring

The results of monitoring at the NE 138th Avenue and the Whitaker Ponds water quality facilities will be reported.

Sediment and Fish Tissue Monitoring Using SPMDs

Eight SPMDs deployed in the Lower Slough will be retrieved and sent to the Texas A&M university lab for analysis. The USGS project manager will review the data and prepare a report which will describe the spatial and seasonal distribution of dissolved PAHs and organochlorine compounds in the slough, and indicate if water or sediments are a source of contamination.

3.9 Innovative Stormwater Management

Construction of the stormwater management facility at NE 92nd will start. This facility will treat stormwater from 53 acres of mixed-use drainage (commercial, industrial, and residential development and Columbia Boulevard, a high-volume road).

BES will begin design for a stormwater management facility at NE 148th Avenue which will treat runoff from 294 acres of mixed land use (primarily residential). BES will also begin to obtain permits for the facility.

An inventory of all potential sites for innovative stormwater management facilities will be conducted for outfall (OF) 100. This storm sewer outfall basin, which is located at NE 122nd and NE Sandy, includes a part of I-84, NE Sandy Blvd., NE 122nd, and several smaller

NE 122nd and NE Shaver

streets. The inventory will select sites for stormwater facilities including street and parking lot swales and planters. An additional inventory may be conducted for OF 104b, which is just east of OF 100. After the sites have been prioritize, stormwater management facilities will be constructed.

BES will continue to offer grants to citizens and non-profit groups to construct stormwater management projects.

3.10 Vegetation

The BES Revegetation Team will continue to monitor and maintain 380 acres of restored land within the Slough Watershed. Friends of Trees will plant at least 500 trees along the right-of-way. The BES partnership with SOLV will continue, and citizens will continue to plant native vegetation in association with the BES Stewardship Grant Program.

3.11 Education

The BES educator will continue to deliver environmental science lessons in the classroom to Columbia Slough Watershed schools. Topics include: Watershed Awareness, Biomagnification and Bioaccumulation, Stormwater Storytelling, Riparian Plants/Riparian Restoration, Water Chemistry, Stream Bugs Tell it All, How We Can Help the Fish, and Stormwater Soak it Up. BES will lead field trips to sites in the Columbia Slough for watershed investigation and assessment technique training.

BES will lead tours of innovative stormwater facilities such as green streets, bioswales, stormwater planters, ecoroofs, and porous pavement throughout the watershed. BES will also lead boat tours of the Columbia Slough for student groups who have participated in Clean Rivers Education programs and who have completed a stewardship project.

BES will work with community partners to remove invasive species along the Slough and revegetate riparian areas.

The Water Bureau will conduct a pilot program of materials developed for the well head protection area. The “Drop of Prevention Program,” designed to help businesses identify ways to reduce amount of hazardous materials used and find less toxic alternatives, will be conducted over the next year.

3.12 Maintenance

The City of Portland will continue street sweeping throughout the watershed. Stormwater facilities such as culverts, drainage ditches, water quality facilities will also be maintained. Debris will be cleaned out and any repairs to stormwater facilities will be made as needed.

3.13 Spill Response and Illegal Connections

BES will continue removing illicit discharges and connections to the storm sewer system as they are identified during IDEP, spill response, pretreatment, or stormwater permit inspection. BES will also continue the 24-hour complaint hotline for citizens to call when they see spills, CSOs, pollution, illegal dumping, etc.

3.14 Enforcement, Zoning, and Regulations

Regulatory Improvement Code Amendment Process (RICAP)

The City will begin to work on the RICAP #3 package for consideration in summer 2007. This package clarifies the zoning regulations on a variety of issues, including those that affect stormwater outfalls in environmental zones.

The City will also begin work on the RICAP #4 workplan which includes several issues related to land divisions. The configuration of a land division can affect watershed health.

Environmental Zoning Codes

The City will issue an RFP for a review of environmental regulations within the Columbia Corridor in fall 2007. The report will be completed by the end of FY 08. It will build on an initial collaborative scoping effort and feedback from key stakeholders. This project will examine the multiple existing environmental regulations and compliance obligations, and recommend options for addressing identified criteria, including improvement of watershed health, clarifying and simplifying regulations, and achieving compliance objectives. The results of this work will inform an anticipated multi-objective Columbia Corridor planning project.

Tree Codes

In an effort to restore the urban tree canopy, the Bureau of Planning will form an inter-bureau committee to review all tree and vegetation-related codes and form recommendations to clarify the codes make them easier to comply with.

3.15 Other Actions

Terrestrial Ecology Enhancement Strategy

Work on the Terrestrial Ecology Enhancement Strategy (TEES) will continue, and it is expected that it will be completed by late 2007. The TEES will recommend watershed-specific objectives for terrestrial ecosystems, strategies and actions, and will provide guidance to city bureaus to restore terrestrial ecosystems.