CITY OF MEDFORD OREGON

Stormwater Management Plan

February 2005

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City of Medford, Oregon

STORMWATER MANAGEMENT PLAN

FEBRUARY 2005

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City of Medford
Stormwater Management Plan

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EXECUTIVE SUMMARY

The *City of Medford Stormwater Management Plan* addresses existing activities to maintain and enhance the quality of stormwater runoff in Medford and outlines required modifications to those activities. The plan coincides with the submittal of the City's management program for Phase II of the National Pollutant Discharge Elimination Program (NPDES). It identifies existing regulatory, maintenance, planning, and public involvement activities that should be continued, modifications to existing activities to address stormwater quality, and recommendations for additional activities not currently performed by the City. The management plan incorporates recommendations from the City's 1996 *Comprehensive Medford Area Drainage Master Plan* into a new capital improvement program (CIP), with estimated costs for maintenance, engineering and other stormwater activities.

STUDY AREA

The City of Medford is in Jackson County in southwestern Oregon, approximately 25 miles north of the Oregon/California border. The City is located within the drainage area of Bear Creek, which is a tributary to the Rogue River. Drainage basins assessed for this management plan include eight that discharge into Bear Creek—Bear Creek East, Bear Creek South, Bear Creek West, Crooked Creek, Elk Creek, Larson Creek, Lazy Creek, and Lone Pine Creek—and one that drains north from Medford and discharges directly to the Rogue River (the Midway Basin). Figure ES-1 shows the basins evaluated for this plan.

The following are key features of the study area related to stormwater management planning:

- **Riparian Areas**—Medford Municipal Code defines a riparian area as the transition area along a stream from the aquatic to the terrestrial ecosystem. Well-established riparian areas can provide water quality, flood management, thermal regulation and wildlife habitat. Much of the creek and riparian area in Medford has been extensively modified by human activity and urbanization. The City has established riparian corridors along Larson Creek and Bear Creek and along the lower reaches of Lone Pine Creek and Lazy Creek.
- **Wetlands**—A wetland is an area whose saturated soils can support a prevalence of vegetation adapted for life in such soils. Six wetlands in Medford have been designated as having sensitive habitat for protection: three on the Medford Airport property in the Midway Drainage Basin and three in the Bear Creek South Basin contains. The City also has 45 wetlands that meet at least one Oregon state criterion for locally significant wetlands.
- **Rainfall**—Medford receives approximately 20 inches of rainfall annually, most of it between October and May.

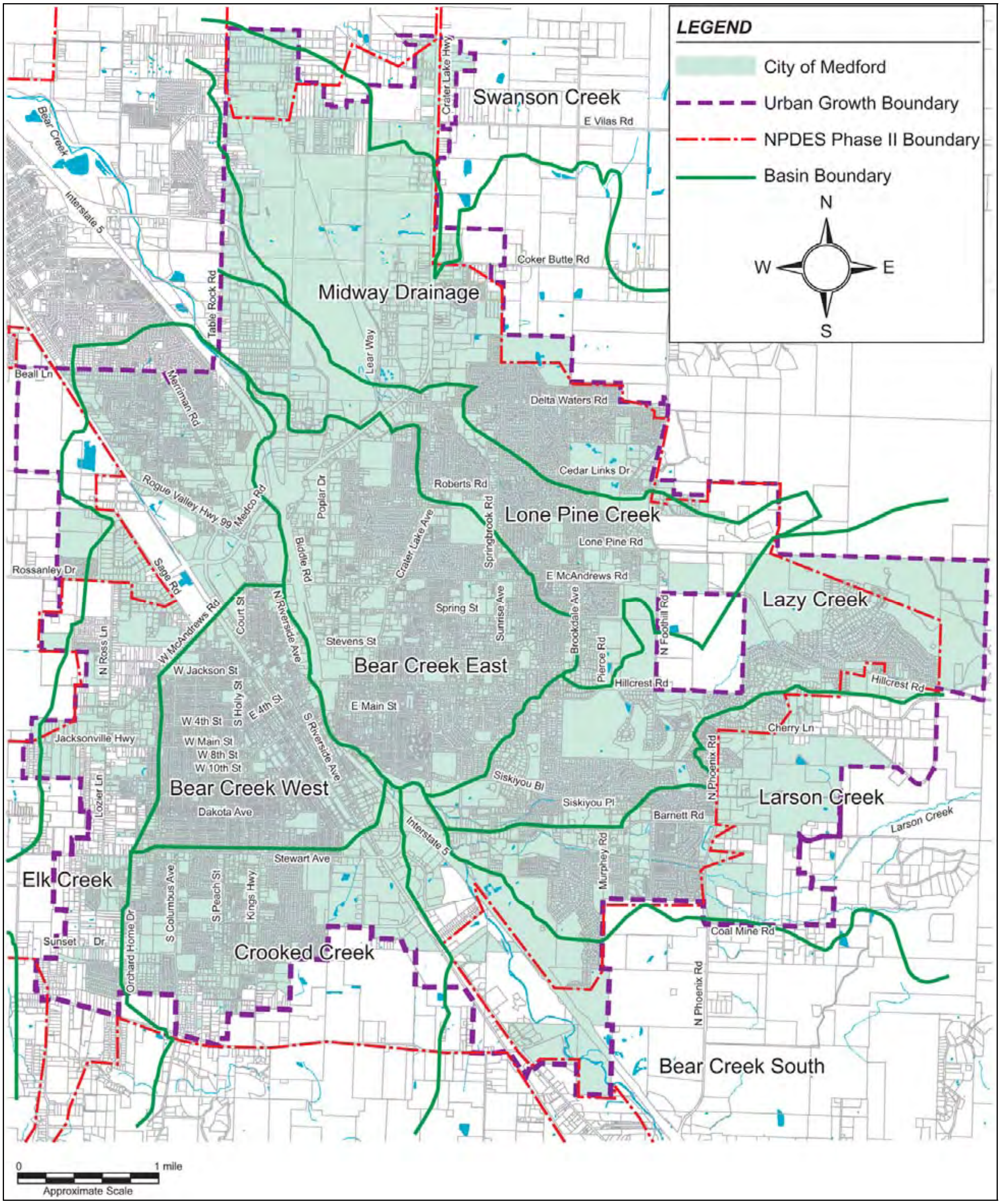

Figure ES-1. Drainage Basins Evaluated in Stormwater Management Plan

- **Land Use**—The 13 land use designations in the City of Medford General Land Use Plan include several residential, commercial and industrial categories, along with parks and schools, greenway, city center, airport and limited service area.

EXISTING DRAINAGE SYSTEM

Bear Creek East Basin

Baby Bear Creek, a perennial stream due to irrigation return flow, is located in this basin. The basin is heavily developed and the remnant portion of Baby Bear Creek is the only stream other than Bear Creek. The Hopkins Canal provides stormwater conveyance for the northeast section of the basin. Three wetlands were inventoried in the basin, totaling 16 acres. Two of the wetlands meet at least one criterion for locally significant wetlands.

Much of the Bear Creek East Basin drainage is collected in a network of drainage pipelines. The system consists of over 250 separate segments, representing 18.4 miles of conveyance. Many of the piped drainage systems in this basin consist of short segments.

Bear Creek South Basin

Gore Creek and an unnamed tributary to Bear Creek are located in this basin. All reaches in this basin are perennial due to irrigation return flow. Gore Creek has been extensively channelized and its riparian areas have been modified by construction of warehouses and parking lots and by agriculture. The unnamed tributary has been extensively modified by human activity. Phoenix Canal and Talent Lateral Canal run through the basin. The 12 wetlands in the basin total 16 acres. Nine of the wetlands meet criteria for locally significant wetlands and three are excavated ponds.

Only a few stormwater pipes collect drainage from the Bear Creek South Basin. Much of the basin drains directly to Bear Creek.

Bear Creek West Basin

Much of the Bear Creek West drainage is collected in a network of drainage pipelines. The basin contains nine separate drainage systems discharging to Bear Creek. There are no wetlands or open channels in this basin.

Crooked Creek Basin

The drainage basin contains Crooked Creek and Hansen Creek, which is a tributary to Crooked Creek. All reaches are perennial due to irrigation return flow. All of the streams and riparian areas in the basin have been extensively modified by human activity. Crooked Creek is listed as a water quality limited stream for fecal coliform. The Talent Lateral Canal and the Phoenix Canal run through the upper portion of the basin. The four wetlands in this basin total 44 acres; three are excavated ponds.

The largest piped system in this basin discharges to Crooked Creek at Stewart Avenue. At this point, most of Crooked Creek is piped to Bear Creek, near the railroad tracks in the north portion of the basin. The remainder of the basin either drains directly to Crooked Creek or is collected in one of several smaller systems that discharge to Crooked Creek.

Elk Creek Basin

Elk Creek and a remnant of an unnamed tributary are located within this basin. All reaches are perennial due to irrigation return flow. All of the streams and riparian areas in the basin have been extensively modified by human activity. The Hopkins Canal runs through this basin. There are 12 wetlands in the Elk Creek Basin, totaling 41 acres. Three of the wetlands meet at least one criterion for locally significant wetlands; two are excavated ponds.

Storm drainage in the northern portion of the Elk Creek basin is collected in a few small pipeline systems that drain to Elk Creek. Drainage in the southern part of the basin flows directly to Elk Creek. Elk Creek has been piped in several locations. On-site detention is currently required on development in Elk Creek under the City's Land Development Code.

Larson Creek Basin

This basin contains Larson Creek and a number of tributaries. The lower reaches and some upper reaches are perennial due to irrigation return flows; all other reaches are intermittent. Almost all of the streams and riparian areas have been extensively modified by human activity. The highest reaches in the basin have had the least amount of human impact and include reaches of relatively undisturbed stream channels and riparian areas. Larson Creek is listed as a water quality limited stream. The East-Main Irrigation Canal runs north to south through this basin and the East Lateral Irrigation Canal runs south to north in the upper portion of the basin. Six wetlands are located in this basin, totaling 19 acres. Three of the wetlands meet at least one criterion for locally significant wetlands; two are excavated ponds.

The portion of the basin west of North Phoenix Road includes four major piped systems and several smaller systems draining to Larson Creek.

Lazy Creek Basin

This basin contains Lazy Creek and a number of tributaries. Lower reaches are perennial due to irrigation return flows and upper reaches are intermittent. Almost all of the streams and riparian areas in the lower reaches have been extensively modified by human activity. Upper reaches have not been as consistently modified by human activity. Lazy Creek is listed as a water quality limited stream. The East-Main Irrigation Canal runs north to south through the basin. Eight wetlands are located in the basin, totaling 9 acres. Six of the wetlands meet at least one criterion for locally significant wetlands; one is an excavated pond.

The portion of the basin west of North Phoenix Road includes several small piped systems draining to Lazy Creek.

Lone Pine Creek Basin

This basin contains Lone Pine Creek and a number of tributaries. Lower reaches are perennial due to irrigation return flows; upper reaches are intermittent. Almost all the streams and riparian areas in the basin have been extensively modified by human activity. Lone Pine Creek is listed as a water quality limited stream. The Hopkins and East Main

Canals flow through the basin. Nine wetlands are located in the basin, totaling 31 acres. All nine of the wetlands meet at least one criterion for locally significant wetlands.

Several piped storm drain systems are in place to the east of Crater Lake Highway, draining to Lone Pine Creek. The portion of the basin west of Crater Lake Highway drains directly to Lone Pine Creek, with only a few short piped systems to convey the stormwater.

Midway Basin

Midway Creek (also know as Upton Slough) and a short tributary know as Garrett Creek are located within this basin. Midway Creek is perennial due to irrigation return flows. Midway Creek and its riparian areas have been extensively modified by human activity. The East Main Canal flows through this basin. The flat slope at the lower end of the basin results in poor drainage, creating many wetlands. The wetlands inventory reported 39 wetlands totaling 102 acres. Thirty-three of the wetlands meet at least one criterion for locally significant wetlands; five are excavated ponds; and three have been designated as having sensitive habitat for protection.

Several short piped systems east of Medco Haul Road drain to Midway Creek. The portion of the basin west of Logging Road drains directly to Midway Creek. Since 1981, on-site detention for all industrial and commercial development in the basin has been required. On-site detention is currently required on development in Midway Creek under the City's Land Development Code.

IMPROVEMENTS RECOMMENDED IN 1996 DRAINAGE MASTER PLAN

The Comprehensive Medford Drainage Master Plan (DMP) (Brown & Caldwell, 1996) evaluated drainage system deficiencies and recommended drainage system improvements. Projects were identified as priority projects or other identified projects. Projects from the DMP that have yet to be started or completed are summarized in Table ES-1.

TABLE ES-1.
BASIN SUMMARY OF 1996 DMP RECOMMENDED IMPROVEMENTS
NOT YET IMPLEMENTED (IN 1996 DOLLARS)

	Priority Projects		Other Identified Projects	
Basin	Number of Projects	Estimated Total Cost	Number of Projects	Estimated Total Cost
Bear Creek East	3	$1,504,419	17	$3,797,918
Bear Creek South & Crooked Creek	2	$387,474	8	$1,638,321
Bear Creek West	3	$2,417,212	4	$2,611,045
Elk Creek	6	$5,430,985	4	$1,474,852
Larson Creek	3	$1,651,544	0	—
Lazy Creek	8	$1,454,923	1	$57,511
Lone Pine Creek	3	$1,404,753	3	$1,200,323
Midway	2	$2,054,145	2	$677,521

WATER QUALITY

The federal Clean Water Act (CWA) set in motion two programs to address water quality in impaired water bodies. One of these programs is the total maximum daily load (TMDL) program, which has identified water quality concerns and parameters for Bear Creek. The other is the NPDES program for municipal communities, which establishes requirements for how urban areas in the U.S. address stormwater.

Under the TMDL program, three water quality concerns were identified for Bear Creek: algae, dissolved oxygen and pH. TMDLs for ammonia, biochemical oxygen demand (BOD) and phosphorus were established to address these concerns. Oregon's 303(d) list of impaired bodies includes two additional parameters for Bear Creek: temperature and fecal coliform. These two parameters are scheduled to become TMDLs for Bear Creek in 2005. Other Medford surface waters included in the 303(d) list are Crooked Creek, Larson Creek, Lazy Creek and Lone Pine Creek.

The management plan recommends the following citywide pollutant reduction measures:

- Reducing the area of impervious surfaces, which have been shown to be the major cause of stream degradation in urban areas
- Controlling sediment and erosion with measures such as encouraging native vegetation use and retention, restricting development in areas with steep slopes, and properly installing BMPs at construction sites
- Requiring water quality treatment facilities with new development
- Maintaining and enhancing stream and wetland buffer areas to provide a natural boundary between development and a stream or wetland
- Establishing shading over streams to reduce water temperatures
- Installing water quality vaults—buried stormwater treatment systems that connect to storm pipe systems—in the City's storm drainage system
- Developing criteria to evaluate the infiltration rate for locations where a stormwater treatment system relying on infiltration may be used
- Establishing guidelines to reduce the effect of livestock on water quality.

In addition to these citywide measures, the management plan identifies specific water quality improvement measures for each basin; these measures are included with drainage capacity improvements in the CIP.

The NPDES Phase II regulations establish the following minimum requirements for local stormwater management programs:

- **Public education and outreach**—Conduct public outreach aimed at informing citizens about the impacts of polluted stormwater as well as ways to minimize their contribution to pollution.
- **Public involvement and participation—**Involve the public in developing and implementing the stormwater management program.
- **Illicit discharge detection and elimination**—Develop and implement a program for detecting and eliminating illicit discharges to the storm drain

system. This includes storm system mapping, dry weather sampling, and citizen information activities.

- **Construction site stormwater runoff control**—Develop, implement, and enforce a program and standards to control erosion and sediment discharges from construction sites that disturb 1 acre of land or more.
- **Post-construction stormwater management**—Develop, implement, and enforce a program and standards to control the discharge of polluted runoff from new development and redeveloped sites. This can include structural treatment and detention systems as well as resource protection measures (wetland protection, habitat protection, etc.) and pollution prevention planning.
- **Pollution prevention in municipal operations**—Develop, implement, and enforce a program to control the discharge of polluted runoff from municipal operations (road maintenance, vegetation management, storm drain maintenance, etc.).

STORMWATER MAINTENANCE PROGRAM

A well-defined stormwater maintenance program provides a general guide to help ensure that work required to keep the stormwater system functioning properly is performed efficiently and in a timely way. It identifies specific tasks that must be performed, potential pitfalls if needed work is not performed, and permitting issues associated with maintenance activities. The management plan outlines the following maintenance program elements:

- **Core maintenance activities**—The essential tasks to be performed to maintain the City's stormwater system. Checklists included in the management plan give detailed information on the maintenance of every kind of facility in the stormwater system.
- **Guidelines for work in environmentally sensitive areas**—Guidelines addressing the considerations that must be taken into account when maintenance is performed in or near streams, wetlands and steep slopes.
- **Regulatory and permitting considerations**—Consideration of regulations that may apply and permits that may be required when maintenance work is to be performed.
- **Sediment and debris management**—An overview of issues associated with the handling and disposal of sediment and debris removed from stormwater facilities.
- **Illicit discharge detection program**—The detection and removal of illicit pollutant discharges to the stormwater system.
- **Safety and training**—Proper technical and safety training for City maintenance staff.
- **Tracking and recordkeeping**—An organized system for recording and tracking maintenance needs and completed activities.

STORMWATER ORDINANCES AND CITY CODES

A key component of effective stormwater management requires the development, review, approval and implementation of City codes and related requirements. The management plan makes recommendations for integration and assignment of stormwater management duties for the practical and efficient use of staff resources:

- **Development of Stormwater Ordinances**
- **Plan Review and Inspection**—Plan review and inspection for development within the City requires coordination among City departments.
  - The overall stormwater management and erosion control program is the responsibility of the Public Works Department; any inspection delegated to other departments should be monitored.
  - The Public Works Department should lead the review and inspection of erosion control measures associated with development.
  - There should be some overlap of responsibility and coordination between the Building and Public Works Departments for plan review and inspection for private on-site drainage and water quality facilities.
  - Public Works staff should be allowed to review tentative plat submittals. The Planning Department should hold up any tentative plat approval until review comments from Public Works are received and incorporated
- **Stormwater Management**—The Public Works Department will take responsibility for the overall stormwater management program that will include the NPDES and TMDL programs. Other departments, including Planning, Parks and Building, would continue with their current activities; however, a greater awareness of stormwater issues should be developed through appropriate training. This training should be led by the Public Works Department and include information concerning the overall goals of the stormwater management program.
- **Staffing**—Additional staffing will be required to meet the additional stormwater responsibilities. The current identified need within the Public Works Department, not including maintenance activity, is for one additional engineer and one additional engineer technician:

CAPITAL IMPROVEMENT PLAN

The CIP includes drainage improvements identified in the 1996 Drainage Master Plan, water quality improvements, and the NPDES program. Table ES-2 summarizes the capital projects in the CIP, along with their estimated costs and phasing.

TABLE ES-2.
RECOMMENDED CAPITAL IMPROVEMENT PROGRAM

	Phase 1 (Year 1-5)	Phase 2 (Year 6-10)	Phase 3 (Year 11-15)	Phase 4 (Year 15-20)
City Wide Activities				
Stormwater Ordinance	$30,000			
NPDES Public Education and Outreach	$26,000	$28,700	$28,700	$28,700
NPDES Public Involvement & Participation	$18,100	$18,400	$18,400	$18,400
NPDES Illicit Discharge Detection & Elimination	$288,000	$288,000	$68,000	$68,000
NPDES Construction Site Runoff Control	$28,100	$23,500	$23,500	$23,500
NPDES Post-Construction Management	$22,900	$17,000	$17,000	$17,000
NPDES Pollution Prevention in Municipal Operations	$51,000	$23,000	$23,000	$23,000
Bear Creek East				
Drainage Projects				
Sunrise Drainage Project		$376,000		
Brookhurst Drainage Project		$1,219,000		
Oregon Ave. Drainage Project			$311,500	
Basin Plan		$60,000		
Water Quality Projects				
Tabby Lane Detention/WQ Facility		$186,300		
WQ Facility with Sunrise Drainage Project		$75,000		
WQ Facility with Brookhurst Project		$75,000		
WQ Facility with Oregon Ave. Drainage Project			$75,000	
Bear Creek South				
Drainage Projects				
Center Drive Drainage Projects				$106,400
Basin Plan		$40,000		
Water Quality Projects				
WQ Facility with Center Drive Drainage Projects				$75,000
Bear Creek West				
Drainage Projects				
Earhart Drainage Project	$1,467,200			
Washington Drainage Project			$1,073,800	
6th Street Drainage Project			$521,700	
Basin Plan		$60,000		
Water Quality Projects				
Earhart Water Quality Wetland Project	$400,000			
Washington Water Quality Facility Project		$75,000		
6th Street Water Quality Facility Project		$75,000		
Crooked Creek				
Drainage Projects				
Crooked Creek Near Stewart Ave			$439,600	
Crooked Creek Near Dove Ave				$256,000
Basin Plan	$60,000			
Water Quality Projects				
Regional WQ Facility near Stewart Ave Drainage Project			$300,000	
S. Holly St. Extension WQ Facility	$22,000			

TABLE ES-2 (continued).
RECOMMENDED CAPITAL IMPROVEMENT PROGRAM

	Phase 1 (Year 1-5)	Phase 2 (Year 6-10)	Phase 3 (Year 11-15)	Phase 4 (Year 15-20)
Elk Creek				
Drainage Projects				
Berrydale Drainage Project	$186,000			
Elk Misc. Drainage Project		$1,231,000		
Howard Drainage Project		$757,400		
Highway 99 Drainage Project				$799,300
Stowe Ave Drainage Project				$3,824,000
Erhman Drainage Project				$626,400
Basin Plan	$75,000			
Water Quality Projects				
Columbus Ave. Extension WQ Facility	$30,000			
Lozier Lane Extension WQ Facility	$15,000			
WQ Facilities with Howard Ave Drainage Project		$300,000		
WQ Facilities with Stowe Ave Drainage Project				$300,000
Larson Creek				
Drainage Projects				
Murphy Rd. Bypass; Juanipero to Larson Ck.	$250,000			
North Fork Project	$1,198,400			
Larson Central Drainage Project			$594,600	
Black Oak Drainage Project				$299,300
Basin Plan	$60,000			
Water Quality Projects				
Regional Detention/WQ facility U/S of Phoenix Rd.	$500,000			
Restoration/Protection Areas				
Restore Creek between Olympic Ave. and Murphy Rd			$250,000	
Separate between East Main Canal and Larson Creek			$100,000	
Lazy Creek				
Drainage Projects				
Eagle Trace			$82,900	
Lazy Creek at Murphy Rd			$78,900	
Lazy Creek at Crestbrook Rd			$213,900	
Lazy Creek at Burgundy			$258,700	
North Phoenix			$488,100	
Lazy Creek at Siskiyou			$319,300	
Lazy Creek at Ellendale Drive			$220,700	
Lazy Creek at Oak Drive				$181,000
Basin Plan	$60,000			
Water Quality Projects				
McAndrews Detentions/WQ Facility	$1,000,000	$1,000,000		
Restoration/Protection Areas				
Restore Creek south of Bear Creek Park			$120,000	

TABLE ES-2 (continued).
RECOMMENDED CAPITAL IMPROVEMENT PROGRAM

	Phase 1 (Year 1-5)	Phase 2 (Year 6-10)	Phase 3 (Year 11-15)	Phase 4 (Year 15-20)
Lone Pine Creek				
Drainage Projects				
Lone Pine Central		$823,700		
Other Structural Cost - Pond		$555,000		
Middle Fork			$401,200	
Basin Plan	$60,000			
Water Quality Projects				
Regional detention/WQ facility with 1996 project		$100,000		
Lone Pine WQ Project			$75,000	
Restoration/Protection Areas				
Separate flow between East Canal and Lone Pine Creek			$100,000	
Separate flow between Hopkins Canal and Lone Pine Cr.			$100,000	
Midway Creek				
Drainage Projects				
King Center Upgrade	$2,064,700			
Delta Waters Upgrade		$538,000		
Basin Plan		$60,000		
Water Quality Projects				
King Center Upgrade WQ Project	$75,000			
Delta Waters Upgrade WQ Project		$75,000		
Restoration/Protection Areas				
Revegetate streams outside the Airport			$40,000	
Total	**$8,047,400**	**$7,870,000**	**$6,343,500**	**$6,646,000**

FUNDING ANALYSIS

Storm Drainage Utility Fee

The City of Medford funds surface water management activities through its storm drainage utility. Drainage utility fees assessed to each user are based on "equivalent residential units" (ERUs). Single-family homes are counted as one ERU. The number of ERUs for other types of properties is based on the measured impervious surface area on the property; calculated as one ERU per 3,000 square feet of impervious surface. The City's current monthly stormwater rate is $3.59 per ERU.

A funding model was developed to calculate monthly user charges (rates) based on variable inputs for inflation, operating costs, customer base (i.e., number of ERUs), and capital improvements. Table ES-3 summarizes the modeling results for six scenarios evaluated.

TABLE ES-3.
MONTHLY RATE ESTIMATES FOR MODELED FUNDING SCENARIOS

	Elements Funded				
	Current Service Level	NPDES Phase II BMPs	Phase 1 Capital Improvements	Capital Funding Mechanism[a]	Monthly Rate per ERU (2007)
Case 1	X	—	—	N/A	$4.56
Case 2	X	X	—	N/A	$4.74
Case 3	X	X	Mid-Range	Revenue Bonds	$3.59
Case 4	X	X	Mid-Range	Pay As You Go	$6.31
Case 5	X	X	Top-Level	Pay As You Go	$7.49
Case 6	X	X	Top-Level	Revenue Bonds	$3.59

a. The "mid-range" option is the CIP outlined in Table Es-2. It includes the priority projects from the 1996 Drainage Master Plan and the water quality and citywide projects developed as part of this management plan. The "top-level" option includes all of the projects from the 1996 Drainage Master Plan, not only the priority projects. It also includes the water quality and citywide projects developed as part of this management plan.

System Development Charges

State law establishes a framework for system development charges (SDCs) as one-time fees imposed on new development to account for the cost of the development's demand on the stormwater system. SDCs consist of two fee components:

- **Reimbursement**—A fee designed to recover costs associated with capital improvements already constructed or under construction
- **Improvement**—A fee designed to recover costs associated with capital improvements to be constructed.

Existing stormwater facilities in Medford were evaluated to assess their available additional capacity, and it was concluded that there is insufficient data available to calculate a reimbursement fee.

The improvement element of the SDC is based on the cost of facilities that are needed only to accommodate growth, either by expanding the stormwater system's capacity or by increasing its level of performance. To develop the improvement portion of the fee for the City of Medford, each project in the proposed CIP was evaluated to identify and exclude all costs related to correcting existing system deficiencies. Based on the resulting cost of improvements needed to accommodate growth, and the estimated growth in the number of ERUs in the service area of the next 20 years, an improvement SDC of $520 per ERU was estimated.

CHAPTER 1.
INTRODUCTION

BACKGROUND

This stormwater management plan for the City of Medford addresses existing City activities and modifications required to maintain and enhance the quality of stormwater runoff in the City. The plan coincides with the submittal of the City's management program for the National Pollutant Discharge Elimination Program (NPDES) Phase II, although the plan is not limited to the NPDES requirements.

The management plan is based on a review of City regulatory, maintenance, planning, and public involvement activities. It identifies existing activities that should be continued, modifications to existing activities to address stormwater quality, and additional activities not currently performed by the City.

The management plan incorporates recommendations from the City's 1996 *Comprehensive Medford Area Drainage Master Plan* into a capital improvements program (CIP) that addresses stormwater quantity and quality. The 1996 recommendations were not reevaluated during development of this plan. The new CIP is combined with new estimates of costs for maintenance, engineering and other programs to estimate an overall annual cost for stormwater activities.

AUTHORIZATION

In September 2003, Medford contracted with Tetra Tech/KCM, Inc. to develop this stormwater management plan. The plan uses information from existing stormwater maps, the 1996 Drainage Master Plan, field reconnaissance, a review of City ordinances and activities and City staff input.

PURPOSE AND SCOPE

This stormwater management plan addresses water quality and water quantity elements of stormwater management. It was developed through investigation of the City's natural and man-made drainage systems and evaluation of ways to enhance the natural systems. The plan addresses the requirements of the NPDES Phase II program. The project scope includes the following:

- Collect and review existing information, including the 1996 Drainage Master Plan, maps, natural resource inventories and field reconnaissance.
- Evaluate the existing and future water quality impacts from City maintenance activities and design standards. Evaluate and recommend ways to reduce the impacts.
- Develop basin-specific stormwater management programs.
- Develop a 5-year plan that meets NPDES Phase II requirements for submittal to the Oregon Department of Environmental Quality (DEQ).

- Investigate and recommend ways to integrate City staff activities to better address stormwater issues, including plan reviews, maintenance, and inspections.
- Develop a capital improvement program with cost estimates and a phasing plan. Conduct a rate study to address funding requirements for the management plan.
- Prepare the final management plan report to document the study.

REPORT ORGANIZATION

The *City of Medford Stormwater Management Plan* consists of the following chapters:

1. Introduction—Describing project background, authorization, purpose, scope, and report organization
2. Study Area and Existing System Description—Describing the study area's location, climate, existing storm systems, creek corridors and land use
3. Drainage System Evaluation—Describing the methods used to evaluate and incorporate the 1996 Drainage Master into this plan
4. Water Quality Evaluation—Describing existing monitoring data, estimating pollutant loads for each drainage basin, and identifying ways to reduce pollutant loads
5. NPDES Phase II Program—Describing the six minimum measures and the 5-year program submitted on March 10, 2004 to DEQ
6. Stormwater Maintenance Program—A review of existing stormwater activities and discussion of recommendations for future changes
7. Stormwater Ordinances—A review of existing City ordinances and a discussion of potential modifications
8. Integration of Citywide Stormwater Staff/Programs—Recommendations for integrating existing programs and staff to address stormwater issues
9. Summary of Stormwater Program—Overall summary of recommended programs, basin-specific capital improvement projects and other findings of this study
10. Funding—Describing existing funding sources and potential modifications to address current and future stormwater funding requirements

Appendices provide supporting information on project cost and evaluation methods.

CHAPTER 2.
STUDY AREA AND
EXISTING DRAINAGE SYSTEM DESCRIPTION

STUDY AREA DESCRIPTION

Location and Boundaries

The City of Medford is in southwestern Oregon in Jackson County, approximately 25 miles north of the Oregon/California border (see Figure 2-1). The City is located within the drainage area of Bear Creek, which is a tributary to the Rogue River.

The City of Medford's *1996 Drainage Master Plan* identified eight drainage basins that discharge into Bear Creek: Bear Creek East, Bear Creek South, Bear Creek West, Crooked Creek, Elk Creek, Larson Creek, Lazy Creek, and Lone Pine Creek. The Midway Drainage flows north from Medford and discharges directly to the Rogue River. Swanson Creek, which is north of the Midway Drainage, was presented as a 10th basin in the City of Medford's *Riparian Inventory and Assessment.* Figure 2-2 shows the location of each basin.

This chapter presents a discussion of the parameters used to describe each basin, followed by discussions of the drainage systems in the individual basins, excluding piped drainage features, which are described in Chapter 3.

Sensitive Areas

Riparian Corridors

The *Medford Riparian Inventory and Assessment* (Wetlands Consulting, 2002a) provides a detailed inventory of riparian conditions along the streams within the City of Medford. As defined in Medford's Municipal Code (Section 10.921), a riparian area is "the area adjacent to a stream consisting of the area of transition from the aquatic to a terrestrial ecosystem." In the 2002 assessment, the *Urban Riparian Inventory and Assessment Guide: A Tool for Oregon Land Use Planning* was used to map and rate riparian conditions in 10 basins within Medford's urban growth boundary (UGB). The assessment gave each stream segment a high, medium or low rating for water quality, flood management, thermal regulation and wildlife habitat. For this stormwater management plan, field investigations were performed on some of the reaches identified in the riparian inventory and assessment. The reach descriptions shown in tables in this chapter are those that were field-investigated for this study. The figures presented for each basin show all the reaches identified in the 2002 inventory.

The City established riparian corridors along the lower reaches of Lone Pine Creek, Larson Creek and Lazy Creek and along Bear Creek (Medford City Code 10.920). Well established riparian areas can provide water quality, flood management, thermal regulation and wildlife habitat. Much of the creek and riparian area in Medford has been extensively modified by human activity and urbanization.

Wetlands

The existence and health of wetlands within a watershed are key to the health of a watershed. The *Medford Local Wetlands Inventory and Locally Significant Wetland Determination* (Wetlands Consulting, 2002b) provides a detailed inventory of the wetlands within the Medford UGB. A wetland is defined as an area that is inundated or saturated by surface or ground water at a frequency or duration to support, and under normal circumstances actually supporting, a prevalence of vegetation typically adapted for life in saturated soil conditions. Indicators used in the inventory include wetland hydrology, hydric soils and hydrophytic vegetation. Wetland summary tables in this chapter's individual basin descriptions do not include wetland's from the inventory that are smaller than 0.5 acres.

According to the inventory, six wetlands in the City have been designated as having sensitive habitat for protection. Three of these are on the Medford Airport in the Midway Drainage Basin (MD-W20, MD-W24, and MD-W25) and have been documented as having Crooks lomatium, a plant species listed as endangered by the State of Oregon and a candidate for federal listing. Bear Creek South contains the other three wetlands with sensitive habitat. BS-W04, BS-W06 and BS-W09 are located on Bear Creek and were designated as critical coho salmon habitat by National Oceanic and Atmospheric Administration Fisheries (NOAA Fisheries).

In addition to the wetlands with sensitive habitat, the inventory listed 44 wetland assessment units and one wetland smaller than 0.5 acres that meet at least one criterion for locally significant wetlands under Division of State Lands (DSL) administrative rules OAR 141-86-300 to 0141-86-350. In order to be defined as a locally significant wetland, at least one of the following criteria must be met:

- Wetland has the highest possible rating for any of the four ecological functions addressed by the Oregon Freshwater Wetland Assessment Methodology (OFWAM) or equivalent methodology:
  - Diverse wildlife habitat
  - Intact fish habitat
  - Intact water quality
  - Intact hydrologic control.
- Wetland is within a quarter-mile of a water body listed by the Oregon Department of Environmental Quality (DEQ) as water-quality-limited and the wetland's water quality function is *intact* or *impacted or degraded*
- Wetland contains one or more rare/uncommon wetland plant communities in Oregon.
- Wetland is inhabited by any species listed by the federal or state government as a sensitive, threatened or endangered species in Oregon (unless consultation with the appropriate agency deems the site not important for the maintenance of the species).
- Wetland has a direct surface water connection to a stream segment mapped by the Oregon Department of Fish and Wildlife (ODFW) as habitat for

"indigenous anadromous salmonids" and the fish habitat function is *intact* or *impacted or degraded.*

The following are optional criteria for defining a wetland as locally significant:

- Wetland represents a locally unique plant community.
- Wetland is publicly owned and determined to have educational uses, and there is documented use for educational purposes by a school or organization.

Soils

A good description of soils data was obtained from the *1996 City of Medford Drainage Master Plan* and portions are presented below. The U.S. Soil Conservation Service (SCS) divides soils into four hydrologic soil groups defined by how easily rainfall can infiltrate the soil:

- Group A—Soils with a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.
- Group B—Soils with a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.
- Group C—Soils with a slow infiltration rate when thoroughly wet. These consist chiefly of soils with a layer that impedes the downward movement of water or soils of moderately fine or fine texture. These soils have a slow rate of water transmission.
- Group D—Soils with a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

The Drainage Master Plan indicated soils range from Class D in the upper reaches of the basin to Class B near and adjacent to Bear Creek.

Rainfall

Medford receives approximately 20 inches of rainfall annually, most of it between October and May. Summer generally has warm days with little rainfall. Table 2-1 shows typical rainfall amounts for storms of varying return frequencies in the Medford area.

TABLE 2-1. STUDY AREA RAINFALL DATA		
Return	Rainfall Depth (in)	
Frequency	6-Hour	24-Hour
2-Year	1.0	2.0
5-Year	1.3	2.5
10-Year	1.5	3.0
25-Year	1.7	3.25
50-Year	1.8	3.5
100-Year	2.0	4.0

Source: *Precipitation—Frequency Atlas of the Western United States, Volume X—Oregon*. National Oceanic and Atmospheric Administration.

Current and Future Land Use

The 13 land use designations in the City of Medford General Land Use Plan include several residential, commercial and industrial categories, along with parks and schools, greenway, city center, airport and limited service area. Residential density generally ranges from high-density multi-family development to urban residential.

Water quality analyses in this report evaluate existing and future (buildout) development conditions. Land use for estimating buildout conditions was taken from the General Land Use Plan. Existing development was estimated from aerial photography.

TABLE 2-2. LAND USE DESIGNATIONS SUMMARY BY BASIN					
	Area (acres)		Land Use Within UGB (%)		
	Within UGB	Total	Residentia l	Commercial/Industria l	Developed
Bear Creek East	2,444	2,444	68%	23%	92%
Bear Creek South	983	2,491	30%	64%	63%
Bear Creek West	1,399	1,399	51%	44%	91%
Crooked Creek	1,402	2,795	74%	20%	86%
Elk Creek	2,572	3,618	58%	39%	86%
Larson Creek	1,752	2,684	92%	7%	43%
Lazy Creek	2,127	2,577	93%	4%	39%
Lone Pine	1,772	1,953	68%	29%	77%
Midway Drainage	2,710	5,056	36%	63%	85%

BEAR CREEK EAST BASIN EXISTING DRAINAGE SYSTEM

The Bear Creek East Basin (see Figure 2-3) is relatively flat, with an average slope of 0.012 feet/foot (ft/ft). Ground elevations range from 1,280 feet at the confluence with Bear Creek to 1,580 feet.

Two types of geology exist in the Bear Creek East Basin. The upper basin (at least a half-mile from the stream) has shallow soils, with depth to bedrock is as little as 1 foot in places. In the upper basin, stormwater becomes subsurface flow parallel to overland flow and emerges as seepage into the stream beds. The shallow depth to bedrock limits the constructability of detention ponds. Deeper soils exist in the lower portion of the basin (within a half-mile of the stream)—up to 70 feet deep in places. The basin is fully developed, therefore underlying soils are less of a factor in determining runoff. Soils range from SCS Class D (very low infiltration) in the upper part of the basin to SCS Class B (moderate infiltration) in the lower part of the basin.

Baby Bear Creek, a perennial stream due to irrigation return flow, is located in this basin. The basin is heavily developed and the remnant portion of Baby Bear Creek is the only stream other than Bear Creek (Wetlands Consulting, 2002a). Table 2-3 summarizes inventoried riparian conditions in the basin. The Hopkins Canal provides stormwater conveyance for the northeast section of the basin.

TABLE 2-3.
BEAR CREEK EAST RIPARIAN CONDITIONS SUMMARY

Location	Condition	Restoration Potential
BE-02	Water in creek is fairly clean water and could be groundwater	Could restore stream as an educational project

Three wetlands were inventoried in the basin, totaling 16 acres. Two of the wetlands meet at least one criterion for locally significant wetlands defined by DSL (Wetlands Consulting, 2002b). Tables 2-4 and 2-5 summarize the wetland characteristics.

The basin contains 89.9 acres of public parks.

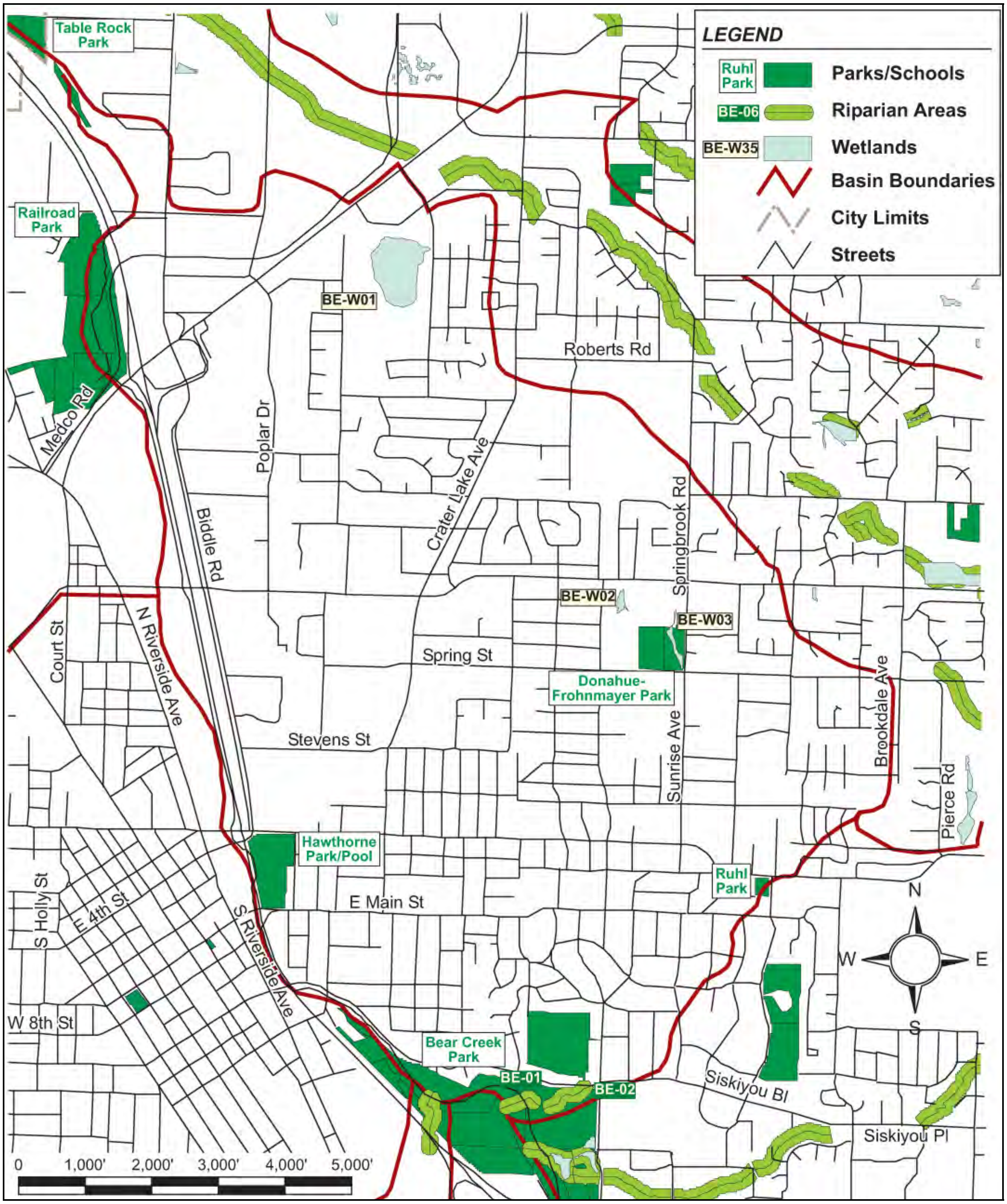

Figure 2-3. Bear Creek East Basin

TABLE 2-4.
BEAR CREEK EAST WETLANDS SUMMARY

ID	Area (acres)	Category
BE-W01	14.5	Locally Significant
BE-W02	0.8	—
BE-W03	0.9	Locally Significant

TABLE 2-5.
BEAR CREEK EAST LOCALLY SIGNIFICANT WETLANDS SUMMARY

	Mandatory Criteria		Optional Criteria
ID	Ecological functions as defined by OFWAM	Within 1/4 mile of a water quality limited stream	Public education use
BE-W01	• Habitat for some species • Intact water quality function	Bear Creek	—
BE-W03	• Habitat for some species • Intact water quality function	Bear Creek	In Donahue-Frohnmayer Park

BEAR CREEK SOUTH BASIN EXISTING DRAINAGE SYSTEM

Ground elevations in the Bear Creek South Basin (see Figure 2-4) range from 1,370 feet to 1,860 feet. A large outcropping of exposed bedrock is located east of Marsha Lane just outside the city limits. Much of the rest of the basin has shallow soils except along Phoenix Canal. Soils in this basin are SCS Class C or Class D. Tight soils and exposed bedrock limit the amount of infiltration that can occur, increasing the volume of runoff.

Gore Creek and an unnamed tributary to Bear Creek are located in this basin. All reaches in this basin are perennial due to irrigation return flow. Gore Creek has been extensively channelized and its riparian areas have been modified by construction of warehouses, parking lots, agricultural cropping and grazing. The unnamed tributary has been extensively modified by human activity; the lowest reach has been rerouted where is passes through an abandoned gravel quarry. Other human modifications include: channelization and placement in underground pipes, residential development and road construction (Wetlands Consulting, 2002a). Table 2-6 summarizes inventoried riparian conditions in the basin. Phoenix Canal and Talent Lateral Canal run through the basin.

TABLE 2-6.
BEAR CREEK SOUTH RIPARIAN CONDITIONS SUMMARY

Location	Conditions	Restoration Needs/Recommendations
BS-01	• Creek has been channelized and has a couple of 90 degree turns. • Little to no vegetation on banks. • A feed lot is adjacent to the stream.	Work with property owner to provide set back from feed lot.

The 12 wetlands in the basin total 16 acres. Nine of the wetlands meet DSL criteria for locally significant wetlands and three are excavated ponds. BS-W04, BS-W06, and BS-W09 have been designated as having sensitive habitat for protection; they are located on Bear Creek and were designated as critical coho salmon habitat by NOAA Fisheries (Wetlands Consulting, 2002b). Tables 2-7 and 2-8 summarize the wetland characteristics.

The basin contains 28.1 acres of public parks.

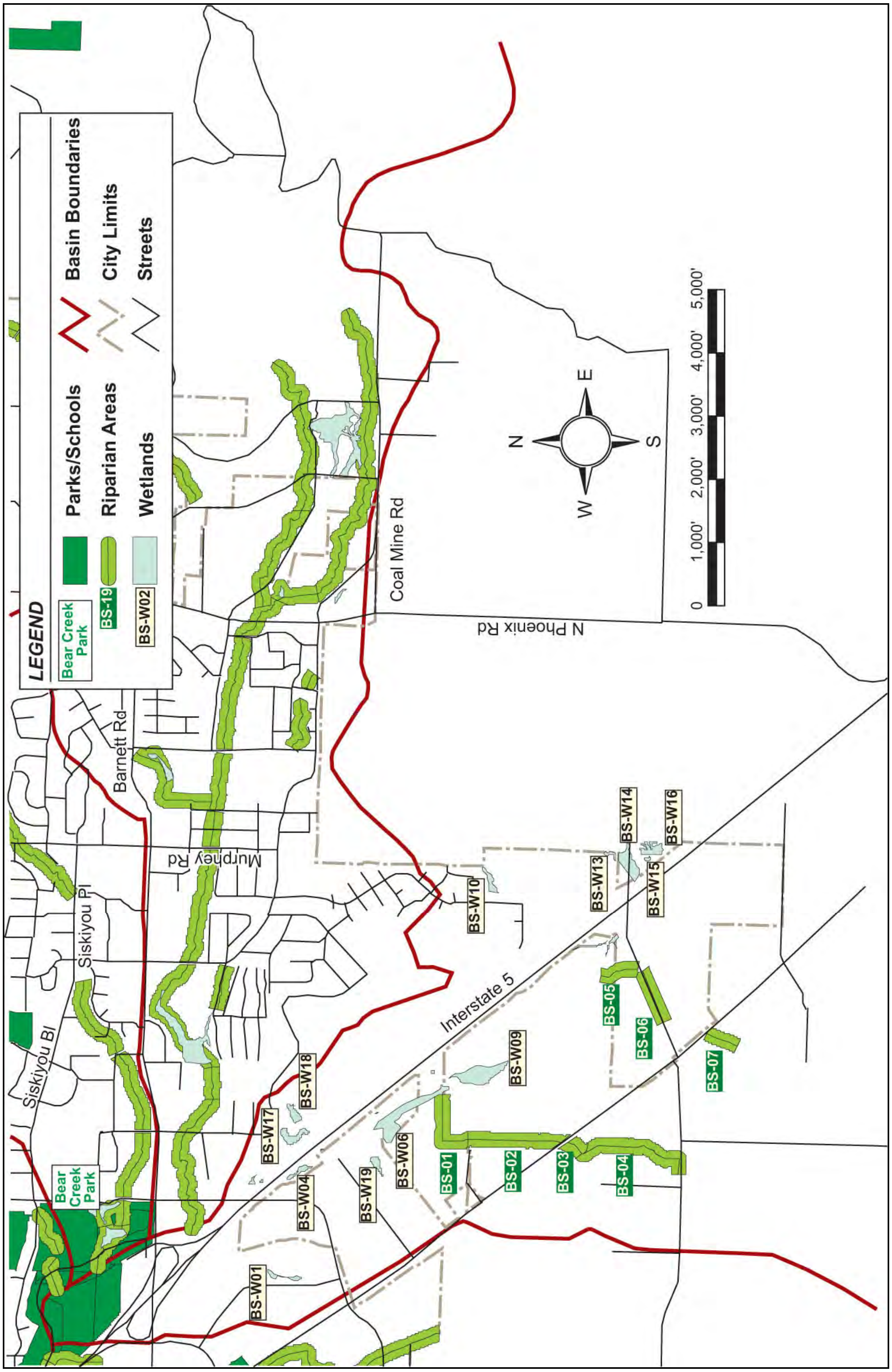

Figure 2-4. Bear Creek South Basin

TABLE 2-7. BEAR CREEK SOUTH WETLANDS SUMMARY		
ID	Area (acres)	Category
BS-W01	0.5	Locally Significant
BS-W04	0.5	Special Interest Locally Significant
BS-W06	4.6	Special Interest Locally Significant
BS-W09	3.7	Special Interest Locally Significant
BS-W10	0.8	Locally Significant
BS-W13/W14	2.4	Locally Significant
BS-W15/W16	1.4	Locally Significant
BS-W17	1.2	Excavated Pond
BS-W18	0.8	Excavated Pond
BS-W19	0.6	Excavated Pond

TABLE 2-8. BEAR CREEK SOUTH LOCALLY SIGNIFICANT WETLANDS SUMMARY			
	Mandatory Criteria		
ID	Ecological functions as defined by OFWAM	Within 1/4 mile of a water quality limited stream	Connects to salmon habitat
BS-W01	• Habitat for some species • Intact water quality function	Bear Creek	-
BS-W04	• Habitat for some species • Intact fish habitat • Intact water quality function	Bear Creek	Bear Creek
BS-W06	• Habitat for some species • Intact fish habitat • Intact water quality function	Bear Creek	Bear Creek
BS-W09	• Habitat for some species • Intact fish habitat • Intact water quality function	Bear Creek	Bear Creek
BS-W10	• Habitat for some species • Intact water quality function	—	—
BS-W13/W14	—	Bear Creek	—
BS-W15/W16	• Habitat for some species • Intact water quality function	Bear Creek	—

BEAR CREEK WEST BASIN EXISTING DRAINAGE SYSTEM

Ground elevations in the Bear Creek West Basin (see Figure 2-5) range from 1,320 feet to 1,440 feet.

Two types of geology exist in the basin. The upper basin (at least a quarter-mile from the stream) has shallow soils, with depth to bedrock is as little as 1 foot in places. In the upper basin, stormwater becomes subsurface flow parallel to overland flow and emerges as seepage into the stream beds. The shallow depth to bedrock limits the constructability of detention ponds. Deeper soils exist in the lower portion of the basin (within a quarter-mile of the stream)—up to 70 feet deep in places. The basin is fully developed, therefore underlying soils are less of a factor in determining runoff. Soils range from SCS Class C (low infiltration) in the upper part of the basin to SCS Class B (moderate infiltration) in the lower part of the basin.

There are no wetlands or open channels in this basin.

The basin contains 24.3 acres of public parks.

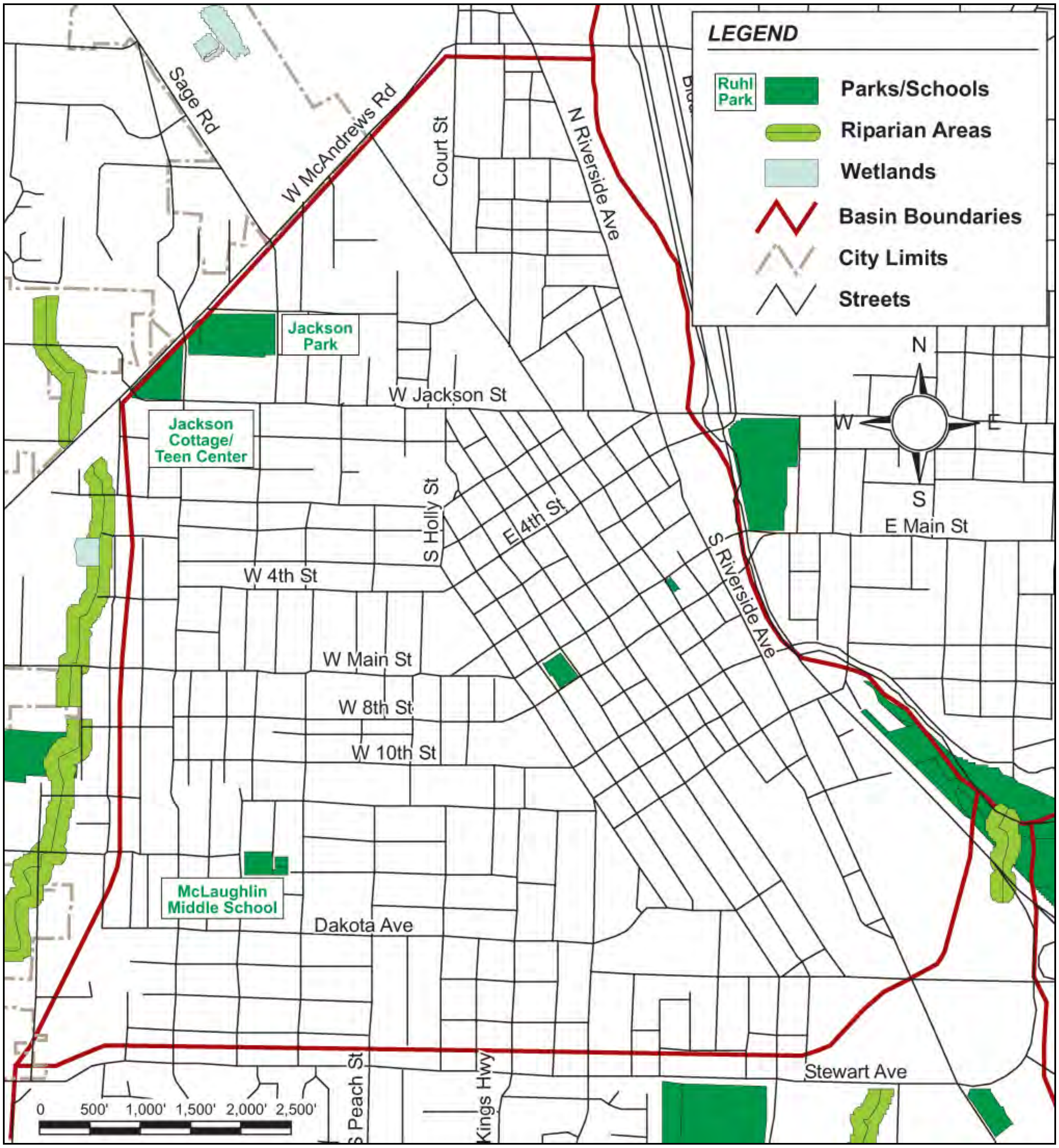

Figure 2-5. Bear Creek West Basin

CROOKED CREEK BASIN EXISTING DRAINAGE SYSTEM

Ground elevations in the Crooked Creek Basin (see Figure 2-6) range from 1,370 feet to 1,710 feet.

The drainage basin contains Crooked Creek and Hansen Creek, which is a tributary to Crooked Creek. All reaches are perennial due to irrigation return flow. All of the streams and riparian areas in the basin have been extensively modified by human activity, including placement of long stream segments in underground pipes, stream channelization, removal of woody vegetation, residential development, industrial development, haying, golf course development, and mowing for fire control (Wetlands Consulting, 2002a). Table 2-9 summarizes inventoried riparian conditions in the basin. Crooked Creek is listed as a water quality limited stream for fecal coliform. The Phoenix Canal runs through this basin.

TABLE 2-9.
CROOKED CREEK RIPARIAN CONDITIONS SUMMARY

Location	Conditions	Restoration Needs/ Recommendations
CR-02, CR-03, CR-04	Much of the creek runs through private property and has no riparian corridor. The vegetation consists mainly of grass and some willows. Concrete has been used to force the creek to make a 90-degree bend at South Stage Road.	Create setbacks to prevent new development from being constructed near the stream.
CR-03 @ Nobility Drive	This area is being used as a local green waste disposal site (grass clippings and a few pumpkins were found on the stream bank)	Educate property owners along stream corridors.
CR-01 Parking lot just south of Stewart Avenue	Parking lot was paved with asphalt right up to the top bank of the creek. Road base material is in still in the creek. Channel has been riprap-lined with no vegetation.	Work with property owner to improve vegetation along creek.
CR-05, CR-06	Hansen Creek. Couldn't access; private property	

The wetlands inventory lists four wetlands in this basin, totaling 44 acres. Three of the wetlands are excavated ponds (Wetlands Consulting, 2002b). Table 2-10 summarizes wetland characteristics.

TABLE 2-10.
CROOKED CREEK WETLANDS SUMMARY

ID	Area (acres)	Category
CR-W01	41.3	—
CR-W02	1.3	Excavated Pond
CR-W03	0.7	Excavated Pond
CR-W04	0.5	Excavated Pond

The basin contains 39.1 acres of public parks.

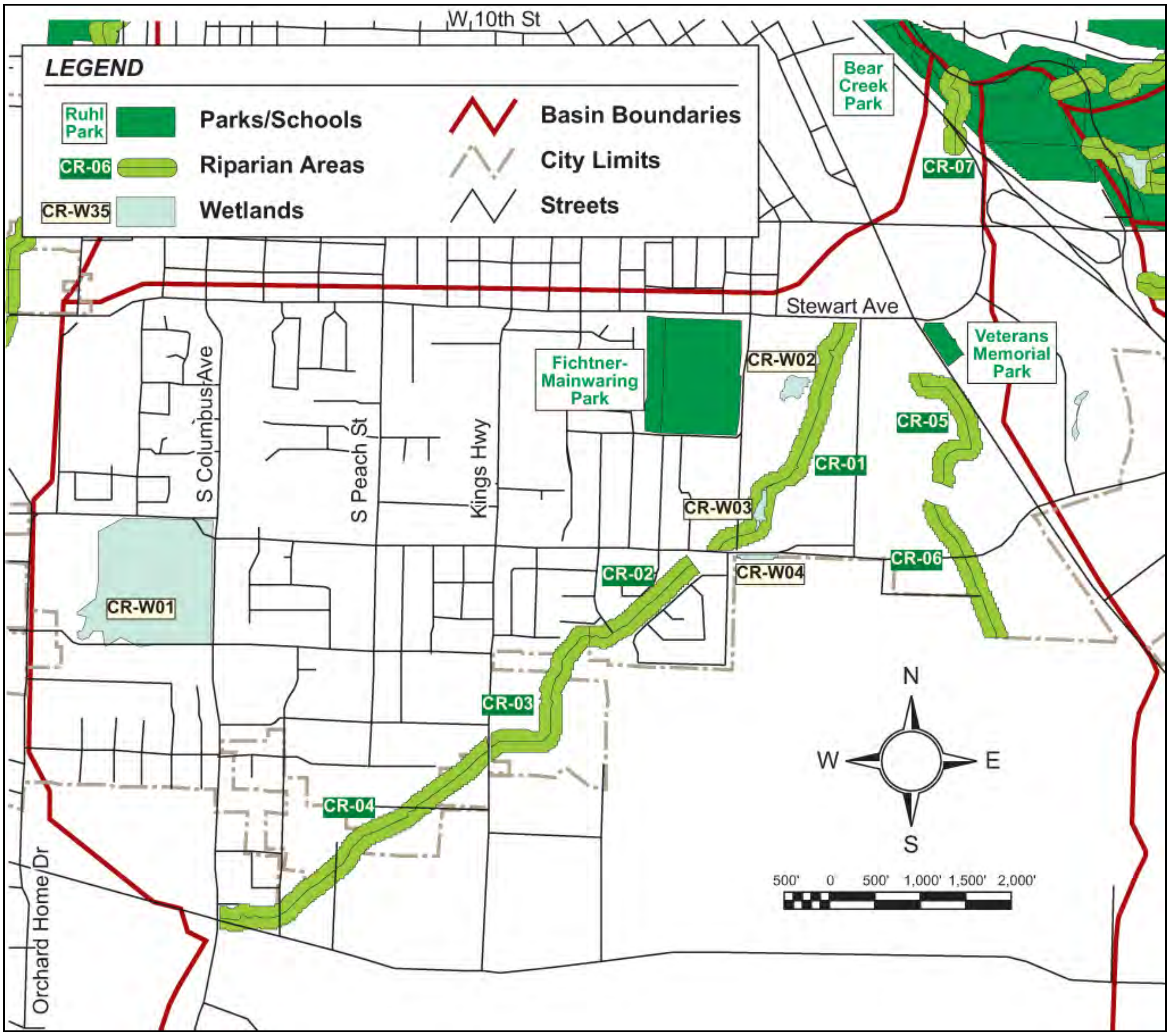

Figure 2-6. Crooked Creek Basin

ELK CREEK BASIN EXISTING DRAINAGE SYSTEM

The Elk Creek Basin (see Figure 2-7) is relatively flat, with an average slope of 0.007 ft/ft. Ground elevations range from 1,270 feet to 1,540 feet. The soils in this basin are deep alluvial deposits. Coleman loam (SCS Class C) is the predominant soil, with a large area of Ruch loam (SCS Class B). The area with the Ruch loam has a deeper water table.

Elk Creek and a remnant of an unnamed tributary are located within this basin. All reaches are perennial due to irrigation return flow. All of the streams and riparian areas in the basin have been extensively modified by human activity, including placement of long stream segments in underground pipes, stream channelization, removal of woody vegetation, residential development, commercial and industrial development, haying, grazing and mowing for fire control (Wetlands Consulting, 2002a). Table 2-11 summarizes inventoried riparian conditions in the basin. The Hopkins Canal runs through this basin.

There are 12 wetlands in the Elk Creek Basin, totaling 41 acres. Three of the wetlands meet at least one DSL criterion for locally significant wetlands. Two of the wetlands are excavated ponds (Wetlands Consulting, 2002b). Tables 2-12 and 2-13 summarize the wetland characteristics.

The basin contains 55.6 acres of public parks.

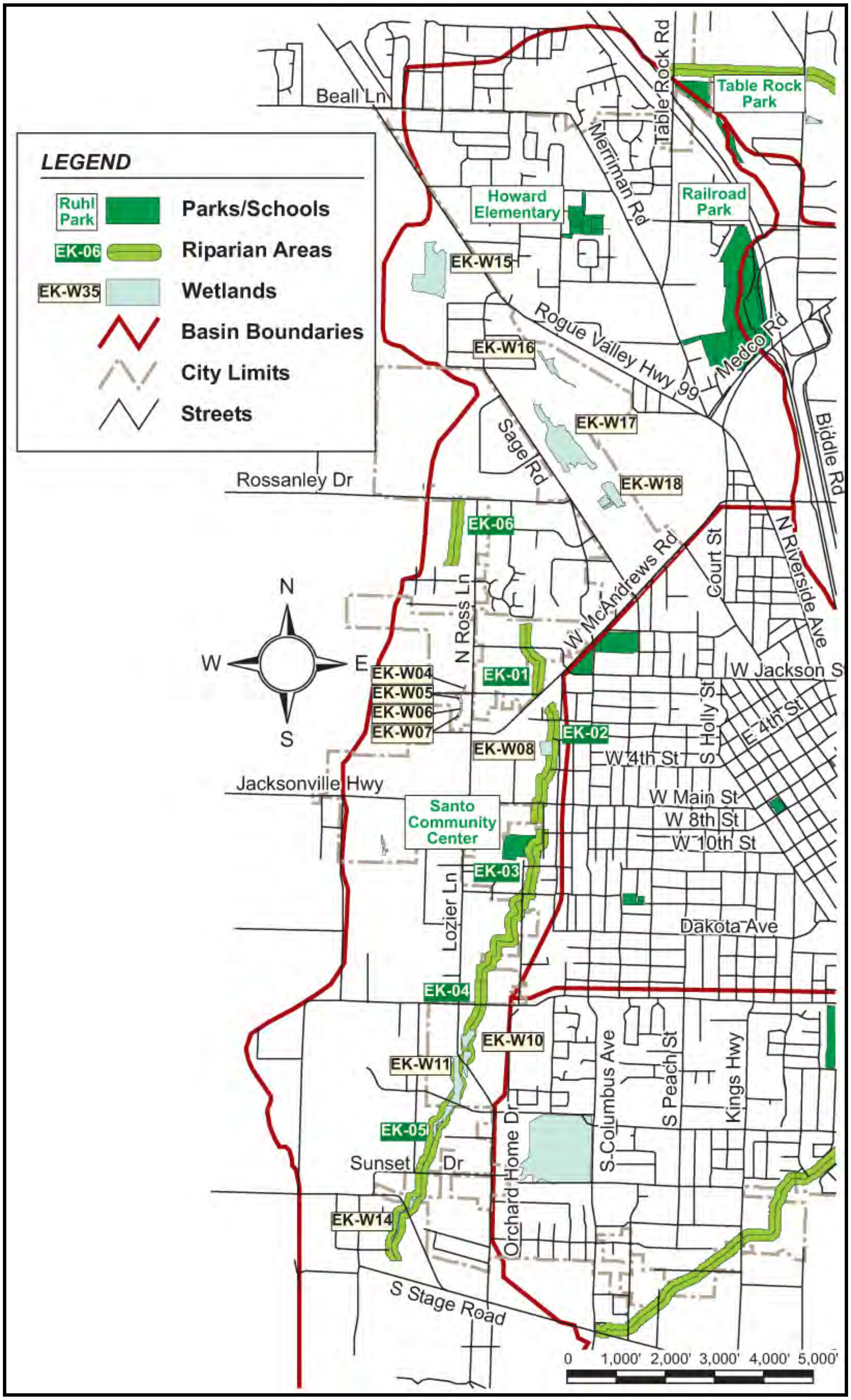

Figure 2-7. Elk Creek Basin

TABLE 2-11.
ELK CREEK RIPARIAN CONDITIONS SUMMARY

Location	Conditions	Restoration Needs/Recommendations
EK-05 at Hopkins Canal	The creek flows through a culvert under the canal	
EK-05 at Arlington	DSL Wetlands, dry (EK-W10, EK-W11)	
EK-05 at Stewart	It appears that there is a berm causing standing water upstream of the culvert.	
EK-04 at Stewart	Cars are parked at stream bank with no water quality treatment. Slow moving to stagnant flow. Little vegetation; some wetlands plants are in the creek.	Work with property owners to provide a buffer between parking lot and the creek.
EK-03 at Cherry St	The stream consists of a grass channel. Stream is impacted by horses entering creek	Work with property owners to limit horses from entering creek.
EK-03 Prune and Cherry St	This reach has been recently piped.	
EK-03 at Meadows	The creek is in poor condition with considerable erosion and no vegetation.	Restore this portion of the creek to stabilize the banks and create habitat.
EK-02 at Jacksonville-Highway	Grass clippings were left on the bank. No vegetation exists upstream, downstream a few trees provide limited tree canopy.	Educate property owners along the creek. Plant more vegetation along creek.
EK-02 at Locust	Little tree canopy or understory.	Plant more trees and shrubs to provide riparian canopy for habitat.
EK-02 2nd	DSL Wetlands (WK-W08) has been enclosed in a concrete retaining wall (assumed that wall is along the delineation boundary)	
EK-01 N. of McAndrews at Western	New bridge associated with new development. No maintenance access road exists along the creek.	
EK-01 @ Maple	48" culvert (Master Plan indicates a 36"). Creek flows between two properties	
EK-01 Mobile Home park	The creek splits into two systems. One is piped across Sage Rd. to Bear Creek. The other system is piped north and outlets into a ditch along the railroad tracks.	

TABLE 2-12.
ELK CREEK WETLANDS SUMMARY

ID	Area (acres)	Category
EK-W04 – W07	0.9	—
EK-W08	1.6	Locally Significant
EK-W10/W11	7.7	Locally Significant
EK-W14	1.3	Locally Significant
EK-W15	11.3	Excavated Pond
EK-W16	1.5	—
EK-W17	12.9	—
EK-W18	3.8	Excavated Pond

TABLE 2-13.
ELK CREEK LOCALLY SIGNIFICANT WETLANDS SUMMARY

ID	Mandatory Criterion: Ecological functions as defined by OFWAM
EK-W08	• Habitat for some species • Intact water quality function
EK-W10/W11	• Habitat for some species • Intact water quality function
EK-W14	• Habitat for some species • Intact water quality function

LARSON CREEK BASIN EXISTING DRAINAGE SYSTEM

Ground elevations in the Larson Creek Basin (see Figure 2-8) range from 1,380 feet at the confluence with Bear Creek to 2,330 feet. Bedrock is present less than 10 feet deep. As a result stormwater becomes subsurface flow parallel to overland flow and emerges as seepage into the stream beds. The low depth to bedrock limits the constructability of deep storm drains and detention ponds. Soils range from SCS Class D (very low infiltration) in the upper part of the basin to SCS Class B (moderate infiltration) in the lower part of the basin.

This basin contains Larson Creek and a number of tributaries in the upper portion of the basin. The lower reaches and some upper reaches are perennial due to irrigation return flows; all other reaches are intermittent. Almost all of the streams and riparian areas in the basin have been extensively modified by human activity, including placement of long stream segments in underground pipes, stream channelization, placement of stream segments in concrete channels, removal of woody vegetation, residential development, orchards, grazing, haying, golf course development and mowing for fire control. The highest reaches in the basin have had the least amount of human impact and include reaches of relatively undisturbed stream channels and riparian areas with intact native Oregon white oak savanna plant communities (Wetlands Consulting, 2002a). Table 2-14 summarizes inventoried riparian conditions in the basin. Larson Creek is listed as a water quality limited stream for DO, fecal coliform, pH, temperature. East Main Canal runs through the basin.

Six wetlands are located in this basin, totaling 19 acres. Three of the wetlands meet at least one DSL criterion for locally significant wetlands. Two of the wetlands are excavated ponds with little or no wetlands vegetation (Wetlands Consulting, 2002b). Tables 2-15 and 2-16 summarize the wetland characteristics.

The basin contains 166.1 acres of public parks; 0.9 acres are within the UGB.

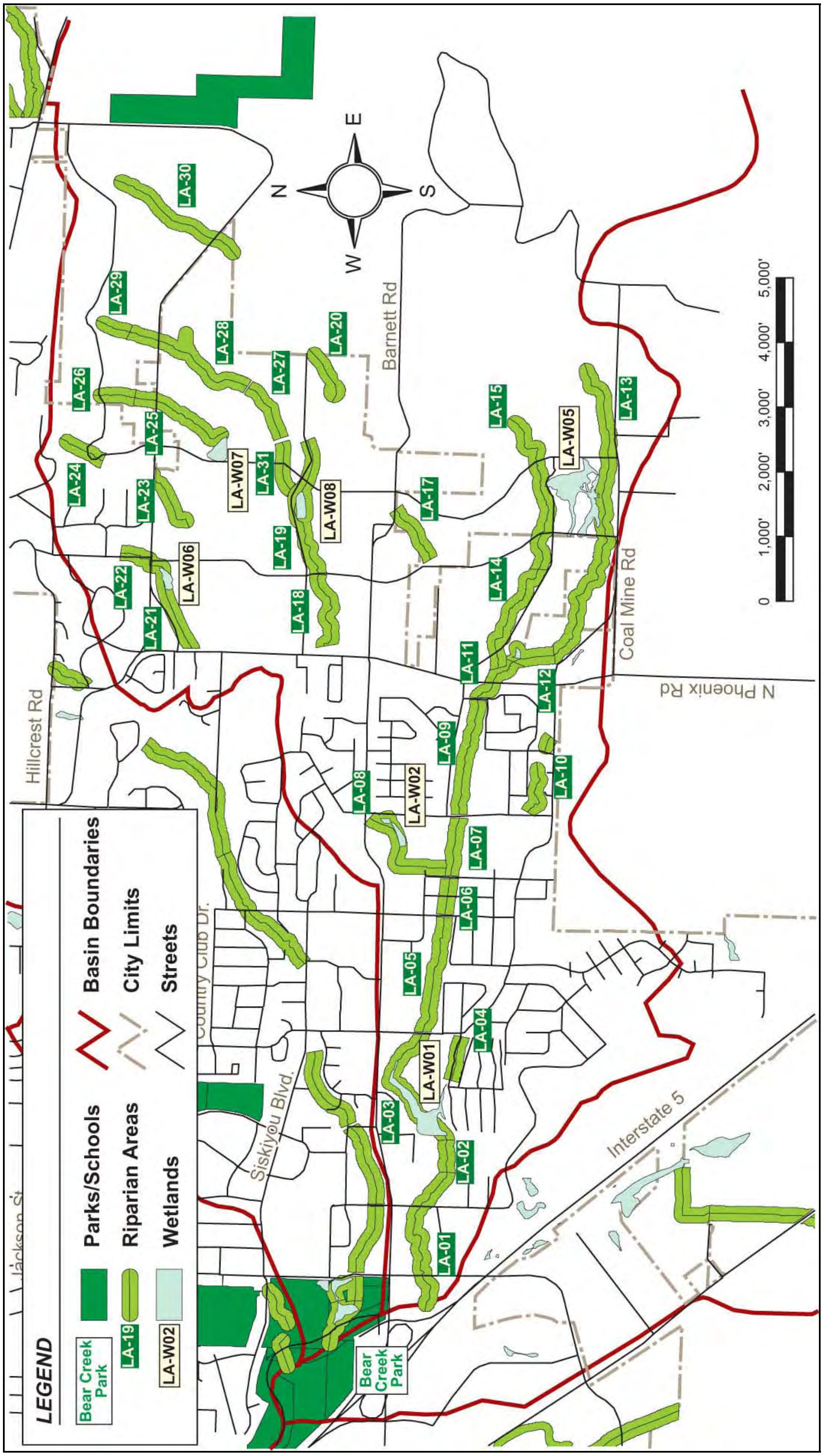

Figure 2-8. Larson Creek Basin

TABLE 2-14.
LARSON CREEK RIPARIAN CONDITIONS SUMMARY

Location	Conditions	Recommendations
All reaches upstream of N Phoenix Road	Undeveloped portion the basin, riparian area tree and understory cover moderate to high.	Protect riparian and stream habitat
LA-09 at Larson Creek Drive	Steep Slopes. Moderate tree and understory cover moderate on right bank, not vegetation on left bank. Left bank is steeper than right bank. Drainage pipes from private residences flow into creek on left bank.	Vegetate banks, regrade to a more stable slope condition, and remove residential drainage pipes
LA-09 at Golf View Drive	Concrete causing ponding, riparian area tree and understory cover moderate to high.	Vegetation enhancement
LA-07 at Golf View Drive	Riparian area tree and understory cover moderate to high.	Vegetation enhancement
LA-21	No vegetation. There is not a clear distinction between creek flow and canal flow at the intersection of Larson Creek and the East Main Canal.	Separate flow in Larson Creek from East Main Canal
LA-08	Locally significant wetland (LA-W02)	Preserve Wetland
LA-08 N. Larson Ck & State St	No Buffer with development. Natural bottom culvert.	Investigate ways to maintain creek buffer
LA-06	2 blocks of concrete-lined channel between Olympic Avenue and Murphy Road	Investigate restoring natural channel
LA-05	Riparian area tree moderate to high, understory starting.	None needed
LA-05 @ Black Oak Dr	A concrete retaining wall in poor condition is located on the left bank. Low to moderate tree and understory cover on banks.	Work with the High School to repair this section of the creek.
LA-04	Need containment where campers are parked on edge of wetland/creek	Provide buffer or filtration between parking and creek.
LA-03	Grass at the retirement community is maintained up to creek bank with no buffer.	Work with Retirement community to provide a buffer to the stream.
LA-02	Culvert appears to be smaller than culverts found upstream, fish attraction chute.	Culvert Improvement Project LA1A2 of the 1996 Plan

TABLE 2-15.
LARSON CREEK WETLANDS SUMMARY

ID	Area (acres)	Category
LA-W01	5.6	Locally Significant
LA-W02	1.0	Locally Significant
LA-W05	8.2	Locally Significant
LA-W06	0.9	—
LA-W07	1.7	Excavated Pond
LA-W08	1.2	Excavated Pond

TABLE 2-16.
LARSON CREEK LOCALLY SIGNIFICANT WETLANDS SUMMARY

	Mandatory Criteria		
ID	Ecological functions as defined by OFWAM	Within 1/4 mile of a water quality limited stream	Connects to salmon habitat
LA-W01	• Habitat for some species • Intact water quality function • Intact hydrologic control	Larson Creek	Larson Creek
LA-W02	• Habitat for some species	Larson Creek	—
LA-W05	• Habitat for some species	Larson Creek	Larson Creek

LAZY CREEK BASIN EXISTING DRAINAGE SYSTEM

Ground elevations in the Lazy Creek Basin (see Figure 2-9) range from 1,370 feet at the confluence of Lazy Creek and Bear Creek to 3,600 feet at Roxy Ann Peak. Bedrock is present less than 10 feet deep. As a result stormwater becomes subsurface flow parallel to overland flow and emerges as seepage into the stream beds. The shallow depth to bedrock raises the cost of deep storm drains and detention ponds. Soils range from SCS Class D (very low infiltration) in the upper part of the basin to SCS Class B (moderate infiltration) in the lower part of the basin.

This basin contains Lazy Creek and a number of tributaries in the upper portion of the basin. Lower reaches are perennial due to irrigation return flows and upper reaches are intermittent. Almost all of the streams and riparian areas in the lower reaches have been extensively modified by human activity, including placement of long stream segments in underground pipes, stream channelization, placement of stream segments in concrete channels, removal of woody vegetation, residential development, golf course development and mowing for fire control. Upper reaches have not been as consistently modified by human activity as the lower reaches, however a number of upper reaches have had extensive modification in the form of placement in underground pipes, removal of woody vegetation, and residential development. The highest reaches in the Lazy Creek Basin are in some of the least developed landscapes in the Medford UGB and have been impacted only through grazing and construction of dirt roads (Wetlands Consulting, 2002a). Table 2-17 summarizes inventoried riparian conditions in the basin. Lazy Creek is listed as a water quality limited stream for fecal coliform, pH, and temperature. East Main Canal runs through the basin

Eight wetlands are located in the basin, totaling 9 acres. Six of the wetlands meet at least one DSL criterion for locally significant wetlands. One of the wetlands is an excavated pond (Wetlands Consulting, 2002b). Tables 2-18 and 2-19 summarize the wetland characteristics.

The basin contains 269.4 acres of public parks; 48.4 acres are within the UGB.

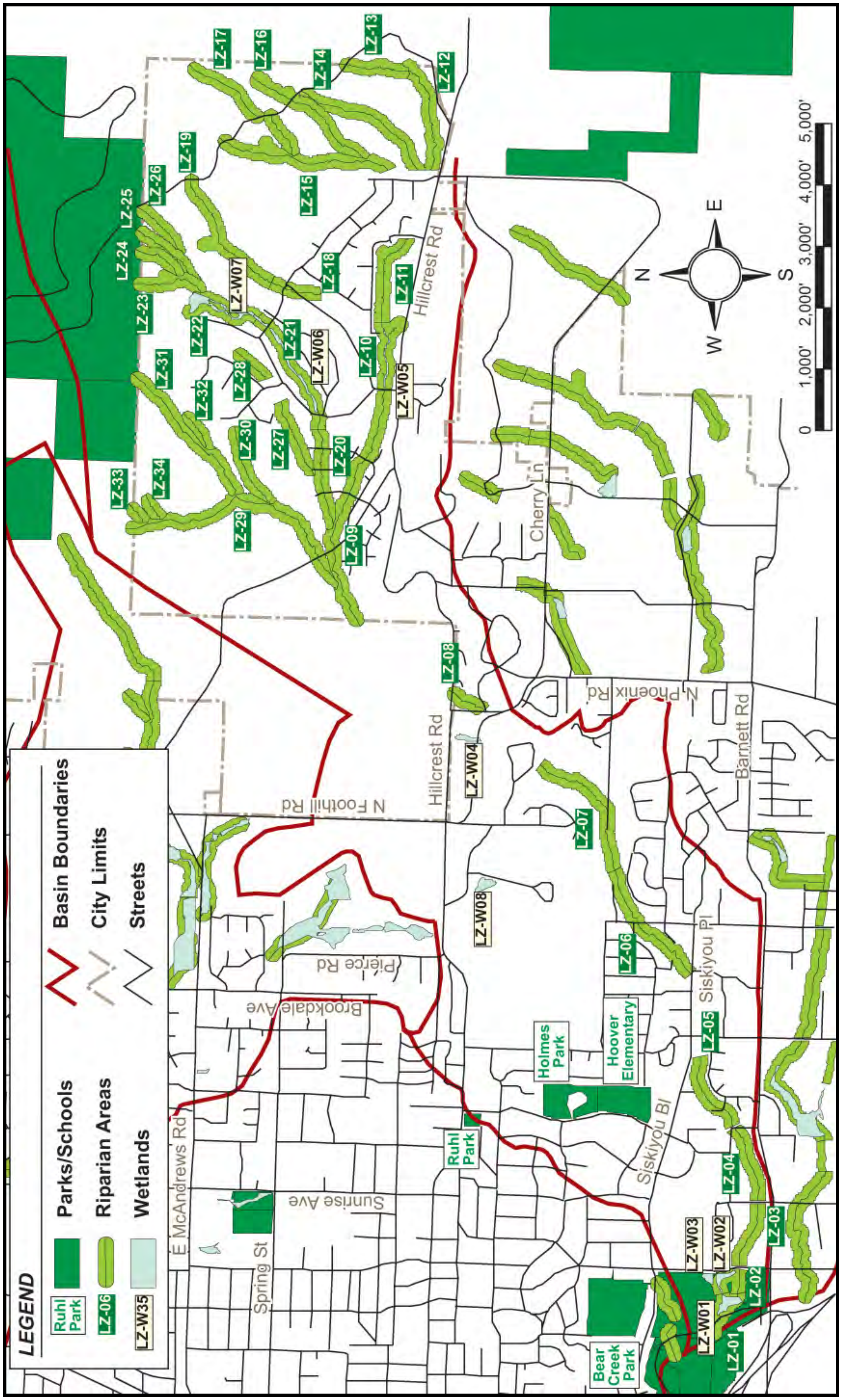

Figure 2-9. Lazy Creek Basin

TABLE 2-17.
LAZY CREEK RIPARIAN CONDITIONS SUMMARY

Location	Conditions	Restoration Needs/Recommendations
LZ-09 through LZ-34	Lots of development in upper portion of basin. Wetlands in the area.	Protect stream in upper reaches
LZ-07	The creek runs through a Rogue Valley County Club. There is a large drop just upstream of the golf course. The creek has steep banks, which have been reinforced with a retaining wall made of concrete. A spoils sight is located on the stream bank in golf course. A new culvert has been installed in golf course. Downstream of the golf course the creek is concrete lined.	Work with Rogue Valley County Club to practice good stream stewardship along this reach.
LZ-06 at Murphy	The concrete channel ends here. The concrete is being undercut downstream of the street crossing.	
LZ-05 at Burgundy	A local resident reported recent work in stream and steelhead in past. Vegetation consists of grass and a few trees.	Plant more trees and shrubs to provide a good riparian canopy for habitat.
LZ-04 Crestbrook	A rock outcrop is located downstream of the street crossing.	
LZ-03, LZ-04 @ Ellendale	A 50-foot stream buffer exists here. The reach needs more riparian canopy. Vegetation consists of a few trees and no understory.	Plant more trees and shrubs to provide a good riparian canopy for habitat.
LZ-02 at Highland Dr	A concrete drop exists here. There is tree and shrub canopy along the stream. The Bear Creek Park BMX track is adjacent to the creek.	A berm and vegetation is needed to protect the creek from erosion off of the BMX track.

TABLE 2-18.
LAZY CREEK WETLANDS SUMMARY

ID	Area (acres)	Category
LZ-W01 – W03	2.7	Locally Significant
LZ-W04	0.7	
LZ-W05	0.6	Locally Significant
LZ-W06/W07	4.3	Locally Significant
LZ-W08	1.0	Excavated Pond

TABLE 2-19.
LAZY CREEK LOCALLY SIGNIFICANT WETLANDS SUMMARY

	Mandatory Criteria	
ID	Ecological functions as defined by OFWAM	Within 1/4 mile of a water quality limited stream
LZ-W01 – W03	• Habitat for some species • Intact water quality function	Lazy Creek
LZ-W05	• Habitat for some species • Intact water quality function	Lazy Creek
LZ-W06/W07	• Habitat for some species • Intact water quality function	Lazy Creek

LONE PINE CREEK BASIN EXISTING DRAINAGE SYSTEM

Ground elevations in the Lone Pine Creek Basin (see Figure 2-10) range from 1,270 feet to 1,670 feet. Bedrock is present less than 10 feet deep. As a result stormwater becomes subsurface flow parallel to overland flow and emerges as seepage into the stream beds. The shallow depth to bedrock limits the constructability of detention ponds. Soils range from SCS Class D (very low infiltration) in the upper part of the basin to SCS Class B (moderate infiltration) in the lower part of the basin.

This basin contains Lone Pine Creek and a number of tributaries in the upper portion of the basin. Lower reaches are perennial due to irrigation return flows; upper reaches are intermittent. Almost all the streams and riparian areas in the basin have been extensively modified by human activity, including placement of long stream segments in underground pipes, stream channelization, placement of stream segments in concrete channels, removal of woody vegetation, residential development, agricultural cropping, mowing for fire control and grazing (Wetlands Consulting, 2002a). Table 2-20 summarizes inventoried riparian conditions in the basin. Lone Pine Creek is listed as a water quality limited stream for temperature. The Hopkins and East Main Canals flow through the basin.

TABLE 2-20.
RIPARIAN CONDITIONS SUMMARY

Location	Conditions	Restoration Needs/ Recommendations
LP-22 Foothill near Eucalyptus	Drainage from this portion of the basin flows into East Main Canal. A small volume flows through Cedar Links Golf Course.	—
LP-15 at Foothill	Upstream portion of flow in East Main Canal intersects with the creek and irrigation water flows down the creek.	Project to separate Lone Pine Creek from East Main Irrigation Canal
LP-08 at Ruby	Private stream diversion to pond	Work with property owner to prevent pond water back into creek.
LP-07 at Lone Pine Road	Appears to be a bank stabilization project by a private resident. Riprap is not tied in, could unravel in high flow event.	Work with property owners to protect/restore the creek and provide riparian areas.
LP-04	Concrete Lined Channel	
LP-01 at Biddle	Parking lot of left bank with no buffer between paving a stream bank. Little tree canopy and understory. Left bank is steep.	Work with property owners to provide a riparian buffer between parking lot and the creek. Plant more trees and shrubs to provide riparian canopy for habitat.

Nine wetlands are located in the basin, totaling 31 acres. All nine of the wetlands meet at least one DSL criterion for locally significant wetlands (Wetlands Consulting, 2002b). Tables 2-21 and 2-22 summarize the wetland characteristics.

The basin contains 37.2 acres of public parks; 10.8 acres are within the UGB.

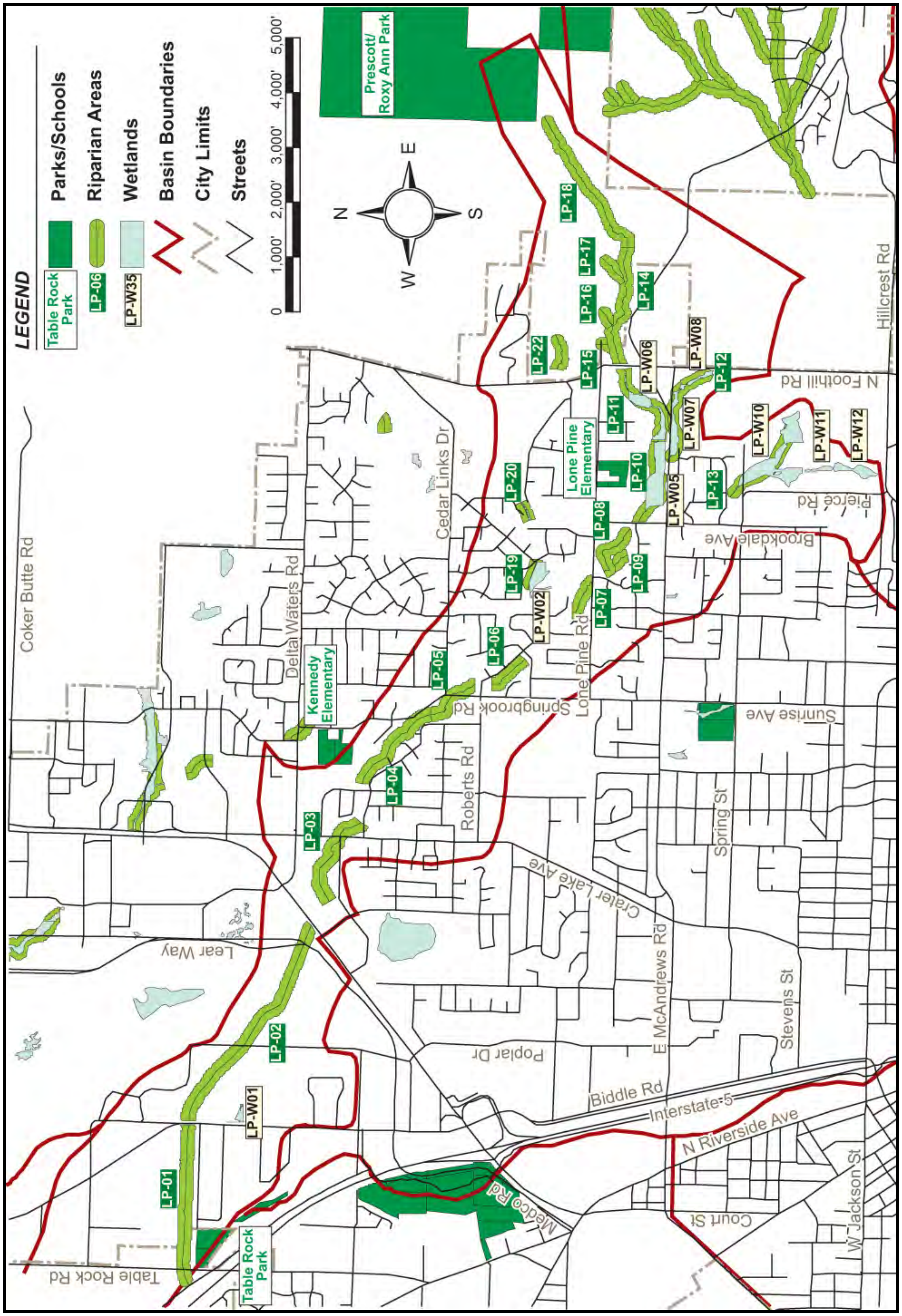

Figure 2-10. Lone Pine Creek Basin

TABLE 2-21.
LONE PINE CREEK BASIN WETLANDS SUMMARY

ID	Area (acres)	Category
LP-W01	0.7	Locally Significant
LP-W02	2.5	Locally Significant
LP-W05/W06	10.6	Locally Significant
LP-W07/W08	3.5	Locally Significant
LP-W10 – W12	14.2	Locally Significant

TABLE 2-22.
LONE PINE CREEK LOCALLY SIGNIFICANT WETLANDS SUMMARY

	Mandatory Criteria		Optional Criteria
ID	Ecological functions as defined by OFWAM	Within 1/4 mile of a water quality limited stream	Public with education use
LP-W01	Intact Water Quality function	Lone Pine	—
LP-W02	—	Lone Pine	—
LP-W05/W06	Intact Water Quality function Intact Hydrologic Control	Lone Pine	McAndrews Road Mitigation Site
LP-W07/W08	—	Lone Pine	—
LP-W10 – W12	Diverse Wildlife Habitat	—	—

MIDWAY DRAINAGE BASIN EXISTING DRAINAGE SYSTEM

The Midway Drainage Basin (see Figure 2-11) is relatively flat, with an average slope of 0.009 ft/ft. Ground elevations in the basin range from 1,270 feet to 1,710 feet. Bedrock is present less than 10 feet deep. As a result stormwater becomes subsurface flow parallel to overland flow and emerges as seepage into the stream beds. The shallow depth to bedrock limits the constructability of detention ponds. Soils range from SCS Class D (very low infiltration) in the upper part of the basin to SCS Class C (low infiltration) in the lower part of the basin.

Midway Creek (also know as Upton Slough) and a short tributary know as Garrett Creek are located within this basin. Midway Creek is a tributary of the Rogue River. The creek is perennial due to irrigation return flows. Midway Creek and its riparian areas have been extensively modified by human activity, including placement of long stream segments into underground pipes, stream channelization and relocation, removal of woody vegetation, industrial development, residential development and mowing for fire control (Wetlands Consulting, 2002a). Table 2-23 summarizes inventoried riparian conditions in the basin. The East Main Canal flows through this basin.

The flat slope at the lower end of the basin results in poor drainage, creating many wetlands. The wetlands inventory reported 39 wetlands totaling 102 acres. Thirty-three of the wetlands meet at least one DSL criterion for locally significant wetlands; five of the wetlands are excavated ponds. MD-W20, MD-W24, and MD-W25 have been designated as having sensitive habitat for protection; they have been documented as having Crooks lomatium, a plant species listed as endangered by the State of Oregon and a candidate for federal listing (Wetlands Consulting, 2002b). Tables 2-24 and 2-25 summarize the wetland characteristics.

The basin contains 1,250 acres of public parks; 5.5 acres are within the UGB.

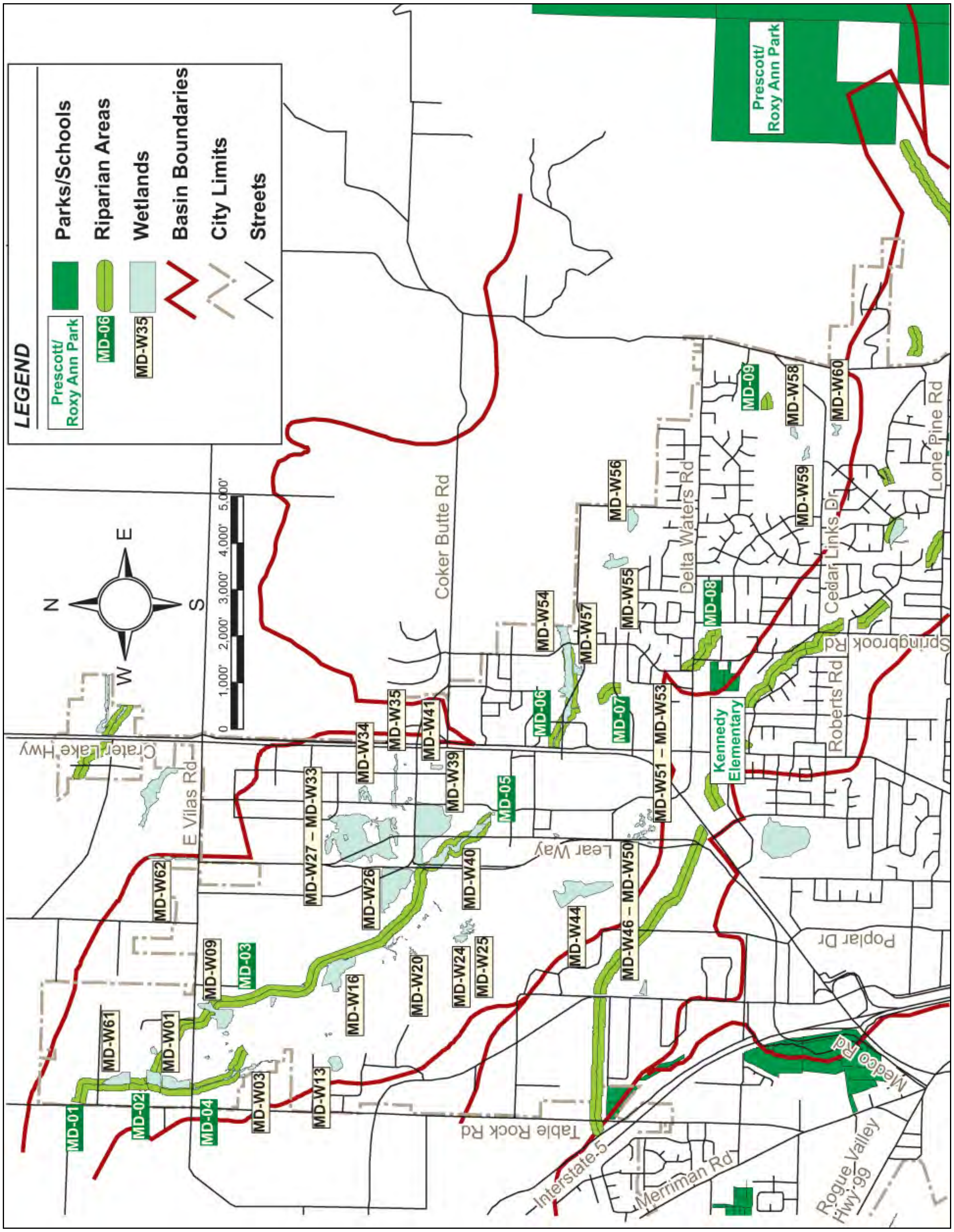

Figure 2-11. Midway Drainage Basin

TABLE 2-23.
MIDWAY DRAINAGE RIPARIAN CONDITIONS SUMMARY

Location	Conditions	Restoration Needs/ Recommendations
MD-08 at Springbrook Rd South of Delta Waters	Vegetation along reach is primarily grass. Wetlands vegetation is growing in the stream.	—
MD-08 at Delta Waters	Vegetation along reach is primarily grass. No riparian canopy.	Work with property owner to improve vegetation along creek.
MD-08 at Springbrook Rd North of Delta Waters	Reach flows through residence backyard. Landscape and grass has been planted along the banks. Banks are vertical, portions of the bank are eroding into the creek. Bridge over stream in backyard.	Work with property owner to improve vegetation along creek and to provide buffer
MD-06 new development off Crater Lake Highway	Channel is riprap lined, with no vegetation. No buffer exists between stream and parking areas.	Work with property owner to improve vegetation along creek and to provide buffer between parking and creek.
MD-04 at Vilas Rd	No riparian vegetation, grass is the only vegetation along the channel.	Provide plants to provide riparian canopy for habitat.
MD-03 at Vilas Rd	No riparian vegetation, grass is the only vegetation along the channel.	Plant trees and shrubs to provide riparian canopy for habitat.

TABLE 2-24.
MIDWAY DRAINAGE WETLANDS SUMMARY

ID	Area (acres)	Category	ID	Area (acres)	Category
MD-W01	4.9	Locally Significant	MD-W41	0.5	Locally Significant
MD-W03	1.4	Locally Significant	MD-W44	8.0	Locally Significant
MD-W09	4.2	Locally Significant	MD-W46 – W50	0.8	Locally Significant
MD-W13	1.6	Locally Significant	MD-W51 – W53	1.1	Locally Significant
MD-W16	6.0	Locally Significant	MD-W54	8.8	Locally Significant
MD-W20	0.2	Special Interest Locally Significant	MD-W55	2.1	Excavated Pond
MD-W24/W25	1.7	Special Interest Locally Significant	MD-W56	1.9	Locally Significant
MD-W26	9.0	Locally Significant	MD-W57	0.8	Excavated Pond
MD-W27 – W33	20.4	Locally Significant	MD-W58	0.6	Excavated Pond
MD-W34	1.1	Locally Significant	MD-W59	0.6	Excavated Pond
MD-W35	1.7	Locally Significant	MD-W60	0.6	Excavated Pond
MD-W39	14.8	Locally Significant	MD-W61	2.6	
MD-W40	5.2	Locally Significant	MD-W62	1.2	Locally Significant

TABLE 2-25.
MIDWAY DRAINAGE LOCALLY SIGNIFICANT WETLANDS SUMMARY

	Mandatory Criteria		
ID	Ecological functions as defined by OFWAM	Within 1/4 mile of a water quality limited stream	Listed Species
MD-W01	• Intact water quality function	—	—
MD-W03	• Intact water quality function	—	—
MD-W09	• Intact water quality function	—	—
MD-W13	• Intact water quality function	—	—
MD-W16	• Intact water quality function • Intact hydrologic control	—	—
MD-W20	—	—	Agate desert parsley (Lomatium Cookii)
MD-W24/W25	• Intact water quality function	—	Agate desert parsley (Lomatium Cookii)
MD-W26	• Intact water quality function		—
MD-W27 – W33	• Intact water quality function	—	—
MD-W34	• Intact water quality function	—	—
MD-W35	• Intact water quality function	—	—
MD-W39	• Intact water quality function	—	—
MD-W40	• Intact water quality function • Intact hydrologic control	—	—
MD-W41	• Intact water quality function	—	—
MD-W44	• Intact water quality function • Intact hydrologic control	Midway Drainage	—
MD-W46 – W50	• Intact water quality function	Midway Drainage	—
MD-W51 – W53	• Intact water quality function	Midway Drainage	—
MD-W54	• Intact water quality function	—	—
MD-W56	• Intact water quality function	—	—
MD-W62	• Intact water quality function	—	—

FLOOD INSURANCE STUDY

A Flood Insurance Study (FIS) was adopted by the City in 1987. The document includes flood elevations for the incorporated areas of the City of Medford in 1980, when the FIS was conducted. This area includes Bear Creek, Lazy Creek, Larson Creek, an unnamed tributary to Larson Creek, Crooked Creek and segments of Lone Pine Creek.

CHAPTER 3.
DRAINAGE SYSTEM EVALUATION

The Comprehensive Medford Drainage Master Plan (DMP) (Brown & Caldwell, 1996) was prepared to evaluate drainage system deficiencies and recommend drainage system improvements, in addition to addressing how the City's drainage system would be impacted by future growth in the City of Medford.

In the DMP the City was divided into nine drainage basins: Bear Creek East, Bear Creek South, Bear Creek West, Crooked Creek, Elk Creek, Larson Creek, Lazy Creek, Lone Pine Creek and Midway Drainage. The DMP combined Bear Creek South and Crooked Creek for purposes of evaluation. Six of the drainage basins have irrigation canals, which complicates the overland flow of stormwater runoff.

This chapter summarizes the drainage system evaluation and recommendations for each basin presented in the DMP. Culvert and pipeline upgrades were grouped into recommended projects throughout each basin. For each basin the DMP suggested alternatives for addressing the needs of the basin including pipeline upgrades, flow diversions and detention ponds. In the DMP priorities were placed on the selected alternatives based on four parameters. These parameters were; flood/flow relief, impact on neighborhood, frequency of problems, and environmental/regulation sensitivity.

This chapter will summarize the proposed plan in the DMP. A discussion of how the DMP recommended plan will be incorporated into this report will be made in Chapter 9 of this report.

BEAR CREEK EAST

Storm System

Much of the Bear Creek East basin drainage is collected in a network of drainage pipelines (see Figure 3-1). The system consists of over 250 separate segments, representing 18.4 miles of conveyance. The Hopkins Irrigation canal provides stormwater conveyance for much of the basin north of Oregon Avenue and east of Royal Avenue; six systems flow into the canal. The canal flows from the north and exits the basin to the east along McAndrews Road. Thirteen pipeline systems along the western and southern portion of the basin drain directly into Bear Creek. Many of the piped drainage systems in this basin consist of short segments.

1996 DMP Recommendations

Two alternatives were presented to address the needs of the basin. Alternative 1 calls for increasing the size of many pipes. Alternative 2 proposes a 3-acre-foot detention pond next to Tabby Lane. Alternative 2 would not significantly decrease the peak flow in the system. Land acquisition, maintenance access, and maintenance costs detract from the water quality and aesthetic benefits provided by the pond. Alternative 1 was the recommended alternative.

Twenty drainage improvement projects were identified within the basin and shown in Table 3-1, three of which were listed as priority projects and are shown in Figure 3-1. The three priority projects are;

Sunrise Improvement Project

Overall priority score is 12.

Flood Relief	2 - 50 to 200-cfs (68-cfs)
Impact to Neighborhood	3 - Moderate
Frequency of Problems	3 - Moderate
Environmental/Regulation Sensitivity	4 - None

Brookhurst Improvement Project

Overall priority score is 11.

Flood Relief	2 - 50 to 200-cfs (113-cfs)
Impact to Neighborhood	3 - Moderate
Frequency of Problems	2 - Seldom
Environmental/Regulation Sensitivity	4 - None

Oregon Avenue Improvement Project

Overall priority score is 11.

Flood Relief	1 - less then 50-cfs (11-cfs)
Impact to Neighborhood	3 - Moderate
Frequency of Problems	3 - Moderate
Environmental/Regulation Sensitivity	4 - None

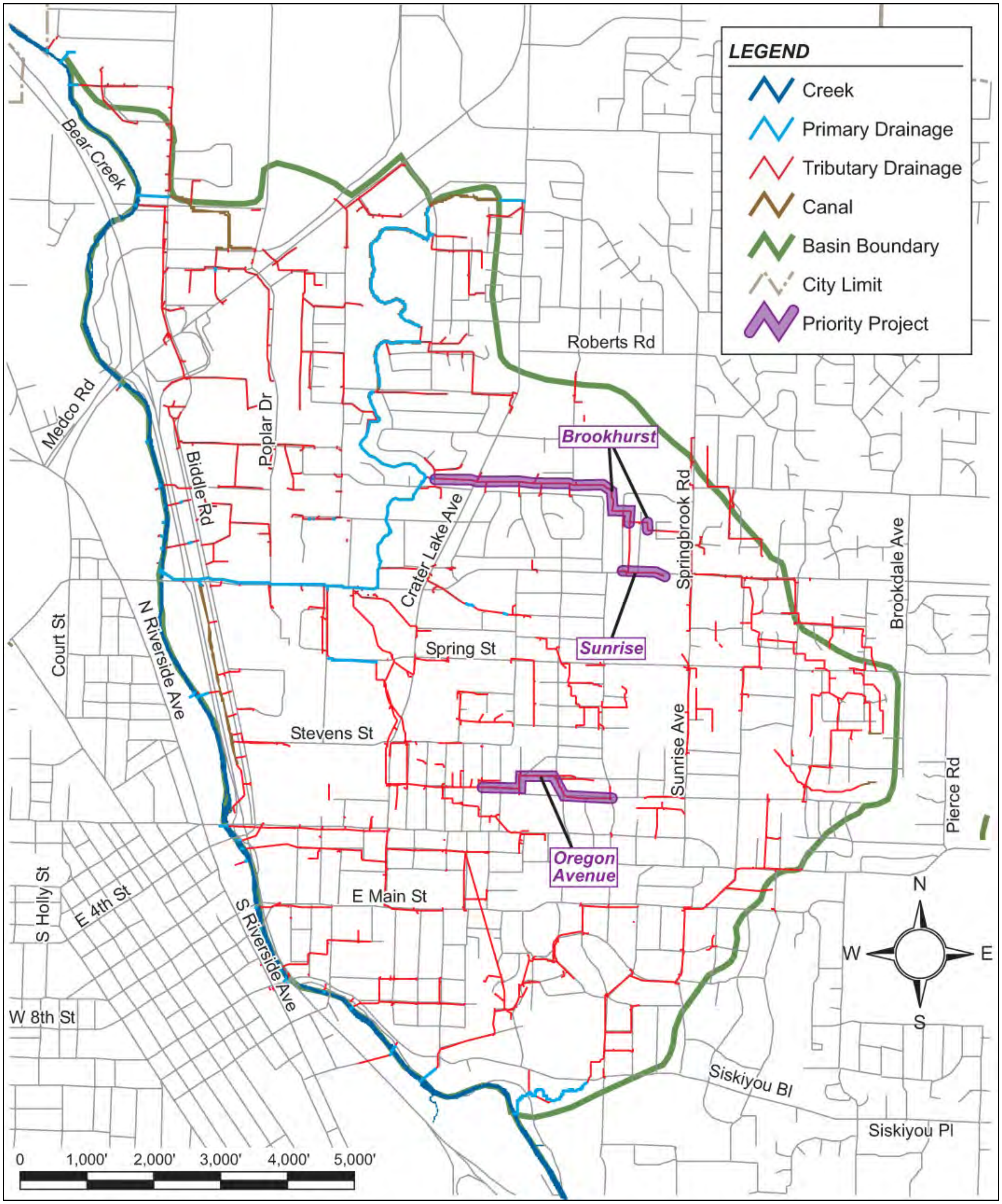

Figure 3-1. Bear Creek East Drainage and Priority Projects

TABLE 3-1.
1996 DMP RECOMMENDED IMPROVEMENTS WITHIN BEAR CREEK EAST
(1996 DOLLARS)

Project	Description	Estimated Cost
Priority Projects		
Sunrise	Install 1170 feet of parallel pipe along McAndrews Road, west of Springbrook	$296,576
Brookhurst	Replace 470 feet of storm drain and install 4490 feet of parallel pipe near Camelia Ave.	$962,013
Oregon Ave.	Replace 2320 feet of storm drain and install 50 feet of parallel pipe along Oregon Ave.	$245,830
	Priority Projects Total	**$1,504,419**
Other Identified Projects		
Main St.	Replace 920 feet of storm drain along Main St.	$78,522
East 9th St.	Replace 610 feet of storm drain on East 9th St.	$72,108
East 10th St.	Replace 1530 feet of storm drain on East 10th St.	$179,697
Eastwood	Replace 1650 feet of storm drain near Eastwood Dr.	$233,185
Barneburg	Replace 1765 feet of storm drain, and install 135 feet of parallel pipe on Barneburg Rd, Woodlawn Dr. and Groveland Ave.	$248,280
Witham	Replace 1560 feet of storm drain on Poplar Dr. and Hilton Rd.	$185,329
Hilton Rd.	Replace 690 feet of storm drain on Logging Rd., Pleasant St., Jubilant Ave., and Crater Lake Hwy.	$72,953
Biddle Rd.	Replace 2520 feet of storm drain on Biddle Rd.	$390,257
Morrow Rd.	Replace 1495 feet of storm drain, and install 2065 feet of parallel pipe on or near Morrow Rd.	$580,286
Grand Ave.	Replace 1365 feet of storm drain on or near Grand Ave.	$151,557
Popular Dr.	Replace 1540 feet of storm drain near Popular Dr.	$213,236
Royal	Replace 1070 feet of storm drain on Royal Ave and Town Centre Dr.	$206,755
Buckshot	Replace 5040 feet of storm drain between Lawnridge St. and Crater Lake Ave.	$572,767
Alcan Dr.	Replace 1170 feet of storm drain on or near Alcan Dr.	$126,999
Gardendale	Replace 2100 feet of storm drain near Gardendale Ave.	$231,593
Providence	Replace 920 feet of storm drain near Providence Hospital	$98,851
Queen Ave.	Replace 690 feet of storm drain, and install 895 feet of parallel pipe on and near Queen Ave. and 140 feet of storm drain on Market St.	$155,543
	Other Identified Projects Total	**$3,797,918**

BEAR CREEK SOUTH/CROOKED CREEK

Storm System

Only a few stormwater pipes collect drainage from the Bear Creek South Basin (see Figure 3-2). Much of the basin drains directly to Bear Creek or Crooked Creek.

The largest piped system within this basin discharges to Crooked Creek at Stewart Avenue. At this point Crooked Creek is piped to Bear Creek, near the railroad tracks in the north portion of the basin (see Figure 3-3). The remainder of the basin either drains directly to Crooked Creek or is collected in one of several smaller systems that discharge to Crooked Creek. The Talent Lateral Canal and the Phoenix Canal run through the upper portion of the basin.

1996 DMP Recommendations

Most of the pipe system along Stewart has been upgraded since the 1981 drainage master plan was completed. Deficiencies exist in the tributaries draining into the system paralleling Stewart. Increasing the size of a number of pipes in the basin was the only alternative presented for this basin. Diversion was considered, but as the City has already begun efforts to increase pipe capacity it was determined that increasing the conveyance would be the cost effective alternative.

Eleven projects were identified within the basin and are listed in Table 3-2, three of which were listed as priority projects and are shown in Figure 3-2. The three priority projects are;

Peach Street Improvement Project (50% Completed)

Overall priority score is 13.

Flood Relief	1 - less then 50-cfs (4-cfs)
Impact to Neighborhood	4 - High
Frequency of Problems	4 - Frequent
Environmental/Regulation Sensitivity	4 - None

Crooked near Stewart Avenue Improvement Project

Overall priority score is 11.

Flood Relief	3 - 200 to 400-cfs (224-cfs)
Impact to Neighborhood	2 - Low
Frequency of Problems	2 - Seldom
Environmental/Regulation Sensitivity	4 - None

Crooked Creek near Dove Lane Improvement Project

Overall priority score is 10.

Flood Relief	2 - 50 to 200-cfs (144-cfs)
Impact to Neighborhood	2 - Low
Frequency of Problems	2 - Seldom
Environmental/Regulation Sensitivity	4 - None

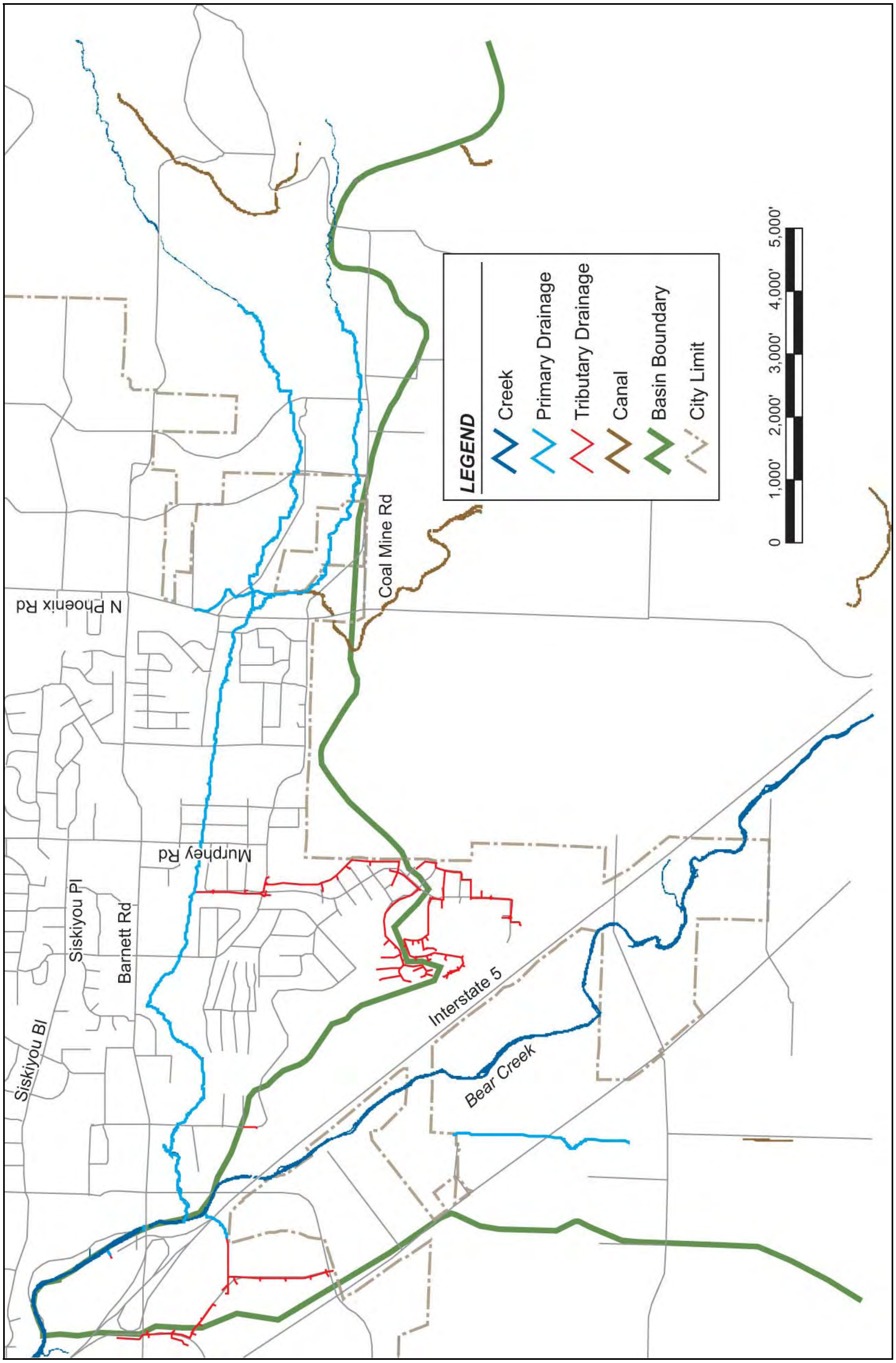

Figure 3-2. Bear Creek South Drainage

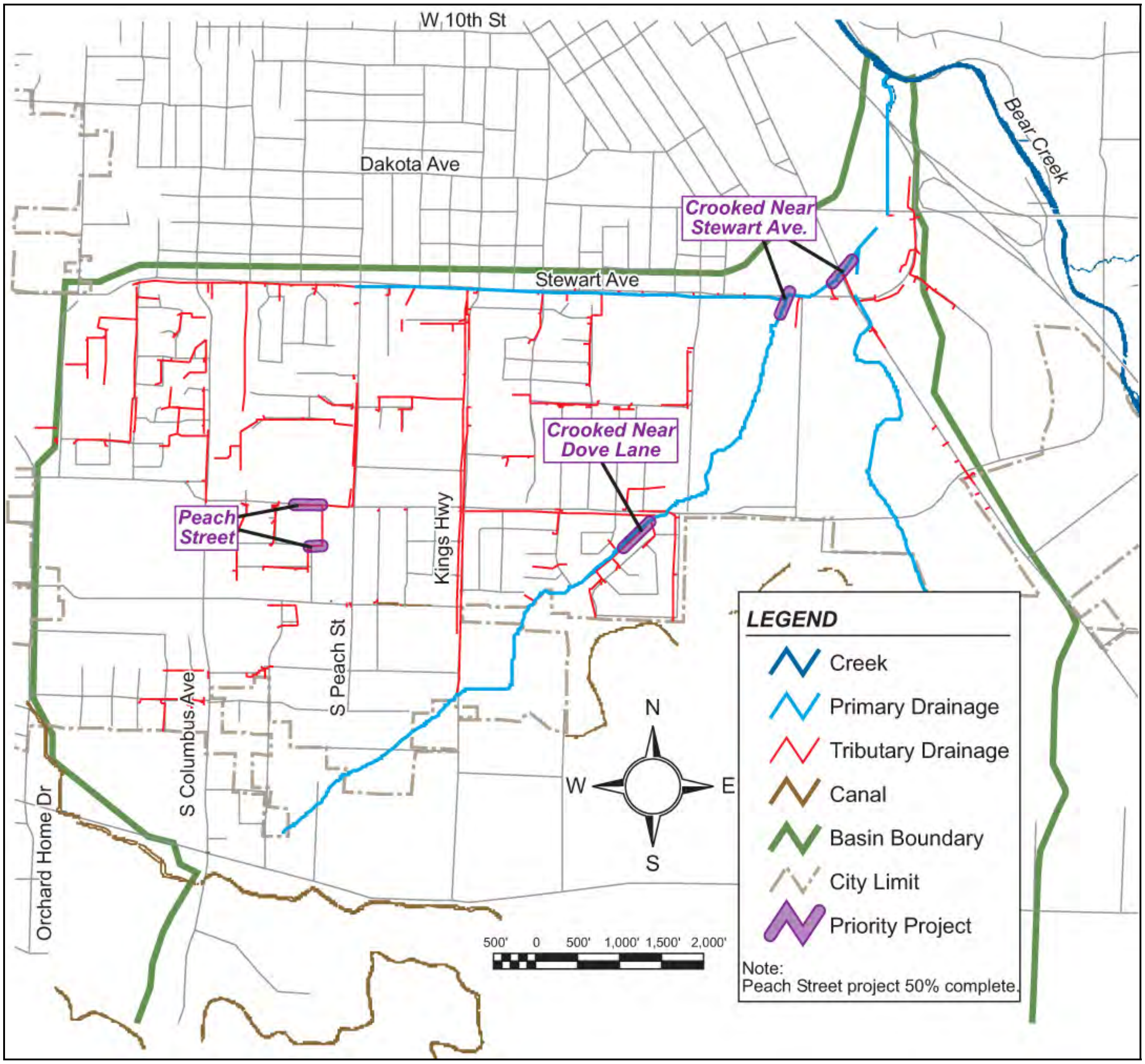

Figure 3-3. Crooked Creek Drainage and Priority Projects

TABLE 3-2.
1996 DMP RECOMMENDED IMPROVEMENTS IN CROOKED CREEK/BEAR CREEK SOUTH
(1996 DOLLARS)

Project	Description	Estimated Cost
Priority Projects		
Peach St.	Replace 1485 feet of pipeline near Peach St.	50% complete
Crooked near Stewart Ave.	Widen 145 feet of box culvert near Stewart Ave.	$185,490
Crooked near Dove Ln.	Install 325 feet of parallel pipe near Dove Ln.	$201,984
	Priority Projects Total	**$387,474**
Other Identified Projects		
Center Dr.	Replace 125 feet of storm drain, and install 265 feet of parallel pipe on Center Dr.	$83,944
Crooked at South State Rd.	Install 100 feet of parallel culvert at South State Rd.	$21,283
Crooked at Kings Hwy	Widen 45 feet of box culvert at Kings Highway	$26,789
Stewart Ave.	Replace 2175 feet of storm drain, and install 1030 feet of parallel pipe on Center Dr.	$346,922
Columbus Ave.	Replace 445 feet of storm drain near Columbus Ave.	$60,206
Kings Hwy	Replace 2320 feet of storm drain on Kings Hwy.	$272,076
South Gateway	Replace 555 feet of storm drain on Center Dr.	$68,635
Hansen Creek	Replace 175 feet of storm drain, install 1120 feet of parallel pipe, and widen 190 feet of box culvert on or near Hansen Creek.	$758,466
	Other Identified Projects Total	**$1,638,321**

BEAR CREEK WEST

Storm System

Much of the Bear Creek West drainage is collected in a network of drainage pipelines (see Figure 3-4). The basin contains nine separate drainage systems discharging to Bear Creek.

1996 DMP Recommendations

Three alternatives were presented to address the identified capacity problems within the basin. Alternative 1 is identified as upgrading pipes throughout the basin. Alternative 2 diverts flow from Mistletoe Street along 6th Street, directly to Bear Creek. Alternative 3 diverts flow from Mistletoe Street along 10th Street, directly to Bear Creek. Although the slope down 6th Street would allow for greater flow construction of a diversion along 6th Street would be difficult with utilities conflicts in the old business district. Alternative 3 was recommended in the DMP because its estimated cost was identified as $100,000 less than Alterative 2 and it presents fewer construction and implementation issues.

Nine drainage improvement projects were identified in the basin and are listed in Table 3-3, five of which were listed as priority projects and are shown in Figure 3-4. The five projects are;

Oak Street Improvement Project (33% Complete)

Overall priority score is 14.

Flood Relief	2 - 50 to 200-cfs (51-cfs)
Impact to Neighborhood	4 - High
Frequency of Problems	4 - Frequent
Environmental/Regulation Sensitivity	4 - None

Earhart Improvement Project

Overall priority score is 13.

Flood Relief	1 – less then 50-cfs (21-cfs)
Impact to Neighborhood	4 - High
Frequency of Problems	4 - Frequent
Environmental/Regulation Sensitivity	4 - None

Washington Improvement Project

Overall priority score is 11.

Flood Relief	1 - less then 50-cfs (31-cfs)
Impact to Neighborhood	3 - Moderate
Frequency of Problems	3 - Moderate
Environmental/Regulation Sensitivity	4 - None

6th Street Improvement Project

Overall priority score is 11.

Flood Relief	1 – less then 50-cfs (18-cfs)
Impact to Neighborhood	3 - Moderate
Frequency of Problems	3 - Moderate
Environmental/Regulation Sensitivity	4 - None

NW Medford Improvement Project (75% Complete)

Overall priority score is 10.

Flood Relief	2 - 50 to 200-cfs (53-cfs)
Impact to Neighborhood	2 - Low
Frequency of Problems	2 - Seldom
Environmental/Regulation Sensitivity	4 - None

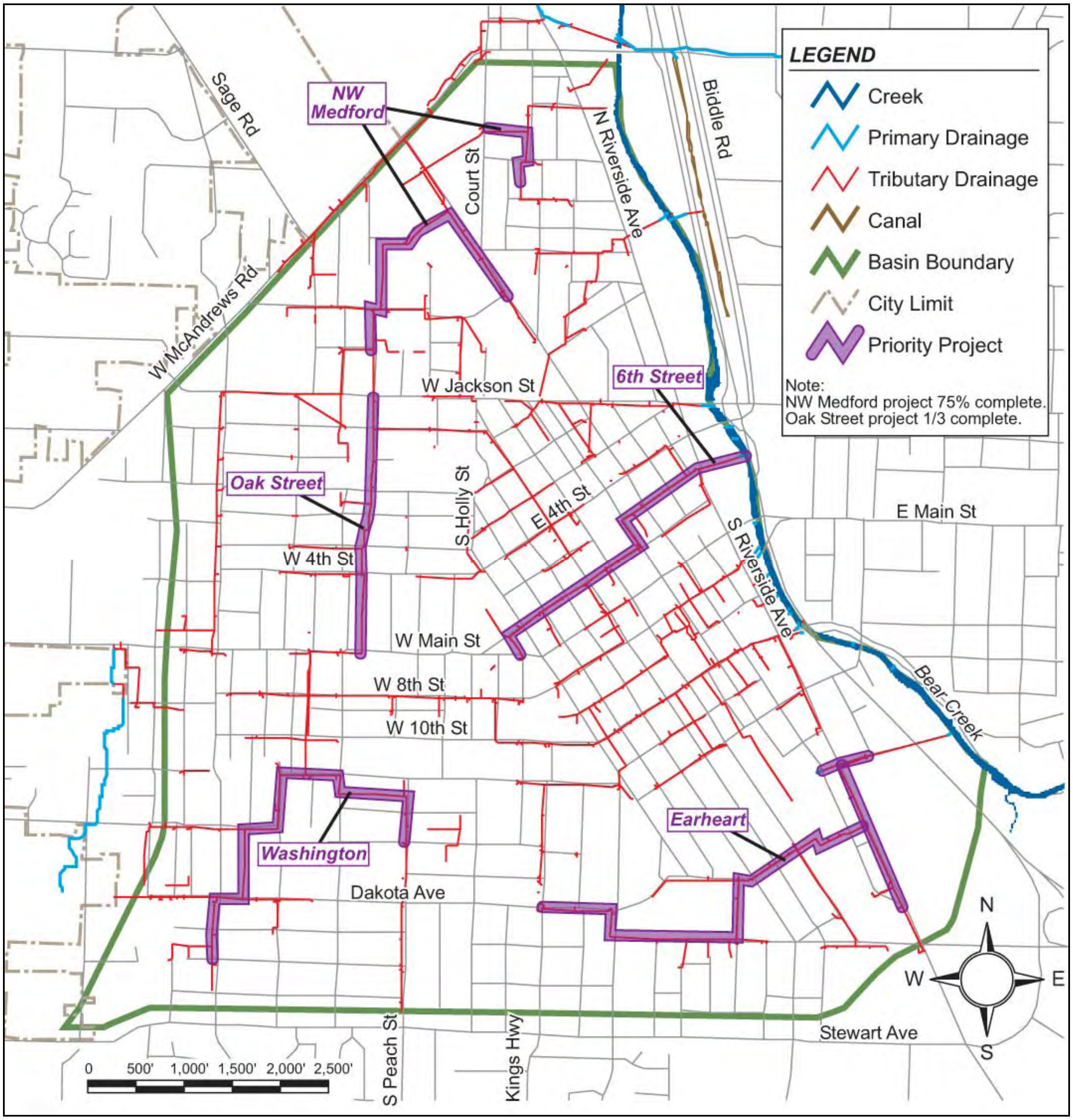

Figure 3-4. Bear Creek West Drainage and Priority Projects

TABLE 3-3.
1996 DMP RECOMMENDED IMPROVEMENTS IN BEAR CREEK WEST
(1996 DOLLARS)

Project	Description	Estimated Cost
Priority Projects		
Oak St.	Replace 2485 feet of storm drain, and install 415 feet of parallel pipe on Oak St.	1/3 complete
Earhart	Replace 6770 feet of storm drain and install 1200 feet of parallel pipe on or near Earhart St.	$1,157,986
Washington	Replace 4370 feet of storm drain, and install 1065 feet of parallel pipe near Washington School.	$847,477
NW Medford	Replace 1500 feet of storm drain, and install 2400 feet of parallel pipe in the northern portion of the basin.	75% complete
6th Street	Replace 3490 feet of storm drain and install 155 feet of parallel pipe along 4th St. and 6th St.	$411,749
	Priority Projects Total	**$2,417,212**
Other Identified Projects		
Bear Creek West - Columbus	Replace 9555 feet of storm drain, and install 2000 feet of parallel pipe on Broad St.	$796,102
Jackson	Replace 4330 feet of storm drain or near Jackson St.	$553,801
8th St.	Replace 1185 feet of storm drain or near 8th St.	$131,350
West 10th	Install 5085 feet of parallel pipe on W. 10th St.	$1,129,792
	Other Identified Projects Total	**$2,611,045**

ELK CREEK

Storm System

Storm drainage in the northern portion of the Elk Creek basin is collected in a few small pipeline systems that drain to Elk Creek (see Figure 3-5). Drainage in the southern part of the basin flows directly to Elk Creek. Elk Creek has been piped in several locations. The Hopkins Canal flows from east to west across the basin; no piped systems discharge into the canal.

1996 DMP Recommendations

Three alternatives were presented to address the needs of the basin. Alternative 1 was increasing the size of pipelines and culverts in the system. Alternative 2 proposes a 20-acre-foot detention pond near Maple Park Drive. Alternative 3 would require constructing a mile of 72-inch pipe to divert flows to Bear Creek, decreasing the flows to the main stem of Elk Creek. The DMP recommended Alternative 3. It would minimize disruption and reduce the pipe upgrades required along the main stem of Elk Creek.

Twelve projects were identified in the basin and are shown in Table 3-4, eight of which were listed as priority projects and are shown in Figure 3-5. The priority projects are;

Berrydale Improvement Project

Overall priority score is 13.

Flood Relief	1 – less then 50-cfs (24-cfs)
Impact to Neighborhood	4 - High
Frequency of Problems	4 - Frequent
Environmental/Regulation Sensitivity	4 - None

Elk Miscellaneous Improvement Project

Overall priority score is 12.

Flood Relief	2 - 50 to 200-cfs (83-cfs)
Impact to Neighborhood	3 - Moderate
Frequency of Problems	3 - Moderate
Environmental/Regulation Sensitivity	4 - None

Howard Avenue Improvement Project

Overall priority score is 11.

Flood Relief	1 - less then 50-cfs (18-cfs)
Impact to Neighborhood	3 - Moderate
Frequency of Problems	3 - Moderate
Environmental/Regulation Sensitivity	4 - None

Connell Avenue Improvement Project (10% Complete)

Overall priority score is 11.

Flood Relief	3 - 200 to 400-cfs (288-cfs)
Impact to Neighborhood	2 - Low
Frequency of Problems	2 - Seldom
Environmental/Regulation Sensitivity	4 - None

Highway 99 Improvement Project

Overall priority score is 10.

Flood Relief	2 - 50 to 200-cfs (124-cfs)
Impact to Neighborhood	2 - Low
Frequency of Problems	2 - Seldom
Environmental/Regulation Sensitivity	4 - None

EKMEDCO – diversion section Improvement Project (100% Completed)

Overall priority score is 10.

Flood Relief	4 - NA
Impact to Neighborhood	2 - Low
Frequency of Problems	1 - None
Environmental/Regulation Sensitivity	3 – Low

Stowe Avenue Improvement Project

Overall priority score is 10.

Flood Relief	2 - 50 to 200-cfs (120-cfs)
Impact to Neighborhood	4 - High
Frequency of Problems	2 - Seldom
Environmental/Regulation Sensitivity	2 – Moderate

Ehrman Way Improvement Project

Overall priority score is 10.

Flood Relief	4 – Greater then 400-cfs (474-cfs)
Impact to Neighborhood	1 - None
Frequency of Problems	1 - None
Environmental/Regulation Sensitivity	4 – None

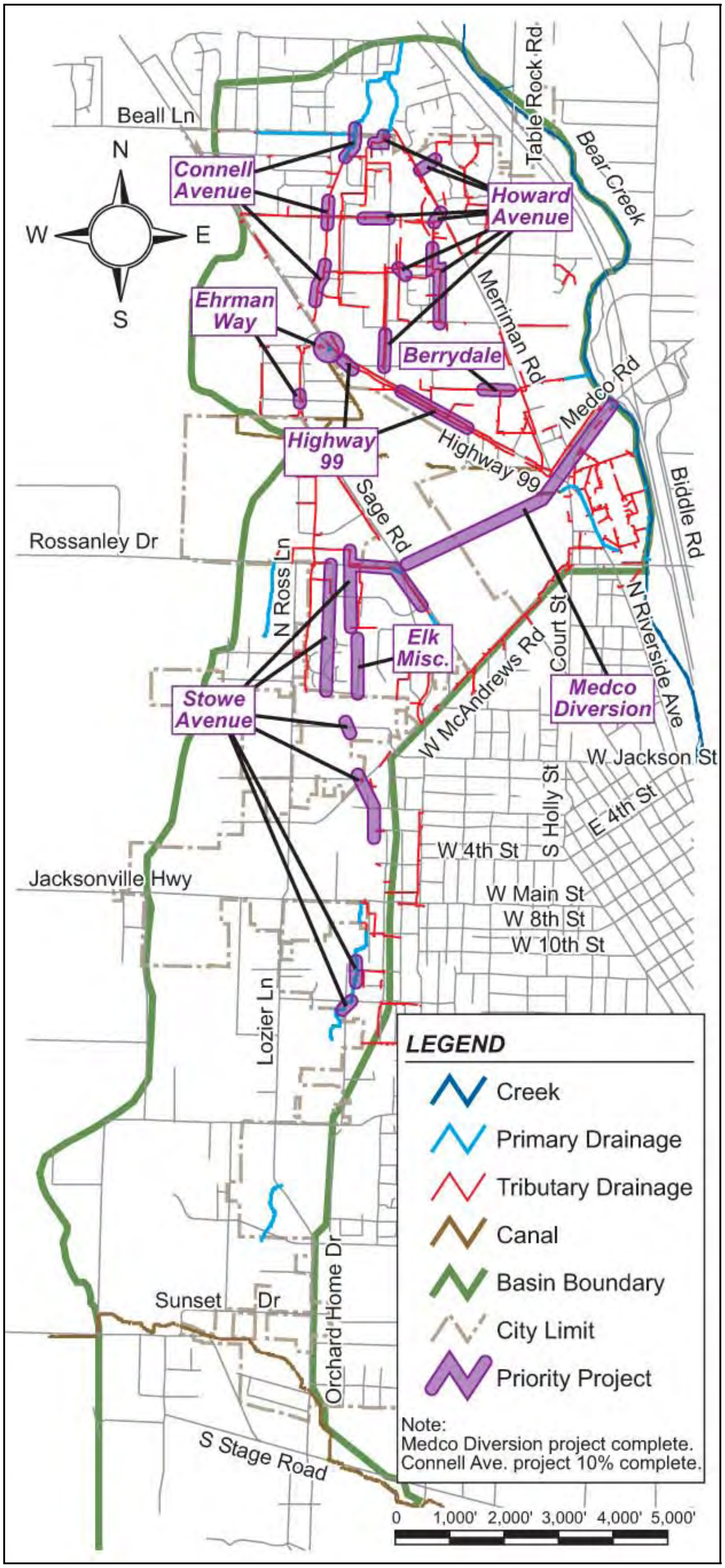

Figure 3-5. Elk Creek Drainage and Priority Projects

TABLE 3-4
1996 DMP RECOMMENDED IMPROVEMENTS IN ELK CREEK
(1996 DOLLARS)

Project	Description	Estimated Cost
Priority Projects		
Berrydale	Install 435 feet of parallel pipe on Berrydale Ave.	$146,786
Elk Misc.	Install 2600 feet of parallel pipe on Mindy Sue.	$971,607
Howard Ave.	Replace 3815 feet of storm drain, and install 610 feet of parallel pipe in the vicinity of Howard Ave.	$597,753
Connell Ave.	Install 3355 feet of parallel pipe and widen 50 feet of box culvert along Connell Ave.	10% completed
Highway 99	Replace 2625 feet of storm drain and widen 100 feet of box culvert on Highway 99.	$630,847
MedCo Diversion	1 mile of 72" pipe to divert flows to Bear Creek (Alternative 3)	completed
Stowe Ave.	Replace 130 feet of storm drain, install 5320 feet of parallel pipe, and widen 350 feet of box culvert on or near Stowe Ave.	$2,589,592
Ehrman Way	Replace 1420 feet of storm drain, install 215 feet of parallel pipe, and widen 160 feet of box culvert on or near Ehrman Way.	$494,400
	Priority Projects Total	**$5,430,985**
Other Identified Projects		
Beall Ln	Replace 215 feet of storm drain on or near Beall Ln.	$23,958
Mace Rd.	Replace 150 feet of storm drain and install 1630 feet of parallel pipe on Mace Rd. and Highway 99.	$384,179
Morningside	Replace 950 feet of storm drain along Far West Ave.	$135,652
Lars Way	Install 1220 feet of parallel pipe and widen 185 feet of box culvert in the vicinity of Lars Way and Sage Rd.	$931,063
	Other Identified Projects Total	**$1,474,852**

LARSON CREEK

Storm System

Drainage in the upper basin of Larson Creek, east of North Phoenix Road, consists of intermittent streams and ditches (see Figure 3-6). The portion of the basin west of North Phoenix Road includes four major piped systems and several smaller systems draining to Larson Creek. The East-Main Irrigation Canal runs north to south through this basin and the East Lateral Irrigation Canal runs south to north in the upper portion of the basin.

1996 DMP Recommendations

One alternative was presented to address the needs of the basin. Alternative 1 calls for increasing the size of only a few pipes in the basin. Detention facilities would be costly due to the shallow soils in the basin. Additionally, multiple feeder streams in the upper reaches make finding a suitable site difficult. Diversion opportunities are limited for this basin.

Three projects were identified in the basin, all are listed as priority projects and are shown in Figure 3-6 and Table 3-5. The three priority projects are;

North Fork Improvement Project

Overall priority score is 13.

Flood Relief	2 - 50 to 200-cfs (51-cfs)
Impact to Neighborhood	4 - High
Frequency of Problems	4 - Frequent
Environmental/Regulation Sensitivity	3 - Low

Larson Central Improvement Project

Overall priority score is 11.

Flood Relief	4 – Greater then 400-cfs (471-cfs)
Impact to Neighborhood	2 - Low
Frequency of Problems	3 - Moderate
Environmental/Regulation Sensitivity	3 - Low

Blackoak Improvement Project

Overall priority score is 10.

Flood Relief	4 – Greater then 400-cfs (474-cfs)
Impact to Neighborhood	1 - None
Frequency of Problems	1 - None
Environmental/Regulation Sensitivity	4 - None

TABLE 3-5.
1996 DMP RECOMMENDED IMPROVEMENTS IN LARSON CREEK
(1996 DOLLARS)

Project	Description	Estimated Cost
Priority Projects		
North Fork	Widen 50-feet of box culvert, install 3,150 feet of parallel pipe and replace 163 feet of pipe along the North Fork of Larson Creek.	$945,871
Larson Central	Widen 190 feet of box culvert along Larson Creek and replace 795 feet of pipe along Juanipero Way.	$469,277
Black Oak	Widen 50 feet of box culvert at Black Oak Place. At Ellendale Place, widen 39 feet of box culvert and replace 254 feet of culvert.	$236,396
	Priority Projects Total	**$1,651,544**

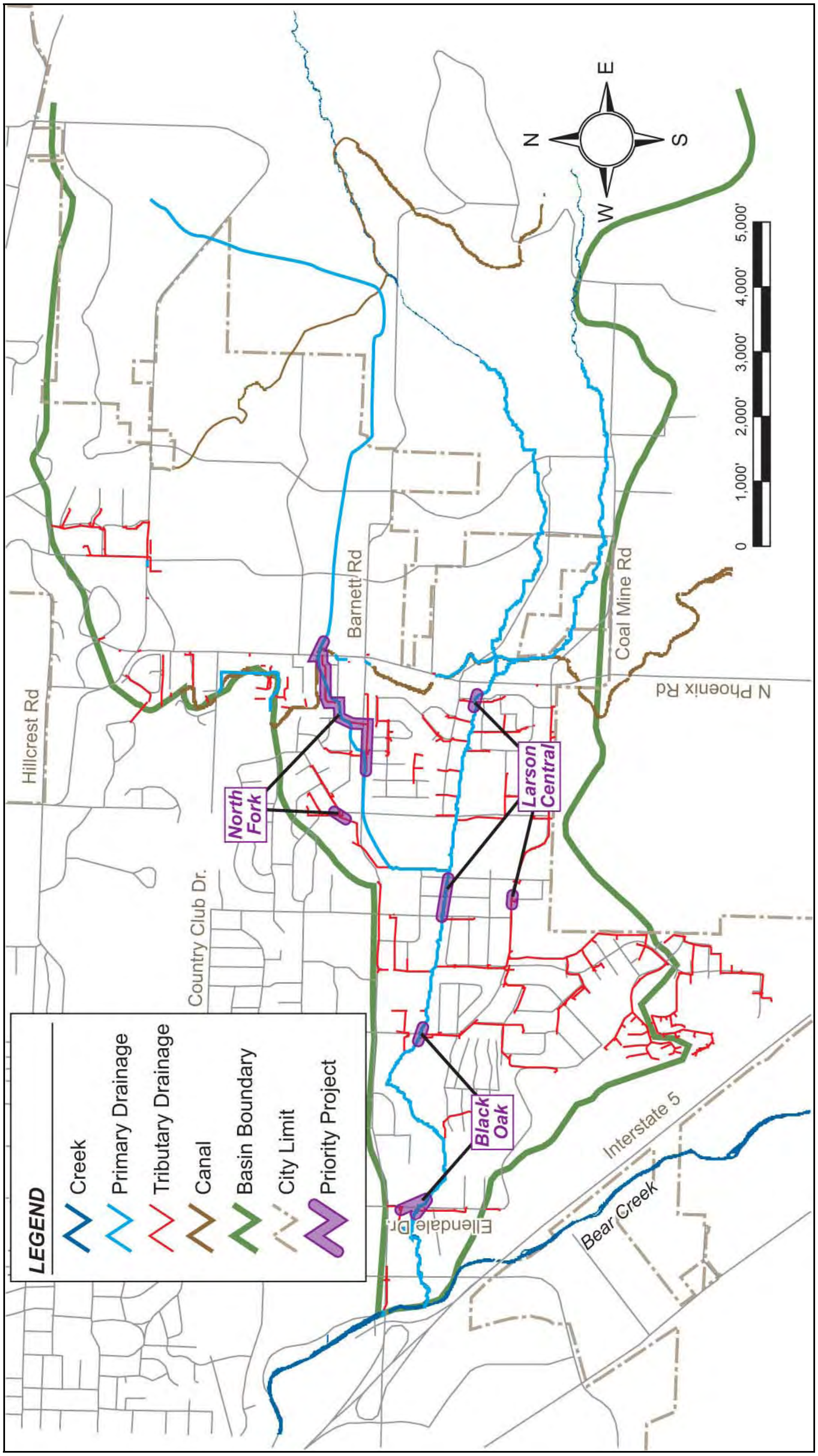

Figure 3-6. Larson Creek Drainage and Priority Projects

LAZY CREEK

Storm System

Drainage in the upper basin of Lazy Creek, east of North Phoenix Road, consists of intermittent streams and ditches (see Figure 3-7). The portion of the basin west of North Phoenix Road includes several small piped systems draining to Lazy Creek. The East-Main Irrigation Canal runs north to south through the basin.

1996 DMP Recommendations

Three alternatives were presented to address the needs of the basin. Alternative 1 calls for increasing the size of 16 pipes and culverts in the lower portion of the basin to allow for projected flows from future development in the upper portion of the basin. Alternative 2 proposes a 30-acre-foot detention pond downstream of Hemlock Drive. This alternative would decrease flow by approximately 100 to 150 cfs, reducing the cost of improvements along the main stem. Additionally, the detention pond would lessen erosion problems in some channel segments along the main stem by decreasing the peak flows. Alternative 3 proposes a 45-acre-foot detention pond downstream of Hemlock Drive. Although this alternative would decrease flow by approximately 200 cfs, it would not provide a significant reduction in the number of downstream pipes that need to be replaced compared to Alternative 2. The cost for Alternative 3 would be approximately 10 percent greater than that of Alternative 2. Additionally, the increased berm height for Alternative 3 compared with Alternative 2 would likely create more public opposition to the project. Alternative 2 is the preferred alternative. A cost savings opportunity exists if the project is constructed in conjunction with the McAndrews Road extension; excavated material from the pond could be used as a road base.

Twelve projects were identified in the basin and are shown in Table 3-6, 11 of which were listed as priority projects and are shown in Figure 3-17. The priority projects are;

Lazy Creek at Highland Drive Improvement Project (Scheduled 2004)

Overall priority score is 14.

Flood Relief	4 – Greater then 400-cfs (573-cfs)
Impact to Neighborhood	3 - Moderate
Frequency of Problems	3 - Moderate
Environmental/Regulation Sensitivity	4 - None

Other Structural costs - pond Improvement Project (Partially Complete)

Overall priority score is 13.

Flood Relief	4 – N/A
Impact to Neighborhood	3 - Moderate
Frequency of Problems	2 - Seldom
Environmental/Regulation Sensitivity	4 - None

Eagle Trace Improvement Project

Overall priority score is 11.

Flood Relief	1 – Less then 50-cfs (19-cfs)
Impact to Neighborhood	3 - Moderate
Frequency of Problems	2 - Seldom
Environmental/Regulation Sensitivity	4 - None

Lazy Creek at Murphy Road Improvement Project

Overall priority score is 11.

Flood Relief	3 – 200-cfs to 400-cfs (285-cfs)
Impact to Neighborhood	2 - Low
Frequency of Problems	2 - Seldom
Environmental/Regulation Sensitivity	4 - None

Lazy Creek at Crestbrook Road Improvement Project

Overall priority score is 11.

Flood Relief	4 – Greater then 400-cfs (602-cfs)
Impact to Neighborhood	2 - Low
Frequency of Problems	1 - None
Environmental/Regulation Sensitivity	4 - None

Lazy Creek at Burgundy Improvement Project

Overall priority score is 11.

Flood Relief	4 – Greater then 400-cfs (637-cfs)
Impact to Neighborhood	2 - Low
Frequency of Problems	1 - None
Environmental/Regulation Sensitivity	4 - None

Lazy Creek at North Phoenix Improvement Project

Overall priority score is 11.

Flood Relief	3 – 200-cfs to 400-cfs (231-cfs)
Impact to Neighborhood	2 - Low
Frequency of Problems	2 - Seldom
Environmental/Regulation Sensitivity	4 - None

Highcrest Road Improvement Project (In Design)

Overall priority score is 11.

Flood Relief	3 – 200-cfs to 400-cfs (213-cfs)
Impact to Neighborhood	2 - Low
Frequency of Problems	2 - Seldom
Environmental/Regulation Sensitivity	4 - None

Lazy Creek at Siskiyou Blvd. Improvement Project

Overall priority score is 11.

Flood Relief	4 – Greater then 400-cfs (502-cfs)
Impact to Neighborhood	3 - Moderate
Frequency of Problems	1 - None
Environmental/Regulation Sensitivity	3 - Low

Lazy Creek at Ellendale Drive Improvement Project

Overall priority score is 11.

Flood Relief	4 – Greater then 400-cfs (616-cfs)
Impact to Neighborhood	2 - Low
Frequency of Problems	1 - None
Environmental/Regulation Sensitivity	4 - None

Lazy Creek at Oak Drive Improvement Project

Overall priority score is 10.

Flood Relief	3 – 200-cfs to 400-cfs (254-cfs)
Impact to Neighborhood	1 - None
Frequency of Problems	2 - Seldom
Environmental/Regulation Sensitivity	4 - None

To provide capacity for future buildout conditions, the DMP recommends upgrades to 15 culverts and pipeline segments. Table 3-6 summarizes each project. Construction of the detention pond downstream of Hemlock Drive was initiated with the extension of McAndrews Road. The Lazy Creek at Highland Drive project is scheduled for 2008 and the Highcrest project is under construction.

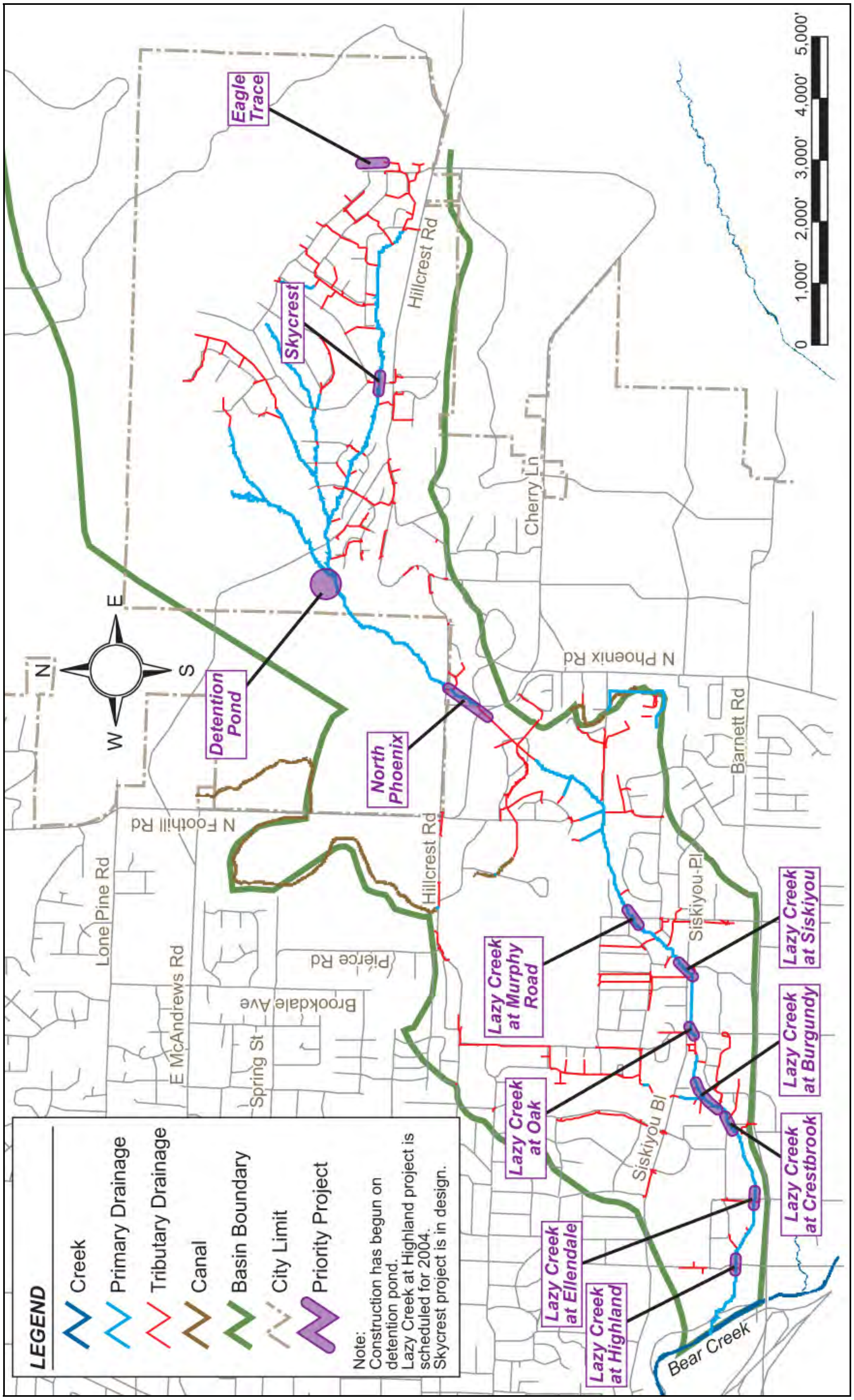

Figure 3-7. Lazy Creek Drainage and Priority Projects

TABLE 3-6.
1996 DMP RECOMMENDED IMPROVEMENTS IN LAZY CREEK
(1996 DOLLARS)

Project	Description	Estimated Cost
Priority Projects		
Lazy Creek at Highland Dr.	Widen 70 feet of box culvert at Highland Dr.	Scheduled for 2004
Pond	Detention pond downstream of Hemlock Drive	Initiated
Eagle Trace	Install 780 feet of parallel pipe near Cherry Ave.	$65,395
Lazy Creek at Murphy Rd.	Widen 50 feet of box culvert at Murphy Rd.	$62,213
Lazy Creek at Crestbrook Rd.	Widen 70 feet of box culvert at Crestbrook Rd.	$168,805
Lazy Creek at Burgundy	Widen 70 feet of box culvert at Burgundy Dr.	$204,208
North Phoenix	Install 1120 feet of parallel pipe and widen 100 feet of box culvert near Hillcrest Rd. and Cherry Ln.	$385,253
Skycrest	Widen 50 feet of box culvert at Highcrest Dr.	In Design
Lazy Creek at Siskiyou Blvd.	Widen 120 feet of box culvert at Siskiyou Blvd.	$252,000
Lazy Creek at Ellendale Dr.	Widen 70 feet of box culvert at Ellendale Dr.	$174,195
Lazy Creek at Oak Dr.	Install 390 feet of parallel pipe on Black Oak Dr.	$142,854
	Priority Projects Total	**$1,454,923**
Other Identified Projects		
Lazy Creek Misc.	Replace 80 feet of culvert at Siskiyou Blvd. and replace 510 feet of storm drain on Ellendale Dr.	$57,511
	Other Identified Projects Total	**$57,511**

LONE PINE CREEK

Storm System

Several piped storm drain systems are in place to the east of Crater Lake Highway, draining to Lone Pine Creek (see Figure 3-8). The portion of the basin west of Crater Lake Highway drains directly to Lone Pine Creek, with only a few short piped systems to convey the stormwater. The East-Main and Hopkins Irrigation Canals flow north to south through the basin.

1996 DMP Recommendations

Two alternatives were presented to address the needs of the basin. Alternative 1 calls for increasing the conveyance capacity of 28 pipeline segments. Alternative 2 proposes a 12.5-acre-foot detention pond between Brookdale Avenue and Lone Pine Road. This alternative would decrease flow by approximately 200 cfs, significantly reducing the cost of improvements along the main stem. According to the DMP, constructing a larger pond lower in the system (approximately a third of the distance from the head waters) would probably have a larger effect, but suitable locations are limited. Alternative 2 was the preferred alternative in the DMP.

The locations for a detention facility in this basin are no longer available and therefore this basin need to be restudied to determine the best alternative. The priority projects within the DMP are listed in Table 3-7 and shown in Figure 3-8.

TABLE 3-7.
1996 DMP RECOMMENDED IMPROVEMENTS IN LONE PINE CREEK
(1996 DOLLARS)

Project	Description	Estimated Cost
Priority Projects		
Lone Pine Central	Replace 425 feet of storm drain, install 875 feet of parallel pipe, and widen 560 feet of box culvert along Lone Pine Creek.	$650,114
Pond	Detention pond Brookdale Ave. and Lone Pine Road	$438,000
Middle Fork	Replace 1380 feet of storm drain and install 280 feet of parallel pipe along the Middle Fork of Lone Pine Creek.	$316,639
	Priority Projects Total	**$1,404,753**
Other Identified Projects		
North Fork	Replace 650 feet of storm drain, install 2050 feet of parallel pipe, and install 600 feet of new storm drain along the North Fork of Lone Pine Creek.	$544,532
South Fork	Replace 760 feet of storm drain along the South Fork of Lone Pine Creek.	$107,457
Airport Rd.	Replace 270 feet of storm drain, install 1640 feet of parallel pipe, and install 115 feet of new culvert along Airport Rd.	$548,334
	Other Identified Projects Total	**$1,200,323**

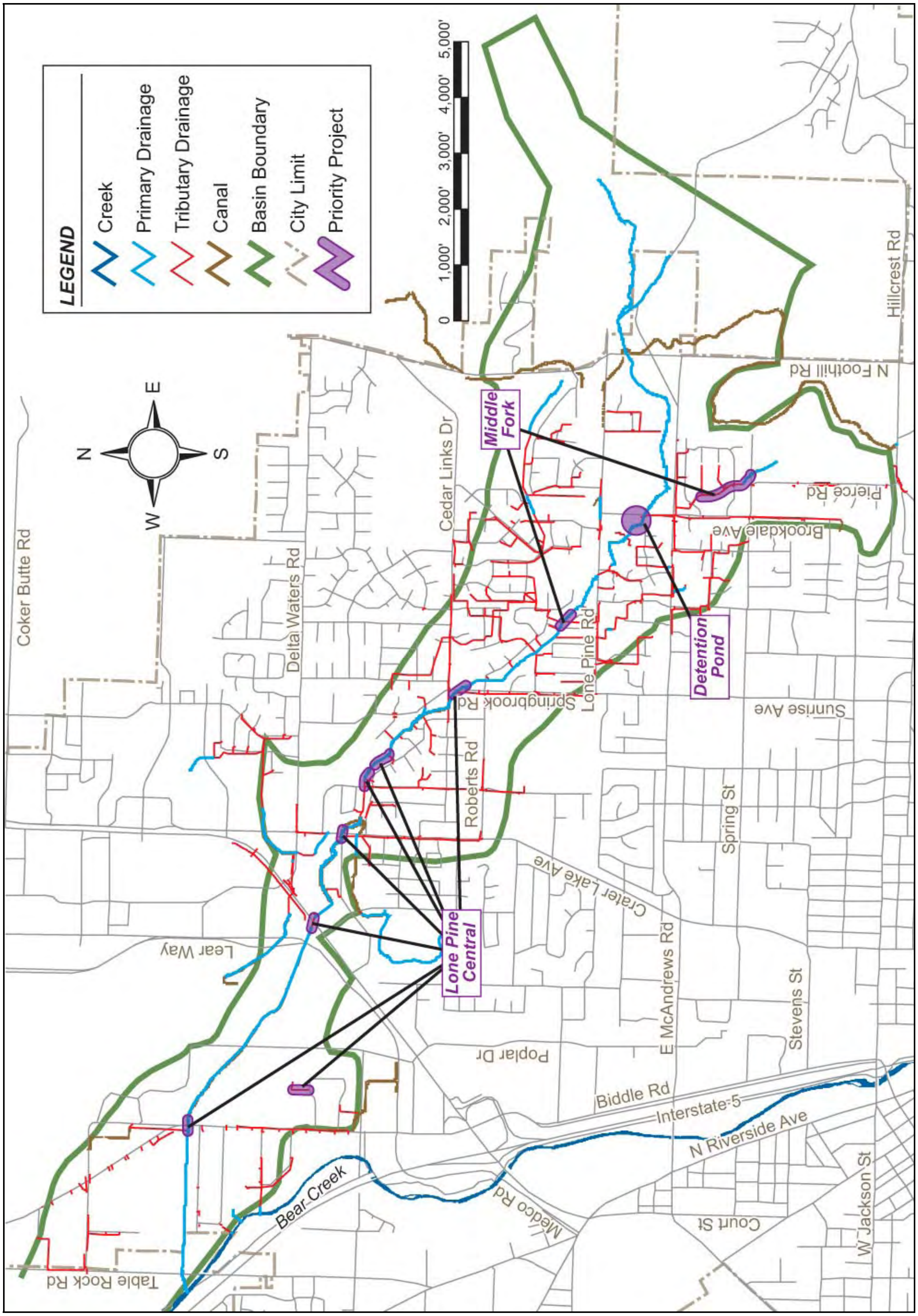

Figure 3-8. Lone Pine Creek Drainage and Priority Projects

MIDWAY DRAINAGE

Storm System

Several short piped storm drain systems exist to the east of Logging Road, draining to Midway Creek (see Figure 3-9). The portion of the basin west of Logging Road drains directly to Midway Creek. The East Main Canal and Hopkins Irrigation Canals flow north to south through this basin.

Since 1981, on-site detention for all industrial and commercial development in the basin has been required. The on-site detention limits the peak runoff rates during the design storms specified for the basin to 0.25 cfs per acre of new development.

1996 DMP Recommendations

The only alternative presented for this basin was upgrading the undersized pipeline segments. Increasing the conveyance was determined to be the only feasible option for this basin due to the flat slopes in the watershed and the high water table. For future buildout conditions, almost the entire main stem below Delta Waters Road is undersized. The conveyance system along many of the tributaries requires upgrading. It was also recommended that requiring stormwater detention for commercial and industrial development be continued.

Four projects were identified in the basin and summarized in Table 3-8, two of which were priorities and shown in Figure 3-9. The priority projects are;

King Center Upgrade Improvement Project

Overall priority score is 13.

Flood Relief	3 – 200-cfs to 400-cfs (247-cfs)
Impact to Neighborhood	4 - High
Frequency of Problems	3 - Moderate
Environmental/Regulation Sensitivity	3 - Low

Delta Waters Upgrade Improvement Project

Overall priority score is 11.

Flood Relief	1 – Less then 50-cfs (53-cfs)
Impact to Neighborhood	3 - Moderate
Frequency of Problems	3 - Moderate
Environmental/Regulation Sensitivity	4 - None

TABLE 3-8.
1996 DMP RECOMMENDED IMPROVEMENTS IN THE MIDWAY DRAINAGE
(1996 DOLLARS)

Project	Description	Estimated Cost
Priority Projects		
King Center Upgrade	Install 1500 feet of parallel pipe and widen 710 feet of box culvert along Midway Creek between Cardinal Ave and Commerce Dr.	$1,629,564
Delta Waters Upgrade	Replace 3930 feet of storm drain along Delta Waters Rd.	$424,581
	Priority Projects Total	**$2,054,145**
Other Identified Projects		
Delta Waters-Springbrook Upgrade	Replace 345 feet of storm drain, install 1425 feet of parallel pipe, and widen 110 feet of box culvert in the vicinity of Springbrook Rd. and Delta Waters Rd.	$351,330
Midway Upgrade	Install 2200 feet of parallel pipeline along Midway Creek south of Leonard Ave.	$326,191
	Other Identified Projects Total	**$677,521**

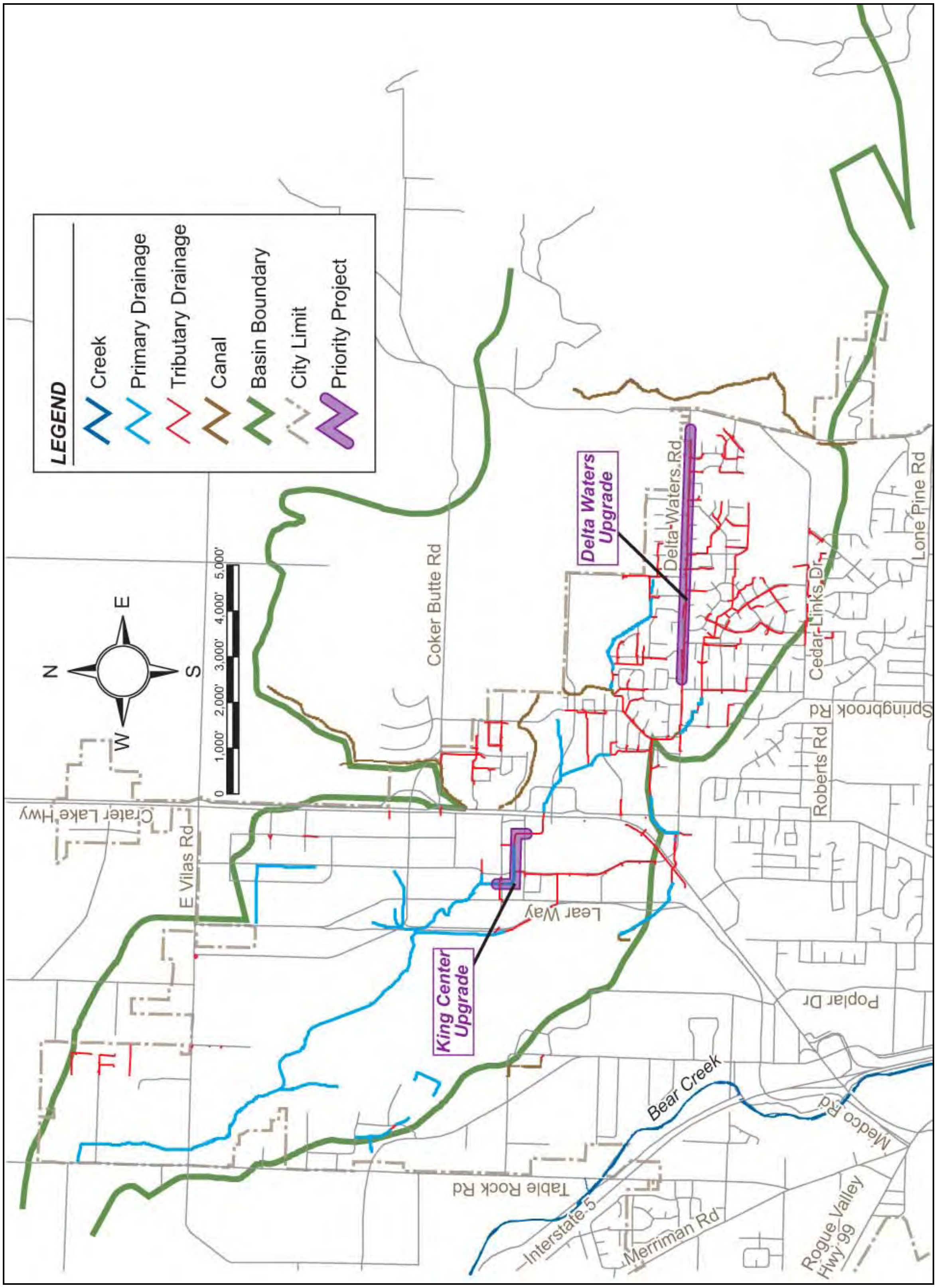

Figure 3-9. Midway Drainage and Priority Projects

CITY WIDE ALTERNATIVES

The DMP did not specifically recommend citywide alternatives for the stormwater drainage system. A *Wetlands Mitigation Concept Plan* and an *Operations and Maintenance Plan* were completed in conjunction with the DMP, but were not included in the document. The *Wetlands Mitigation Concept Plan* presents an approach to protecting and enhancing wetlands within the City's UGB. The draft *Operations and Maintenance Plan* was completed but not adopted. The plan provides a discussion of the existing maintenance program and presents a plan for developing a comprehensive stormwater facility maintenance program.

CHAPTER 4.
WATER QUALITY EVALUATION

Several issues currently affect how water quality and water quality treatment should be approached in Medford and the Bear Creek Valley. Many of these issues revolve around requirements of the 1972 federal Clean Water Act (CWA) and later revisions. The CWA set in motion two programs to address how impaired water bodies in the U.S. should be treated. One of these programs is the total maximum daily load (TMDL) program, which has identified water quality concerns and parameters for Bear Creek. The other is the National Pollutant Discharge Elimination Program (NPDES) for municipal communities, which establishes requirements for how urban areas in the U.S. address stormwater. Medford falls into Phase II for this program (communities with a population greater than 50,000). This program requires a broad approach to address stormwater discharges. Details of the City's approach to the NPDES program are covered in Chapter 5.

In the recent draft NPDES permit, the Oregon Department of Environmental Quality has combined the TMDL program into the NPDES permit requirements. This will require a program to monitor the effects the City is having on TMDLs.

TMDL PROGRAM

In Division 42 of Chapter 340 of the Oregon Administrative Rules (OAR) the State of Oregon has adopted rules to address the federal requirements for the TMDL program. The EPA has delegated the management of the TMDL program to the Oregon DEQ. Bear Creek was identified as a water quality limited stream and placed on the 303(d) list of impaired waters in 1987.

Three water quality concerns were identified for Bear Creek: algae, dissolved oxygen and pH. On December 8, 1992 three TMDL parameters were adopted for Bear Creek to address these concerns. These parameters were ammonia, biochemical oxygen demand (BOD) and phosphorus, as summarized in Table 4-1.

TABLE 4-1.
EXISTING BEAR CREEK TMDLS

Water Quality Parameter	Limit
Low flow season (May 1 through November 30)	
Ammonia Nitrogen	0.25 mg/L
In-Stream 5-Day BOD	3.0 mg/L
In-Stream Total Phosphorus	0.08 mg/L
High flow season (December 1 through April 30)	
Ammonia Nitrogen	1.25 mg/L
In-Stream 5-Day BOD	2.5 mg/L

The current 303(d) list of impaired bodies includes two additional parameters for Bear Creek: temperature and fecal coliform. These two parameters are scheduled to become TMDLs for Bear Creek in 2005. All areas within Medford discharge to Bear Creek and therefore any program to address water quality should address these parameters.

Four other creeks in Medford are on the current 303(d) list. These creeks, along with the corresponding parameters, are shown in Table 4-2.

TABLE 4-2.
303(D) PARAMETERS FOR CREEKS WITHIN THE CITY OF MEDFORD

Stream	303(d) Parameter
Bear Creek	Temperature, Bacteria
Crooked Creek	Fecal Coliform
Larson Creek	Dissolved Oxygen (DO), Bacteria, pH, Temperature
Lazy Creek	Bacteria, pH, Temp.
Lone Pine Creek	Temperature

As part of the TMDL program, the Rogue Valley Council of Governments (RVCOG) monitors water quality in the Bear Creek Watershed. The RVCOG monitoring program consists of routine stream monitoring, TMDL monitoring, storm drain monitoring and hot spot monitoring. Samples are analyzed for temperature, dissolved oxygen, turbidity, E. coli bacteria, total suspended solids (TSS), total phosphorus, and conductivity. Monitoring locations are shown on Figure 4-1.

Figures 4-2 though 4-7 present the available monitoring data for temperature, TSS, total phosphorus, E. coli, and dissolved oxygen. Temperature is a problem in all the monitored locations. Temperature is likely to become a TMDL in 2005 and should be addressed in all creeks throughout Medford. Total phosphorus was monitored in Larson Creek, the Rogue River Valley Irrigation District (RRVID), and Lone Pine Creek; in all these location the TMDL is exceeded at least part of the time. Dissolved oxygen was monitored in Larson Creek, the RRVID, and Lone Pine Creek; in all these locations the TMDL is exceeded at least part of the time. Monitoring data for E. coli shows that both the average and maximum TMDL are exceeded in a majority of samples. Although TSS is not a TMDL, monitoring shows that Medford does contribute to the TSS in the creek systems; significant spikes in the suspended solids are shown at all monitoring locations.

WATER QUALITY FLOWS AND POLLUTANT LOAD ESTIMATIONS

How stormwater becomes runoff and how runoff picks up pollutants are difficult to estimate. This section estimates pollutant loads using existing published data and Medford's basin information. Later in this chapter, these pollutant loads are used to estimate pollutant load reductions from various best-management practices (BMPs) and capital improvement projects.

Water Quality Flows by Basin

The first step is to determine a storm event that captures the majority of pollutants. Water quality design storms are used to estimate pollutant loads from different land uses and to design stormwater treatment facilities. Therefore the storm needs to be large enough to capture pollutants, but not the largest storm, since this would make the design of pollutant facilities too large to be practical. Monitoring data has demonstrated that the highest concentration of pollutants are in the smaller more frequent storm events.

The design storm used for pollutant loading for the City of Medford was 0.8 inches in 24 hours or 40 percent of the 2-year, 24-hour rainfall event. The 2-year, 24-hour storm event for Medford is 2.0 inches, according to the NOAA Atlas 2 (Vol. X for Oregon). This water quality design storm is comparable to other Pacific Northwest communities. Design guidelines for four other Pacific Northwest communities are presented in Table 4-3.

TABLE 4-3.
WATER QUALITY DESIGN STORMS FOR COMMUNITIES IN THE PACIFIC NORTHWEST

Community	Water Quality Design Storm	Percentage of 2-Year, 24-hour Storm Event
Portland, Oregon	0.83 inches in 24 hours	33%
Clean Water Services[a]	0.36 inches falling in 4 hours with a storm return of 96 hours	
Eugene, Oregon	1.4 inches in 24 hours detention facilities 0.13 in/hr off-line flow-through facilities 0.22 in/hr on-line flow-through facilities	40%
Grants Pass	1 inch; the 1-year, 24-hour storm event	33%
Western Washington	6 month, 24 hour storm event	72%

a. Clean Water Services is a public utility serving the Tualatin River Watershed

The water quality storm for Clean Water Services is specified for a flow-through facility. The City of Eugene also defines a water quality design storm for flow-through facilities. These facilities are designed for a greater pollutant loading over a shorter duration of time. The design storms for Medford and Portland are similar. Although, the average annual rainfall is significantly lower in Medford than in Portland, the 2-year, 24-hour storm event for Portland is 2.5 inches, which is similar to that of Medford. This indicates that although it rains less in Medford, rainfall events likely have a greater intensity than in Portland.

Water quality flows were computed for each basin following the procedure outlined in the 2001 *Stormwater Management Manual for Western Washington* (Vol. V). Soil information was obtained from Medford's 1996 Drainage Master Plan. Effective impervious area (EIA) was approximated based on the *General Land Use Plan* and aerial photographs. Water quality flows were computed by multiplying the water quality storm by EIA-weighted ratios provided in the *Stormwater Management Manual*. Table 4-4 summarizes the results.

TABLE 4-4.
WATER QUALITY FLOWS

Basin	Tributary Area (acres)	EIA (%)	Pervious Area (acres)	EIA (acres)	Flow (cfs)	Water Quality Flow (cfs)
Bear Creek East	2,444	57%	2,430	1,397	244	67.1
Bear Creek South	2491	40%	2481	996	187.1	44.9
Bear Creek West	1399	70%	1389	979	163.5	47.4
Crooked Creek	2,795	40%	2,784	1,106	185	44.5
Elk Creek	3,619	57%	3,598	2,077	356	98.9
Larson Creek	2,684	33%	2,675	883	175.3	41.2
Lazy Creek	2,577	28%	2,570	733	201.3	43.7
Lone Pine Creek	1,952	52%	1,942	1,020	197.3	52.8
Midway Drainage	5,056	48%	5,032	2,409	460.2	123.2

Notes:
1. Per methodology from *2001 Stormwater Management Manual for Western Washington*
2. Water quality storm = 0.8 inches in 24 hours

Pollutant Loading

To calculate the pollution removal efficiency of any identified improvements, an estimate of pollutant loading rates for various land uses was applied to each of the Medford drainage basins. Average annual loading rates for TSS, total nitrogen (TN), total phosphorus (TP), and oil and grease (O&G), obtained from *Stormwater Treatment* (Minton 2002), were used for the analysis, as summarized in Table 4-5; complete analysis for each basin is presented at the end of this chapter. Land use was roughly estimated from aerial photographs for existing conditions and the General Land Use Plan for buildout conditions. Table 4-6 summarizes the pollutant loading estimates for each basin. Appendix A shows the detailed calculations.

TABLE 4-5.
POLLUTANT LOADING RATES

	Pollutant Loading Rate (pounds/acre/year)			
Land Use	TSS	TN	TP	O&G
Commercial	725	4.7	0.72	0.000890
Multifamily	400	5.0	0.63	0.000080
Single Family High Density	290	5.2	0.59	0.000080
Single Family Low Density	180	3.6	0.50	0.000080
Roads	452	2.2	1.00	0.010867

TABLE 4-6.
POLLUTANT LOADING ESTIMATES BY BASIN

Basin	Condition	Area (acre)	TSS lb/year	TSS lb/acre	TN lb/year	TN lb/acre	TP lb/year	TP lb/acre	O&G lb/year	O&G lb/acre
Bear Creek East	Existing	2,444	733,435	300	8,286	3.4	1,252	0.5	4.4	0.002
	Build out	2,444	733,435	300	8,286	3.4	1,252	0.5	4.4	0.002
Bear Creek South	Existing	2,491	417,478	168	2,809	1.1	444	0.2	1.0	0.001
	Build out	2,491	511,997	206	3,968	1.6	610	0.2	1.3	0.001
Bear Creek West	Existing	1,399	534,298	382	4,786	3.4	760	0.5	3.0	0.003
	Build out	1,399	534,298	382	4,786	3.4	760	0.5	3.0	0.003
Crooked Creek	Existing	2,795	336,634	120	4,158	1.5	638	0.2	2.4	0.001
	Build out	2,795	400,947	143	4,906	1.8	746	0.3	2.5	0.001
Elk Creek	Existing	3,618	862,868	238	8,225	2.3	1,255	0.3	3.8	0.001
	Build out	3,618	1,019,001	282	9,936	2.7	1,494	0.4	4.3	0.001
Larson Creek	Existing	2,068	253,889	123	3,104	1.5	483	0.2	2.1	0.001
	Build out	2,068	463,699	224	6,964	3.4	1,003	0.5	2.9	0.002
Lazy Creek	Existing	2,577	162,292	63	2,564	1.0	405	0.2	1.9	0.001
	Build out	2,577	426,689	166	7,296	2.8	1,066	0.4	2.9	0.001
Lone Pine	Existing	1,953	466,248	239	4,882	2.5	745	0.4	2.5	0.001
	Build out	1,953	586,603	300	6,451	3.3	968	0.5	2.8	0.002
Midway Drainage	Existing	5,056	1,242,993	246	9,735	1.9	1,514	0.3	3.9	0.001
	Build out	5,056	1,417,391	280	11,423	2.3	1,761	0.3	4.2	0.001

POLLUTANT REMOVAL

The amount of pollutant removal that could be achieved by system drainage improvements and BMPs was estimated as described below.

Nonstructural BMPS

A number of common problems can contribute to water quality problems associated with the pollutants of concern identified above:

- High concentrations of BOD can reduce dissolved oxygen concentrations.
- Lack of vegetative cover can lead to high water temperature.
- Low stream flow can lead to high water temperature.
- Erosion and dust can contribute to turbidity.
- The dumping or leaching of waste into or near streams can contribute a variety of pollutants, including petroleum, fecal coliform and pollutants that affect pH.

- Stagnant water can lead to high temperatures, reduced dissolved oxygen concentrations and the settling of solids that can contribute to turbidity when flushed by the next runoff event.
- Illicit discharges can contribute a variety of pollutants, including petroleum, fecal coliform and pollutants that affect pH.

Table 4-7 summarizes the benefits of nonstructural BMPs that are now or could easily be put in place to address potential causes of water quality problems. It also identifies NPDES Phase II minimum control requirements that each BMP helps satisfy. Table 4-8 translates the benefits of the non-structural BMPs to the priority pollutants. Pollution reductions as a result of these programs are not easily quantified but tend to occur gradually or incrementally. The nonstructural BMPs with the most easily quantifiable results relate to maintenance activities. Options for improved maintenance activities are described below, followed by descriptions of more general, long-term BMPs.

TABLE 4-7.
BENEFITS OF NONSTRUCTURAL BMPS

	Benefit Area							
BMP	BOD	Lack of Cover	Low Flow	Erosion Dust	Waste	Stagnant Water	Illicit Discharge	NPDES[a]
Street Sweeping	◆			◆				4, 5
Catch Basin Cleaning				◆	◆	◆	◆	4, 5
Development Standards	◆	◆		◆	◆	◆	◆	5
Tree City Program		◆		◆				4
Pollution Prevention in City Operations	◆				◆		◆	5
Pet Regulations	◆				◆			5
Trash Container Protection, Separation	◆				◆		◆	5
Illicit Discharge Inspection & Enforcement							◆	3, 5
System Mapping					◆	◆	◆	3, 5
Web Site	◆	◆	◆	◆	◆	◆	◆	1
Bill Inserts	◆	◆	◆	◆	◆	◆	◆	1
Talks, Articles	◆	◆	◆	◆	◆	◆	◆	1
Public Reporting					◆		◆	2
Water Quality Monitoring	◆	◆	◆	◆	◆	◆	◆	5

a. Indicates the NPDES minimum control requirements that the BMP helps to satisfy, numbered as follows: 1. Public education; 2. Public involvement/participation; 3. Illicit discharge detection & elimination; 4. Post-construction controls; 5. Pollution prevention/good housekeeping.

TABLE 4-8.
BENEFITS OF NONSTRUCTURAL BMPS FOR PRIORITY POLLUTANTS

	Pollutant Reduction Benefit				
	Temp.	Low DO	Turbidity (TSS)	Oil/Sheen	Fecal Coliform
Street Sweeping		◆	◆	◆	◆
Catch Basin Cleaning		◆	◆	◆	◆
Development Standards	◆	◆	◆	◆	◆
Pollution Prevention by City Operations		◆	◆	◆	◆
Pet Regulations		◆	◆		◆
Trash Container Protection, Separation		◆	◆	◆	◆
Illicit Discharge Inspect/Enforce			◆	◆	
System Mapping					
Website	◆	◆	◆	◆	◆
Bill Inserts	◆	◆	◆	◆	◆
Water Quality Monitoring	◆	◆	◆	◆	◆

Storm Drain Maintenance

Improving storm drain maintenance provides immediately quantifiable results in improving storm water quality. Storm Drain Maintenance will be discussed further in Chapter 6.

Street sweeping and catch basin cleaning have the benefit of flexibility, in that the equipment can be deployed at times and places as needed. Studies have shown significant improvement in the amount of solids removed from streets, and hence prevented from entering the storm drain system, with increased use of street sweeping and catch basin cleaning. A 1999 Port of Seattle study found that frequent street and catch basin cleaning can offer water quality benefits comparable to the use of a wet vault for stormwater treatment.

It is recommended that the City maintain its street sweeping and catch basin cleaning schedule. The pollution removal efficiency for street sweeping was analyzed based on TSS and TP generated by roads. Medford uses a regenerative type of street sweeper. The street sweeping removal rate for TSS was estimated at 43 percent of the total annual load in residential areas and 15 percent on arterial roads. The street sweeping removal rate for TP was estimated at 20 percent of the total annual load. Although research shows that high efficiency street sweeper are the most effective types of street sweepers, regenerative street sweep rank second. These rates apply only to the area of road surface, not to the broader basin. Due to variability of oil and grease conditions on roads (such as quantity, location, condition), no factor for oil and grease reduction was used. In reality, however, some oil and grease reduction would occur with removal of oil and grease adsorbed into particles. Sweeper efficiency can be affected by pavement conditions and rain. Dry conditions and smooth open pavement provide the best conditions for sweeping.

Structural BMPs

Numerous studies have been done on the effectiveness of structural BMPs. The pollution removal efficiency for structural BMPs vary based on the type of facility used, design, construction, and maintenance. Table 4-9 (provided at the end of this chapter) lists characteristics of various structural BMPs from *Stormwater Best Management Practices in an Ultra-Urban Setting: Selection and Monitoring* (May 2000) the Department of Land Conservation and Development and Department of Environmental Quality *Water Quality Model Code and Guidebook* (October 2000), and Center for Watershed Protection's *Site Planning for Urban Stream Protection* (December 1995). General types of BMP technologies are described below; more detail is provided in such references as EPA, Minton, FHWA, and Schueler.

CITY WIDE ALTERNATIVES

The following BMPs are applicable in all basins and can be implemented citywide.

Reducing Impervious Surface

Impervious surface area is the single largest cause of the degradation of streams within urban areas. Degradation of streams begins with even small quantities impervious surface (10-20 percent). (Center for Watershed Protection, 1995). The correlation of impervious surface and the quantity of water has been the cornerstone of urban drainage studies. The effects of impervious surface on water quality is not as well understood and the correlation is not as intuitively obvious. Studies have shown that reducing the amount of impervious surface by 20 percent can reduce total suspended solids by up to 90 percent. Runoff volumes can be reduced by 20-60 percent, if the corresponding impervious area is reduced. 20-40 percent reduction in impervious surface can reduce nitrogen by 40-70 percent and phosphorous by 40-80 percent. (Land Conservation and Development and DEQ, 2000).

In areas with suitable soils, reducing impervious surface allows more infiltration. The increase in infiltration not only removes pollutants but increases groundwater flow and therefore increases the base flow in streams. Increase base flow generally reduces water temperatures in streams.

Some options for reducing impervious surface are:

- Porous pavement for streets or parking areas with a low traffic volume such as fire lanes, parking area turnarounds, or sidewalks
- Encourage narrow roads in rural areas
- Constructed street without curbs to allow drainage to run into vegetation
- Encourage common parking areas for multiple businesses or residents
- Encourage road pattern designs patterns to minimize impervious surface

- Require BMPs to be installed in parking lots such as vegetated swales
- Separate the sidewalk and housing from the street with a vegetation strip
- Reduce number & size of cul-de-sacs
- Use smaller parking stalls
- Establish a maximum number of parking spaces a developer is allowed to install (such as 10 percent over the relevant parking demand ratio)
- Differential between primary & spillover parking, allow spillover parking to use alternative paving surfaces such as grid pavers, porous pavement, gravel or mowed grass.

The City of Medford could review the current street design ordinances to allow for and encourage reductions in impervious surfaces.

Sediment and Erosion Control

Erosion can be a large source of sediment loading in stormwater runoff or stream. Erosion comes from a variety of places including construction sites, unstable slopes, or any other surface with bare soil. BMPs for control sediment and erosion are encouraging native vegetation use and retention, restricting development in areas with steep slopes, and properly installing BMPs at construction sites.

Native Vegetation has the additional benefit of reducing the use of water, pesticides and fertilizer. Properly selected native riparian vegetation can provide for shade along stream corridors, which reduces water temperatures.

Many construction BMPs are available, but they must be installed and used correctly to prevent sediment and other pollutants from leaving the site.

All commercial, industrial, multi-family, housing subdivision construction projects requiring building permits and single-family residential projects greater than 1 acres are required to obtain a 1200-C permit from the City of Medford for erosion control and inspection. It is the recommendation of this report that all construction projects and earth disturbance projects with ground disturbance over 1,000 square feet be required to obtain an erosion and sediment control permit and implement BMPs. This would eliminate the potential of small single-family residential projects causing erosion. Chapter 8 includes a further discussion on construction sediment and erosion control. The permitting and inspection of these sites is discussed in Chapter 8.

Post-Construction Water Quality Facilities

There are several different approaches for a municipality to develop requirements for post-construction water quality. Such approaches include setting a requirement for the percentage of a pollutant to be removed, requiring treatment for the design storm and the Simplified Approach used by the City of Portland.

Percentage Removal

The City could require that new developments install post-construction BMPs that will remove a specified percentage of a pollutant or pollutants for a particular storm event. The advantage of this method is that specific pollutants could be targeted. The disadvantage is that a method must be defined to quantify how much a facility can remove. Studies have shown that the percentage removal of pollutants can vary among facility types and their loading rates.

Approved Water Quality Facilities

The City could require that new developments install post-construction BMPs that have been previously approved by the City. This would allow the City to select only BMPs that have been proven to be effective for the needs of the Medford area. This would not encourage the reduction in impervious surfaces. Structural water quality treatment facilities typically require that an engineer design the facilities. City staff would also be required to check each design to ensure that it is appropriately sized.

Simplified Approach

The simplified approach for stormwater management used by the City of Portland focuses on impervious surface area management. A worksheet is used which gives credit for reductions in impervious surface and various stormwater management facilities. If the calculations show the amount of impervious area managed is not adequate the size of the facilities must be increase or alternative facilities may be used.

Under this format, combinations of facilities are used on the site which is more practical than building separate water treatment and flow control facilities. Management of stormwater onsite also allows for ground water recharge and reduces the quantity of water flowing to the storm system. The worksheet format clearly shows the advantages of reducing impervious surfaces. Facilities are simple and do not need to be designed by a water quality engineer. This type of requirement would be easy to administer.

The simplified approach focuses on infiltration, which could be a disadvantage in Medford due to the low infiltrating soils. Using soils which allow infiltration for the facility and installing an underdrain to collect the stormwater at the downstream end, could resolve this problem. This would not reduce flows to the storm system, but pollutants would be removed prior to entering the system. A simplified approach for Medford would need to include stormwater management facilities that are appropriate for the City.

Stream and Wetland Buffers

Stream and wetland buffers provide a natural boundary between development and a stream or wetland. Vegetated stream buffers maintain bank stability, reduce sediment and nutrient loads from overland flow runoff, and allow infiltration to occur. Vegetated buffers reduce pollutant loading when runoff crosses the buffer as sheet flow, not when pipes transport stormwater directly to the creek or when channels are formed and runoff bypasses the vegetation. When a buffer is vegetated and no pesticides or herbicides are applied, TSS reductions of 40 to 80 percent can be achieved. When lawns are not located within a stream buffer, nitrogen reductions of 25 to 65 percent and phosphorous reductions of 30 to 70 percent can be achieved. (Land Conservation and Development and DEQ, 2000). Buffers can be combined with other BMPs to ensure pollutant reduction.

To be effective, stream buffers must be managed and protected during construction and for the ongoing period after construction. Residents can be educated to prevent dumping, trails, tree removal, erosion and lawns encroaching into the buffer. Education can include pamphlets, boundary markers, buffer walks, regular homeowner association meetings and individual maintenance agreements. Residents can also be encouraged to participate in stewardship of buffers and streams. Allowable and unallowable activities in stream buffers should be clearly defined.

Stream and wetland buffers are appropriate for Crooked Creek, Elk Creek, Larson Creek, Lazy Creek, Lone Pine Creek, and the Midway Drainage. The lower portions of Larson Creek, Lone Pine Creek and Lazy Creek have a riparian corridor designation under Medford City Code 10.920.

Shading

Riparian vegetation performs many beneficial functions for stream ecosystems. One of these is to regulate water temperature through direct shading. Temperature is scheduled to become a TMDL for Bear Creek in 2005. Water quality monitoring data shows that Bear Creek temperatures increase in the City of Medford.

Shading the stream will reduce water temperatures. Factors that determine the amount of solar radiation that reaches a stream channel include the width of the channel, the type and density of the riparian vegetation, the orientation (east-west vs. north-south) of the channel, and the angle of the sun.

Because the sun is usually positioned to the south in the Pacific Northwest, areas with southern exposure receive more direct sunlight than those with northern exposures, resulting in higher water temperatures. Riparian vegetation can provide shade from both sides of the stream, but shading from the southern direction provides the most thermal regulation. On north-south oriented streams, vegetation must grow on both sides to provide a shade canopy over the stream.

Stream Reach Ranking for Thermal Regulation

The Medford Riparian Inventory and Assessment ranked thermal regulation along each stream reach in the City with one of the following rankings:

- **High or intact—**Riparian areas that provide adequate shading for the stream, meeting the following criteria:
  - Riparian area is on the south side of the stream, and
    - woody vegetation is dominant, or
    - woody vegetation hangs over the stream.
- **Medium or somewhat degraded**—Riparian areas that provide some shading for the stream, meeting one of the following criteria:

  - Riparian area is on the north side of the stream, and
    - woody vegetation is dominant, or
    - vegetation is a combination of herbaceous and woody vegetation, with woody vegetation hanging over the stream bank.
  - Riparian area is on either side of a stream that is oriented due north-south, and
    - woody vegetation is dominant, or
    - vegetation is a combination of herbaceous and woody vegetation, with woody vegetation hanging over the stream bank.
  - Riparian area is on the south side of the stream, and herbaceous vegetation is dominant.
- **Low or severely degraded**—Riparian areas that provide little or no shading for the stream, meeting one of the following criteria:
  - Riparian area is on the north side of the stream, and
    - herbaceous vegetation is dominant, or
    - bare ground is dominant.
  - Riparian area is on a stream oriented north-south, and
    - herbaceous vegetation is dominant, or
    - bare ground is dominant.

Riparian Area Management for Thermal Regulation

Based on the ranking of stream reaches for thermal regulation, each reach was designated as one of two categories for riparian area management: riparian areas to be protected and riparian areas to be enhanced. Areas that are currently providing shade for the stream should be protected and those that are not should be enhanced. The categories were assigned as follows:

- Riparian areas to be protected:
  - Areas with a high/intact ranking
  - Areas with a medium ranking located on the north side of a stream
  - Areas with the medium ranking located on north-south oriented streams.
- Riparian areas to be enhanced:
  - Areas with a low/severely degraded ranking
  - Areas with the medium ranking located on the south side of the stream.

Figure 4-8 shows the designated category for each stream reach.

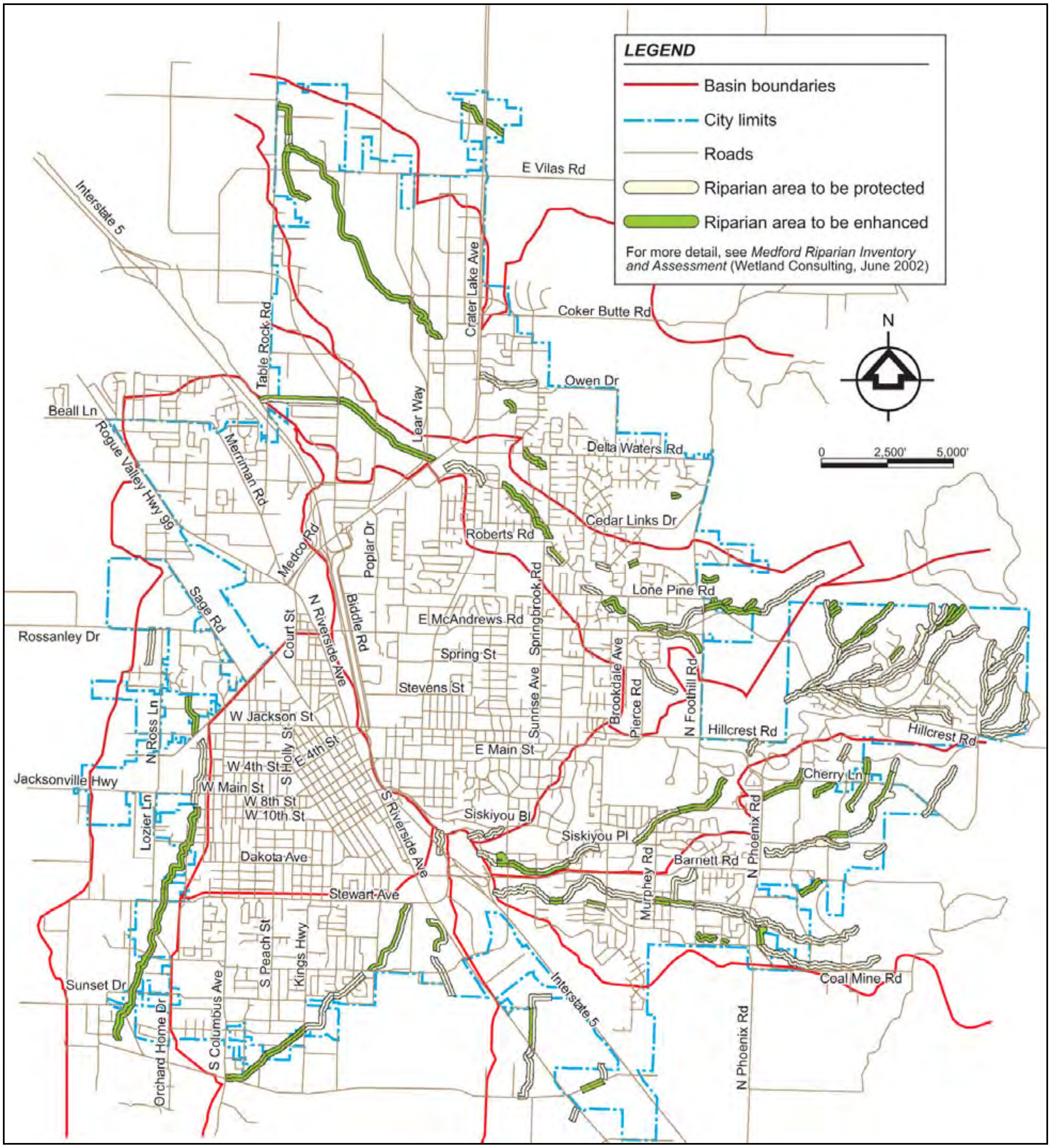

Figure 4-8. Riparian Area Protection and Enhancement Plan

Enhancement Methods

Riparian vegetation enhancement can be facilitated in the following ways:

- **Capital Improvement Projects—**Parks Department capital improvement projects to enhance riparian area vegetation
- **Development Requirements—**Requirements for improvement and/or protection of riparian vegetation and shading along a stream corridor for development close to stream channels.
- **Public Involvement/Education:**
  - Encourage school and volunteer groups to take on stewardship of stream reaches, including planting and maintaining riparian vegetation.
  - Encourage private landowners through education about the benefits of riparian vegetation.

The following could be implemented to maintain and improve shading as part of projects including stream work conducted in Medford:

- Maintain trees and plant trees on the south side, to shade creeks
- Use native, riparian vegetation for landscaping along creeks
- Locate paths on the north side, to minimize disturbance to vegetation on the south side of the creek.

Stream Shade Monitoring

Photo documentation was identified as an easy and cost-effective method for monitoring stream shade and canopy cover in the *Stream Shade and Canopy Cover Addendum to the Water Quality Technical Guide Book* (Oregon Watershed Enhancement Boards, July 1999). Procedures for preparing a photo documentation monitoring program, along with several other monitoring methods involving specific monitoring equipment, are described in the document. The addendum should be reviewed prior to development of a riparian shade monitoring program for the City of Medford.

Water Quality Vaults

Water Quality vaults are buried stormwater treatment systems that connect to storm pipe systems. There are several manufacturers of the vaults, and all have similar products and characteristics. This report does not recommend a specific vault because company names and products change and site conditions vary.

Stormwater vaults can be grouped into media filtration vaults and settling vaults. Media filtration vaults generally provide better treatment, but they tend to be more expensive to install and maintain. Settling vaults use a variety of shapes to cause settling of particulates. These vaults tend to be less expensive to install and maintain and usually can be designed to treat larger flows.

As a stand-alone treatment system, some cities require media filtration because settling systems to not achieve desired treatment effectiveness. Settling vaults are frequently used as pretreatment to media filtration or other types of treatment facilities. Many communities use settling vaults as forebays to constructed wetland facilities.

Water quality vaults could also be installed in drainage collection systems in commercial areas when upgrades and maintenance are performed. Depending on the flow and size, a water quality treatment vault's cost ranges from $15,000 to $40,000. For the purpose of developing a CIP, the cost of a vault, including design and installation, is estimated to be $100,000 in this report.

Infiltration

Although infiltration can be an effective tool for reducing stormwater runoff, the 1996 Drainage Master Plan indicated that the soils in the Medford area prevent effective use of infiltration systems. Soils throughout the City range from Class D (low infiltration) to a Class B (moderate infiltration). Generally soils in the upper portion of the basins have a low infiltration, and more permeable soils are located near and adjacent to Bear Creek. Figure 4-9 shows the hydrologic groups of the soils in Medford, soil types A and B are suitable for infiltration.

Many stormwater treatment methods are based on infiltration; in areas where soils do not infiltrate stormwater, other methods of treatment are required. One method requires facilities to be constructed using imported soils that do allow infiltration, with stormwater collected by an underdrain at the downstream end.

This report does not identify areas where infiltration is allowed because of the limited site-specific soil data available for the City. This report recommends developing criteria to evaluate the infiltration rate for specific locations where a stormwater treatment system relying on infiltration is planned. This will allow a site-specific analysis. Low-cost ways to evaluate infiltration are outlined in Chapter 2 of the *City of Portland Stormwater Management Manual* (Revision 3, September 1, 2004). Other methods include the Double Ring Infiltrometer Test (ASTM D3385) or the EPA Falling Head Percolation Test.

Farm Animal Management

Medford is primarily an urban setting; however, there are some agricultural uses within the City and in basins that drain through the City.

Farm animals contribute to erosion and increase nutrient loads in storm water. Livestock should be kept away from areas which drain directly to stormwater collections system and out of riparian corridors. Livestock BMPs include containment of contaminated runoff, proper storage of manure, installation of runoff treatment systems, reduction of livestock densities, and separation of livestock from sensitive water quality areas.

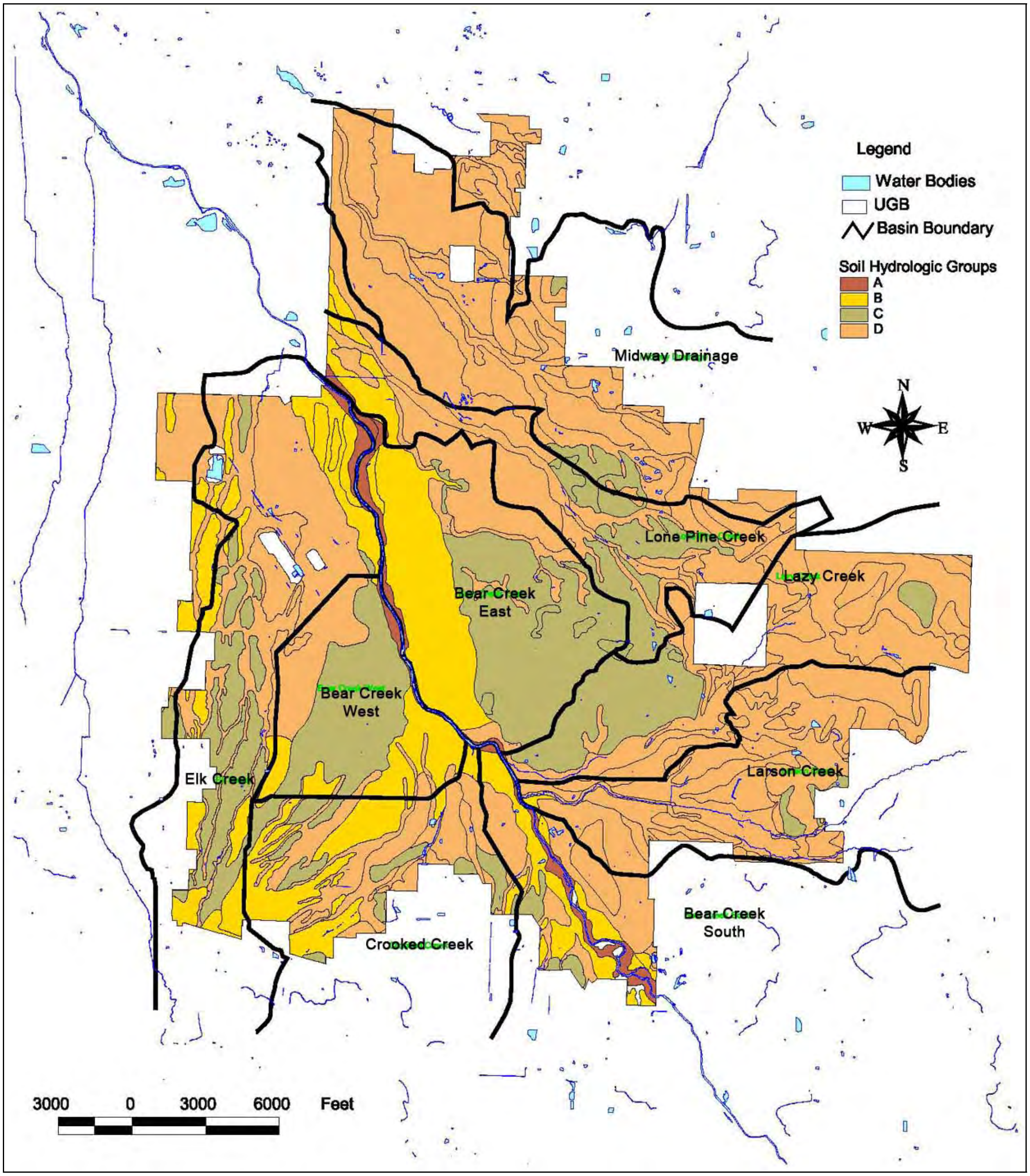

Figure 4-9. Area Soil Types

The following are some recommended guidelines for livestock from *Water Quality Model Code and Guidebook:*

- Prohibited Areas. Livestock shall not be kept within any of the following areas, as applicable, due to the higher intensity living environments of these areas or the potential impact on water quality.

  - Multi-family sub-district
  - Manufactured housing park sub-district
  - Neighborhood commercial sub-district
  - Within a riparian protection overlay
- Minimum Lot Size. No livestock shall be kept on any lot less than one acre in area.
- Density. Limit the number of livestock over the age of six months that may be maintained per acre.
- Farm Structures. Limit the distance from the property line new barns, stables, and other buildings or structures used to house livestock can be located.
- Storage of fertilizer, pesticide herbicide, or animal waste. Fertilizer, pesticide and/or herbicide or other similar farm chemicals shall be covered and stored at an elevation one foot higher than the 100 year flood. Animal waste that is collected shall also be stored at an elevation one foot higher than the 100 year flood.

BASIN-SPECIFIC ALTERNATIVES

The following discusses specific water quality alternatives for each basin. Basin specific water quality improvements include BMPs, stream and wetlands protection and stream restoration opportunities.

Bear Creek East

Bear Creek East is a highly urbanized basin consisting of a mixture of commercial, multifamily housing and single family residential housing. Open space is limited in this basin, therefore water quality improvements are limited to systems requiring little to no surface area, such as water quality vaults or similar structural BMP facilities.

Water Quality Projects

It is recommended that water quality vaults be incorporated into major system improvements such as the construction of the Brookhurst drainage improvement project. A water quality vault could be installed at the downstream end of this system at Crater Lake Avenue and Johnson Street. Other potential locations for including water quality vaults in the storm system are:

- Biddle and McAndrews
- Medco Logging Road and Bullock—North Medford Interchange
- Medco Logging Road between Bullock and Biddle

Restoration/Protection Areas

The following areas are Locally Significant Wetlands and should remain protected:

- South of Crater Lake Highway between White Ave and Corona Ave
- At Spring St and Springbrook Road

Stream restoration opportunities include:

- Restoring Baby Bear Creek as a Public Education Project. This project is in the Parks Department budget for 2005.

Bear Creek South

Bear Creek South is approximately 86 percent developed. Land use in this basin consists mainly of commercial and industrial use, with a small amount of single family residential housing.

Water Quality Projects

It is recommended that water quality vaults be incorporated into major system improvements such as the construction of the Center Drive drainage improvement project. Water quality vaults are discussed in Appendix C.

Restoration/Protection Areas

The following areas of wetland should be protected in this basin:

- East of Center Drive
- Along Bear Creek west of Hwy 5 (3 wetland)
- East of Laloma Drive
- In the south portion of the basin east of Hwy 5 (4 wetland)

Bear Creek West

Bear Creek West a highly urbanized basin. Land use in this basin consists of mixture of commercial, industrial, single family residential housing and some multifamily housing. Open space is limited in this basin, therefore water quality improvements are limited to systems taking up little to no space, such as manufactured facilities.

Water Quality Projects

It is recommended that water quality vaults be incorporated into major system improvements such as the construction of the 6th Street and Earhart drainage improvement projects. Water quality vaults could be installed at the downstream end of the 6th Street systems on 4th at Rouge Valley Boulevard. A vault or treatment wetland could be constructed in the Earhart system on Earhart Street at Franquette Street. Other potential locations for including water quality vaults in the storm system are:

- Walnut Street at Rouge Valley Boulevard
- Alice Street at Rouge Valley Boulevard
- Jackson Street at Rouge Valley Boulevard

- 8th Street at Rouge Valley Boulevard
- 10th Street at Rouge Valley Boulevard

Restoration/Protection Areas

No tributary stream or wetlands area are located within this basin.

Crooked Creek

Crooked Creek is approximately 86 percent developed. Land use in this basin consists of mixture of commercial, industrial, and single family residential housing.

Water Quality Projects

It is recommended that water quality vaults be incorporated into major system improvements such as the construction of the Crooked Creek near Stewart Avenue drainage improvement project. A water quality vault could also be installed in the storm system at Stewart Avenue and Barnett Road.

Restoration/Protection Areas

Stream restoration opportunities along Crooked Creek include:

- Work with Stewart Meadows Golf Course to vegetate Creek Banks.

Elk Creek

Elk Creek is approximately 85 percent developed. Land use in this basin consists of a mixture of commercial, industrial, and single family residential housing with some multi-family housing.

Water Quality Projects

It is recommended that water quality vaults be incorporated into major system improvements such as the construction of the Lars Way drainage improvement project. A water quality vault could be installed at the downstream end of the system on Sage Road at Lars Way. Other potential locations for including water quality vaults in the storm system are:

- Berrydale Avenue east of Table Rock Road
- Medco Logging Road at Bear Creek

The City should also investigate treatment options for runoff from the Medford Mall.

Restoration/Protection Areas

The following areas of wetland should be protected in this basin:

- North & South of Arlington Drive (2 wetlands)
- South of Willowbrook Drive

Stream restoration opportunities along Elk Creek include:

- It is difficult to follow the path of Elk Creek through the basin, much of the creek flows through private properties and a large section is piped. The piped section of the creek daylights and crosses Hopkins canal before joining with Bear Creek; flow between Elk Creek and Hopkins canal should be separated. There are many potential restoration opportunities in this basin, including vegetating stream banks, creating set backs, and stabilizing stream banks. Due to the complexity of this basin it is recommended that an individual basin plan be developed for Elk Creek Basin.

Larson Creek

Larson Creek is approximately 43 percent developed. Land use in this basin consists mainly of single family residential housing with some commercial and multi-family housing.

Water Quality Projects

Much of the future development in this basin will occur upstream of Phoenix Road, the City could investigate construction of a regional detention/water quality facility for development in this area. Cost for this facility is difficult to determine at this time; it is dependant on many factors that are unknown at this time, such as the size of facility required and the type of development that will occur. This work should be coordinated with the development in this area.

Restoration/Protection Areas

The following areas of wetland should be protected in this basin:

- Upstream of Golf Course between Hillsdale Ave and Black Oak Drive
- Downstream of Golf View Drive (For development within wetland work with developer to provide buffer and planting for creek and wetland)
- Upstream of North Phoenix Road
- For development within wetland LA-W02, work with developer to provide buffer and planting for creek and wetland

Stream restoration opportunities along Larson Creek include:

- Restore Creek system between Olympic Avenue and Murphy Road. This portion is currently a concrete lined channel; consider purchasing property along the channel to restore stream and riparian habitat. The cost to restore this section of Larson Creek including land purchasing, removing the concrete lining, grading and revegetation is estimated to be $800,000; the 1996 Drainage Master Plan identified a cost of $300,854 for improvements to the box culverts along this reach of Larson Creek.
- Define separation of flow between East Main Canal and Larson Creek

Lazy Creek

Lazy Creek is approximately 40 percent developed. Land use in this basin consists mainly of single family residential housing with some commercial in the middle and western portions of the basin.

Water Quality Projects

The McAndrews Detention/Water Quality facility should be constructed. The 1996 Drainage Master Plan recommended a 30 acre-foot facility. Lazy Creek should be modeled with the facility to ensure that the 25-year storm can be detained at a minimum. A low-flow channel would flow along the bottom of the facility to keep summer flow temperatures down, and wetland vegetation would provide water quality treatment for the water quality design storm. Trees would be provided along the low-flow channel for riparian habitat and to shade the stream. The water quality facility will provide for solids detention from the development upstream of the facility. Shading the stream will prevent the water temperature from elevating. The construction of a downstream dike and outfall structure for this facility was initiated with the extension of McAndrews Road. The estimated cost to complete this project, including modeling, a control structure, planting and potential excavation, is $800,000.

An example water quality vault could be installed near the Rogue Valley Medical Center.

Restoration/Protection Areas

The following areas of wetland should be protected in this basin:

- Downstream of Highland Drive
- Upstream of Hillcrest Drive
- Upstream of Cloudcrest Drive.

Stream restoration opportunities along Lazy Creek include:

- The stream channel banks at the downstream end of Lazy Creek, south of Bear Creek Park have little vegetation. This reach should be revegetated, and the constructing a water quality facility at this location should be explored.
- The creek banks along the reach which flow through Rouge Valley Country Club are steep and have little riparian vegetation. The City should work with the Country Club to stabilize and vegetated the creek banks and to practice good creek stewardship.

Lone Pine Creek

Lone Pine Creek is approximately 77 percent developed. Land use in this basin consists of a mixture of commercial, industrial, and single family residential housing with a small amount of multi-family housing.

Water Quality Projects

Much of the future development in this basin will likely occur upstream of Foothill Road, the City could investigate construction of a regional detention/water quality facility for development in this area. Cost for this facility is difficult to determine at this time; it is dependant on many factors that are unknown at this time, such as the size of facility required and the type of development that will occur. This work should be coordinated with the development in this area.

Restoration/Protection Areas

The following areas of wetland should be protected in this basin:

- Lawndale Road and Airport Road.
- West of Gene Cameron Way.
- North of McAndrews Road and East of Foothill Road.
- South of McAndrews Road and East of Foothill Road. (2 wetlands)
- Between East Canal and Pierce Way (3 wetlands)

Stream restoration opportunities along Lazy Creek include:

- Define separation of flow between East Canal and Lone Pine Creek
- Define separation of flow between Hopkins Canal and Lone Pine Creek.

Midway Drainage

Midway Drainage is approximately 85 percent developed. Land use in this basin is primarily commercial and industrial, with some single family residential housing.

Water Quality Projects

It is recommended that water quality vaults be incorporated into major system improvements such as the construction of the Delta Waters Upgrade drainage improvement project. A water quality vault could be installed at the downstream end of the system on Delta Waters Road at Kingsgate Drive. Other potential locations for including water quality vaults in the storm system are:

- Lear Way at Cardinal Avenue
- International Way at Butte Lateral

Restoration/Protection Areas

The following areas of wetland should be protected in this basin:

- North of Vilas Way
- South of Vilas Way (2 wetlands)
- Near Hadley Drive and Schulz Road
- West of Midway Creek (4 wetlands)

- East of Midway Creek
- East of Medco Haul Road (10 wetlands)
- Along Midway Creek East of Medco Haul Road
- West of Crater Lake Hwy
- At Airport West of Medco Haul Road
- North of Medco Haul Road and Crater Lake Hwy junction (8 wetlands)
- East of Crater Lake Hwy
- Off Edmond Way north of Delta Water Road

Stream restoration opportunities include:

- Revegetate streams outside of the Airport.

Summary

Table 4-10 provides a summary of the applicable water quality BMPs for each basin in the City of Medford.

TABLE 4-10.
RECOMMENDED WATER QUALITY BMPS WITHIN MEDFORD

Basin/Project Type	Recommendation
City Wide	• Reduce impervious surface area throughout Medford • Require sediment and erosion control permits and BMPs for all projects disturbing 1,000 square feet or more, including single-family residential construction • Adopt a requirement for post construction water quality facilities • Adopt stream and buffers for creeks and protected wetlands within Medford. • Educate property owners about farm animal management drainage courses • Investigate opportunities for infiltration • Remove concrete channels where possible
Bear Creek East	
Water Quality Projects	• Install Water Quality Vaults
Restoration/Protection Areas	• Protect 2 wetland areas • Restore Baby Bear Creek as a Public Education Project
Bear Creek South	
Water Quality Projects	• Install Water Quality Vaults
Restoration/Protection Areas	• Protect 9 wetland areas
Bear Creek West	
Water Quality Projects	• Install Water Quality Vaults

TABLE 4-10 (continued).

RECOMMENDED WATER QUALITY BMPS WITHIN MEDFORD	
Basin/Project Type	Recommendation
Crooked Creek	
Water Quality Projects	• Install Water Quality Vaults
Restoration/Protection Areas	• Work with Stewart Meadows Golf Course to vegetate Creek Banks
Elk Creek	
Water Quality Projects	• Install Water Quality Vaults • Investigate treatment options for runoff from the Medford Mall
Restoration/Protection Areas	• Protect 4 wetland areas • Develop a Basin Plan for Elk Creek
Larson Creek	
Water Quality Projects	• Investigate feasibility of a regional detention/water quality facility upstream of Phoenix Road
Restoration/Protection Areas	• Protect 4 wetland areas • Restore Creek system between Olympic Avenue and Murphy Road. • Define separation of flow between East Main Canal and Larson Creek
Lazy Creek	
Water Quality Projects	• Include a water quality component in the construction of the McAndrews Detentions Facility • Install an example water quality vault near Rogue Valley Medical Center
Restoration/Protection Areas	• Protect 3 wetland areas • Restore Creek south of Bear Creek Park and investigate the construction of a water quality facility • Work with Rouge Valley Country Club to revegetate stream banks
Lone Pine Creek	
Water Quality Projects	• Investigate feasibility of a regional detention/water quality facility upstream of Foothill Road
Restoration/Protection Areas	• Protect 8 wetland areas • Define separation of flow between East Canal and Lone Pine Creek • Define separation of flow between Hopkins Canal and Lone Pine Creek.
Midway Drainage	
Water Quality Projects	• Install Water Quality Vaults
Restoration/Protection Areas	• Protect 32 wetland areas • Revegetate streams outside of the Airport

TABLE 4-9.
STRUCTURAL BMP SELECTION CHARACTERISTICS

BMP Types	Ultra-Urban	Area Served (acres)	BMP Area	Min. Head Req'd (feet)	Summer Temp Increase[a]	Contaminant Removal Percentage: TSS	Bacteria[c]	BOD	Oil & Grease	TP	TN	Metals	Capital Costs	Maintenance	O&M Costs	Effective Life (years)
Ext. Detention Wet Pond	no	2 (min)	10-20%	3-6	Yes	46-98	NA	25-45[d]	NA	20-94	28-50	24-89	Mod	Annual Inspection	Low	20-50
Underground Det. Tanks	yes	1-2	0.5-1%	5-8	No	NA	NA	10-20[d]	NA	NA	NA	NA	Mod to High	Frequent cleanout	High	50-100
Infiltration Trench	yes	2-4	2-4%	3-8	No	75-99	60-100	70-90	NA	50-75	45-70	75-99	Mod to High	Sediment & debris removal	Mod	10-15
Infiltration Basin	no	2-20	2-4%	3-4	No	75-99	60-100	70-90	NA	50-70	45-70	50-90	Mod	Mowing	Mod	5-10
Bioretention	yes	1-50	4-10%	2-3	No	75	NA		NA	50	50	75-80	Mod	Mowing / plant replacement	Low	5-20
Catch Basins and Inlets	yes	<1	none		No	20-40	NA	10-20[d]	NA	10-20[d]	10-20[d]	10-20[d]	Low	Frequent Cleanout	Low	?
Catch Basin Inserts	yes	<1	none	1-2	No	NA	NA		up to 90	NA	NA	NA	Low	Frequent Cleanout	Mod to High	10-20
Control Structures/Flow Restrictors	yes				No	20-40	NA	10-20[d]	NA	10-25[d]	10-20[d]	10-25[d]	Low	Frequent Cleanout	Low to Mod	
Manufactured Systems	yes	1-10	none	4	No	NA	NA		up to 96	NA	NA	NA	Mod	Periodic cleanout	Mod	50-100
Premanufactured Vaults[b]																
Storm Vault	yes	no	0.5-1%	low	No	86	NA		high	48	NA	36	Mod to High	Periodic cleanout and inspection	Mod	50-100
Vortechs	yes	limits	0.5-1%	low	No	80	NA		high	67	54	NA	Mod to High	Frequent cleanout	Mod	50-100
Multi-Chambered Treatment Train (MCTT)	yes	0.2-2.5	0.5-1.5%	4-6	No	83	NA		NA	NA	NA	95	High	Sand filter cleaning & replacement of oil absorbent material	High	5-20
Oil-Grit Separators (Coalescent Plate)	yes	1-2	<1%	3-6	No	20-40	NA	10-20[d]	50-80	<10	<10	<10	Mod	Frequent Cleanout	High	50-100
Ditches (with vegetation)	yes				Yes	0-50	NA	0-25[d]	0-25[d]	0-25[d]	0-25[d]	0-25[d]	Low	Frequent Cleanout	Low to Mod	
Vegetated Swales	yes	2-4	10-20%	2-6	Yes	30-90	NA	50-80	NA	20-85	0-50	0-90	Low to Mod	Mowing	Low	5-20
Vegetated Filter Strips	no	NA	25%	Neg	Yes	27-70	NA	50-80	NA	20-40	20-40	2-80	Low	Mowing	Low	20-50
Constructed Wetlands	no	1 (min)	10%	1-8	Yes	65	NA	40-80	NA	25	20	35-65	Mod to High	Annual Inspection / Plant replacement	Mod	20-50
Natural Streams/Wetlands	no				Yes	50-95	50-98	40-80	40-90	20-85	20-85	40-90	Low	Regular inspection / debris removal / erosion control	Low to Mod	
Vegetated Rock Filters	yes	2-5	3-5%	2-4	No	95	78		NA	82	75	21-80	High	Regular inspection and cleanout	High	5-20
Underground Sand Filters	yes	2-5	2-3%	1-8	No	70-90	NA		NA	43-70	30-50	22-91	High	Annual Media Removal	High	5-20
Surface Sand Filters	no	2-5	2-3%	5-8	No	75-92	NA		NA	27-80	27-71	33-91	Mod	Biannual media removal	Mod	5-20
Organic Media Filters	yes	2-5	2-3%	5-8	No	90-95	90		NA	49	55	48-90	High	Annual media removal	High	5-20
Porous Pavements	no	2-4	NA	NA	No	82-95	NA		NA	60-71	80-85	33-99	Low	Semi annual vacuum cleaning	Mod	15-20

General Source: *FHWA-EP-00-002 Stormwater Best Management Practices in an Ultra-Urban Setting: Selection and Monitoring*, February 2000.
NA means Not Applicable or Not Available
a. Open systems exposed to solar radiation that do not infiltrate assumed to increase water temperature in summer.
b. Per manufacturer's monitoring reports.
c. Schueler, *Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs*, MWCOG, July 1987, bacteria removal data for infiltration noted bacteria as fecal coliform, pp. 1-6, 2-13. Data for other BMPs is from FHWA; data falls within the 60%-100% removal range, and is presumed to apply to fecal coliform bacteria.
d. estimated based on 50% particulate fraction

CHAPTER 5.
NPDES PHASE II EVALUATION

A Stormwater Management Program for Medford was developed and submitted to the DEQ to meet requirements of the NPDES Phase II program. Phase II regulations require operators of municipal storm systems to implement a program of stormwater management activities to protect water quality.

A Stormwater Advisory Team (SWAT) was formed in 2003 to coordinate the Phase II program in the Rogue Valley region. The SWAT is made up of representatives from Ashland, Central Point, Jackson County, Medford, Phoenix and Talent. The municipalities involved in the regional effort hired a consultant to develop individual stormwater management programs along with documenting a regional approach. The *Rogue Valley Regional NPDES Phase II Stormwater Program Guide* (February 2004) was prepared as a regional guideline to be used in developing programs for individual jurisdictions.

NPDES REQUIREMENTS

The NPDES Phase II regulations establish the following minimum requirements for local stormwater management programs:

- **Public education and outreach**—Develop and distribute educational materials and conduct public outreach aimed at informing citizens about the impacts of polluted stormwater as well as ways to minimize their contribution to pollution.
- **Public involvement and participation—**Involve the public in developing and implementing the stormwater management program.
- **Illicit discharge detection and elimination**—Develop and implement a program for detecting and eliminating illicit discharges to the storm drain system. This includes storm system mapping, dry weather sampling, and citizen information activities.
- **Construction site stormwater runoff control**—Develop, implement, and enforce a program and standards to control erosion and sediment discharges from construction sites that disturb 1 acre of land or more.
- **Post-construction stormwater management**—Develop, implement, and enforce a program and standards to control the discharge of polluted runoff from new development and redeveloped sites. This can include structural treatment and detention systems as well as resource protection measures (wetland protection, habitat protection, etc.) and pollution prevention planning.
- **Pollution prevention in municipal operations**—Develop, implement, and enforce a program to control the discharge of polluted runoff from municipal operations (road maintenance, vegetation management, storm drain maintenance, etc.).

Measures beyond these minimum requirements may be needed to meet TMDLs requirements or other cleanup plans. Storm system operators also must evaluate their programs' compliance with the permit requirements and assess the effectiveness of any BMPs implemented as part of the program. Any changes to the program resulting from the evaluation must be reported to the DEQ.

The NPDES and TMDL programs will be combined in the NPDES stormwater permit the DEQ will issue to the City. The permit, which has not been issued at the time of this report, will include a measure for the City to develop a monitoring program by Year 2 of the NPDES program.

The requirements of the monitoring plan should be developed once the permit is issued.

STORMWATER MANAGEMENT PROGRAM SUMMARY

The Medford Stormwater Management Program is arranged by the six minimum requirements defined in the NPDES Phase II regulations. It identifies specific activities to achieve each minimum requirement and provides a five-year schedule for when the activities will take place. The program also establishes measurable goals for assessing whether the activities have been successfully implemented. Some of the activities are continuations of existing City programs; others are new activities needed to meet the NPDES requirements. Many of them can be conducted regionally with other Rogue Valley jurisdictions. The activities associated with each minimum requirement are summarized below.

Public Education and Outreach

Medford intends to participate in a regional stormwater public education program with other members of the SWAT. The program will be a combination of regional efforts and activities at the local level. RVCOG implemented a program to educate the public about the effort to prepare the stormwater management program and what the NPDES Phase II program means to the community. The outreach included open houses, a television talk show, and presentations to city councils. The Medford stormwater management program includes the following activities:

- Develop a Stormwater Education and Outreach Strategy—This activity completed with the publication of the stormwater management program, which includes the elements of the education and outreach strategy.
- Stormwater Brochure for the General Public—The City will distribute a stormwater brochure for the general public. The brochure will either be developed by the City or the City will work with other members of the SWAT to develop a regional brochure. The City will include the homeowner brochures in one normal utility bill mailing.
- Targeted Stormwater Brochures—RVCOG will develop a targeted brochure for erosion control. The brochure will discuss the need for erosion control along within general prevention and where more information can be obtained. The brochure will be included in all building permit application packages. Other targeted brochures might address homeowners along creek corridors, or new development requirements.

- Storm Drain Stenciling—The City will continue to supply equipment and material for volunteer organizations to stencil the words "Dump No Waste—Drains to Streams" on City storm drains. It is estimated that approximately a third of the storm drains have been stenciled citywide. Some new developments are including storm drains with the "no dumping" message already cast on to the grate.
- Promote Water Quality Education with School Districts—The City will coordinate and promote stormwater education through the SWAT. The effort will include meeting with educators to determine how RVCOG staff can provide instruction and material to local educators. The coordination will include working with local organizations and school districts to develop a water quality education program.
- Work with Volunteer Groups on Stormwater Education Projects—Medford will work with local volunteer organizations to discuss opportunities to integrate stormwater into existing education projects.
- Develop a Stormwater Speakers Bureau—RVCOG has facilitated stormwater presentations for the region. Two presentations were given in the region over the past year to educate the public about the regional effort for developing stormwater management plans. RVCOG participates in a bimonthly community television program "Regional Focus" which educates the public on local issues. In November 2003, the show focused on stormwater and the regional effort for developing stormwater management plans. Speakers are available from RVCOG and the SWAT participating communities. The SWAT will maintain available speakers on stormwater issues.
- Create Stormwater Public Service Announcements [Optional]—This activity will be investigated if grant funding becomes available or if it is found that other public education efforts are not adequate.
- Design a Stormwater Display—RVCOG has developed a large assortment of stormwater exhibits and display materials to be used throughout the region. RVCOG will periodically update these materials and make them available to the SWAT participating communities and others.
- Create a Stormwater Web Site—RVCOG has begun developing a stormwater section on its website. The website is located at: http://rvcog.org/MN.asp?pg=WR_Stormwater

Public Involvement and Participation

Medford will participate in a regional stormwater public involvement and participation program with other members of the SWAT. The program will be a combination of regional efforts and activities at the local level. The Medford stormwater management program includes the following activities:

- Public Review/Public Meetings—The City will work with the SWAT to investigate ways to encourage the involvement of the public in stormwater activities. A significant amount of public input and involvement was included in the development of the Regional Guide. This effort will continue and the SWAT is committed to working with interested individuals or groups.

- Distribute News Releases— The distribution of news releases will be provided when the local press is available and interested in stormwater topics. No schedule for this has been developed and opportunities will depend on the news agencies' interest in stormwater activities.
- Stormwater Advisory Team—The SWAT has been developed for the region to coordinate regional stormwater programs. The SWAT is a stormwater advisory panel with staff from each jurisdiction and will solicit input on the development and implementation of the stormwater program. Input will be solicited from representatives of businesses, industries, conservation groups, residential and civic associations, and other interested stakeholders. The panel will have bi-monthly or quarterly meetings to coordinate the regional effort.

Illicit Discharge Detection and Elimination

An illicit discharge detection and elimination program will be developed for the City. The following elements of the program are outlined in the stormwater management program:

- Storm Sewer System Map—Medford recently completed a storm sewer system map. The City has over 100 miles of storm pipe, 55 miles of roadside ditches and 25 miles of creek channels. As new development is permitted, the new drainage systems will be added to the base map.
- Ordinance to Prohibit Non-Stormwater Discharges—The following sections of Medford City Code address illicit discharges to the storm sewer system:
  - *Medford City Code Section 11.201*: It is unlawful to discharge, permit the discharge, or permit or allow a connection that will result in the discharge of sewage or industrial waste into a storm drain.
  - *Medford City Code Section 4.850*: This ordinance makes it unlawful to discharge polluting elements into the stormwater system. Section 4.900 states the enforcement that can be taken if a violation occurs.

  The ordinances will be as needed to comply with NPDES Phase II.
- Detect and Address Non-Stormwater Discharges—An Illicit Discharge Plan will be prepared, with procedures for inspection and detection of illicit discharges. The following components will be included in the plan:
  - Identification of priority areas for assessment
  - Field assessment activities
  - Routine schedule for system inspection
  - Characterization of any discharges found
  - Procedures to trace an illicit discharge
  - Procedures to remove an illicit discharge

- Conduct Field Inspections—The Illicit Discharge Plan will provide a schedule and reporting procedures for inspections. At a minimum each outfall will be inspected on a three-year rotation. Appropriate actions will be taken to determine the source of any illicit discharges found during the inspections.
- Spill Response Plan—Medford currently has a Spill Response Plan that includes cleanup of public spills and reporting to the Oregon Emergency Response System. The City has a truck dedicated to spill cleanup. Medford will continue to follow its Spill Response Plan.
- Plan for Enforcement Actions—Enforcement action for illicit discharge violation is presented in Section 4.900 and Sections 11.701 through 11.721 of the Medford City Code. Enforcements will be documented, and all records will be reported annually.
- Train Municipal Staff on Spill and Illicit Discharge BMPs—Municipal staff will be trained in the proper BMPs to use for spill response and illicit discharge detection and removal. The training will occur in combination with training for pollution prevention. Refresher training will update staff on changes to the procedures as needed.

Construction Site Stormwater Runoff Control

The City will develop, implement, and enforce a program to reduce pollutants in stormwater runoff from construction activities. Regulations covering this activity will be part of an overall City stormwater ordinance to be developed. The stormwater management program outlines the following activities:

- Adopt an Erosion and Sediment Control Ordinance—Medford will develop an ordinance addressing construction site runoff for construction projects disturbing at least 1 acre. The ordinance will require that construction sites comply with erosion and sediment control requirements in design manuals or standards adopted by the City of Medford. The ordinance will also address the control of dust from construction sites. City Code 6.361, which prohibits track-out onto city streets, is the only City ordinance at this time that addresses erosion control practices.
- Train Plan Reviewers and Field Inspectors—Medford will train City staff responsible for reviewing plans and inspecting construction sites to ensure that erosion and sediment control BMPs are properly installed and maintained. Refresher training will update staff on changes to the procedures as needed. Medford may participate in a regional training program, which might include training programs by DEQ and RVCOG.
- Review Site Plans for Erosion and Sediment Controls—Once a stormwater ordinance is adopted, construction site plans will be reviewed to ensure that they comply with local ordinances and stormwater management manuals. Plans will also be reviewed for appropriate use of erosion and sediment BMPs as well as post-construction controls.
- Receive Information from Public—On brochures, permit applications and other publications, the phone number of the City's Public Works

Department will be given to allow the public to report complaints or comments regarding construction site runoff. Comments and follow up activities will be monitored internally by City staff. The City's construction inspector will receive information on each complaint by the end of the day and will be responsible for following up on each complaint within two days. The phone number will be published in the local phone book, in stormwater brochures, and on the RVCOG stormwater website.

- Inspect Construction Sites—All construction sites that are required to submit site plans for erosion and sediment control will be inspected to ensure that the selected BMPs are installed and maintained correctly. Site plans must reflect any changes made on-site after the plans were reviewed. The frequency of inspection will be determined based on the complexity of the project. Each construction site shall be inspected at least once.
- Provide Information on Training for Construction Operators—A brochure on construction site erosion control and post construction controls will be prepared and distributed. This will include brief descriptions of erosion control methods and sources of additional information. The brochure will include information on training available for local construction operators.

Post-Construction Stormwater Management

The City is currently developing stormwater detention requirements for development within the city limits. The stormwater management program outlines the following activities:

- Ordinance Requiring Post-Construction Control—The City is in the process of adopting an ordinance for post-construction control. The draft ordinance specifies detention facility requirements and operation and maintenance requirements. Medford currently has post-construction requirements for the Elk Creek and Midway Basins. These requirements limit the peak runoff rates during the design storm from any new commercial or industrial development in either basin to 0.25 cfs per acre. Medford is currently working with the City of Ashland to develop development standards that will include requirements for post-development runoff control.
- Develop a Plan to Address Post-Construction Runoff—Medford will either develop a stormwater design manual or work with local jurisdictions to adopt a regional design manual for addressing stormwater issues. The manual will include construction site erosion and sediment controls as well as design guidelines for post-construction water quality BMPs and runoff quantity control.
- Training for Plan Reviewers and Field Inspectors—Once an updated ordinance is in place, Medford will train City staff responsible for reviewing plans and inspecting construction sites to ensure that appropriate post-construction stormwater management is employed. Refresher training will update staff on changes to the procedures as needed.
- Site Plan Review for Post-Construction BMPs—Once the updated stormwater ordinance is adopted and a design manual is developed, City

staff will start reviewing permit drawings for compliance with local ordinances and stormwater management manuals. Plans will also be reviewed for appropriate post-construction controls as well as erosion and sediment BMPs.

- Inspections of Structural Post-Construction BMPs—The proposed post-construction detention ordinance includes requirements for operation and maintenance. An operations and maintenance manual will be required prior to obtaining a building permit or approval to construct stormwater detention facilities. Once the facility is constructed, the engineer will be required to file a construction inspection report with the City prior to final acceptance.

Pollution Prevention in Municipal Operations

Most City operations already meet NPDES pollution-prevention requirements, but the City will develop a formal operations and maintenance (O&M) plan to document existing activities, with minor modifications to reduce pollutants. The stormwater management program outlines the following activities:

- Operation and Maintenance Plan—The City of Medford will review existing public works O&M activities and document the activities in a plan that will include the following:
  - Descriptions of required maintenance activities and procedures
  - Identification of the departments and personnel responsible for each activity
  - A schedule of activities, including maintenance, inspections and reports.
  - Rules for the use of herbicides and pesticide by the Public Works Department.
- Park and Open Space Maintenance—The Public Works Department will work with the City's Parks Department to implement BMPs such as reducing and monitoring fertilizer, herbicide and pesticide application; vegetation maintenance and disposal; and trash management.
- Vehicle and Equipment Washing—Medford will implement vehicle and equipment washing practices as outlined in the O&M Plan. All publicly owned vehicles shall be washed in a self-contained covered building or a designated wash area. The City is scheduled to construct a vehicle and equipment washing facility during 2005.
- New Construction and Land Disturbances—Medford currently requires that BMPs be followed for public construction projects. This practice will continue once the O&M Plan is developed. Public construction projects will be required to follow the same requirements and procedures as private development.

- Dust Control Practices—Erosion control and dust control are currently required for all public construction projects as part of the bid documents and specifications.
- Stormwater System Maintenance—Medford will continue its existing stormwater system maintenance schedule, which includes the following:
  - Storm line cleaning—5-year rotation
  - Culverts—5-year rotation
  - Drainage ditches—as needed, some cleaned each year
  - Creeks—annual vegetation maintenance and debris removal (8 miles per year)
  - Inlets—5-year rotation and as needed
  - Trash racks—weekly in winter
  - Manholes—5-year rotation.
- Open Channels and Structural Stormwater Controls—Open channels and structural stormwater controls will be inspected and maintained regularly. Waste from the stormwater controls will be disposed of properly, and records of cleaning and maintenance will be kept. Medford currently conducts annual vegetation maintenance and debris removal in creeks.
- Road, Highway and Parking Lot Maintenance—The City's Road Department currently follows pollution prevention practices for sanding and street sweeping. Once the O&M Plan is adopted, the Road Department will continue to following practices outlined in the Plan for snow removal. Medford contracts with the Oregon Department of Transportation for deicing, which occurs only on overpasses. All sanding materials are kept in a concrete bin specifically for that purpose. The City conducts street sweeping on all curb-and-gutter streets every three to four weeks with a regenerative street sweeper. Streets that have been sanded are swept when the sand is no longer needed.
- Flood Management Projects—The City will implement review procedures for flood management projects. All new flood management projects will include water quality considerations. Previously identified priority flood management projects will be reevaluated for water quality considerations.
- Employee Training on O&M Implementation—City staff will be trained on O&M procedures. The training will occur in combination with training for the illicit discharge and spill plan. Training will be general for all municipal employees, with more specific training for specific program areas. Refresher training will update staff on changes to the procedures as needed.

CHAPTER 6.
STORMWATER MAINTENANCE PROGRAM

A well-defined stormwater maintenance program is a working tool for the benefit of City maintenance personnel. Such a program provides a general guide to help ensure that the work required to keep the stormwater system functioning properly is performed efficiently and in a timely way. An ideal maintenance program identifies specific tasks that must be performed, potential pitfalls if needed work is not performed, and permitting issues associated with maintenance activities. A clear definition of work to be done allows for reasonable cost estimates to be developed so that maintenance activities can be budgeted for along with capital improvements.

There are many documents to assist communities with developing an overall maintenance program to reduce pollutants and sediment in stormwater. Many of these were used to develop this chapter and should be reviewed prior to finalizing a maintenance program. A good document for citywide activities is *Oregon Municipal Stormwater Toolbox for Maintenance Practices* (Oregon Association of Clean Water Agencies, June 1998). The City's road maintenance department should adopt *Routine Road Maintenance; Water Quality and Habitat Guide Best Management Practices* (Oregon Department of Transportation, July 1999).

This chapter describes elements that can be used to develop an overall stormwater maintenance program for the City of Medford. Some of the elements presented can be incorporated into current maintenance activities; others will be investigated by City staff and developed in the future as part of the overall program. Examples of specific program elements are presented, along with recommendations for future maintenance activities. The following program elements are presented:

- **Core maintenance activities**—This is a summary of the essential tasks to be performed to maintain the City's stormwater system. Checklists at the end of this chapter give detailed information on the maintenance of every kind of facility in the stormwater system.
- **Guidelines for work in environmentally sensitive areas**—These guidelines address the specific considerations that must be taken into account when maintenance activities are performed in or near streams, wetlands and steep slopes.
- **Regulatory and permitting considerations**—Information is provided on regulations that may apply and permits that may be required when maintenance work is to be performed.
- **Sediment and debris management**—An overview is provided on issues specifically associated with the handling and disposal of sediment and debris removed from stormwater facilities.
- **Illicit discharge detection program**—An essential stormwater maintenance activity is the detection and removal of illicit pollutant

discharges to the stormwater system. The illicit discharge detection program outlines practices for addressing such discharges.

- **Safety and training**—A summary is provided of the need for City maintenance staff to have proper training and to be safety-conscious.
- **Tracking and recordkeeping**—Efficient ongoing maintenance requires an organized system for recording and tracking maintenance needs and completed activities. An information management system is described and forms are provided at the end of the chapter.

CORE MAINTENANCE ACTIVITIES

The City of Medford currently provides the following stormwater maintenance activities.

- **Street and Drainage System Cleaning**—The City conducts street sweeping on all curb and gutter streets every three to four weeks with a regenerative type street sweeper. Streets are also swept after being sanded once the sand is no longer needed.

  The drainage system (manholes, catch basins, pipes, culverts) is cleaned on a five-year cycle. Trash racks are cleaned weekly during winter. The City of Medford has two vacuum combination machines for cleaning all its storm lines.
- **Maintenance of Streams**—Vegetation maintenance and debris removal are conducted annually on creeks in the City; approximately 8 miles per year are maintained.

The City's stormwater system consists of many diverse elements—from the streams and wetlands that convey and store runoff to constructed treatment and detention facilities. Properly maintaining all these elements requires regular inspection and clear guidelines for maintenance and repair activities. Inspection and maintenance action checklists are provided for maintenance field staff at the end of this chapter. The checklists detail the recommended inspection frequency for stormwater facilities, conditions to look for, corrective actions, special considerations, and estimated time to perform the work.

The checklists identify required tasks for each type of facility. They do not describe the best way to perform identified tasks; this is generally determined by crews doing the work. Only routine maintenance is addressed; emergency response and system repair and construction are not discussed.

The City is responsible for ensuring that appropriate equipment is available for needed maintenance activities. The equipment should be serviced and maintained as needed to ensure that it remains operational. Medford currently has a washing facility for its maintenance vehicles and equipment. An additional facility is being constructed that will be used for maintenance vehicles only; the existing facility will be used for all other publicly owned city vehicles.

GUIDELINES FOR WORK IN ENVIRONMENTALLY SENSITIVE AREAS

Special considerations apply whenever a maintenance activity is conducted in a sensitive area such as a stream, a wetland, a steep slope, or the associated buffer area. Maintenance work in these areas requires special consideration to protect the quality of surface water, groundwater, shorelines, stream flow, slope stability, and wildlife and fisheries habitat. This section outlines recommendations for working in sensitive areas.

Maintenance activities in sensitive areas must be performed in a way that accomplishes the goals of minimizing adverse impacts and protecting surface and groundwater resources. Proven best management practices (BMPs) should be used to achieve these goals. Specific objectives for achieving the goals include the following:

- Minimize disturbance
- Control siltation
- Minimize turbidity
- Maintain stream flows
- Preserve natural flood storage capacity
- Protect fish-bearing waters
- Protect groundwater recharge
- Protect associated wildlife habitat.

Erosion and Sediment Control

Erosion and sediment control should be used for any maintenance activity that will result in disturbed areas in a stream, wetland, lake, steep slope or associated buffer area. General principles for erosion and sediment control include the following:

- **Scheduling work for the dry season—**Construction in the dry season (April 1 to September 30) is one of the most effective forms of erosion control.
- **Minimizing the extent and duration of exposed area—**Restrict the area to be cleared and the length of time it is exposed to substantially reduce the risk of erosion. This includes seeding or covering the exposed area immediately after work is completed. In the wet season, soil may remain uncovered for a maximum of two days; in the dry season, the duration will depend on weather conditions.
- **Providing barriers between the project area and surface water—**Anticipate rainfall and potential high water. Isolate the work area with berms, sandbags, or filter fencing.
- **Consideration of topography, soils, drainage patterns—**Limit disturbance of steep slopes, erosive soils, and natural drainage ways.
- **Emphasizing erosion control rather than sediment control—**Limiting erosion will greatly reduce the effort required to control sediment once it is entrained in runoff.

- **Treating pumped water—**Remove sediment from dewatering operations by releasing the water into vegetated areas well away from surface water or by using sediment traps.
- **Limiting runoff velocities—**Reduce the possibility of concentrated runoff forming rills and gullies and causing severe erosion.
- **Providing sediment retention—**Contain or filter all sediment-entrained runoff using methods to remove coarse as well as fine sediment.
- **Monitoring and maintaining all BMPs—**Regular monitoring of conditions and maintenance of erosion and sediment control measures ensures maximum protection of sensitive areas.

Projects in or near fish-bearing streams or connected wetlands may require specific provisions determined by the Oregon Department of Fish and Wildlife (ODFW). Any activity that has the potential to damage water resources should be discussed with ODFW.

Table 6-1 provides a guideline for selecting from several of the most common sediment and erosion control practices. Numerous sources exist that include more detailed information regarding sediment and erosion control. The DEQ is in the process of developing an erosion control manual for Oregon. Training courses will be provided by DEQ throughout the state.

Temporary erosion and sediment control measures must not be removed until the site is permanently restored. All temporary control measures should be removed within 30 days after the site is stabilized or after the measures are no longer needed. Sediment collected in traps, ponds, or silt fences must be removed and disposed of in an approved manner or stabilized on site. Disturbed soil areas resulting from sediment removal should be permanently stabilized within seven days.

Vegetation Management

Vegetation plays an important role in soil stabilization, water quality, and wildlife habitat. The purpose of vegetation management is to establish and maintain stable plant communities that resist encroachment by undesirable plants, noxious weeds, and other pests. In addition, maintaining certain operational, health, natural resource, or environmental standards may warrant vegetation control. The following are basic guidelines for vegetation management associated with the stormwater system:

- Poisonous vegetation that constitutes a hazard to maintenance personnel or the public should be removed.
- Invasive exotic species that interfere with channel flow and limit habitat diversity should be removed.
- Weeds, grasses, or brush that obstruct access or stormwater flow and crowd out native vegetation should be removed.
- Roots of native vegetation that obstruct pipes and culverts should be removed.

TABLE 6-1
APPLICATION LIMITS OF EROSION AND SEDIMENTATION CONTROL TECHNIQUES

Technique	Maximum Drainage Area (acres)	Maximum Velocity (ft/sec)	Maximum Discharge (cfs/sq ft)	Slope (H:V)
Sediment pond, sediment trap	Depends on load capacity of pond	Depends on settling velocity of particles	N/A	N/A
Silt/filter fabric fence	1	N/A	0.05 to 0.1	1:1
Straw or hay bale barrier[a]	0.25	N/A	0.01	1:1
Brush berm	0.25	N/A	0.1	N/A
Sandbag berm	5	N/A	N/A	N/A
Rock berm	5	N/A	1 cfs per 8 linear feet 0.1 cfs/sq ft	Depends on spacing of berms
Triangular sediment filter dike	1	N/A	0.05	N/A
Perimeter dike	5	N/A	N/A	Depends on spacing between dikes
Gravel outlet structure	5	N/A	N/A	N/A

a. Not to be used in high sediment producing areas. Length of slope should be less than 100 ft (50 ft if slope is greater than 10%)
Source: City of Olympia Drainage Design and Erosion Control Manual, 1994

- Trees should be left alone as long as they do not interfere with maintenance activities or pose safety hazards. Selective pruning may be performed to facilitate access, improve tree health, or reduce hazards, but at no time should a tree be topped. Trees should be removed only when absolutely necessary.
- The City's Park Department should develop detailed guidelines for maintenance activities, along with lists of desirable and invasive plants.

Vegetation removal and control should always be followed by replacement with native species vegetation and seed.

Biological Methods

Cost-effective long-term control of invasive or weedy vegetation can be achieved through biological means such as competition management. Competition management makes use of natural plant succession to achieve the desired results. For example, many weedy species are relatively intolerant to shading, such as reed canary grass. By encouraging competition by taller native species of shrubs and trees and allowing them to grow freely, the weed species will be overtopped and shaded. Eventually the shade will reduce the amount of weed cover to more tolerable levels. Other biological methods include release of plant-specific insects and browsing of aquatic vegetation by fish.

Mechanical Methods

Mechanical methods of vegetation control include hand pulling, mowing, flooding, and shading with artificial covers such as geotextiles, plastic sheeting, rock or organic mulches.

Chemical Methods

The use of chemicals for vegetation control should be determined by qualified personnel, and is normally prescribed only for major weed infestations. Herbicides may be used in pre-emergent or post-emergent applications or as growth regulators to kill or control weeds. Factors such as timing of use, application rates, methods, and environmental precautions such as location relative to water bodies are specific to each type of chemical. Maintenance staff should ensure that application of all herbicides is performed in strict accordance with label instructions and local, state, and federal laws.

Pesticides, including insecticides, herbicides, and fungicides, should not be used within sensitive areas or their buffers. If no reasonable alternative exists, application of pesticides should be strictly controlled and performed by a certified pesticide applicator following all safety precautions and application recommendations.

Application of fertilizers within the buffer area of any aquatic sensitive area should be performed on a limited basis and timed to avoid wet, rainy weather. If fertilizer is required within the buffer area of a lake, the use of a no- or low-phosphorus type is recommended.

Recommendations

Steep Slopes

Steep slopes require erosion and sediment control parameters to avoid erosion and landslides. Maintenance activities in steep slope areas need to be sensitive to the role vegetation plays in stabilizing highly erodible soils and steep slopes. Activities in these areas should be scheduled to be performed during the dry season (April 1 to September 30) if possible. The area and duration of disturbed and exposed soils should always be minimized; application of erosion control techniques that prevent soil from eroding is preferred to treating runoff. These techniques include project phasing, runoff diversion, and the maintenance and establishment of vegetation.

Some maintenance activities require the temporary rerouting of stormwater. Concentrated flows that would cross an exposed slope should be diverted or contained to prevent erosion, sedimentation, and undermining of slope stability. Where drainage from impervious surfaces flows toward steep slopes, the flow should be piped or "tightlined" down the slope and beyond the buffer boundary. If large areas are exposed, the slope surface should be contour-plowed or shaped to retard the flow of stormwater runoff and prevent the formation of concentrated flows. All disturbed areas should be seeded with an erosion-control mix immediately after completion of the work.

Mulch, erosion control blanket material, rooted plants, or bioengineering techniques may be required to stabilize the slope, depending on such factors as the size of area disturbed, steepness of slope, soil conditions, time of year, and hazard potential. Where necessary, interceptors, check dams, cribbing, riprap, or other appropriate measures should be employed to minimize erosion and maintain slope stability.

Streams

Medford city code includes stream buffer protection in Sections 10.920 through 10.928. Maintenance of utilities or other public improvements is addressed in Section 10.925. Section 10.924 identifies permitted activities within a riparian buffer and Section 10.926 identifies the prohibited activities. The City Code defines a riparian buffer follows:

> "Riparian Corridors," shall be applied to those waterways, or portions thereof, identified by the Medford Comprehensive Plan as being fish-bearing streams, and any other waterways, or portions thereof, specified in the Medford Comprehensive Plan as having riparian areas determined to be significant."
>
> The riparian corridor boundary shall extend 50 feet measured horizontally from the top-of-bank, as defined herein, on both sides of those waterways identified in section 10.922 A. "Riparian Corridors, Applicability", and having an average annual stream flow of less than 1,000 cubic feet per second (cfs), unless a request to reduce the setback has been approved according to section 10.927, "Riparian Corridors, Reduction or Deviation." Where the top-of-bank has been relocated as part of an approved waterway restoration project, at the request of affected property owners, the riparian corridor boundary shall extent 50 feet from the original top-of-bank.

Although not all streams within the Medford city limits are protected under the city code, the most of the stream length within the city limits drain to Bear Creek, which is listed as a water quality limited stream by the DEQ; therefore the following recommendations are for all streams and drainageways in the City.

Before any work beyond the maintenance activities described in this manual is performed in streams, applicable permits, if any, from the Oregon Division of State Lands and the U.S. Army Corps of Engineers shall be obtained. If necessary, plans for development or improvements within a riparian corridor shall be submitted to the Oregon Department of Fish and Wildlife for a habitat mitigation recommendation pursuant to OAR 635-415 (Fish and Wildlife Habitat Mitigation Policy).

Maintenance work in streams or their buffer areas should be performed during the dry weather season (April 1 to September 30) following the general guidelines provided. Due to the probable presence of fish in the wet weather season, extra precaution should be used to avoid disturbing stream bottoms during non-emergency maintenance.

Soil-disturbing maintenance activities in streams or within their buffer areas require erosion and sediment control BMPs to prevent sediment from entering the stream. Work within the ordinary high water mark of the stream may require a temporary bypass of flows around the work area. This is the preferred method of limiting sediment inputs to the stream for larger projects. If a bypass is not possible, or if the project is small, sediment and erosion control BMPs such as sediment traps, check dams, and silt fences should be in place and functioning before work begins.

With the exception of invasive non-native or noxious species, removal of streambank vegetation for maintenance purposes should be minimized. Streambank stabilization BMPs should be performed as soon as practicable following all disruptive maintenance activities. The selection of streambank stabilization BMPs depends on slope conditions, proximity to flow and structures, flood levels, and City requirements. Vegetative methods or a combination of vegetative and structural techniques are preferred over purely structural methods (e.g., riprap or gabions), which should be used only when absolutely necessary.

Replacement culverts in major streams must be sized and placed to provide fish passage and to convey the 100-year flow without creating a net rise in the base flood elevation. The culverts should also comply with the City's adopted Drainage Master Plan. Such replacement is normally closely regulated by the City and ODFW and is subject to review for its impact on downstream flows as well as on fishery resources.

Wetlands

The city code for riparian buffers states the following regarding locally significant wetlands within or adjacent to a riparian corridor:

> "When a locally significant wetland is located within or adjacent to a riparian corridor, the riparian corridor setback will be applied, and shall be measured from the boundary of the wetland."

The *Medford Local Wetlands Inventory and Locally Significant Wetland Determination* (Wetland Consulting, 2002), identified 293 acres of wetland in the City. Forty-five of these wetlands were defined as locally significant and six were identified as being special interest for protection. When working in or near wetlands, maintenance activities should use appropriate BMPs to prevent pollutants from entering the wetland.

The recommendations for streams also apply to maintenance activities in wetlands and their buffer areas. An additional concern for wetlands is the potential impact of any activity on wetland water levels and hydroperiod.

REGULATORY AND PERMITTING CONSIDERATIONS

The Clean Water Act of 1977 and the Water Quality Act of 1987 (amendments to the Federal Water Pollution Control Act) provide the backbone for the national approach to water quality policy and action. The U.S. Army Corps of Engineers and the Oregon DEQ have authority to implement and enforce regulations and work cooperatively with local governments to enforce the programs of the federal Clean Water Act, such as with the National Pollutant Discharge Elimination System Program (NPDES). The state, in turn, has delegated the implementation and enforcement of many programs to local agencies.

This section briefly summarizes applicable local, state, and federal programs that implement aspects of the Clean Water Act and provide permits for working in sensitive areas. Each agency must be contacted for specific requirements, permits, and regulations.

Local

The City of Medford is responsible for implementing state and federal requirements that affect activities in sensitive areas. Medford City Code Section 10.925 requires that a conditional use permit be obtained for utilities and other public improvements. The code also requires that "Applicable permits, if any, from the Oregon Division of State Lands and the U.S. Army Corps of Engineers shall subsequently be obtained. All development and improvement plans shall be submitted to the Oregon Department of Fish and Wildlife for a habitat mitigation recommendation pursuant to OAR 635-415."

State and Federal

Specific permits may be required by other agencies to perform certain types of maintenance work in sensitive areas and their buffers. The following agencies should be contacted well in advance of scheduled work to determine the need for a permit.

Department of State Lands

Under Oregon's Removal-Fill Law (ORS 196.795-990) a permit from the Department of State Lands is required for removal of fill material from waters of the state. A permit or general authorization is required by the Oregon Department of State Lands for projects involving the following activities:

- Projects requiring the removal or fill of 50 cubic yards or more of material in waters of the state.
- The removal or fill of any material, regardless of the number of cubic yards affected, in a stream designated as essential salmon habitat.
- The removal or fill of any material from the bed and banks of scenic waterways, regardless of the number of cubic yards affected.

Bear Creek and Larson Creek have been identified as essential salmon habitat within Medford.

Department of Environmental Quality

The requirements of Section 401 of the Clean Water Act pertain to any activity that requires a federal permit and that may result in a discharge to state water. The Section 401 certification process is implemented through the DEQ. Its purpose is to certify that materials to be discharged into waters of the state comply with applicable effluent limitations, water quality standards, and other applicable conditions of state law.

U.S. Army Corps of Engineers

The two federal permits most often required for maintenance activities in sensitive areas are issued by the Corps of Engineers. The following is a general summary of the Corps' regulatory program.

Section 404 Permit

This permit is required under Section 404 of the Clean Water Act and is intended to restore and maintain the chemical, physical, and biological integrity of the nation's waters through the control of discharges of dredged or fill material. Activities requiring a Section 404 permit include discharge of dredged material, fills, groins, breakwaters, road fills, riprap, and jetties. Many other activities, such as ditching, drainage, and revegetation removal, may also be regulated under Section 404.

Letters of permission are given for minor or routine work with minimal impact. Nationwide permits (NWPs) are those that have already been issued to the public at large. Several NWPs relate to maintenance and repair work. NWP 3 authorizes the repair, rehabilitation, or replacement of structures destroyed by storms, floods, fire, or other discrete events. NWP 13 allows bank stabilization activities necessary for erosion prevention, provided it meets several requirements. The local Corps office should be notified of all activities in sensitive areas, including those covered by NWPs.

Section 10 Permit

This permit, authorized under Section 10 of the U.S. Rivers and Harbors Act, is required for any structure or work in navigable water of the U.S. Examples of projects requiring Section 10 permits include utility lines, floats, intake pipes, outfall pipes, bulkheads, dredging, and fills. Navigable waters are those waters of the U.S. that are subject to the ebb and flow of the tide shoreward of the mean high water mark, or that have been used to transport interstate or foreign commerce, and their adjacent wetlands.

SEDIMENT AND DEBRIS MANAGEMENT

Frequent removal of accumulated sediment and debris significantly improves the conveyance capacity and pollutant removal efficiency of stormwater facilities. Frequent street sweeping reduces the pollutant load entering the storm system, and in turn the amount of pollutant that need to be removed from the storm system. Handling and disposing of the solids, organic debris, and trash that accumulate in facilities such as catch basins, vaults, and swales entails, in most cases, hauling to the nearest landfill site.

Organic debris such as leaves should be composted. Tree limbs should be chipped for mulch or composting. Organic material is considered a valuable resource by many people, and many landfills now provide a separate holding or composting area for these materials.

Sediment removed from detention facilities, biofilters, open channels, or culverts may be temporarily stockpiled as long as runoff is positively prevented and the pile is covered between November 1 and March 31. Generally, bottom sediments removed from these facilities are not classified as hazardous waste and have heavy metal concentrations less than those of typical wastewater sludge. These sediments can be disposed of by land application, or as required by the City Waste Management Division.

Pollutant-contaminated sediments, waste oil, and debris from oil/water separators must be disposed of in accordance with OAR 340-093 (Solid Waste: General Provisions), and where appropriate OAR 340-093-0170 (Cleanup Materials Contaminated with Hazardous Substances) and OAR 093-0190 (Waste Requiring Special Management).

Oil/water separator waste is often too "dirty" to be recyclable; however, several vendors handle waste oil hauling and disposal. Any standing water removed during maintenance operations should be disposed of in a sanitary sewer.

ILLICIT DISCHARGE DETECTION PROGRAM

An illicit discharge plan must be prepared in accordance with the *Rogue Valley Regional NPDES Phase II Stormwater Program Guide*. The plan will include the following components:

- **Identification of priority areas for assessment—**Priority areas for investigation should be identified; past experience and knowledge of surrounding land use are effective indicators to determine the priority for different areas of the storm drain systems.
- **Field inspections—**A schedule and reported procedures should be developed. At a minimum, each outfall shall be inspected on a three-year rotation. Appropriate actions should be taken to determine the source of any illicit discharges found during the inspections.
- **Characterization of any discharges found—**If a discharge is found, it must be determined whether it is illicit, not contaminated, or a non-stormwater discharge. Determination of whether a discharge is illicit can require visual inspection, field sampling, and laboratory analysis.
- **Procedures to trace an illicit discharge—**When an illicit discharge is identified, its source must be identified in order to stop it. Three steps can be taken to identify the source of an illicit discharge:
  - Visually inspect the surrounding area and storm drain system for an obvious source of surface runoff and any potential contributing sources.
  - If the source is not quickly identified on the surface, trace the discharge upstream in the storm drain by opening manholes.
  - If the previous methods are not successful, a more detailed inspection may be required. It may be necessary to use the city's video truck or dye testing to locate the source of an illicit discharge.
- **Procedures to remove an illicit discharge—**The procedure necessary for removing the source of an illicit discharge varies depending on the severity and nature of the event. The first step in removing an illicit discharge is to notify the appropriate authorities. Second, the property owner must be notified of the discharge, the corrective action necessary,

and an appropriate timeframe for eliminating the discharge. Enforcement action for illicit discharge violation is outlined in Sections 11.701 through 11.721 of the Medford City Code and in Section 4.900. Escalating enforcement and legal actions may be required if the discharge is not eliminated**.**

SAFETY AND TRAINING

Safety is a major consideration while performing maintenance of stormwater facilities, due to the potentially harmful atmosphere in below-ground spaces, corroded supports, traffic, swift or deep flowing water, falling objects, powerful machinery, sharp edges, heavy lifting, and hazardous materials. One of the most critical safety precautions to take is to provide an adequate number of personnel to perform the work and provide assistance.

Formal safety training and regular refreshment safety training are integral parts of the maintenance program. Current safety training includes special instruction in trenching and shoring protection, flagging and traffic control, first aid and CPR, confined space entry, slope protection, dam safety, and first responder hazardous materials handling. Possible additional safety training could include instruction in the following:

- Powered hand tools, mowers, chippers
- Water rescue
- Pesticide use, including applicator certification with aquatics endorsement.

Other types of training should include the following:

- Erosion and sediment control
- Stormwater facility inspection
- Habitat modifications
- Vegetation management.

TRACKING AND RECORDKEEPING

Organizing inspections and maintenance using a computerized information system would position the City of Medford to handle its expanding stormwater maintenance needs. Staff could be assigned an inventory of facilities to inspect for specific maintenance, with a laptop computer for field use. The information system would contain an identification number for each facility, its type (e.g., catch basin, wet pond, or swale), location, data on previous maintenance, and any special notes. After each visit, the inspector could enter a maintenance needs assessment in the computer database that would then generate a maintenance work order. Computer software programs are available that the maintenance department can use to schedule, inventory, locate, search maintenance history, prioritize, and track all work.

Maintenance records are important for tracking citizen reports, follow-up actions, work requests, inspection findings, descriptions of maintenance activities, and dates of actions. This information is critical for staff management, planning, and budgeting. The information can also be beneficial to other Public Works divisions in meeting stormwater program requirements, aiding in problem identification, field investigation, and enforcement.

Inspections, routine and preventive maintenance activities, and corrective maintenance actions should be recorded. This information can be used for reference, scheduling, tracking, and accounting purposes. All activities could be recorded on inspection/maintenance field forms or, at some point, entered directly into a maintenance database by field staff. Optimum recordkeeping information should consist of the following, at a minimum:

- Inspection/Maintenance Field Forms (an example is provided at the end of this chapter)
- GIS mapping of facilities tied to a database containing such information as:
  - Location/ownership information
  - Facility descriptions
  - Records of inspection
  - Operation and maintenance requirements and frequencies
  - Maintenance actions and maintenance history
  - Findings of fact from any exemption granted by the City
  - As-built plans
- Facility operation and maintenance manuals or engineering reports
- A master maintenance schedule (an example is provided at the end of this chapter); this schedule could be facility-specific and revised as facilities are encountered in the field.

In addition to the recommended minimum information above, the following information related to each stormwater facility can benefit the maintenance program:

- Types of BMPs and their locations
- Maintenance responsibility (private vs. public)
- Present condition
- Needed repairs
- Facility capacity
- Unique problems
- Incoming conveyance system type and location
- Receiving conveyance system or receiving water

Generally, the more information kept on all aspects of inspection and maintenance activities, the better. Records, whether maintained manually or with a computerized system, must be kept current and complete and be referenced for easy retrieval. These records will assist the City in meeting other stormwater program requirements, such as problem identification, field investigation, enforcement and NPDES reporting. Good recordkeeping also facilitates planning future work and identifying problems or facilities that require further attention.

Considerable time and effort may be necessary to gather baseline information on the system, and this should be considered an ongoing effort. Recording information gained through maintenance activities will broaden the stormwater system database.

STORMWATER MAINTENANCE CHECKLISTS AND FORMS

Inspection and Maintenance Action Checklists

Stormwater Facility Inspection/Maintenance Field Form

Master Maintenance Schedule

INSPECTION AND MAINTENANCE ACTION CHECKLISTS

The following inspection and maintenance action checklists (IMACs) are provided primarily for maintenance field staff. The checklists indicate recommended inspection frequency, conditions to look for, corrective actions, special considerations, and estimated time to perform the work. They can assist management staff with maintenance planning, scheduling, staffing, and budgeting. The work time estimates given on the checklists should be compared to actual effort required to perform each task in the future and revised as necessary.

Continual review, feedback, and revision of the checklists will make them more effective tools in the effort to manage stormwater. Some facilities will have specific maintenance requirements that are not included in these checklists; these requirements should be followed in addition to what is included on the IMACs.

The IMACs define the frequency at which facilities should be inspected for each potential problem condition. The frequencies are defined as follows:

- Storm—After any major storm (0.8 inches or more in 24 hours)
- Monthly—Each month from November through April
- Annual—Once a year in early spring or fall.

Special considerations listed in the checklists are given as code numbers, identified as follows:

1. **Procedures**—Consult the City Engineer prior to performing work.
2. **Waste management**—Dispose per Oregon Department of Environmental Quality standards.
3. **Sensitive area**—Consult the appropriate section of this chapter prior to performing work.
4. **Timing**—Check for optimum seeding/planting time.
5. **Safety**—Follow all safety protocols.
6. **Water quality**—Perform during prolonged dry periods or install temporary erosion and sediment control (TESC) features prior to performing work.

Inspection and Maintenance Action Checklist **Detention Ponds***

Inspection Frequency						
Storm	Monthly	Annual	Conditions to Check For	Action	Special Considerations	Man hours/ Action (est.)
X	X		**Trash and debris** of more than 1 cubic foot.	Remove and dispose of waste.	2	1 mh/cf
	X		**Sediment accumulations** exceeding 10 percent of the forebay design capacity or 6 inches, whichever is less.	Evaluate whether cleaning can be performed with an eductor, backhoe, or excavator. Perform work or contract out. Record amount of waste collected. Reshape and reseed as necessary.	2, 6	1-2 mh/cy
	X		**Clogging of rock "window"** between forebay and detention area with sediment or debris.	Manually remove or use mechanical equipment as described for sediment removal.	2	0.5 mh/sy
		X	**Missing rock or exposed soil** at top or outside slope of overflow spillway.	Replace rock to design elevation and revegetate as necessary to specifications.	1, 4	0.5 mh/cy
	X		**Erosion around inlets and outlets**, and any berms more than 2 inches deep.	Determine cause of erosion and eliminate it. Stabilize erosion area with rock, vegetation, or appropriate slope protection.	4	1-2 mh/sf
		X	**Settlement of dikes or berms** by more than 4 inches below design elevation.	Repair or build up to original elevation. Evaluate need for future major repair work. Revegetate as necessary.	1, 4	0.5-1 mh/cy
X	X		**Odor, sludge, or unusual color**. Presence of flammable chemicals such as natural gas, oil, and gasoline. Presence of any other chemical pollutants.	Notify appropriate city staff to investigate and determine chemical type. Remove contaminant by appropriate methods and dispose of as directed by hazardous waste protocols. Provide sign or stencil as necessary	2, 5, 6	2-4 mh/cleanup
		X	**Vegetation** that inhibits flow by more than 10%, is a risk to public health (poison oak, stinging nettles, tansy), or is an invasive species (purple loosestrife, blackberry)	Cut or remove vegetation. Consult appropriate city staff regarding use of herbicides and timing of applications.	2, 4, 5, 6	0.5-1 mh/ 100 sf
X	X		**Plugged or missing trash rack**. More than 25% of bar screen area covered.	Remove and dispose of waste. Replace screen as necessary, and take additional measures to prevent future debris accumulations.	2	0.5-1 mh/screen
	X		**Rodent holes.** Any evidence of rodent holes in facility dam or berm, or any evidence of water piping through dam or berm via rodent holes.	Destroy rodents and repair dam or berm. Contact the County Health Department for guidance.		

* Also see IMACs for Monitoring Stations, Facility Access Roads, Fencings, and Grounds Maintenance.

Inspection and Maintenance Action Checklist	Detention Vaults/Tanks/Pipes

Inspection Frequency						
Storm	Monthly	Annual	Conditions to Check For	Action	Special Considerations	Man hours/ Action (est.)
	X		**Sediment and debris** exceeding 10% of the vault/tank height or 6" in depth, whichever is less.	Remove and dispose of waste. Contract for cleaning if necessary.	2, 5	1-3 mh/cy
	X		**Plugged or blocked air vents.** Accumulations of debris or sediment exceed one-half of the vent end area.	Remove and dispose of waste.	2	1-2 mh/cy
		X	**Cracks** in joints between tank or pipe sections that leak soil into the facility.	Manually seal all cracks with appropriate grout material.	5	0.5 mh/cy
		X	**Tank/pipe bent** out of shape	Repair or replace tank/pipe to design. Use professional engineer for evaluation as needed.	1, 5	
X	X		**Missing or open manhole cover.** Locking mechanism difficult to open or lacking more than 1/2 inch of thread; cover difficult to remove.	Replace cover or repair and reinstall. Cover should operate properly and be removed easily by one maintenance person.	None	1-2 mh/cover
X	X		**Cleanout shear gate damaged**, rusted, not watertight or missing. Gate cannot be adjusted by one person. Chain or rod missing or damaged	Repair or replace to meet design standards. Repair, lubricate, or replace gate as necessary. Repair or replace chain or rod as necessary.	None	1-6 mh/repair
		X	**Ladder rungs missing**, misaligned rusted or cracked.	Replace rungs or ladder to ensure structural stability and safe access.	5	0.5-1 mh/rung
X	X		**Odor, sludge, or unusual color**. Presence of flammable chemicals such as natural gas, oil, and gasoline. Presence of any other chemical pollutants.	Notify appropriate city staff to investigate and determine chemical type. Remove contaminant by appropriate methods and dispose of as directed by hazardous waste protocols. Provide sign or stencil as necessary.	2, 5, 6	2-4 mh/cleanup

Inspection Frequency						
Storm	Monthly	Annual	**Conditions to Check For**	**Action**	**Special Considerations**	**Man hours/ Action (est.)**
X	**X**		**Trash and debris** of more than 1 cubic foot (1 garbage can).	Remove and dispose of waste.	2	1-2 mh/cf
		X	**Poorly draining facility**: operating on less than 90% of design capacity, or overflowing.	Remove and dispose of clogged filter media. Determine need for deep tilling or extensive replacement of filter media. Consider installation of sediment trap.	1, 2	1 mh/20 cy
	X		**Sediment or debris accumulations** exceeding 2 inches.	Remove with appropriate equipment to limit compaction or damage to infiltration media. Record amount of waste collected.	1, 2	1 mh/20 cy
	X		**Trash, debris, or sediment** in any inlet/ outlet pipe, sump, vault, manhole, catch basin, or settling pond.	Manually remove or use mechanical equipment such as jet spray equipment.	2	1-2 mh/cy
		X	**Rock protection missing** from overflow spillway. Rock filter clogged or damaged.	Replace rock or gravel according to design specifications. Remove blockage manually or with appropriate equipment.	1	0.5 mh/sy
		X	**Erosion within facility**.	Determine cause of erosion and eliminate. Apply appropriate temporary erosion control BMPs. Evaluate options for permanent solution.	None	1-2 mh/sf
	X		**Odor, sludge, or color**. Presence of flammable chemicals such as natural gas, oil, and gasoline. Presence of any other chemical pollutants.	Notify appropriate city staff to investigate and determine chemical type. Remove contaminant by appropriate methods and dispose of as directed by hazardous waste protocols. Provide sign or stencil as necessary.	2, 5	2-4 mh/cleanup
		X	**Vegetation is sparse, unhealthy looking.** **Vegetation is overgrown.** **Vegetation poses potential health hazard** (poison oak, stinging nettles, tansy).	Determine cause of poor growth. Revegetate to specifications as necessary. Avoid use of fertilizers. Cut vegetation and remove cuttings. Remove mechanically or evaluate herbicide treatment. Apply approved herbicide conservatively and as directed.	2, 5	1-2 mh/100 sf

* Facilities may have unique O&M requirements or manuals. Consult supervisor.

Inspection and Maintenance Action Checklist	Catch Basins and Inlets

Inspection Frequency						
Storm	Monthly	Annual	Conditions to Check For	Action	Special Considerations	Man hours/ Action (est.)
X	X		**Trash, debris, and sediment on grating.** More than 1/2 cu ft in front of or on grating, blocking capacity by more than 10%	Remove and dispose of waste.	2	0.5-1 mh/grate
	X		**Sediment or debris in sump**. Depth exceeds 1/3 the distance between the bottom of basin and the invert of lowest pipe into or out of the basin.	Evaluate whether cleaning can be performed manually or mechanically. Perform work or contract out. Record amount of waste collected at each basin.	2	2 mh/sump
X	X		**Trash or debris in any inlet or outlet pipe** blocking more than 1/3 of its height.	Manually remove or use mechanical equipment such as jet spray equipment.	2	1-2 mh/cb
	X		**Structural damage** to catch basin frame or top slab: corner extends more than 3/4" past curb face; top slab has holes larger than 2 sq in or cracks wider than 1/4"; frame is 3/4" from flush on top slab	Repair, adjust or replace as necessary to eliminate hazards to street and sidewalk users and ensure that all stormwater flow enters catch basin. Investigate potential for repair work to coincide with road resurfacing.	1	4-8 mh/cb
		X	**Cracks in basin walls or bottom** exceeding 1/2" ×1', soil particles entering catch basin through cracks	If basin is structurally sound, patch or repair as necessary. If basin is not deemed structurally sound or cracks are greater than 3' in length, replace to design standards.	1	2-16 mh/cb
		X	**Settlement of basin** by more than 1" or rotation of more than 2" from alignment.	Repair, reset, or replace to design standards.	1	8-16 mh/cb
X	X		**Odor, sludge, or unusual color**. Presence of flammable chemicals such as natural gas, oil, and gasoline. Presence of any other chemical pollutants.	Notify appropriate city staff to investigate and determine chemical type. Remove contaminant by appropriate methods and dispose of as directed by hazardous waste protocols. Provide sign or stencil as necessary.	2, 5	2-4 mh/cleanup
X	X		**Vegetation visibly inhibiting flow**.	Depending on surrounding land use either cut vegetation or remove. Consult appropriate city staff regarding use of herbicides and timing of applications.	5	0.5-2 mh/cb
	X		**Broken grate.** Grate has multiple crack or any cracks longer than 2".	Replace Grate	5	

Inspection Frequency						
Storm	Monthly	Annual	**Conditions to Check For**	**Action**	**Special Considerations**	**Man hours/ Action (est.)**
	X		**Sediment, debris, or trash** is blocking or is less than 1½' from restrictor/orifice plate	Remove and dispose of waste. Contract for cleaning if necessary.	2, 5	6-12 mh/structure
		X	**Structural integrity**. Tee-type flow restrictor is not securely attached to manhole wall and outlet pipe. Weir or baffle flow restrictor not securely attached to manhole. Flow restrictor is not plumb within 10% Connections to outlet pipe are leaking and show signs of rust Holes in plates, baffles, elbows, etc.	Determine best method for anchoring flow restrictor based on materials and severity of situation. Consult supervisor if necessary. Replumb and realign restrictor, securing as necessary. Repair or replace as necessary to eliminate leakage. Plug or patch holes if structural integrity is not affected. Replace part if possible, replace entire structure if severely failing.	1, 5	8-16 mh/repair
X	**X**		**Cleanout weir gate damaged**, rusted, not watertight or missing. Gate cannot be adjusted by one person. Chain or rod is missing or damaged	Repair or replace to meet design standards. Repair, lubricate, or replace gate as necessary. Repair or replace chain or rod as necessary.	none	1-6 mh/repair
X	**X**		**Trash, sediment, or debris** blocking overflow pipe.	Remove material manually or with mechanical equipment. Contract for cleaning if necessary.	1, 4	4-8 mh/pipe

Inspection and Maintenance Action Checklist — Culverts

Inspection Frequency			Conditions to Check For	Action	Special Considerations	Man hours/ Action (est.)
Storm	Monthly	Annual				
X	X		**Trash, debris, or sediment** filling more than 20% of the diameter of the pipe or trash rack or within 25 feet of pipe outlet.	Evaluate whether cleaning can be performed manually or mechanically using an eductor, jet or bucket loader. Perform work or contract out. Record amount of waste collected at each culvert.	2, 3	1-2 mh/cy
	X		**Vegetation** that reduces free movement of water through culvert.	Cut vegetation to 6 inches minimum and remove. Take care to limit damage to embankment and side slopes. Prune back woody vegetation without killing and leaving roots in place if possible.	2	0.5-1 mh/100 sf
		X	**Damage to pipe** such as rusting of more than 50% of wall area, bent or crushed ends. Major dents that significantly impede flow or decrease cross sectional area of pipe by more than 20% Cracks or tears that allow groundwater seepage	Repair or replace pipe as necessary.	1, 3, 6	1-3 mh/lf
		X	**Cracking or buckling of headwall**. Erosion or piping occurring at backside or around ends of headwall.	Determine extent of problem and monitor for changes. Contact appropriate city staff for evaluation. Repair or replace as necessary.	1	6-24 mh/headwall
	X		**Trash rack damaged or missing**.	Repair or replace as necessary. Provide means to remove trash rack using ordinary hand tools.	1	4-8 mh/rack
	X		**Missing rock or riprap** within upstream or downstream apron areas or side slopes. Active erosion within area.	Repair eroded areas as necessary. Determine cause of rock movement and replace with similar size rock or larger as necessary.	1	0.5-1 mh/cy

Inspection and Maintenance Action Checklist — **Energy Dissipators***

Inspection Frequency: Storm	Monthly	Annual	Conditions to Check For	Action	Special Considerations	Man hours/ Action (est.)
External Energy Dissipator						
		X	**Missing layer of rock** in area 5 sq ft or larger. Exposed soil.	Replace rock of size and at depth specified. Evaluate need to replace with larger rock.	1	1-2 mh/cy
		X	**Broken wires** in gabion structure.	Replace rock as necessary and wire shut. Evaluate need to replace structure.	none	0.5-1 mh/sf
Dispersing Trench						
	X		**Accumulated sediment** in pipe exceeds 20% of design depth.	Vacuum or jet clean pipe, catching or collecting sediment for proper disposal.	2	1-2 mh/cf
X	X		**Discharge flow is concentrated**, not dispersed, causing erosion.	Regrade trench lip to provide “sheet” flow. Evaluate need to redesign and rebuild.	1	0.5-1 mh/lf
	X		**Perforated pipe is plugged** for half of openings.	Jet clean, catching sediment for proper disposal. Evaluate need to replace pipe.	2	1-2 mh/cf
X	X		**Stormwater flows out** top of distribution manhole or catch basin.	Check outlet pipe for restrictions and clean if necessary. Confirm design storm parameters. Provide erosion control BMPs. Evaluate need to redesign and reconstruct.	1	1-2 mh/sf
X	X		**Oversaturated receiving area**, slope failure; potential for landslide.	Divert flow if possible, stabilize bank using appropriate BMPs.	1	2-6 mh/sf
Manhole Chamber						
		X	**Worn or damaged dissipating structure** or walls exceed 1 sq ft.	Replace structure to design standards. Evaluate need for alternative design.	1	20-48 mh/structure

* See also “Catch Basins and Inlets” IMAC

Inspection and Maintenance Action Checklist **Oil/Water Separators***

Inspection Frequency						
Storm	Monthly	Annual	**Conditions to Check For**	**Action**	**Special Considerations**	**Man hours/ Action (est.)**
X	**X**		**Odor, sludge, or unusual color** of discharge water.	Determine reason for problem. Eliminate source if possible. Close effluent shutoff valve and clean facility. Replace standing water with clean water.	2	8-12 mh/OWS
	X		**Depth of sediment exceeds 6 inches.**	Determine need to contract work out. Remove sediment using vacuum equipment and dispose of properly. Replace standing water with clean water.	2	6-8 mh/OWS
	X		**Trash and debris accumulation** in vault, inlet/outlet pipes.	Remove and dispose of all floatable and non-floatable trash or debris.	2	4-8 mh/OWS
		X	**Damage to inlet/outlet pipe.**	Repair or replace as necessary.	1	10-24 mh/pipe
	X		**Oil accumulation** exceeds 1 inch at water surface.	Determine need to contract work out. Extract oil by vacuuming methods. Clean and rinse all surfaces thoroughly. Dispose of oil in accordance with state and local regulations.	2	8-12 mh/OWS
		X	**Oil absorbent pads** are saturated or missing.	Replace and dispose of properly.	2	2-4 mh/OWS
		X	**Access cover damaged**, corroded or cannot be opened by one person.	Repair to specifications or replace.	1	4-8 mh/cover
		X	**Access ladder damaged**, corroded, misaligned, cracked, or with missing rungs.	Repair to specifications or replace.	1	4-8 mh/ladder
		X	**Cracks in vault** wider than 1/2 inch, evidence of soil infiltration, damage to structural stability.	Grout, repair as necessary, and evaluate need for extensive repair or replacement.	1, 5	16-24 mh/OWS
		X	**Baffles damaged**, corroded, cracked, or warped.	Repair to specifications as necessary or replace.	1	24-72 mh/OWS
		X	**Coalescing plates damaged**, broken, deformed, cracking.	Replace damaged portion of media pack or replace entire plate pack as necessary.	1	24-48 mh/OWS

* Facilities may have unique O&M requirements or manuals. Consult supervisor.

Inspection and Maintenance Action Checklist — **Ditches/Pipes***

Inspection Frequency			Conditions to Check For	Action	Special Considerations	Man hours/ Action (est.)
Storm	Monthly	Annual				
X			**Trash and debris**. More than 1 cubic foot (1 garbage can).	Remove and dispose of waste.	2	1 mh/cf
X	X		**Accumulated sediment** exceeds 20% of ditch depth or pipe diameter.	Remove and dispose of waste. Avoid altering ditch geometry unless planned and revegetated.	2	1 mh/cy
	X		**Vegetation or roots in pipe** reducing free flow of water.	Cut back vegetation or roots manually or contract out. Remove cuttings and dispose of waste.	2	0.5 mh/lf
		X	**Weedy shrubs or saplings in ditch** reducing free flow of water.	Manually cut or brush-hog. Remove cuttings and dispose of waste. Avoid disturbing soil and grasses.	2	0.5-1 mh/100 sf
	X		**Damaged pipe** (cracked, rusted, bent, or crushed).	Repair or replace. Evaluate need to upgrade entire system.	1	2-6 mh/lf
	X		**Erosion on ditch** sides or bottom, or banks.	Determine cause of erosion and eliminate. Provide temporary erosion control and consult appropriate city staff for permanent solution.	1	1-2 mh/sf
		X	**Rock lining out of place or missing** (if applicable).	Replace rock to design level. Determine cause of damage and consult appropriate city staff if necessary for permanent solution.	1	0.5 mh/cy

* Excluding those used by salmonids.

Inspection and Maintenance Action Checklist	Biofilters (Swales, Filter Strips)

Inspection Frequency: Storm	Monthly	Annual	Conditions to Check For	Action	Special Considerations	Man hours/ Action (est.)
X	X		**Dumping of waste** such as grass clippings, branches, and garbage. Unsightly accumulation of trash.	Remove and dispose of waste. Talk to adjacent landowners regarding water quality and dumping. Notify the appropriate city staff to send educational flyers.	2	1 mh/cf
	X		**Sediment accumulation** exceeding 4 inches, particularly within first several feet of biofilter.	Remove and dispose of sediment without damaging biofilter shape and vegetation. Restore disturbed areas.	2, 6	0.5-1 mh/cy
X	X		**Erosion damage**. Action is necessary if erosion is over 2 inches deep or greater than 10 square feet in area, or if the potential for continued erosion exists.	Determine cause(s) of erosion and eliminate. Stabilize area using permanent erosion control measures. Replant using appropriate species vegetation.	1, 4	1-2 mh/sf
	X	X	**Poor vegetation growth** **Excessive vegetation growth** **Weedy species.**	Aerate soil and reseed; mow grassy biofilters regularly; cut other vegetation to 2 inches above design water surface depth and remove cuttings promptly; pull weeds or selectively apply approved herbicide, following all precautionary measures.	2, 4, 5	0.5-1 mh/sf
	X		**Operation**. Swale has been filled in or blocked by adjacent land owner.	Request owner to restore original configuration. Report problem to enforcement personnel if problem is not rectified promptly.	none	1 mh/occurrence
		X	**Hydraulic performance**. Imperceptible flow velocity within swale or stagnation indicated by dead or dying vegetation, algae growth.	Check for blockage downstream and remove if action is not deemed to cause additional problems. If no blockage, request survey to check grade, if less than 1%, consult appropriate city staff regarding installation of underdrains and replanting.	1, 6	1-2 mh/occurrence
		X	**Hydraulic performance**. Flow has become channelized and does not spread over bottom of swale.	Recontour and replant biofilter bottom; consider installing a flow spreader device.	1, 4, 6	0.5-2 mh/lf
		X	**Pollutant removal**. Visual discharge of sediment or other pollutants at downstream end.	Check biofilter for sediment source, e.g., erosion; check for upstream sources and implement source control; modify biofilter as necessary to remove pollutant, e.g., increase vegetation density or height, increase swale length, install catch basin or construct sedimentation forebay, clean catch basin or sedimentation forebay, consider construction of high flow bypass.	1, 4, 6	3-16 mh/occurrence

Inspection and Maintenance Action Checklist	**Constructed Wetlands, Wet Ponds**

Inspection Frequency						
Storm	Monthly	Annual	**Conditions to Check For**	**Action**	**Special Considerations**	**Man hours/ Action (est.)**
	X		**Yard waste, trash, and debris** of more than 1 cu ft (1 garbage can)	Remove and dispose of waste. Notify appropriate city staff for potential enforcement or public education.	2	1 mh/cf
X	**X**		**Trash rack or bar screen** missing or more than 25% covered	Remove debris and dispose of waste. Repair or replace rack as necessary.	2	0.5-1 mh/screen
	X		**Weedy, invasive or poisonous vegetation** such as blackberry, purple loosestrife, tansy ragwort, poison oak, stinging nettles, etc. **Sparse vegetation**, sickly or overgrown.	Ask if there is an O&M plan for the facility or if an evaluation by a wetland ecologist is recommended prior to maintenance. If not, remove manually or use mechanical equipment as necessary; minimize disturbance to other vegetation. Do not spray pesticides without consulting appropriate city staff. Determine cause of poor plant growth; correct problem and replant as specified or directed by appropriate city staff. If vegetation is cut, remove all cuttings and dispose offsite.	1, 2, 5, 6	0.5-1 mh/ 100 sf
	X		**Inlet, outlet, or rock window clogged** with sediment or debris.	Remove blockage manually or with appropriate equipment. Minimize disturbance to surrounding vegetation. Evaluate need for facility modifications to eliminate problem.	6	0.5 mh/sy
	X		**Sediment accumulation** interfering with treatment function.	Remove sediment using appropriate equipment to restore design contours. Minimize disturbance to surrounding vegetation and replant as necessary using specified vegetation.	1, 2, 4, 6	1-2 mh/cy
		X	**Settlement of structures** dikes, berms, pipes, by more than 10%	Notify appropriate city staff and request an inspection. Stabilize slopes or structures as necessary until final evaluation and specific solution is determined.	1	0.5-1 mh/cy
X	**X**		**Odor, sludge, or unusual color**. Presence of flammable chemicals such as natural gas, oil, or gasoline. Presence of other chemical pollutants.	Notify appropriate city staff to investigate and determine chemical type. Remove contaminant by appropriate methods and dispose of as directed by hazardous waste protocols. Provide sign or stencil as necessary.	2, 5	2-4 mh/cleanup
X			**Overflow berms or spillways exposed** and either actively eroding or vulnerable to erosion.	Replace armoring or replant as specified in design plans and specifications.	1, 4	0.5 mh/cy
X			**Erosion** at inlet or on side slopes or scouring of pond bottom of > 6”.	Consult appropriate city staff on cause of erosion. Stabilize eroded areas ASAP using proper erosion control methods.	1, 4	1-2 mh/sf
	X		**Rodent holes.** Any evidence of rodent holes in facility dam/berm, or any evidence of water piping through dam/berm via rodent holes	Destroy rodents and repair dam or berm. Contact the County Health Department for guidance.		

Inspection and Maintenance Action Checklist — **Streams and Wetlands***

Inspection Frequency			Conditions to Check For	Action	Special Considerations	Man hours/ Action (est.)
Storm	Monthly	Annual				
		X	**Trash and debris** of more than 1 cubic foot.	Remove and dispose of waste.	2	0.5-1 mh/cf
		X	**Trash or debris in any inlet or outlet pipe** blocking more than 1/3 of its height.	Manually remove debris and dispose of waste.	2	1-2 mh/cf
	X		**Encroachment, clearing, or construction of structures** within stream, wetland, or buffers.	Notify supervisor immediately to investigate.	3	0.5 mh/ incident
	X		**Sediment or debris accumulations** exceed 20% of active channel depth or 4 inches, whichever is less.	Determine probable cause and eliminate. Evaluate whether cleaning can be performed manually or mechanically. Notify and consult supervisor before proceeding.	1, 2, 3	0.5-1 mh/cy
	X		**Erosion damage**, slope failures.	Provide TESC BMPs as soon as possible. Consult appropriate city staff for long-term solution.	3	1-2 mh/cf
	X		**Dead fish, mammals, or amphibians**.	Notify appropriate city staff and health officials immediately to investigate. Do not remove bodies until directed.	5	1 mh/ incident
X	**X**		**Unusual color, odor, or volume of existing discharge** to or from stream or wetland.	Notify appropriate city staff immediately to investigate.	none	0.5-1 mh/ incident
	X		**Odor, sludge, or color**. Presence of flammable chemicals such as natural gas, oil, and gasoline. Presence of any other chemical pollutants.	Notify appropriate city staff to investigate and determine chemical type. Remove contaminant by appropriate methods and dispose of as directed by hazardous waste protocols. Provide sign or stencil as necessary.	5	1 mh/ incident
		X	**Vegetation is sparse or unhealthy.** **Vegetation is overgrown and inhibits flow.** **Vegetation is weedy or poses a health or safety hazard.**	Determine cause of problem and eliminate. Replant using appropriate native vegetation. Cut or pull vegetation and dispose of waste.	4	0.5-1 mh/ 10 sf
		X	**Illicit pipes, culverts, or drainage ways**	Notify appropriate city staff immediately to investigate. Contact owners to remove or reroute conveyance structure and restore area.	1, 3	1-2 mh/ incident

* See the discussions in this chapter on work in sensitive areas and on permits and regulations prior to performing work in streams or wetlands.

Inspection and Maintenance Action Checklist **Monitoring Station***

Inspection Frequency			Conditions to Check For	Action	Special Considerations	Man hours/ Action (est.)
Storm	Monthly	Annual				
	X		Sediment accumulation in stilling well exceeds 1-2 cubic feet.	Remove by hand or by vacuum, depending on accessibility.	none	1-2 mh/cf
		X	Vegetation interferes with access or accurate flow measurement.	Trim or prune vegetation as necessary without disturbing ground surface.	none	0.5-1 mh/ 100 sf
X	**X**		Debris or channel changes interfere with normal flow through control section.	Remove debris as necessary to restore normal flow or evaluate need to move station.	3	1-2 mh/cf
X	**X**		Disturbed or damaged monitoring equipment.	Evaluate need to replace station, completely or in part.	none	no est.
		X	Access route damaged or overgrown with woody vegetation.	Cut and remove vegetation, repair minor damage by hand; revegetate.	none	0.5-1 mh/ 100 sf
X	**X**		Erosion of streambank or area adjacent to monitoring station.	Install biotechnical slope protection. Consult appropriate city staff for design recommendations.	1	1-2 mh/sf
		X	Native vegetation missing or damaged.	Revegetate using appropriate native plants and methods.	4	0.5-1 mh/10 sf

* Work to be performed by appropriate city staff, or with authorization.

Inspection and Maintenance Action Checklist — Access Roads & Easements

Inspection Frequency						
Storm	Monthly	Annual	Conditions to Check For	Action	Special Considerations	Man hours/ Action (est.)
		X	No access road for maintenance by motorized equipment.	Determine whether an easement to drainage feature exists. If so, obtain City permits and construct gravel (or equivalent) access road. If not, call lack of easement to City's attention.	1, 3	No estimate
	X		Debris blocks access or could damage vehicle tires (glass or metal).	Remove debris.	2	1 mh/cf
		X	Obstructions reduce clearance above road surface to less than 14 feet.	Clear overhead area to 14 feet high.	5	1 mh/100 sf
X		X	Settlement, potholes, mush spots, or ruts exceed 6 inches in depth or 6 square feet in area. Surface defect hinders or prevents maintenance access.	Grade road uniformly smooth with no evidence of settlement, potholes, mush spots, or ruts. Apply additional gravel or pit-run rock as needed	none	0.5 mh/sf
	X		Woody vegetation or excessive weed cover blocks vehicular access.	Remove woody growth; cut back weeds regularly or when they encroach on road surface.	2	0.5-1 mh/ 100 sf
	X		Erosion damage is within 1 foot of the roadway and is more than 8 inches wide and 6 inches deep.	Place fill material or rock to match the surrounding slope; Revegetate as necessary.	4	0.5-1 mh/cy

Inspection and Maintenance Action Checklist	Fencing & Gates

Inspection Frequency						
Storm	Monthly	Annual	**Conditions to Check For**	**Action**	**Special Considerations**	**Man hours/ Action (est.)**
		X	Fence posts out of plumb more than 6 inches.	Straighten posts to within 1½ inches of plumb.	none	0.5 mh/post
		X	Fence rails bent more than 6 inches.	Straighten bends to within 1 inch.	none	0.5 mh/10 lf
		X	Any part of fence (including posts, top rails, and fabric) more than 1 foot out of design alignment.	Align fence to meet design standards.	none	0.5-2 mh/10 lf
		X	Missing or loose tension wire.	Re-tension wire in place.	none	0.5 mh/10 lf
		X	Barbed wire is sagging more than 2½ inches between posts or is missing.	Restring or tighten wire to less than 3/4-inch sag between posts.	none	0.5 mh/10 lf
		X	Extension arm is missing, broken, or bent out of shape more than 1½ inch.	Straighten or replace arm with no bends larger than 3/4 inch.	none	0.5-1 mh/arm
		X	Paint or decorative coating exhibits rusting or scaling condition affecting structural adequacy.	Replace with structurally adequate posts or parts, or parts with a uniform protective coating.	none	2-3 mh/50 sf
	X		Openings in wire fence fabric are such that 8-inch ball could fit through.	Repair fence to eliminate all large openings.	none	1-2 mh/50 sf
	X		Gate is broken, jammed, or missing.	Repair or replace as necessary to allow entry of people and maintenance equipment. Provide staff with duplicate keys to new locks.	none	1-8 mh/gate
	X		Gate cannot be easily opened or closed by maintenance person due to broken or missing hinges.	Replace and lubricate hinges as necessary.	none	1-4 mh/gate
		X	Gate is out of plumb more than 6 inches and more than 1 foot out of design alignment.	Align and plumb to allow free-swinging operation.	none	1-4 mh/gate
			Stretcher bar, stretcher bands, or ties are missing.	Replace stretcher bar, bands, and ties.	none	2-4 mh/gate
	X		Defect in fence or vegetation screen permits easy entry to facility.	Mend fence or replace shrubs to form a solid barrier.	none	2-4 mh/10 lf

Inspection and Maintenance Action Checklist	Grounds Maintenance (Landscaping)

Inspection Frequency						
Storm	Monthly	Annual	**Conditions to Check For**	**Action**	**Special Considerations**	**Man hours/ Action (est.)**
	X		Vegetation is overgrown or dominated by weeds.	Trim, prune, and weed to provide appealing aesthetics. Follow City vegetation management guidelines.	none	2-4 mh/100 sf
	X		Weeds occupy more than 20% of the landscaped area.	Remove weeds to less than 5% of the landscaped area.	2	0.5-1 mh/100 sf
	X		Poisonous vegetation, or insect nests present a safety hazard.	Remove poisonous vegetation or insect nests using best professional judgment of methods and safety precautions.	2, 5	1-2 mh/100 sf
X	**X**		Unsightly accumulation of trash or debris	Remove and dispose of trash or debris.	2	0.5 mh/cf
X	**X**		Noticeable erosion such as rills in landscaped areas	Identify cause of erosion. Slow down or spread out surface water flow. Fill, contour, and seed eroded areas.	4	1-2 mh/tree
		X	Limbs or part of trees or shrubs are split or broken, affecting more than 25% of the total foliage of the plant.	Trim or prune trees or shrubs to restore shape. Do not top. Replace severely damaged trees or shrubs.	2	2-4 mh/tree
	X		Trees or shrubs have been blown over or knocked down.	Inspect for injury to stem or roots; replant if possible. Replace if severely damaged.	none	1-2 mh/tree
		X	Trees or shrubs are leaning over, exposing the roots.	Place stakes and rubber-coated ties around young trees or shrubs for support.	none	0.5-1 mh/tree

STORMWATER FACILITY
INSPECTION/MAINTENANCE FIELD FORM

Facility Type:	
Facility Location (name):	
Inspection Date:	
Inspected By:	

Insp. Freq. (S/M/A)	Conditions Checked	Observations	Actions Taken or Required	Date Action Taken	Actual mh/action

S/M/A - Storm, Monthly, Annual

MASTER MAINTENANCE SCHEDULE													
Year: 2004													
	Storm[a]	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
Detention Ponds	Tr/Sed/Clg	M: Tr/Sed/Er/ Veg/Chem	M: Tr/Sed/Er/ Veg/Chem	A: Str/Veg							A: Str/Veg	M: Tr/Sed/Er/ Veg/Chem	M: Tr/Sed/Er/ Veg/Chem
Detention Ponds													
Infiltration Basins													
Catch Basins													
Control Structures													
Culverts													
Energy Dissipators													
Oil/Water Separators													
Ditches/Pipes													
Biofilters													
Constructed Wetlands													
Misc. Stormwater Facility													

a. Storm activities to be carried out after any major storm (0.8" in 24 hours)]

Key: Tr = Trash; Sed = Sediment; Clg = Clogging; Er = Erosion; Veg = Vegetation; Chem = Chemicals; Str = Structural
Inspection: M = Monthly; A = Annual
Maintenance: Normal or Preventive

CHAPTER 7.
STORMWATER ORDINANCES AND CITY CODES

The City of Medford is expecting to receive an NPDES Phase II permit from the DEQ for management and discharge of stormwater. The permit is expected to be issued in 2005. This permit will be for a term of five years and will require the City to perform a variety of stormwater management activities. The management activities will involve continuation of current activities, enhancement of or change to current activities, and performing new activities.

A key component of effective stormwater management requires the development, review, approval and implementation of City codes/ordinances, and related requirements. This chapter reviews existing City stormwater-related codes and ordinances and summarizes changes to be considered. Recommendations are provided for ordinances to update existing stormwater codes and create new codes.

EXISTING STORMWATER-RELATED CODES AND ORDINANCES

Summary

The following existing codes, ordinances and related documents were obtained and reviewed:

- Municipal Code, Title 4: *Utilities and Sanitation*, Chapter 4.7: *Drainage Utility and System Development Charge*. City of Medford, Oregon, Municipal Code On-Line January 7, 2004.
- Municipal Code, Title 6: *Streets, Highways, Public Parking, and Public Right-of-Way*, Section 6.361: *Trackout Prohibited*, and Section 6.525: *Leaf Collection*. City of Medford, Oregon, Municipal Code On-Line January 7, 2004.
- Municipal Code, Title 9: *Building*, Chapter 9.45: *Flood Damaged Buildings Code*. City of Medford, Oregon, Municipal Code On-Line January 7, 2004.
- Municipal Code, Title 10: *Land Development Code*, Article I—*General Provisions*, DRAFT Changes to Section 10.012: *Definitions Specific*. City of Medford, Oregon, January 9, 2003.
- Municipal Code, Title 10: *Land Development Code*, Article IV—*Public Improvement Standards and Criteria.* City of Medford, Oregon, April 29, 2003.
- Municipal Code, Title 10: Land *Development Code*, Article V—*Site Development Standards*. City of Medford, Oregon, April 29, 2003.
- Municipal Code, Title 11: Industrial Waste Pretreatment, Chapter 11.2: *Prohibitive Discharge*, Section 11.201: *Sanitary Sewer/Storm Drain*. City of Medford, Oregon, Municipal Code On-line January 7, 2004.
- *Maintenance Program*. City of Medford, Oregon, April 9, 2003.
- DRAFT Ordinance, *Stormwater Detention Facilities*. City of Medford, Oregon, April 29, 2003.

These documents were reviewed by stormwater professionals including consultants and City staff. Several meetings and communications were held to discuss related items; this chapter summarizes those discussions and suggests next steps for preparing ordinances and updates to City codes.

Discussion

Generally, requirements for stormwater management are incorporated within City ordinances and codes that are not exclusively related to stormwater. Other than Chapter 4.7 and 4.850, there is no City code that deals with stormwater as a stand-alone topic. The past effectiveness of this integrated format has not been discussed in detail, but it seems appropriate to consider developing a separate code title for stormwater requirements. We recommend that the City explore the appropriateness of creating a new code section for stormwater requirements.

To date, the key stormwater topics addressed by existing codes and ordinances have focused primarily on flooding and safety issues. A stormwater utility has been set up to generate a source of revenue for operations and maintenance, and a system development charge has been established to generate revenue for capital facilities. These functions would continue with, and be supported by, additional activities described below.

POTENTIAL CHANGES TO EXISTING CODES AND ORDINANCES

The following comments are offered for considering changes to existing codes. Specific language is not provided at this time; codes and ordinances that are currently being revised by the City are indicated:

- Chapter 4.6: *Stormwater Detention Facilities*, Sections 4.601 to 4.617 *(draft revisions are proposed by the City)*—These sections currently being proposed by the City discuss design, construction, and O&M of stormwater detention facilities. Suggested updates are generally appropriate; however, they need to be reviewed along with other recommendations in this chapter. Specific comments related to the draft revisions are as follows:
  - Section 4.609 (1) (e). The term “approved stormwater facility” should be defined.
  - Section 4.609 (2) (a) allows detention in depressed areas of parking lots. This has the potential of impacting water quality wherever the water is released. The ordinance should be expanded to address the prevention of mixing cleaner runoff with parking lot runoff, as well as the treatment of parking lot detention water before it is released. It might be simple to modify the ordinance to indicate that parking lot detention can only be used for runoff from parking lots and roof areas.
  - Section 4.609 (2) (b) discusses underground detention. This could be misunderstood by a developer as more than just detention, but rather as a way to release stormwater into the ground (e.g. underground injection) and should be clarified.

  - Section 4.609 (2) (c) does not address where water can be discharged or how water quality requirements are met. This should be clarified and added.
  - Section 4.609 (4) addresses erosion as it affects property damage, but not as it relates to water quality or the construction phase of a project. This should be expanded and coordinated with the future construction phase erosion control program.
  - Section 4.613 discusses operation and maintenance of stormwater detention facilities. It does not address inspection and enforcement of O&M requirements, which should be added.
  - Section 4.617 indicates that the engineer must file a construction inspection report. Construction phase erosion control, etc. are not discussed, and should be added.

- Section 4.725: *Collection of Delinquent Drainage Charges*—This section gives the City the authority to withhold water service if storm drain utility fees are not paid. This probably can remain as is, however it should be reconfirmed as the most appropriate method.
- Section 10.012: *Definitions (draft revisions are proposed by the City)*—Proposed changes include paragraphs relating to detention and detention facilities but do not address where water is released. The revisions briefly mention= "little or no infiltration;" this should be clarified.
- Section 10.485: *Storm Water (draft revisions are proposed by the City)*—Edits are proposed to this section to coordinate with the proposed detention facilities chapter. The paragraph starts with the words "Storm drains." It might be clearer if it said "Storm drain systems." Direct discharge to a watercourse is discussed with no mention of treatment. This section should have language added about treatment and/or water quality. The term "good drainage requirements" is used; "good" probably is too vague and should be modified for clarity.
- Section 10.486: *Stormwater Detention Facilities Required (draft revisions are proposed by the City)*—This proposed section mentions that detention is required because it will help improve water quality, but water quality is not defined and should be.

POTENTIAL NEW STORMWATER CODES AND ORDINANCES

New codes and ordinances, based on the anticipated requirements of the NPDES Phase II permit to be issued to Medford by DEQ, are recommended as described below. Several of these topics are described in more detail in the *Regional NPDES Phase II Stormwater Program Guide, Rogue Valley, Oregon* (March 2004). The specific text of ordinances and codes will need to be prepared as part of the overall program development.

Illicit Discharge Detection and Elimination Program

No formal program is in place that deals with this topic. A program should be developed and ordinances should be updated or created to establish it. Chapter 4 of the *Regional*

NPDES Phase II Stormwater Program Guide, Rogue Valley, Oregon describes the details of such a program.

Construction Phase Erosion Control Program

The DEQ has a program and a permitting process in place to manage erosion during construction, but soon will expect the City to administer its own program. Medford has no formal program that deals with erosion during construction. A program should be developed and ordinances should be updated or created to establish it. Chapter 5 of the *Regional NPDES Phase II Stormwater Program Guide, Rogue Valley, Oregon* describes the details of such a program. The DEQ is also in the process of developing a guidance document and providing training for such programs. The City should track this effort by DEQ and incorporate it into the City program as appropriate.

Post-Construction BMPs for Stormwater Management

Flow control is discussed in detail in the City's proposed stormwater detention code chapter, but there is no mention of water quality or treatment of runoff. Technical requirements for flow control should be updated, and new requirements for stormwater quality and stormwater treatment BMPs should be added. These requirements are typically handled by adopting a technical stormwater manual, and the City should consider such a manual.

Riparian Corridor Management

This topic is discussed in detail in Sections 10.920 to 10.928. Currently the riparian corridor is defined from the "top of bank;" however, other ways to define the corridor boundaries can be used. It is recommended that the City consider appropriate updates to the code sections dealing with riparian corridors.

Hillside Development Ordinance

The City has indicated an intention to develop an ordinance for controlling hillside development. No outline or text for this ordinance was reviewed or discussed.

Infiltration Requirements

Infiltration requirements are not discussed in current ordinances and codes. This topic relates primarily to underground injection control (UIC) program requirements, which are outside the scope of NPDES Phase II. Nevertheless, City codes and ordinances should refer to the state's UIC program where appropriate.

Maintenance Provisions

Basic maintenance provisions and requirements are addressed in the proposed ordinance for detention facilities; however, maintenance requirements for other stormwater BMPs need to be added, as described in Chapter 6.

Maintenance Enforcement

This is not addressed effectively and should be added. The City also needs to add code provisions that give the City the authority to "stop work" due to pollution, or potential pollution, during construction.

CHAPTER 8. INTEGRATION OF CITYWIDE STORMWATER STAFF/PROGRAMS

Stormwater quantity and quality are managed and impacted by many City operations. This chapter reviews existing City stormwater activities and new activities developed as part of this plan, and makes recommendations for integration and assignment of stormwater management duties for the practical and efficient use of staff resources.

The first task was to define existing roles through staff interviews, meetings and workshops in order to identify any gaps in coverage or redundancies of effort. Once the existing responsibilities were defined, the added responsibilities from the NPDES Phase II permit were added and responsibilities for these efforts were assigned.

EXISTING STORMWATER ACTIVITIES AND RESPONSIBILITIES

Overview

There are several areas of activities involving stormwater management. Maintenance of stormwater facilities is the responsibility of the Parks Department on park property and the Public Works Department on all other City rights of way. This management plan proposes no changes in these responsibilities; changes to the maintenance program are addressed in Chapter 6.

Design and construction of new stormwater facilities is generally conducted by the Public Works Department; however, the Parks Department constructs small re-grading projects on park property. The Public Works Department is the lead for stormwater on all City property. No changes are proposed for these responsibilities, although opportunities can be explored for joint efforts to accomplish stormwater treatment and provide open space.

The stormwater activity requiring the most interdepartmental coordination is the review, inspection and permitting of private development and construction activity. The following discussion focuses on private development plan reviews and inspections, but it also applies to public construction projects under the City's plan review and inspection process.

Several City departments are involved in plan review and permitting:

- **Building**—The Building Department addresses safety in the built environment by providing residential and commercial plan review and inspections associated with building permits. Department staff work with contractors and homeowners to ensure that projects meet or exceed building, mechanical, electrical, and plumbing code requirements. The Building Department's main focus is on buildings themselves rather than stormwater management. The review process includes some consideration of grading and stormwater infrastructure, but there has been little follow-up with inspection verification during project construction on private property.

- **Public Works**—The Public Works Department consists of Engineering and Development, which provides services related to expanding public infrastructure by providing information and resources, planning, funding, design, engineering, inspection and construction; Infrastructure Maintenance; and Wastewater Treatment and Disposal. Public Works but has not focused on stormwater management components to the degree that will be needed to comply with the NPDES Phase II stormwater permit. During the review process, there has been consideration of grading and stormwater infrastructure, but there has been little follow-up with inspection verification during project construction, particularly on private property. Management of erosion during construction has been limited to DEQ management of 1200-C Erosion Control Permits.
- **Planning**—The Planning Department manages changes in the use of land to best serve the Medford community as a whole. Planning has been involved primarily in the plan review phase of projects, but its focus has not been on stormwater management. Planning inspects landscaping construction on commercial properties.
- **Parks**— The Parks Department manages parks and open spaces, including recreation facilities, city trees, the cemetery, and special park events. Parks has been involved primarily in the plan review phase of projects, but its focus has not been on stormwater management. Parks inspects landscaping construction on public projects and performs maintenance on streets and medians.

Other City agencies, including the City Attorney, the Finance Department, and others, also contribute, but the four departments listed above are key to stormwater management and were evaluated the most for this effort. Figure 8-1 presents a variety of activities pertinent to stormwater management and denotes the existing status of each among the four key departments.

Stormwater-Related Plan Review

There are four avenues for development plans to enter the City's review process:

- Tentative plats to the Planning Department—When a developer wants to develop property, the first step is to submit a planning level drawing of the partitioning of the property. This is commonly called a tentative plat and is submitted directly to the Planning Department. The tentative plat submittal must include the items outlined in the City's Municipal Code 10.267.
- Building permit applications to the Building Department—Once the tentative plat is approved, or if the development is on a single property zoned for the development, the developer submits a building permit application.

Department / Activity	Building	Public Works (Engineering)	Planning	Parks
Plan Review (Pre & Final)			**Plan review starts here**	
Plats - Tentative		*Proposed*	Existing	
Floodplain Mgmt./CRS	Existing			
Plats - Final		Existing	Existing	Existing
Site Plan	Existing	Existing	Existing	Existing
Stormwater		Existing		
Grading & Fill		Existing		
Building				
Building Drainage Stormwater	Existing			
Site Drainage	Existing	Existing		
Stormwater Treatment		Existing		*Proposed*
Landscape				Existing
Erosion				
Single Family Residential Site Drainage		*Proposed*		
All Other Construction		*Proposed*		
Permits				
Building				
Subdivision		Existing		
All Other	Existing			
Demolition	Existing			
Grading & Fill	Existing	*Proposed (review)*		
Erosion				
Single Family Residential Site Drainage		*Proposed*		
All Other Construction		*Proposed*		
Construction Inspection				
Building Drainage	Existing			
Streets (Public)		Existing		
Stormwater Treatment		Existing		
Landscape				Existing
Grading (building)	Existing (private)			
Grading (no building)		Existing		
Erosion				
Single Family Residential Site Drainage		*Proposed*		
All Other Construction		*Proposed*		

Figure 8-1. Existing and Proposed Stormwater Management Activities Department Roles and Responsibilities for Medford

- Public improvement plans to the Public Works Department—If the project is a subdivision requiring streets and utility infrastructure that will be turned over to the City, the submittal goes directly to the Public Works Department (all other submittals go to the building department).
- Grading permit applications to the Building Department—The grading permit is a permit for re-contouring property without the construction of a building and is submitted to the building department.

Landscape aspects of a submittal are reviewed by the Parks Department. Once a permit application is submitted, there is considerable interdepartmental coordination.

Stormwater-Related Inspection

Site inspection is generally covered by the Building and Public Works Departments, with some landscaping covered by the Parks Department. Currently, the Building Department inspects on-site drainage features according to the Uniform Plumbing Code and on-site grading. The Building Department does not inspect stormwater treatment facilities. The Public Works Department inspects stormwater facilities in areas that will become public right-of-way. The Public Works Department does not inspect the construction of private development. Therefore private stormwater facilities are currently not being inspected.

NEW STORMWATER PROGRAM REQUIREMENTS

NPDES Phase II Permit Requirements

The City of Medford is scheduled to receive an NPDES Phase II permit from the Oregon DEQ for management and discharge of stormwater. This permit will be for a renewable term of five years and will require the City to perform a variety of stormwater management activities, including the continuation of current activities, the enhancement of current activities, and the incorporation of new activities. The NPDES Phase II stormwater regulations will require a program of stormwater management activities to protect water quality that includes the following minimum requirements:

- Public education and outreach—Develop and distribute educational materials and conduct public outreach aimed at informing citizens about the impacts of polluted stormwater and ways to minimize their contribution to pollution.
- Public involvement and participation—Involve the public in stormwater management program development and implementation.
- Illicit discharge detection and elimination—Develop and implement a program of detecting and eliminating illicit discharges to the storm drain system. This includes storm system mapping, dry weather sampling, and citizen information activities.
- Construction site stormwater runoff control—Develop, implement, and enforce a program and standards to control and prevent construction site erosion and sediment discharges from construction sites that disturb 1 or more acres of land. This includes preparation of a construction site erosion and sediment control plan.

- Post-construction stormwater management—Develop, implement, and enforce a program and standards to control or prevent discharge of polluted runoff from new development and redeveloped sites. This can include structural treatment and detention systems as well as resource protection measures (wetland protection, habitat protection, etc.) and pollution prevention planning.
- Pollution prevention, or "good housekeeping," for municipal operations—Develop, implement, and enforce a program to control or prevent the discharge of polluted runoff from municipal operations (road maintenance, vegetation management, storm drain maintenance, etc.).
- Compliance with more stringent conditions—Perform measures beyond the six above as needed to meet total maximum daily load (TMDL) requirements or other plans to meet federal Clean Water Act requirements related to beneficial uses of impaired water bodies.
- Evaluation and assessment—Evaluate the program's compliance with permit conditions and the effectiveness and appropriateness of identified best management practices. Keep records, and report to the permitting authority (DEQ) any changes in activities resulting from program evaluation and assessment.

The federal regulations do not require Phase II jurisdictions to inspect industrial sites. DEQ is responsible for inspecting industrial sites to ensure compliance with the statewide Industrial Stormwater General Permits. Phase II communities are still expected to investigate reports of illicit discharges to their storm drain systems at industrial sites, review erosion and sediment control plans for construction of new industrial sites, and implement other jurisdiction-wide aspects of their stormwater management programs.

Development of a Phase II-compliant stormwater management program may necessitate additional staff, office space, equipment, and funding.

New Stormwater Program Implementation Activities

Implementing a stormwater management program to achieve the minimum requirements of an NPDES permit requires that municipal storm system operators consider the following steps:

- Integrate a stormwater management program into the existing organizational structure.
- Hire additional staff (or contract with others) to carry out the required work (e.g., public involvement and education, plan review, inspection and enforcement, maintenance, planning, complaint response, management, etc.).
- Find additional office space for staff.
- Obtain additional office, field, and maintenance equipment.
- Develop and adopt ongoing funding methods.
- Develop and adopt various legal ordinances.

- Conduct ongoing stormwater and surface water planning efforts.

The City of Medford coordinated with several Rogue Valley jurisdictions to prepare a *Regional NPDES Phase II Stormwater Program Guide,* which proposes detailed information and activities for compliance with the NPDES Phase II permit. The City also prepared an individual plan specifying dates and levels of effort for the first five-year permit. These requirements are incorporated into the recommendations below.

RECOMMENDATIONS FOR INTEGRATION

Plan Review and Inspection

Plan review and inspection for development within the City requires coordination among City departments. Any program implemented should be periodically reviewed to determine whether all areas are being covered and whether any activities are redundant. The overall stormwater management and erosion control program is the responsibility of the Public Works Department; any inspection delegated to other departments should be monitored.

Erosion Control

The Public Works Department should lead this effort since it will be coordinating with the Oregon DEQ. The NPDES five-year program calls for the 1200-C permitting effort for erosion control permitting and inspection to be turned over to the City of Medford in Year 3. The City will need to work out specific arrangements with DEQ on the cost of permit applications and how much of the fee the City retains to implement the program. We recommend the following for a City erosion-control program:

- All commercial, industrial, multi-family, and housing subdivision construction projects requiring building permits should be required to obtain a 1200-C erosion control permit from the City, as well as single-family residential (SFR) projects larger than 1,000 square feet. These permits should be obtained from the Public Works Department, which will review the permit application.
- SFR projects less than 1,000 square feet should be exempt from the 1200-C program. Provisions should be placed on SFR building permits requiring the contractor to provide erosion control, establishing penalties and the ability to stop work if the provisions are not met. Building Department inspectors should be trained to observe if erosion controls are in place on SFR projects however the erosion control program for all development will be under the Public Works department. General guidelines for SFR development could be developed and updated by the Public Works personnel in charge of the erosion control program.
- After the City has taken over the 1200-C process, building permits on projects requiring erosion control permits should not be issued until the 1200-C permit is issued. This would be part of the Building Department's checklist of requirements prior to issuing a building permit.
- Except for SFR construction, the Public Works staff will conduct the plan review, issue the permit and conduct site inspections.

- Fees for this activity could be collected by the Building Department and transferred to Public Works. This would keep the Public Works Department out of fee collection and give the development community a one-stop window for all development.

Private On-Site Drainage and Stormwater Treatment

Separation of plan review and inspection for private on-site drainage and water quality facilities is complex. There should be some overlap of responsibility and coordination between the Building and Public Works Departments. The Building Department regulates private drainage according to the Uniform Plumbing Code (UPC). The Public Works Department regulates on-site stormwater according to impacts on the City's system, including the quality of the water entering the City system. We recommend the following for the on-site drainage program:

- Any requirements for on-site stormwater treatment for SFR construction less than 1,000 square feet should be written so as not to require Public Works review. These could include downspouts connected to the storm system in some areas of the City and disconnected in other areas where soils allow infiltration. As with the erosion control program, review and inspection for SFR projects will not involve Public Works staff.
- The review of all utilities for construction of subdivisions will be by Public Works staff. This includes all stormwater management.
- Commercial development and multi-family development projects will require both the Building Department and the Public Works Department to conduct plan review and on-site inspection. All drainage connected to the building should be reviewed and inspected by the Building Department staff. This includes downspouts, stormwater treatment planters connected to the building and piping leading away from the building. Public Works staff should be responsible for all stormwater treatment facilities not connected to the building and all site drainage piping and grading. Public Works staff will inspect the grading in parking areas but not the structural component of the parking areas.
- Any grading project requiring a grading permit and not associated with a building should be reviewed and inspected by the Public Works Department.
- All demolition projects requiring a permit should be reviewed and inspected by the Building Department.
- All road work and public utility projects will continue to be reviewed and inspected by the Public Works Department.
- City and Parks Department projects should be handled like commercial project above.
- The Parks Department should continue to review and inspect projects with open space and water quality treatment facilities using plants. If this coordination is not feasible, the Parks Department could provide the Public

Works Department with guidelines for reviewing and inspecting these facilities.

- All fees should be collected by the Building Department and money transferred to the Public Works Department for its involvement. Permits will be issued by the Building Department.

Tentative and Final Plat Review

Many of the decisions on how a site will handle stormwater management are made in the tentative plat submittal and approval process. Since the Public Works Department is taking responsibility of stormwater management for the City through the NPDES program, it is essential that Public Works staff be allowed to review tentative plat submittals and that the comments and concerns of Public Works staff be incorporated into the review. This would require the Planning Department to hold up any tentative plat approval until review comments from Public Works are received and incorporated. Public Works staff should also review tentative plat submittals for additional information that should be required. One item might be stormwater treatment method.

The Parks Department has also expressed an interest in reviewing the Tentative Plat submittals.

Stormwater Management

Many aspects of stormwater management under the NPDES permit that are outside of plan review and inspection will require staff time. Many of these are discussed in detail in Chapters 5 and 6. The Public Works Department will assume responsibility for the additional work discussed below. Other departments, including Planning, Parks and Building, would continue with their current activities; however, a greater awareness of stormwater issues should be developed through appropriate training. This training should be led by the Public Works Department and include information concerning the overall goals of the stormwater management program.

The Public Works Department will take responsibility for the overall stormwater management program that will include the NPDES and TMDL programs. This will take considerable coordination time for engineer level staff. Additional work will include the following:

- Annual inspection of constructed public and private stormwater facilities; where maintenance agreements are provided by private parties, the City should notify responsible parties and enforce all required maintenance.
- An illicit discharge detection and elimination program will need to be developed to find and stop illicit discharges to the stormwater system.
- The City is required to permit certain facilities that meet specific Standard Industrial Classification (SIC) Codes, in accordance with DEQ requirements. The Public Works Department should take the lead and coordinate with other departments to ensure that all such facilities are permitted with DEQ as part of its overall NPDES Phase II compliance program.

- Maintenance activities by the City must be done in a manner that minimizes and prevents stormwater pollution. The Public Works Department should develop a program with the support of all departments, and maintenance activities by all should be modified as needed to meet the program requirements.
- The Public Works Department should evaluate and incorporate the implications of any future TMDL studies on stormwater management.

Staffing

It is projected that additional staffing will be required to meet the additional stormwater responsibilities. The above discussions identify many additional tasks for the Public Works Department and clarification of responsibilities for other departments. The stormwater program within the Public Works Department is growing, and it is difficult to project the final overall staffing requirements or the timing of adding staff. The current identified need within the Public Works Department, not including maintenance activity, is for one full time engineer and one full time engineer technician:

- Currently the stormwater engineering activities are close to full time position. Under this plan the stormwater engineer will be responsible for coordinating training, coordinating and tracking the NPDES and TMDL programs and other state and federal programs, reviewing development submittals, and coordinating the illicit detection and program and the pre- and post-construction inspection program.
- The additional engineer technician will review plans, inspect site development and erosion control measures, assist with the illicit discharge detection program, and coordinate the need for stormwater maintenance.

Both of these positions will require full-time or close to full-time commitments. The staffing of these positions would require tracking to determine if additional staffing is required in the future. It would be the responsibility of the additional engineer to track and identify additional stormwater responsibility that might be required from future regulations. This plan does not identify the need for additional staff in other departments.

CHAPTER 9.
SUMMARY OF STORMWATER PROGRAM

A stormwater program consists of stormwater staff, maintenance staff and equipment, and a capital improvement program (CIP). The previous chapters discussed projects and programs to be included in a CIP; this chapter summarizes the CIP and itemizes costs and phasing over a 20-year period. The CIP includes drainage improvements identified in the 1996 Drainage Master Plan and discussed in Chapter 3, water quality improvements discussed in Chapter 4, and the NPDES program discussed in Chapter 5. Table 9-1 summarizes the capital projects in the CIP, along with their estimated costs and phasing.

All drainage capital projects in the CIP are taken from the 1996 study; no computer modeling was conducted to identify new capital projects for this study. The capital projects from the 1996 study account for 75 percent of the cost of the 20-year CIP. Only projects identified as priority projects in the 1996 Plan are included in this 20-year CIP program; priority projects from that plan that have been fully or partially completed are omitted. The drainage projects should be investigated during design to determine if pipe lengths can be reduced or eliminated along creek corridors. Open channel riparian areas generally help with improving overall stream health and water quality.

Water quality elements have been added to several of the drainage capital projects, with sizing based on information from the 1996 study. For some of the water quality projects, specific technologies and locations will be defined in individual basin plans recommended here. This will allow flexibility to respond to regulators and to experiment with the types of treatments that work best on identified TMDLs. Required modeling and a review of flooding and natural resources should be performed as part of the basin planning efforts. Basin-specific water quality projects include protecting existing wetlands and riparian areas, installing water quality vaults and swales, adding water quality elements to drainage improvement projects, and adding detention/water quality facilities. Wetland creation projects can include such elements as public education or trail segments.

Regional water quality and detention facilities are proposed for several basins. The 1996 plan compared the costs of detention facilities to the cost of upgrading structures downstream. This comparison, however, is oversimplified because allowing more flow down a stream destabilizes the creek and causes erosion. This degrades stream health and aesthetics and conflicts with the Phase II NPDES permit due out this spring.

Citywide programs include NPDES activities, development of a stormwater ordinance, and new maintenance and inspection activities. The program developed for the Phase II NPDES permit is scheduled to be implemented over five years. Costs for the first five years of the program are included in Phase 1 of the CIP; Phases 2, 3, and 4 include costs to continue the program. These costs are primarily associated with increased staffing rather than specific improvement projects.

TABLE 9-1.
RECOMMENDED CAPITAL IMPROVEMENT PROGRAM

	Phase 1 (Year 1-5)	Phase 2 (Year 6-10)	Phase 3 (Year 11-15)	Phase 4 (Year 16-20)
City Wide Activities (not capital projects; most costs are added to current engineering & maintenance programs)				
Stormwater Ordinance	$30,000			
NPDES Public Education and Outreach	$26,000	$28,700	$28,700	$28,700
NPDES Public Involvement & Participation	$18,100	$18,400	$18,400	$18,400
NPDES Illicit Discharge Detection & Elimination	$288,000	$288,000	$68,000	$68,000
NPDES Construction Site Runoff Control	$28,100	$23,500	$23,500	$23,500
NPDES Post-Construction Management	$22,900	$17,000	$17,000	$17,000
NPDES Pollution Prevention in Municipal Operations	$51,000	$23,000	$23,000	$23,000
Bear Creek East				
Drainage Projects				
Sunrise Drainage Project		$376,000		
Brookhurst Drainage Project		$1,219,000		
Oregon Ave. Drainage Project			$311,500	
Basin Plan		$60,000		
Water Quality Projects				
Tabby Lane Detention/WQ Facility		$186,300		
WQ Facility with Sunrise Drainage Project		$75,000		
WQ Facility with Brookhurst Project		$75,000		
WQ Facility with Oregon Ave. Drainage Project			$75,000	
Bear Creek South				
Drainage Projects				
Center Drive Drainage Projects				$106,400
Basin Plan		$40,000		
Water Quality Projects				
WQ Facility with Center Drive Drainage Projects				$75,000
Bear Creek West				
Drainage Projects				
Earhart Drainage Project	$1,467,200			
Washington Drainage Project			$1,073,800	
6th Street Drainage Project			$521,700	
Basin Plan		$60,000		
Water Quality Projects				
Earhart Water Quality Wetland Project	$400,000			
Washington Water Quality Facility Project			$75,000	
6th Street Water Quality Facility Project			$75,000	
Crooked Creek				
Drainage Projects				
Crooked Creek Near Stewart Ave			$439,600	
Crooked Creek Near Dove Lane				$256,000
Basin Plan	$60,000			
Water Quality Projects				
Regional WQ Facility near Stewart Ave Drainage Project			$300,000	
S. Holly St. Extension WQ Facility	$22,000			

TABLE 9-1 (continued).
RECOMMENDED CAPITAL IMPROVEMENT PROGRAM

	Phase 1 (Year 1-5)	Phase 2 (Year 6-10)	Phase 3 (Year 11-15)	Phase 4 (Year 16-20)
Elk Creek				
Drainage Projects				
Berrydale Drainage Project	$186,000			
Elk Misc. Drainage Project		$1,231,000		
Howard Drainage Project		$757,400		
Highway 99 Drainage Project				$799,300
Stowe Ave Drainage Project				$3,824,000
Erhman Drainage Project				$626,400
Basin Plan	$75,000			
Water Quality Projects				
Columbus Ave. Extension WQ Facility	$30,000			
Lozier Lane Extension WQ Facility	$15,000			
WQ Facilities with Howard Ave Drainage Project		$300,000		
WQ Facilities with Stowe Ave Drainage Project				$300,000
Larson Creek				
Drainage Projects				
Murphy Rd. Bypass; Juanipero to Larson Ck.	$250,000			
North Fork Project	$1,198,400			
Larson Central Drainage Project			$594,600	
Black Oak Drainage Project				$299,300
Basin Plan	$60,000			
Water Quality Projects				
Regional Detention/WQ facility U/S of Phoenix Rd.		$500,000		
Restoration/Protection Areas				
Restore Creek between Olympic Ave. and Murphy Rd			$250,000	
Separate between East Main Canal and Larson Creek				$100,000
Lazy Creek				
Drainage Projects				
Eagle Trace			$82,900	
Lazy Creek at Murphy Rd			$78,900	
Lazy Creek at Crestbrook Rd			$213,900	
Lazy Creek at Burgundy			$258,700	
North Phoenix			$488,100	
Lazy Creek at Siskiyou			$319,300	
Lazy Creek at Ellendale Drive			$220,700	
Lazy Creek at Oak Drive				$181,000
Basin Plan	$60,000			
Water Quality Projects				
McAndrews Detentions/WQ Facility	$500,000	$500,000		
Restoration/Protection Areas				
Restore Creek south of Bear Creek Park			$120,000	

TABLE 9-1 (continued).
RECOMMENDED CAPITAL IMPROVEMENT PROGRAM

	Phase 1 (Year 1-5)	Phase 2 (Year 6-10)	Phase 3 (Year 11-15)	Phase 4 (Year 16-20)
Lone Pine Creek				
Drainage Projects				
Lone Pine Central		$823,700		
Other Structural Cost - Pond		$555,000		
Middle Fork			$401,200	
Basin Plan	$60,000			
Water Quality Projects				
Regional detention/WQ facility with 1996 project		$100,000		
Lone Pine WQ Project		$75,000		
Restoration/Protection Areas				
Separate flow between East Canal and Lone Pine Creek			$100,000	
Separate flow between Hopkins Canal and Lone Pine Cr.			$100,000	
Midway Creek				
Drainage Projects				
King Center Upgrade	$2,064,700			
Delta Waters Upgrade		$538,000		
Basin Plan		$60,000		
Water Quality Projects				
King Center Upgrade WQ Project	$75,000			
Delta Waters Upgrade WQ Project		$75,000		
Restoration/Protection Areas				
Revegetate streams outside the Airport			$40,000	
Total	**$6,987,400**	**$8,005,000**	**$6,318,500**	**$6,746,000**

This plan recommends several citywide design standards as part of a stormwater ordinance. These include buffers along all open streams, stormwater management for all construction activities, water quality treatment for all new development, and water quality treatment and detention for larger developments.

PHASING

Table 9-1 lists capital expenditures for the CIP projects during each of four CIP phases. The rating system developed in the 1996 study was used to establish project priorities. Capital drainage projects receiving a total score of 13 or higher in the 1996 study are scheduled for Phase 1 (Years 1 – 5). Other projects are scheduled for later phases based on their score in the 1996 study. Water quality projects are scheduled to correspond with future drainage or road projects or expected development trends. They should be investigated as add-ons to any new construction project. Funding for water quality elements is included for three upcoming road projects: the Lozier Lane extension and Columbus Avenue Extension in the Elk Creek Basin and the South Holly Street extension in Crooked Creek Basin.

COST

Estimates for capital improvement projects include the following:

- Construction cost—the cost of materials and installation
- Construction contingencies—20 percent of construction cost
- Allied costs (engineering, administration, legal, financing and construction administration)—30 percent of construction.

Costs for land purchases are not included. The estimates are budget-level estimates only; actual project cost should be within plus 35 percent to minus 20 percent of the estimate. Project cost estimates from the 1996 Drainage Master Plan were adjusted to 2004 levels, assuming an annual increase of 3 percent.

A budgetary cost of $75,000 is included where a water quality element is added to another capital project. The cost of a small water quality facility without other work is estimated to be $100,000. Grants to help fund these facilities should be investigated.

Estimates for water quality projects associated with upcoming road work (the Lozier Lane extension, Columbus Avenue Extension and South Holly Street extension) include only the construction cost; engineering and project administration costs are part of the overall project. These projects have lower cost because they are sized to address only the new impervious pavement and not an entire basin. Impervious area was estimated for these improvements and cost estimates were developed based on a cost of $5 per square feet for the construction of a swale. The size of the swale was calculated using the simplified method (City of Portland Stormwater Management Manual, 2004), which multiplies the impervious area by 0.09 to size a vegated swale. For a grass swale, the multiplier is 0.12.

Table 9-2 provides a detailed cost of the Earhart Water Quality facility.

The protection of wetlands is achieved through ordinances, so no cost is identified for wetland protection. Estimates for restoration projects are based on the extent of restoration, difficulty, access constraints, and permitting.

The cost of separating creeks and irrigation canals cannot be estimated without basin modeling. A placeholder cost of $100,000 is included with each of these projects to include design, staff time and construction. These estimates should be further defined when basin plans are developed.

Costs associated with NPDES Phase II work generally represent increased maintenance and engineering staff. These costs were developed as part of the development of the NPDES program.

TABLE 9-2.
ESTIMATED COST FOR EARHART WATER QUALITY PROJECT

Improvement	Quantity	Unit	Unit Cost	Total Cost
Mobilization	1	LS	$30,000	$30,000
Excavation and Grading	13,000	CY	$10	$130,000
Inlet Structure	1	LS	$10,000	$10,000
Outlet Structure	1	LS	$15,000	$15,000
Gravel Access Road (800 LF')	360	CY	$20	$7,000
Landscaping	4.0	AC	$15,000	$60,000
Erosion Control	1	LS	$15,000	$15,000
Subtotal				***$267,000***
Construction Total				$267,000
Construction Contingencies (percent of total)			20%	$53,000
Engineering / Legal / Administration Fees (percent of total)			30%	$80,000
Total Project Cost				**$400,000**

Notes:
1. Invert elevation at wetland inlet is approximately 1,362.8 feet.
2. Assume property is owned by City of Medford.
3. Wetland could be connected to the Bear Creek Trail System (not included in estimate).
4. Educational materials have not been included in the cost estimate.

BASIN PLANS

This plan recommends that several basin plans be completed within the first five years. Estimated basin planning costs are listed in Table 9-1. The basin plans will combine modeling, natural resource protection and restoration, creek/irrigation-canal separation projects, and possibly basin-specific stormwater quantity design standards. Each basin's plan is identified separately in the CIP list; however, plans can be developed in groups for basins with similar characteristics to save project administration costs. Attention to specific regions of the City will allow basin plans to be developed alongside the illicit discharge program as part of the NPDES requirements.

Elk Creek—Highest Rank

As became apparent from field reconnaissance and review of existing documents, a better understanding of the Elk Creek Basin is required before improvement projects can be recommended. Flooding has been reported, the basin is under heavy development pressure in the upstream reaches, and it is difficult to map the drainage system through the heavily industrial downstream reaches. Using recent storm maps, the basin plan should investigate ways to keep development from impacting downstream areas. The plan should assist the City with developing an illicit discharge plan for the downstream industrial area. Using modeling and field reconnaissance, multi-objective projects could be developed to improve water quality and control flooding.

Midway, Lazy Creek, Larson Creek and Lone Pine Creeks—High Priority

Development pressures in the Midway, Lazy Creek, Larson Creek and Lone Pine Creek Basins make these basins high priority. These basins are all on the east side of the City and their basin plans will address development in the east hills. This development should be addressed through detention and hillside ordinances. The CIP program will be reviewed and details outlined in these basin plans.

Midway Basin could be the second basin after Elk Creek. Lone Pine could be studied concurrently or separately since it is in the vicinity and has similar characteristics and the major improvement identified in the 1996 Plan cannot be constructed. Items that need to be investigated are drainage and water quality, along with separation of irrigation canals and creeks.

The Lazy Creek and Larson Creek Basins have large development projects upstream, which could warrant early basin planning. In some areas these creeks are in good condition, and protecting them from development and upstream flows should be goals for these basin plans.

Bear Creek West, East and South, and Crooked Creek—As Needed

Crooked Creek is the most important basin in this group since it still experiences development pressure. Although all of the City's basins were studied for the 1996 DMP, the Bear Creek West and East Basins were most suitable for the methodologies used in that effort; many of the projects proposed for these basins still apply and can be completed as required. Potential locations for water quality facilities have been identified as part of the pipe improvements projects. Bear Creek West could be revisited if funding becomes available for the Earhart Street water quality facility since some modeling of this subbasin would be required. Bear Creek South includes only a small amount of City area, so it can be investigated after the other basins. Combining of these studies can reduce cost when basin planning.

COMPREHENSIVE WATER QUALITY PROGRAM

A comprehensive plan to enhance stormwater quality will use many approaches:

- The first is source control, which includes education programs for businesses and homeowners and retrofitting buildings to prevent pollutants from entering the system. The City has already started such a program and it will be augmented with the NPDES program.
- A second approach is to ensure that new development does not adversely impact water quality. This is addressed by planning and design standards and inspection during construction. As discussed in Chapter 7, new or revised ordinances for development standards are recommended, including streamside buffers, erosion control, and hillside development.
- A third approach is to protect, preserve and enhance existing wetland and riparian areas. Wetland and riparian areas act as a filter and help in the cleaning of urban runoff.

- The fourth approach is to clean stormwater once it enters the City right-of-way using man-made facilities. This involves constructing and maintaining water quality wetlands and storm treatment facilities. These facilities can range from roadside or park bioswales to water quality vaults below City streets. Many of these are identified in the CIP program; however, each new project the City implements should be reviewed to determine how water quality might be addressed in a cost-effective manner.

All of these approaches are recommended as part of this stormwater management plan. However, equal emphasis should be placed on aggressive implementation of the first three approaches, as they are preventive—keeping pollutants from entering the stormwater system. The fourth approach, which acts to remove pollutants that have already entered the system, is more difficult and expensive than the preventive approaches.

Implementing water quality projects in fully built-out basins such as Bear Creek East and West is difficult, and options are limited. Unless the City chooses to purchase property or remove tenants, water quality treatment must be provided in existing right-of-way. One method is to place in-line or off-line water quality vaults into existing storm systems below City streets. There are several manufacturers of water quality vaults, and customized vaults can be designed and constructed. Each project should be reviewed for available right-of-way, flow rates and upstream land use. If conditions are right, water quality vaults or swales should be added. The following locations could be suitable for water quality treatment projects (locations are not listed in order of preference):

- Bear Creek East Basin
  - In Brookhurst Project
  - At Biddle and McAndrews
  - At Medco Logging Road and Bullock
  - At Medco Logging Road between Bullock and Biddle
- Bear Creek South Basin
  - In Center Drive Project
- Bear Creek West Basin
  - In Earhart Project
  - In 6th Street Project
  - On Walnut Street at Rouge Valley Boulevard
  - On Alice Street at Rouge Valley Boulevard
  - On Jackson Street at Rouge Valley Boulevard
  - On 8th Street at Rouge Valley Boulevard
  - On 10th Street at Rouge Valley Boulevard
- Crooked Creek Basin
  - In Stewart Avenue Project
  - At Stewart Avenue and Barnett Road

- Elk Creek Basin
  - In Lars Way Project
  - On Berrydale Avenue east of Table Rock Road
  - On Medco Logging Road at Bear Creek
- Lazy Creek Drainage Basin
  - Near Rogue Valley Medical Center
- Midway Drainage Basin
  - In Delta Waters Upgrade Project
  - On Lear Way at Cardinal Avenue
  - On International Way at Butte Lateral.

Prior to the completion of individual basin plans, demonstration projects can be constructed to document maintenance requirements. Suitable locations for the demonstration swales include the following sites on public lands:

- Elk Creek Basin—At the end of the stormwater system flowing east along Berrydale Avenue into a tributary draining into Bear Creek
- Bear Creek East Basin—At the end of the stormwater system flowing south on Willamette Avenue into the unnamed tributary to Bear Creek north of Baby Bear Creek in Bear Creek Park
- Bear Creek South Basin (alternative)—At the end of the stormwater system flowing east of Center Drive draining into an unnamed tributary to Bear Creek.

The experience of constructing and monitoring these facilities will prepare City staff to select BMP facilities in the future. Additional bioswale locations can be identified in individual basin plans using detailed storm maps and land ownership maps.

CITY STORMWATER ORDINANCE

A Citywide stormwater ordinance should be developed to address erosion control, post-development water quality design and detention, creek setback buffers, design storms, illicit discharges, creek crossing design standards, hillside development and which new facilities require stormwater management. This activity is identified to be accomplished by Year 2 in the NPDES Phase II program. It is recommended that this work begin as soon as possible, as it will have the biggest impact on the City's stormwater management and stormwater quality.

CIP BREAKDOWN BY BASIN

Figures 9-1 through 9-9 and Tables 9-3 through 9-11 summarize the elements of the recommended CIP in each drainage basin.

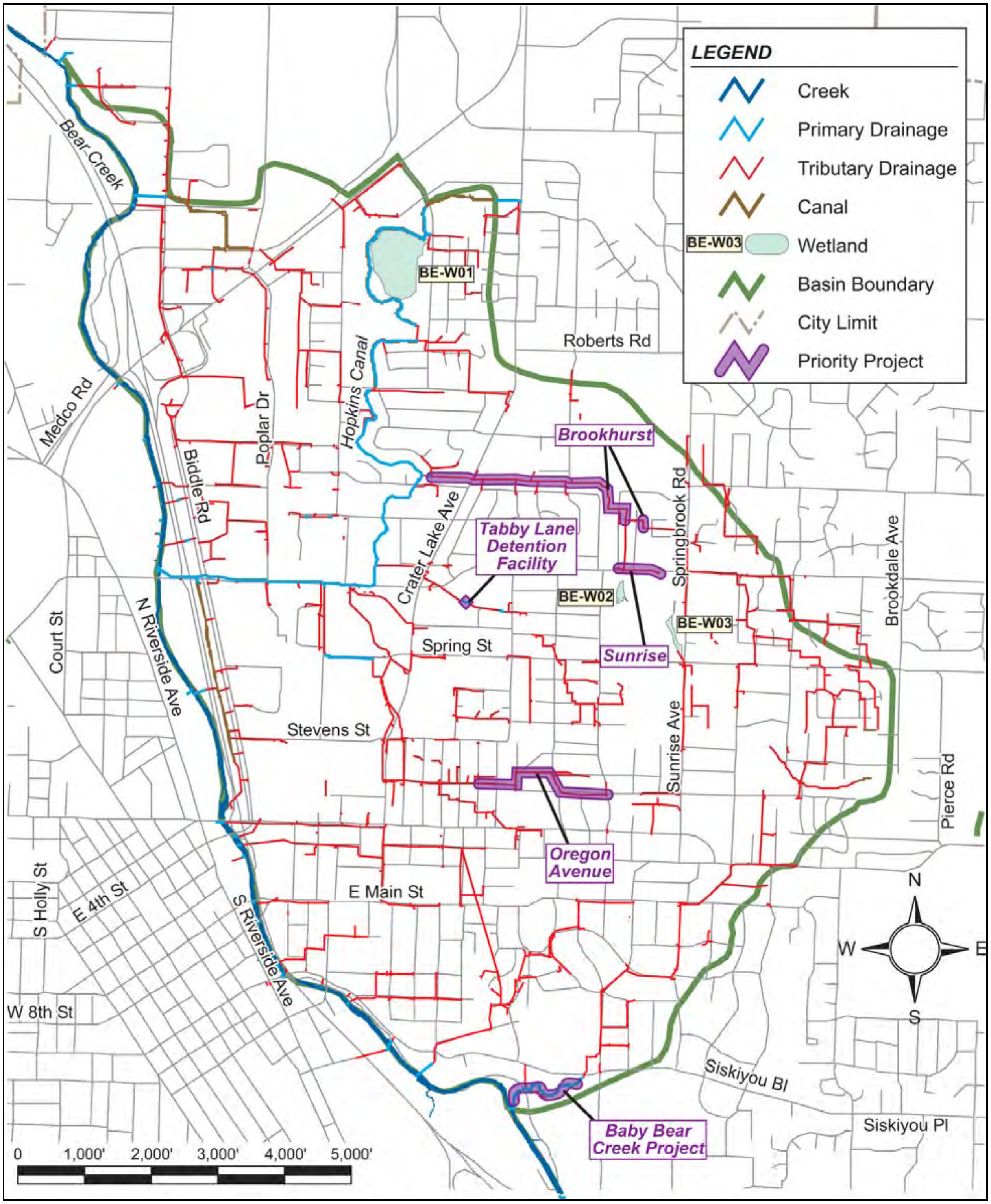

Figure 9-1. CIP Elements for Bear Creek East Basin

TABLE 9-3.
BEAR CREEK EAST CIP PROGRAM

Project Name	Project Description	Schedule (CIP years)	2004 Cost
Drainage Projects			
Sunrise Drainage Project	This project is identified in the 1996 DMP as the construction of 1,166 feet of 24" and 27 " storm pipe located in the area of McAndrews Road and Bonita Ave. or Ramada Ave.	6-10	$376,000
Brookhurst Drainage Project	This project is identified in the 1996 DMP as the construction of 4,959 feet of storm sewer pipe ranging between 21" and 48". The project is located in the area of Camellia Ave.	6-10	$1,219,000
Oregon Ave. Drainage Project	This project is identified in the 1996 DMP as the construction of 2,365 feet of 21" and 24" storm pipe. The project is located along Oregon, Stratford and Salino Avenues.	11-15	$311,500
Water Quality Projects			
Tabby Lane Detention Facility	The 1996 DMP identified the Tabby Lane 3 acre-feet detention facility as an alternative to simple pipe upsizing. The cost estimate of the overall alternative was the same as pipe upsizing however this alternative was not selected because of the long term maintenance cost. This alternative should be reconsidered as on option to pipe replace because of the added benefit of a properly designed detention facility being a created wetland and providing water quality treatment.	Not a DMP Priority Project	$186,300
Water Quality Elements of Drainage Projects	No water quality facilities were identified in the 1996 DMP projects and therefore as part of the water quality improvements $75,000 should be added to each of the drainage projects above to investigated the placement of WQ vaults or vegetated swales. These facilities would be better placed during the design of the project or during the basin plan projects.	6-10 11-15	$150,000 75,000
Basin Plan			
Bear Creek East Basin Plan	Bear Creek east is almost fully developed. Therefore the Basin Plan for Bear Creek East is not as high a priority as other basins receiving intense development pressure.	Schedule: years 6-10	2004 Cost: $60,000
Wetland and Stream Protection and Restoration			
	Three wetlands have been identified within the basin. All three wetlands should be protected. BE-W01 and BE-W03 are locally significant. Because of the low number of wetlands in the Bear Creek East Basin City staff should investigate any opportunities to enhance all three wetlands. The only open stream corridor is Baby Bear Creek. This Creek segment is within the Medford Parks Department property and they are currently investigated restoration opportunities.		

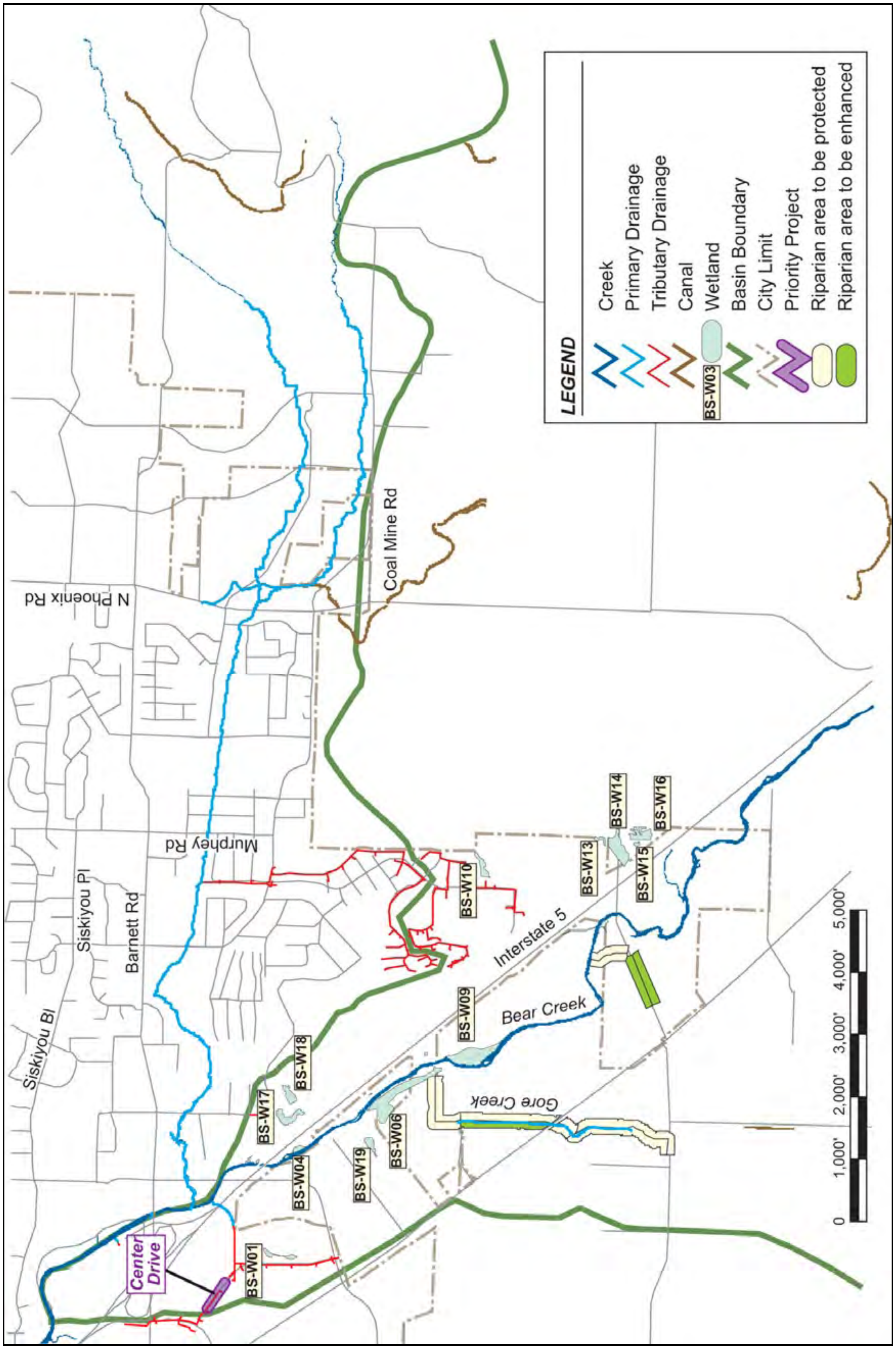

Figure 9-2. CIP Elements for Bear Creek South Basin

TABLE 9-4.
BEAR CREEK SOUTH CIP PROGRAM

Project Name	Project Description	Schedule (CIP years)	2004 Cost
Drainage Projects			
Center Drive Drainage Project	This project is identified in the 1996 DMP as the construction of 390 feet of 30" and 36 " storm pipe located along Center Drive.	15-20	$106,400
Water Quality Projects			
Water Quality Element of Center Drive Drainage Project	The area within the Bear Creek South Basin and the city limits consists mainly of the Bear Creek and I-5 corridor. The only water quality project recommended in this basin is to add a water quality facility to the Center Drive Drainage Project. This would either be a swale or vault depending on available space.	15-20	$75,000
Basin Plan			
Bear Creek South Basin Plan	Bear Creek South is a small area and therefore the plan is not a high priority. It would be cost affected to combine this basin plan with the Crooked creek Basin plan.	6-10	$40,000
Wetland and Stream Protection and Restoration			
	There are considerable opportunities within the Bear Creek South Basin to preserve and enhance existing wetlands and streams. Efforts should be made to protect buffers along Gore creek and plant material to allow for shading. There are twelve identified significant wetlands in this basin. These should be protected along with other wetlands not identified as significant. Protection and enhance cost for this area have not been incorporated into the CIP cost.		

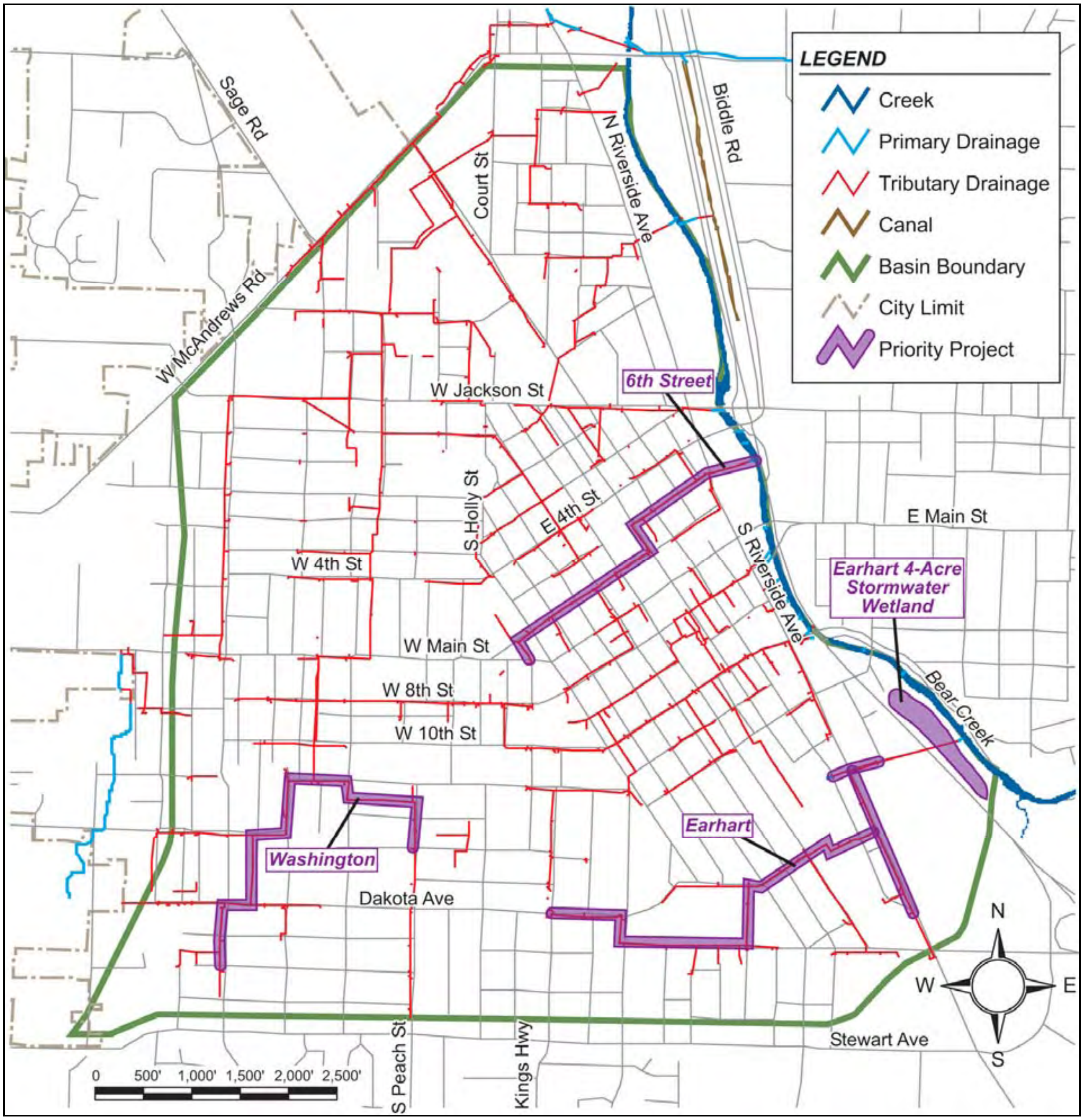

Figure 9-3. CIP Elements for Bear Creek West Basin

TABLE 9-5.
BEAR CREEK WEST CIP PROGRAM

Project Name	Project Description	Schedule (CIP years)	2004 Cost
Drainage Projects			
Earhart Drainage Project	This project is identified in the 1996 DMP as the construction of 7,969 feet of storm sewer pipe ranging between 21" and 36". The project covers a large area in the south east portion of Bear Creek west as is shown in the Figure.	1-5	$1,467,200
Washington Drainage Project	This project is identified in the 1996 DMP as the construction of 5,435 feet of storm sewer pipe ranging between 24" and 30". The project covers a large area in the south west portion of Bear Creek west as is shown in the Figure.	11-15	$1,073,800
6th Street Drainage Project	This project is identified in the 1996 DMP as the construction of 3,644 feet of 27" and 30" storm pipe. The project is located along 6th and 7th Street in the downtown area.	11-15	$521,700
Water Quality Projects			
Earhart Street Water Quality Wetland Project	The Earhart Street wetland is a proposed wetland between I-5 and Bear Creek near the outfall from the Earhart storm outfall. The property is identified as City property and the current use is an open field. This would be a large wetland/treatment facility to treat the entire 182 acre basin. Preliminary sizing would be to detain approximately 0.5" of runoff for 24 hours. The property is identified as 5 acres and the plan would be to use approximately 4 acres. This could be developed as a wetland feature with education and trial features. These amenities have not been included in the cost estimate of the project. This project could potentially get some grant funding through DEQ's 319 NPS grant program or the Oregon Watershed Enhancement Board (OWEB). These opportunities should be explored. This project does not have to be in conjunction with the Earhart Drainage Project.	1-5	$400,000
Washington Water Quality Facility	$75,000 should be added to the Washington drainage project to investigate the placement of WQ vaults or vegetated swales. These facilities would be better placed during the design of the project or during the basin plan projects.	11-15	$75,000
6th Street Water Quality Facility	$75,000 should be added to the 6th Street drainage project to investigate the placement of WQ vaults or vegetated swales. These facilities would be better placed during the design of the project or during the basin plan projects.	11-15	$75,000
Basin Plan			
Bear Creek West Basin Plan	Bear Creek West is almost fully developed. Therefore the Basin Plan for Bear Creek East is not as high a priority as other basins receiving intense development pressure. Design of the Earhart drainage and wetland project will require modeling. This could but does not have to run concurrently with the basin planning.	6-10	$60,000
Wetland and Stream Protection and Restoration			
	Except for Bear Creek itself the Bear Creek West basin does not have identified creek corridors or wetlands to enhance or protect.		

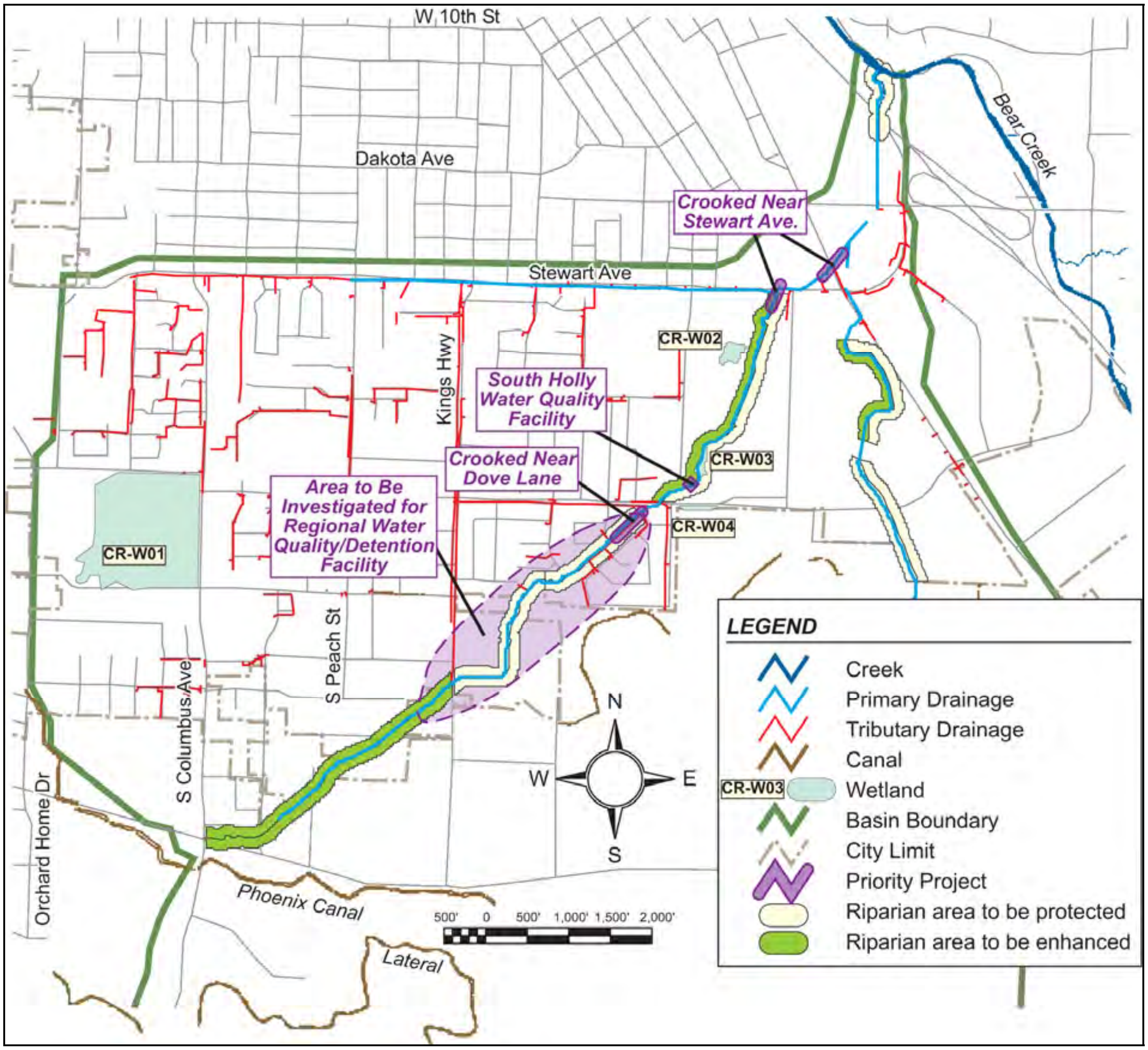

Figure 9-4. CIP Elements for Crooked Creek Basin

TABLE 9-6.
CROOKED CREEK CIP PROGRAM

Project Name	Project Description	Schedule (CIP years)	2004 Cost
Drainage Projects			
Crooked Creek near Stewart Ave	This project is identified in the 1996 DMP as the construction of two new bridge or culvert crossings for Crooked Creek, at Stewart Avenue and at Highway 99.	11-15	$439,600
Crooked Creek near Dove Lane	This project is identified in the 1996 DMP as the construction of 325 feet of 60" storm sewer pipe located in the area of Dove Ave.	16-20	$256,000
Water Quality Projects			
Regional Water Quality and Detention Facility	A regional water quality and detention facility should be investigated as part of the basin plan to reduce flows in the downstream reaches of the creek and reduce pollutants from the upstream reaches. The downstream segments of the Creek have been channelized and are receiving increased flows from the upper reaches. A regional facility could reduce the need to upsize the pipe structure at Dove Lane and Stewart Ave. The Project would also provide for more habitat and public open space within the basin. It is difficult to estimate the cost of a detention basin without modeling. The cost estimate is an approximate amount for a 1.5 acre wetland creation project.	11-15	$300,000
South Holly Street Water Quality Facility	The South Holly Road project is 1,250 feet of new road. With the project a new vegetated swale should be constructed prior to discharging into Crooked Creek. The size of the swale will depend on the width of the road however the size has been estimated at 4300 square foot facility based on a 38 foot width. The design of the road should consider a reduced road width.	1-5	$22,000
Basin Plan			
Crooked Creek Basin Plan	Crooked Creek is under development pressure and a basin plan should be implemented within the first few years of the CIP. Protection of Crooked Creek along with a regional facility in the middle segments of the creek should be investigated. The facility would be a detention and wetland creation project.	1-5	$60,000
Wetland and Stream Protection and Restoration			
	Most of Crooked Creek has a riparian area that should be protected when development occurs. Development standards should address new standards to help shade the middle creeks and the City should investigate ways to encourage residents to help shade the middle portion of the Creek and work with Stewart Meadows golf course to provide more shade along the courses segments.		

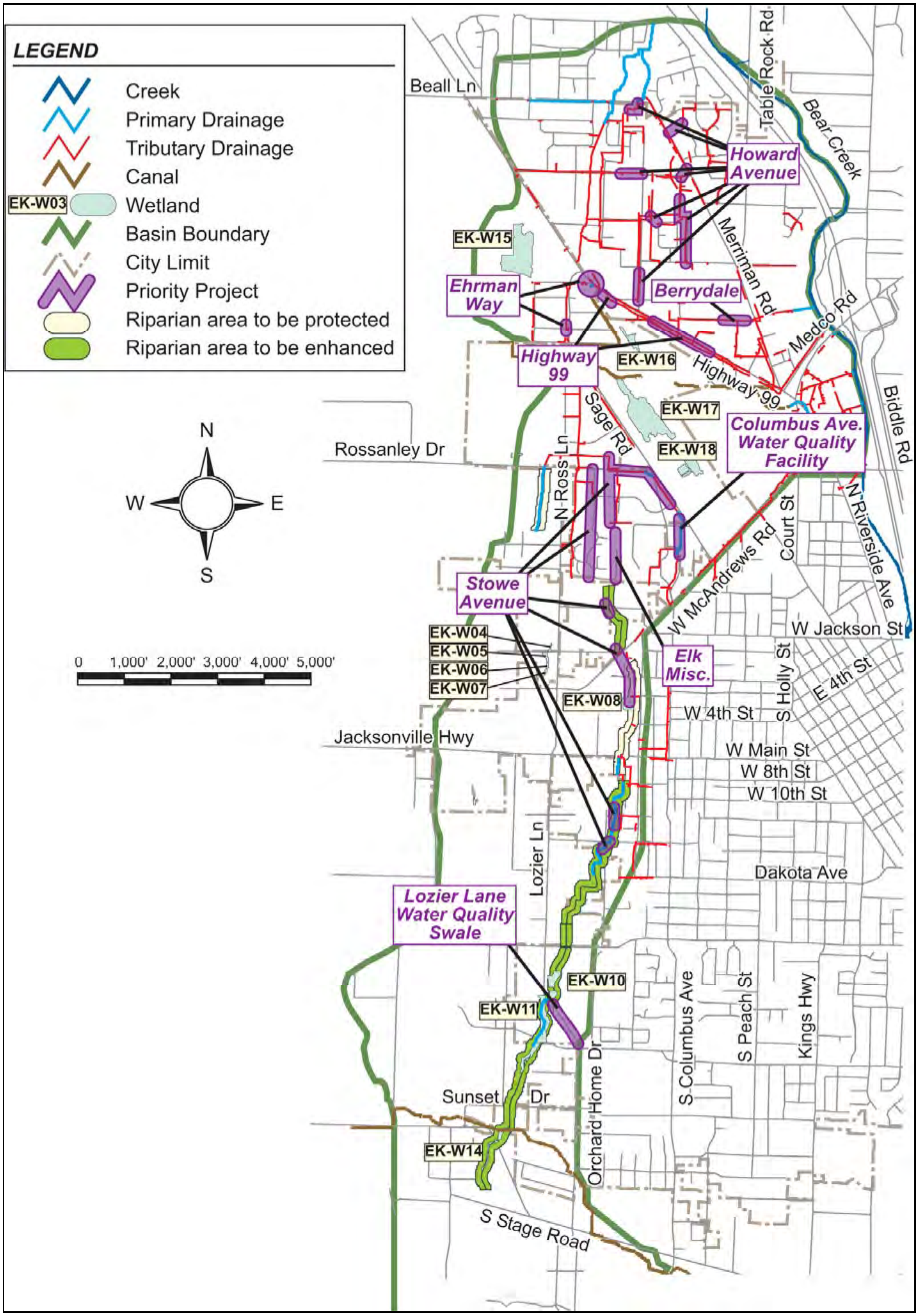

Figure 9-5. CIP Elements for Elk Creek Basin

TABLE 9-7.
ELK CREEK CIP PROGRAM

Project Name	Project Description	Schedule (CIP years)	2004 Cost
Drainage Projects			
Berrydale Ave Project	This project is identified in the 1996 DMP as the construction of 435 feet of 27" storm pipe located along Berrydale Ave.	1-5	$186,000
Elk Misc. Project	This project is identified in the 1996 DMP as the construction of 2,600 feet of 30" storm pipe as a bypass paralleling Stowe Ave. on the east.	6-10	$1,231,000
Howard Ave. Project	This project is identified in the 1996 DMP as the construction of 4,418 feet of storm sewer pipe ranging between 24" and 36". The project is located in the area around Howard Ave and Mace Road.	6-10	$757,400
Highway 99 Project	This project is identified in the 1996 DMP as the construction of 2,621 feet of 27" and 36 " storm pipe runs along Hwy 99 and 96 feet of box culvert below Ehrman Way just west of Hwy 99.	16-20	$799,300
Stowe Ave. Project	This project is identified in the 1996 DMP as the construction of 5,800 feet of storm sewer pipe ranging between 18" and 60". The project runs along Stowe Ave.	16-20	$3,824,000
Ehrman. Project	This project is identified in the 1996 DMP as the construction of 1,791 feet of storm sewer pipe ranging between 21" and 42". The project is located along Ehrman Way and Sage Road.	16-20	$626,400
Water Quality Projects			
Columbus Avenue Water Quality Facility	Design of the Columbus Avenue road extension (an 850-foot extension of Columbus Ave.) should include a water treatment facility (a swale or small vegetated wetland). The size has been estimated at 6,000 square feet for a vegetated facility or 8,000 square feet for a grass swale. The layout will depend on the design and land available.	1-5	$30,000
Lozier Lane Water Quality Swale	The Lozier Lane road extension project is approximately 800 feet of new road. A vegetated bio-swale can be added as part of the design of the project. Sizing the swale using a ration of 0.09 would lead to a swale of about 2800 square feet. The swale would be designed between 7 and 10 feet wide and therefore 300 to 400 feet in length.	1-5	$15,000
Stowe Ave. Area Regional WQ/Detention Facility	A regional facility in the Stowe Avenue area would detain peak flows and address water quality. Sizing would be address in the Basin Plan modeling and the cost is a rough estimate approximate. The detention would require reevaluation of the drainage projects above.	16-20	$300,000
Howard Ave. Area Regional WQ/Detention Facility	A regional facility in the Howard Avenue area would detain peak flows and address water quality. Sizing would be address in the Basin Plan modeling and the cost is a rough estimate approximate. The detention would require reevaluation of the drainage projects above.	6-10	$300,000
Basin Plan			
Elk Creek Basin plan	The Elk Creek Basin plan should be the first basin plan prepared and will be the most difficult. The complex creek system starts in an area of considerable residential development, flows through a partially developed area of mixed land use and finally flows through a highly industrial area. Portions of the creek are on private property.	1-5	$75,000
Wetland and Stream Protection and Restoration			
	There is considerable open channel creek that should be protected and enhanced when development occurs in the surrounding land. The figure presents areas that have been identified as requiring shading.		

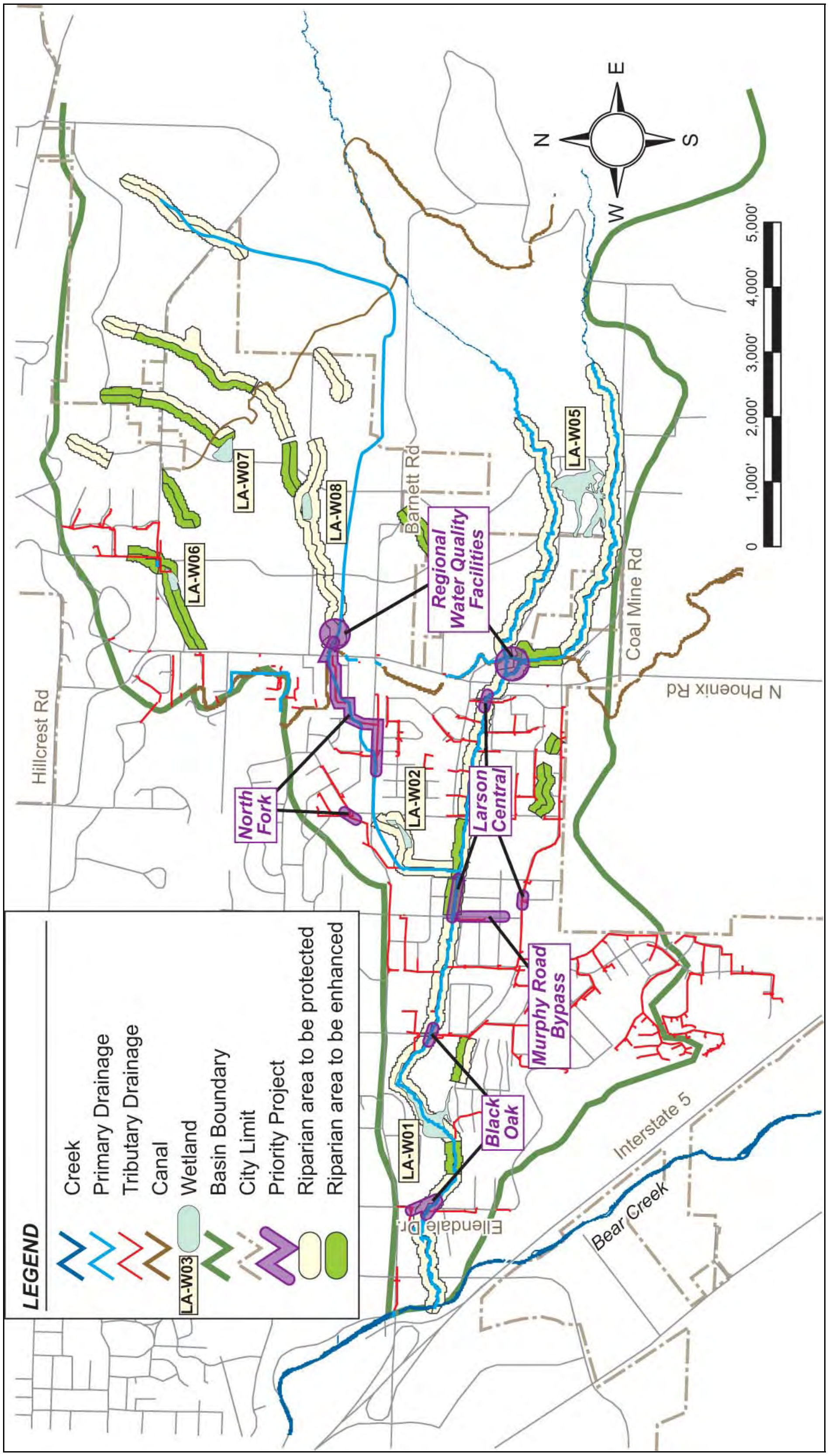

Figure 9-6. CIP Elements for Larson Creek Basin

TABLE 9-8.
LARSON CREEK CIP PROGRAM

Project Name	Project Description	Schedule (CIP years)	2004 Cost
Drainage Projects			
Murphy Rd. Bypass – Juanipero to Larson Creek	This project is identified by City staff as a required project. The project is to size and construct a pipe along Murphy Road from Juanipero Way to Larson Creek.	1-5	$250,000
North Fork	This project is identified in the 1996 DMP as the construction of 3,363 feet of pipe ranging from 21" pipe to a box culvert. This project should be revisited to determine if day lighting of portions of the North Fork of the Creek is possible.	1-5	$1,198,400
Larson Central Drainage	This project is identified in the 1996 DMP as the construction of 795 feet of 36" pipe on Juanipero Way and the replacement of four culverts along the main branch of Larson Creek.	11-15	$594,600
Black Oak Drainage	This project is identified in the 1996 DMP as the construction of 254 feet of 27" storm pipe and two box culverts. The project is located along Black Oak Drive near the main branch of Larson Creek.	16-20	$299,300
Water Quality Projects			
Regional Detention/WQ Facilities U/S of Phoenix Road	The 1996 DMP stated detention was not an option for Larson Creek because of shallow rock and the creek forks into several branches. This plan is recommending two smaller detention /WQ facilities on the north and main branch. The WQ facilities would simply be a buffered low flow channel and the detention would be a dedicated upland area where flows from the one-year storm would back up. The slope allows this backing and the upland area could serve as open space. This facility would work hand in hand with site specific WQ control measures and low impact development designs. Simply upsizing downstream culverts will destabilize the D/S creek and not meet the intention of the NPDES stormwater permit. Sizing and a cost estimate is impossible without modeling. These projects should work with developers in the area to determine the funding and construction of these projects. The cost estimate is simply funding for the City to cost share in these projects.	Not a DMP Priority Project	$500,000
Basin Plan			
Larson Creek basin plan	The Larson Creek basin plan should be a high priority project.	1-5	$60,000
Wetland and Stream Protection and Restoration			
Restore Creek between Olympic Ave. and Murphy Road	The concrete lined portion of Larson Creek should be restored to a natural stream system. This should be coordinated with the replacement of culverts as identified in the Larson Central drainage Project. The length of the segment is 600 feet with a property width of 30-40 feet. Additional property might be required but is not included in the estimated cost.	11-15	$250,000
Separate Larson Cr. from Main Canal	This project identifies the need to separate Larson Creek from the Main Canal.	Not a Priority Project	$100,000

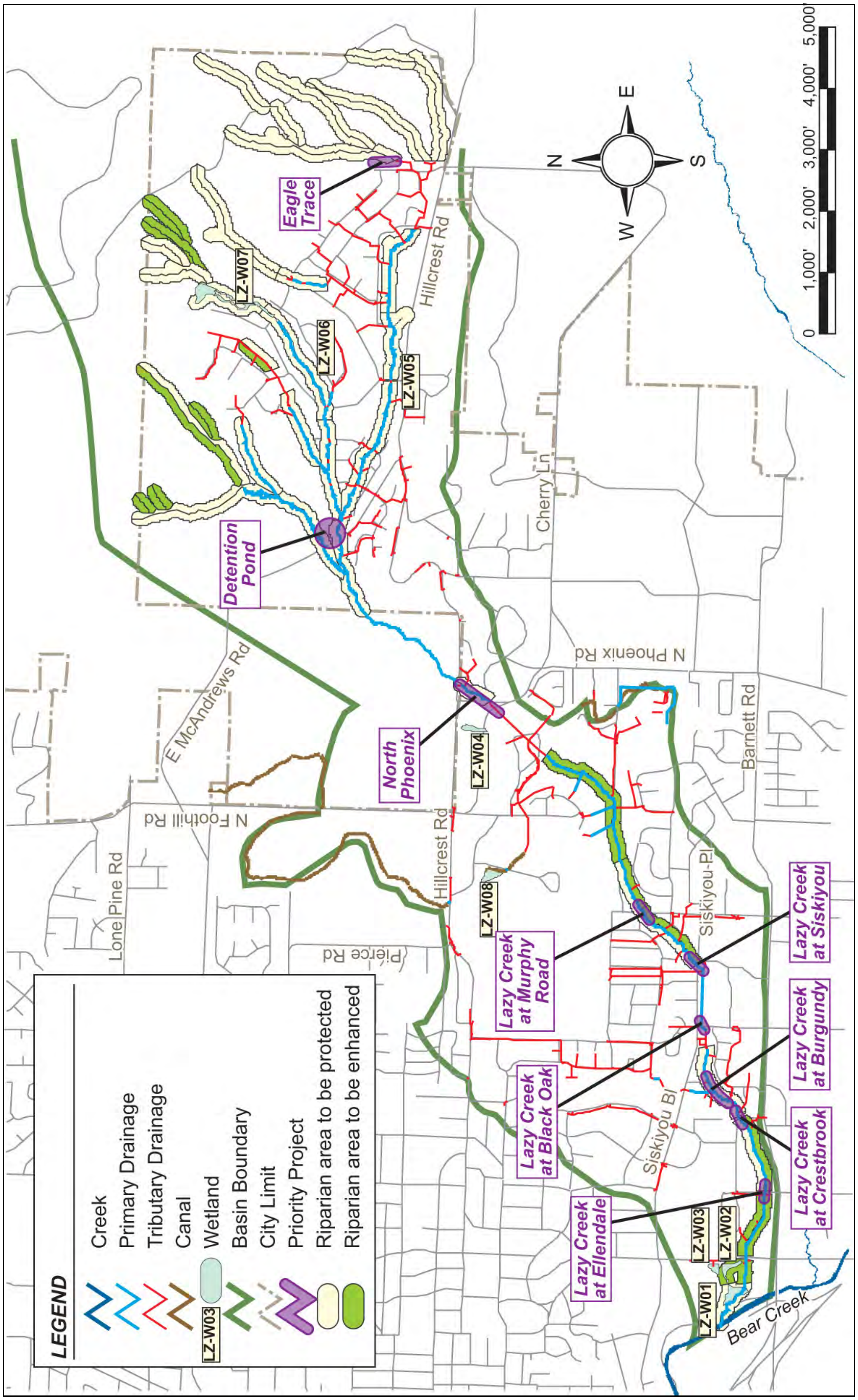

Figure 9-7. CIP Elements for Lazy Creek Basin

TABLE 9-9.
LAZY CREEK CIP PROGRAM

Project Name	Project Description	Schedule (CIP years)	2004 Cost
Drainage Projects			
Lazy Creek at Murphy Road	This culvert replacement was identified in the 1996 DMP	11-15	$78,900
Lazy Creek at Crestbrook Road	This culvert replacement was identified in the 1996 DMP	11-15	$213,900
Lazy Creek at Burgundy	This culvert replacement was identified in the 1996 DMP	11-15	$258,700
Lazy Creek at Siskiyou	This culvert replacement was identified in the 1996 DMP	11-15	$319,300
Lazy Creek at Ellendale Drive	This culvert replacement was identified in the 1996 DMP	11-15	$220,700
Eagle Trace Project	This project, identified in the 1996 DMP, increases the capacity of the 780-foot-long 48-inch pipe that extends from Cherry Lane to Eagle Trace Drive. The need for the project should be reviewed during development of the basin plan.	11-15	$82,900
North Phoenix Project	The 1996 DMP calls for this project to rebuild the 1,220-foot, 72-inch pipe that crosses under North Phoenix Road and Hillcrest Road. The City owns 0.93 acres at this corner and this project should be changed to a daylighting and water quality project.	11-15	$488,100
Lazy Creek at Black Oak Drive Project	This project, identified in the 1996 DMP, is to reconstruct the culvert and pipe system (90 feet of 48-inch pipe and 300 feet of 54-inch pipe) where Black Oak Drive crosses Lazy Creek.	16-20	$181,000
Water Quality Projects			
Regional Detention/WQ Facilities U/S of McAndrews Road	This project was identified in the 1996 DMP as a $2,000,000 project however the City now owns the land and the downstream dike has been constructed as part of the McAndrews Road Project. The Creek should be remodeled to determine if 30 acre-feet are required in the detention facility and how the culvert replacement projects downstream are affected. The detention facility should maintain the low flow channel and provide landscaping to ensure the area keeps the aesthetic nature of the area.	1-10	$1,000, 000
Basin Plan			
Lazy Creek basin plan	The Lazy Creek basin plan should be a high priority project.	1-10	$60,000
Wetland and Stream Protection and Restoration			
Restore Lazy Creek South of Bear Creek Park	Lazy creek flows through the south end of Bear Creek Park and this presents a restoration opportunity. The restoration cost is estimated at $100 a linear foot including design cost.	11-15	$120,00 0
Miscellaneous Projects	Other projects include working with Rouge Valley Country Club to help restore and protect Lazy Creek.		

Protect wetlands and shade riparian areas as shown.

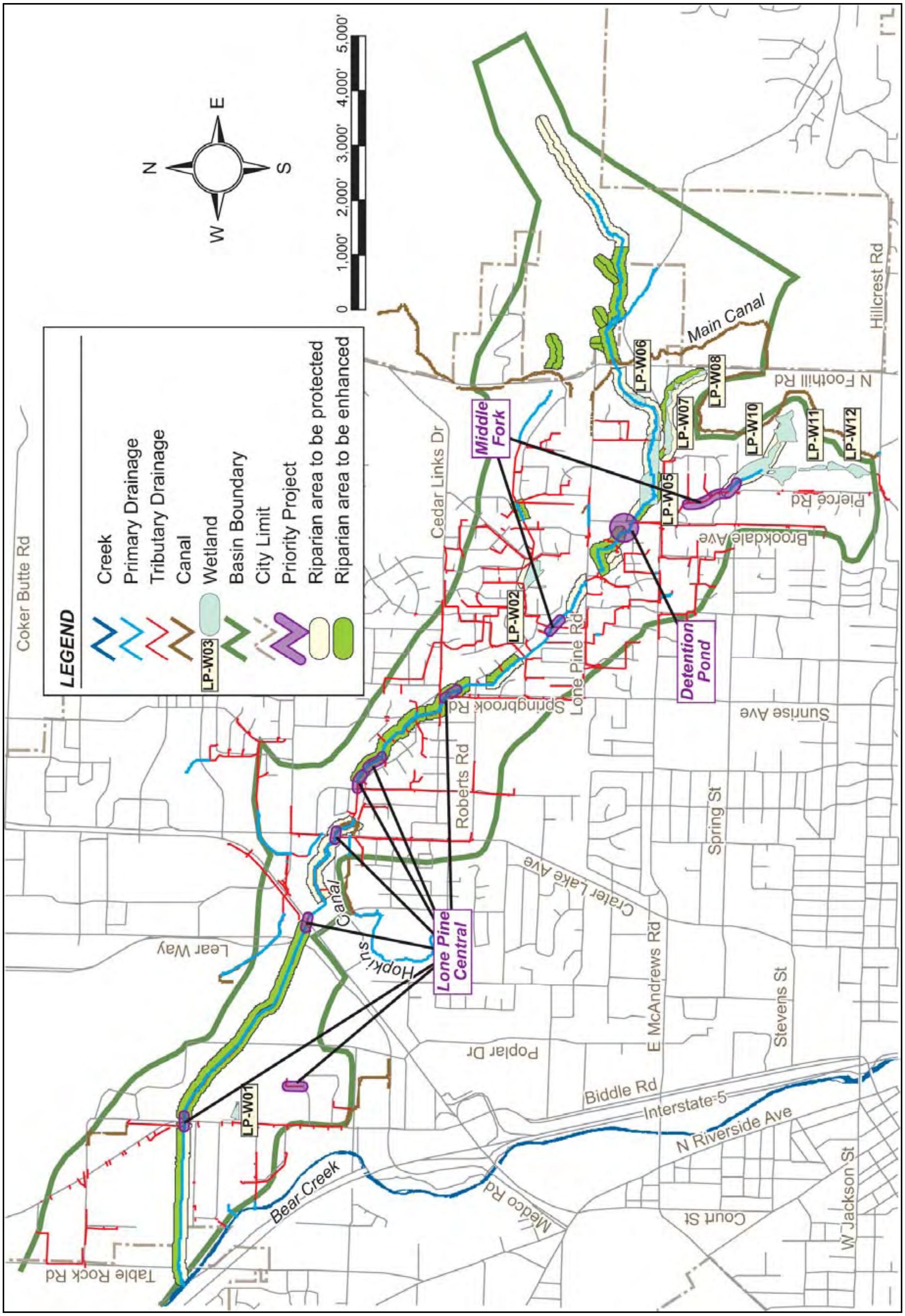

Figure 9-8. CIP Elements for Lone Pine Creek Basin

TABLE 9-10.
LONE PINE CREEK CIP PROGRAM

Project Name	Project Description	Schedule (CIP years)	2004 Cost
Drainage Projects			
Lone Pine Central Project	This project is identified in the 1996 DMP as the construction of a series of culverts and pipe replacements along the main stem of Lone Pine Creek.	6-10	$823,700
Other Structural Cost – Pond	This project is identified in the 1996 DMP as the construction of a 12.5 acre foot detention pond. This project was not constructed and the identified property is no longer available. Culvert sizing in this basin is using the flows with the detention and therefore this storage should be placed in a different location.	6-10	$555,000
Middle Fork Project	This project is identified in the 1996 DMP as the construction of 1,377 feet of 36" near Meadowcreek drive and 280 feet of 48" pipe near Roberts Road.	11-15	$401,200
Water Quality Projects			
Regional Detention/ WQ Facilities	With the construction of the regional pond identified under the drainage projects a water quality element should be included. This would include benched plant material for pollutant uptake.	6-10	$100,000
Lone Pine Water Quality Facility	Add a small water quality facility as part of the Lone Pine Central drainage project	6-10	$75,000
Basin Plan			
Lone Pine Creek basin plan	The Lone Pine Creek basin plan should be a high priority project.	1-5	$60,000
Wetland and Stream Protection and Restoration			
Separate flow from East Canal and Hopkins Canal	This cost is the separation of creek flow from East Canal and Hopkins canal.	11-15	$200,000

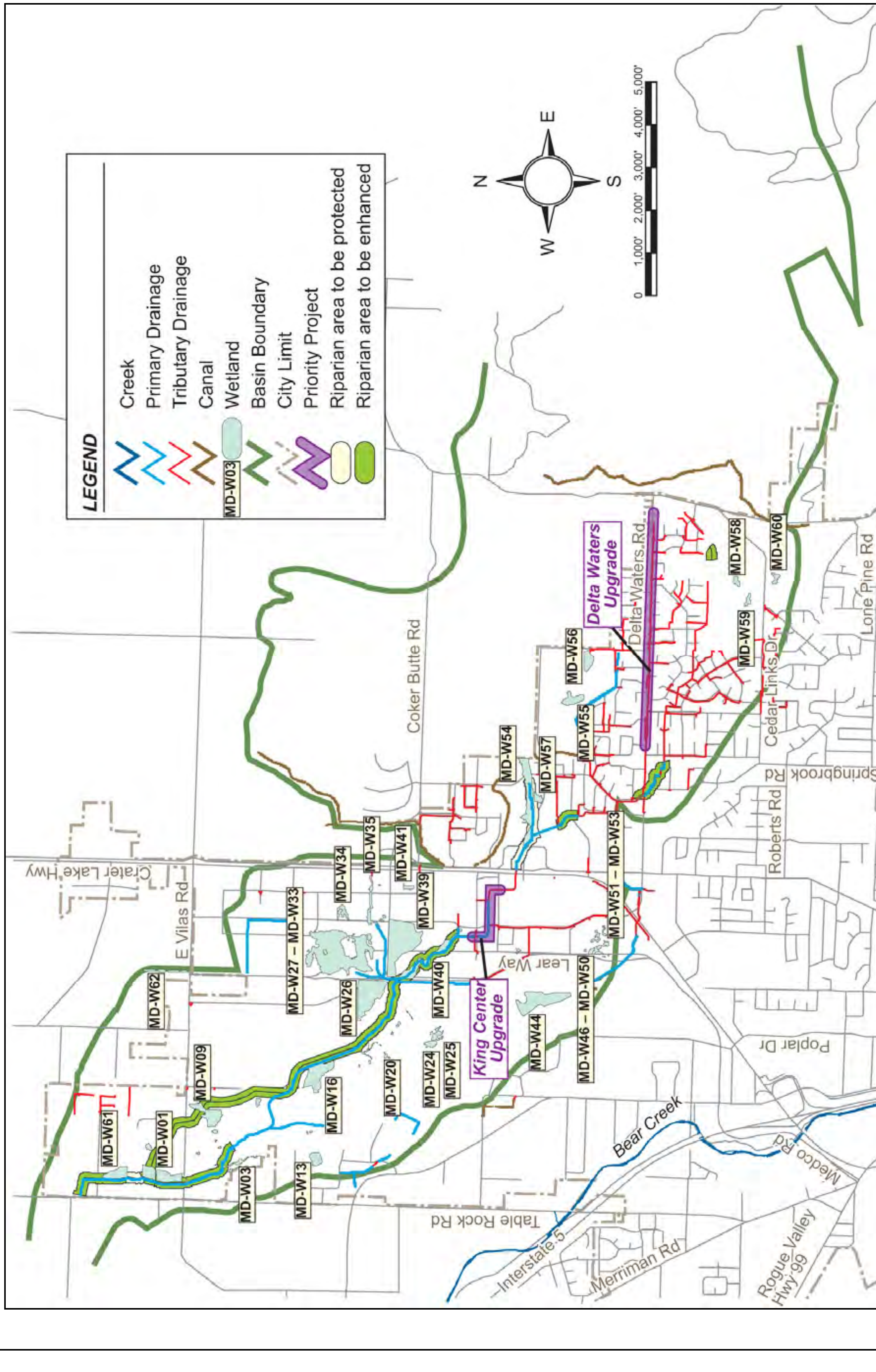

Figure 9-9. CIP Elements for Midway Basin

TABLE 9-11.
MIDWAY CIP PROGRAM

Project Name	Project Description	Schedule (CIP years)	2004 Cost
Drainage Projects			
King Center Upgrade Project	This project is identified in the 1996 DMP as the construction of a series of culverts and pipe replacements in the King Center area.	1-5	$2,064,700
Delta Waters Upgrade Project	This project is identified in the 1996 DMP as the replacement of several pipes and culverts in the area of Delta Waters Road.	6-10	$538,000
Water Quality Projects			
King Center Water Quality Facility	This project will explore two small WQ facilities to include in the King Center Project.	1-5	$75,000
Delta Waters Water Quality Facility	This project will explore a small WQ facility to include in the Delta Waters project.	6-10	$75,000
Basin Plan			
Midway Basin Plan	The Midway Basin Plan is not a high priority basin plan.	6-10	$60,000
Wetland and Stream Protection and Restoration			
Revegetate Channels Outside of Airport	Midway creek is void of vegetation on and off airport property. The City should work with community groups to help vegetate these segments of the Creek to reduce temperatures. This basin has many opportunities for wetland restoration and riparian area shading.	11-15	$40,000

CHAPTER 10.
FUNDING ANALYSIS

This chapter describes Medford's storm drain utility's financial performance, its ability to support the programs and facilities recommended in the Stormwater Management Plan, and a financial strategy for moving ahead with plan implementation.

STORM DRAIN UTILITY FEE

Stormwater management utilities are authorized by Oregon statute as enterprise funds within a City's budget structure. They are defined as being financially self-sufficient and can be designed to furnish a comprehensive set of services related to stormwater quantity and quality management. A utility may issue revenue bonds or pledge its revenues to meet City-issued general obligation bond debt service requirements. In the latter instance, the full faith and credit of the City is pledged to secure general obligation bond funding, to the extent that capacity under the statutory debt ceiling is available. In most cases, a general obligation bond issue would require a vote of the people. Neither form of debt financing is currently being considered by the City to implement the Stormwater Management Plan. The City has opted for a "pay as you go" philosophy in moving ahead with Plan implementation.

Services that stormwater management utilities provide include not only the construction and maintenance of facilities necessary to control flooding and improve the character of surface runoff, but also implementation of BMPs designed to address nonpoint source pollution. These BMPs include water quality sampling, public education and plan review, storm drain system maintenance, site inspections, and basin planning. All these program elements are part of the NPDES permit requirements.

The City of Medford currently funds stormwater management activities through its Storm Drain Utility. The City began collecting storm drainage service charges and system development charges in the early 1980s. Rates were established based on gaining public acceptance and responding to "rate elasticity" concerns rather than on a thorough calculation of revenue requirements and cost of service. The primary objective was to establish a stand-alone funding source and to win acceptance for a fee for service/utility approach.

Current drainage utility fees assessed to each user are based on "equivalent residential units" (ERUs). Single-family homes are counted as one ERU. The number of ERUs for other types of properties is based on the measured impervious surface area on the property; calculated as one ERU per 3,000 square feet of impervious surface. The City's current monthly stormwater rate is $3.59 per ERU.

The analysis presented in this chapter represents an order-of-magnitude evaluation of the rate required to fund implementation of the Stormwater Management Plan's recommendations.

FUNDING MODEL

The technical analysis of Medford's stormwater management needs produced operations, maintenance and capital improvement program with associated costs. The financial review assessed the impact of this program on the City's Storm Drain Utility rates and system development charges (SDCs). A funding model was developed as an electronic spreadsheet-based work product. This model simulates the fiscal management of the City's Storm Drain Utility and can accommodate the following conditions:

- A 20-year forecast horizon (the current start year is for fiscal 2005)
- A construction fund where capital improvement projects are budgeted
- An operating fund where revenues and expenses are budgeted
- Issuing and servicing debt to fund capital improvements (during any forecast year, the user can issue revenue bonds, bond anticipation notes, or general obligation bonds; after issuance, the model automatically services the debt throughout the balance of the forecast horizon). Again, the City has opted not to use debt financing within its Storm Drain Utility, however, the model does contain that option if the City wishes to evaluate that financial approach at some future point.
- Rate-making based on the revenue requirements for the utility during each forecast year.

The model calculates monthly user charges (rates) based on variable inputs for inflation, operating costs, customer base (i.e., number of ERUs), and capital improvements.

Input Requirements

The model is designed as a single spreadsheet that requires the user inputs listed in Table 10-1.

TABLE 10-1.
MODEL INPUTS

	User Inputs Required	Purpose
Financing Assumptions	Type of debt financing to be used, term of indenture, interest rates, etc.	Debt sizing and servicing
Capital Improvement Projects Schedule	Project cost, description, year of implementation, CIP inflation rate	CIP costing
Operating Revenues and Expenses	Start year budgeted revenues and expenses by line item, billable ERUs, general cost inflation index, projected growth in ERU (as a percent)	Cash flow and income statement for the utility
Land Use Characteristics (Optional)	Acreage by land use designation (zoning), runoff coefficients	Optional method of estimating billable ERUs

Assumptions

Key modeling assumptions are as follows:

- 20-year revenue bonding at an interest rate of 5.15 percent
- A coverage factor of 1.25 times maximum annual debt service
- Level debt service
- Reserve account funded from the proceeds of each indenture
- Growth of 2 percent per year
- Cost escalation at 3 percent.

Model Outputs and Reports

The model has eight standard reports:

- **Schedule of financing assumptions**—This report itemizes the user inputs that are required by the model to create debt issuances and bond proceeds that will be used to pay for capital improvements. It is always assumed that debt proceeds are only used to pay for capital improvement projects and related coverage, underwriting, and reserve funding requirements. The model logic will not allow the user to divert bond proceeds to be used to fund the cost of operations and maintenance expenses. These costs are assumed to be funded through user charges (rates). The debt service requirements created as a result of the inputs itemized in this report are also assumed to be funded from user charges.
- **Debt sizing and servicing report**—This report itemizes the calculated amount of annual debt service for each forecast year. Based on the level of net capital improvement spending in any forecast year and the debt funding choice supplied by the user, the model calculates principal, interest, coverage, and reserve funding requirements.
- **Listing of capital projects and construction fund activity**—This report itemizes the scheduled capital improvement projects over the forecast horizon. The model adjusts project costs for the effects of inflation as future projects are scheduled for implementation. This report also tracts the activity within the construction fund for transfers, interest earnings on fund balance, and beginning and ending fund balances.
- **Schedule of revenue requirements and monthly rates**—The rate-making process is displayed in this report. The model uses two tests to solve for rates. The first is for the sufficiency of cash flows to fund operations and debt service. The second is a test of bonded debt coverage requirements. After solving for each of these tests in each forecast year, the model prescribes a user charge that will be sufficient to fund the more stringent test.
- **Statement of revenues and expenses**—Often referred to as an income statement, this report calculates the results of operations for each forecast year prior to rate adjustments. Based on a start-year level of operating

revenues and expenses, the model forecasts the net utility income if revenues and expenses are incurred as projected based on inflation assumptions and customer base growth.

- **Analysis of equivalent service units by land use**—This is a subsidiary report to the statement of revenues and expenses and allows the user the option of estimating start-year ERUs based on current zoning. The key output of this report is an estimate of potential ERUs (versus actual billed ERUs). This report can be useful during "what if" studies and if questions of potential or planned changes in the service area need to be modeled.
- **Debt service worksheet; revenue bonds**—This worksheet shows the debt servicing for revenue bonds by year and by indenture. The model assumes level debt service for all revenue bonds that are issued over the forecast horizon. The purpose of this report is to allow the user not only to see the total debt service in any year, but also to see how much of the total service consists of interest and principal repayment.
- **Debt service worksheet; general obligation bonds**—This worksheet shows the debt servicing for general obligation bonds by year and by indenture. As in the case of revenue bonds, the model assumes level debt service for all general obligation bonds that are issued and serviced over the forecast horizon. Also like revenue bonds, the purpose of this report is to allow the user not only to see the total debt service in any year, but also to see how much of the total service consists of interest and principal repayment.

Modeled Cases and Results

The Stormwater Management Plan presents a number of options regarding NPDES compliance activities and the funding of water quality and water quantity projects. Six cases were evaluated, depicting variations in level of service, capital improvement schedule and operation and maintenance cost. Two capital improvement options were evaluated:

- The "mid-range" option is the CIP outlined in Chapter 9 of this plan. It includes the priority projects from the 1996 Drainage Master Plan and the water quality and citywide projects developed as part of this management plan.
- The "top-level" option includes all of the projects from the 1996 Drainage Master Plan, not only the priority projects. It also includes the water quality and citywide projects developed as part of this management plan.

The City wanted to understand the rate impacts of these options under pay-as-you-go or revenue bonding approaches. The modeled cases and results were as follows (detailed results are presented in Appendix D):

- **Case 1**—This case represents the status quo for Medford's stormwater management program at current levels of service. The City currently has drainage utility revenues of just over $2 million annually but is showing expenditures of approximately $2.4 million. The balance is struck through use of beginning fund balances, which will be depleted by 2007, at which time rate or spending adjustments will be required. Due to the drawing down of beginning fund balances within each of these cases, the base year for comparison is 2007 (as indicated by the arrow on the summary tables in Appendix D).

- **Case 2—**This case depicts current service levels in Medford with the addition of NPDES compliance activities in the area of BMP implementation. The additional costs under this case are paid for strictly through rates on a cash, or pay-as-you-go, basis. The impact of this cost increase is calculated beginning in 2007.
- **Case 3**—This case combines the costs for current service levels, NPDES compliance and the mid-range capital improvement projects, with all the mid-range capital costs funded through revenue bonds. This results in a smoothing of the revenue requirement and a general reduction of the rate requirement.
- **Case 4—**Using the identical cost base as in Case 3, expenditures for capital programs would be in the range of $1.7 million annually. This case depicts the rate impact of these costs under a pay-as-you-go funding approach.
- **Case 5—**The most aggressive in terms of program implementation, this case combines current service levels, NPDES compliance and the top-level capital improvement program and schedule. This case funds these expenditures entirely through rates.
- **Case 6**—This case takes the capital costs reflected in Case 5 and supports them through issuance of revenue bonds.

Table 10-2 summarizes the monthly rate results for the six modeled cases.

TABLE 10-2.
MONTHLY RATE ESTIMATES FOR MODELED FUNDING SCENARIOS

	Elements Funded				
	Current Service Level	NPDES Phase II BMPs	Phase 1 Capital Improvements	Capital Funding Mechanism	Monthly Rate per ERU (2007)
Case 1	X	—	—	N/A	$4.56
Case 2	X	X	—	N/A	$4.74
Case 3	X	X	Mid-Range	Revenue Bonds	$3.59
Case 4	X	X	Mid-Range	Pay As You Go	$6.31
Case 5	X	X	Top-Level	Pay As You Go	$7.49
Case 6	X	X	Top-Level	Revenue Bonds	$3.59

Each of these cases was reviewed with staff and during these discussions a new option was developed, referred to as "Case 4-b." This case would continue to provide current service levels, implement NPDES Phase 2 BMPs, construct the mid-level capital improvement program and fund these improvements through a pay-as-you-go approach. However, by scheduling the capital improvements over time, the City could ramp-in rate requirements rather than immediately increasing the rate to a level that would finance all the mid-level improvements. This ramping is shown in Figure 10-1.

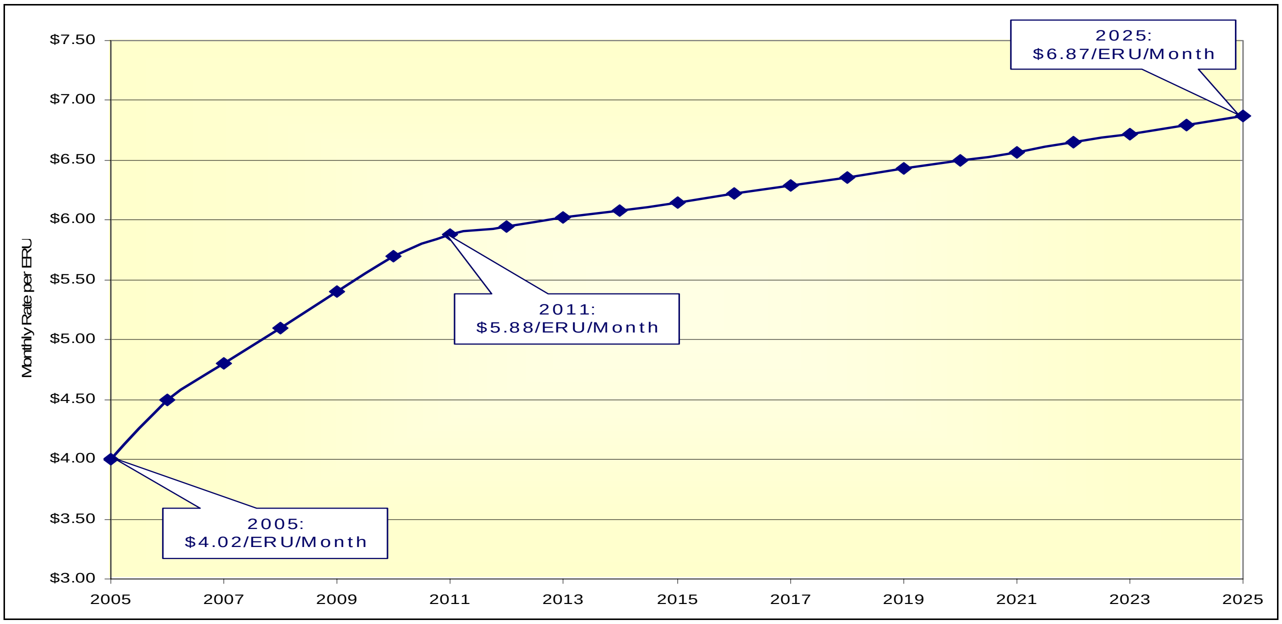

Figure 10-1. Monthly Rate Over Time for Case 4-b

SYSTEM DEVELOPMENT CHARGES

Oregon Revised Statute (ORS) 223 establishes a framework for SDCs as one-time fees imposed on new development to account for the cost of the development's demand on the stormwater system. SDCs are commonly used funding sources for such costs. A methodology for calculating SDCs in a way that complies with the statute is presented in this section. The methodology must accurately allocate to new development only the system cost associated with providing or expanding stormwater infrastructure to meet the capacity need created by the development.

The following objectives have been set for this analysis:

- Develop a basis for charges and a consistent methodology for SDCs.
- Determine the most appropriate and defensible fee to ensure that new development pays its equitable share of public facility costs.
- Establish policy recommendations to make the charges as fair and equitable as possible.
- Provide clear and orderly documentation regarding the methodology, assumptions and costs supporting the recommended SDC.

This option was the rate recommendation approved by the City Council which emphasized rate adjustments that coincided with the scheduling of mid-level capital improvements over the 20 year planning period.

SDC Legal Authority

ORS 223 is specific in establishing a structure for SDCs, outlining how they can be applied and used, and describing the means of their accounting. SDCs are intended to promote equity between new and existing users of public facilities by recovering from new development in the stormwater management service area a proportionate share of the cost of capital facilities that will serve the developing property. ORS 223 provides that the charge consist of two fee components:

- **Reimbursement**—A fee designed to recover costs associated with capital improvements already constructed or under construction
- **Improvement**—A fee designed to recover costs associated with capital improvements to be constructed.

The reimbursement fee is determined based on the cost of existing facilities, prior contributions by existing users of those facilities, the value of the unused and available capacity, and generally accepted ratemaking principles. The objective is to ensure that "future system users contribute no more than an equitable share to the cost of existing facilities." The reimbursement fee can be spent on capital costs or debt service related to the systems for which it is applied. This means that reimbursement fee revenues can be used on capital outlays for both existing and future construction, but must be used only for the type of infrastructure for which they are collected.

The improvement fee addresses the cost of future capital improvements needed to increase the capacity or level of service of the system. The cost of projects that correct existing deficiencies may not be included in the improvement fee calculation. Also, there must be made available to new development a credit against the improvement fee that recognizes additional costs incurred by new development in providing a qualified public improvement.

The City of Medford currently imposes an SDC of $486 per ERU, which consists only of an improvement element; no reimbursement element has been established.

Reimbursement Fee Calculation Methodology

ORS 223 stipulates the following:

> "Reimbursement fees shall be established by ordinance or resolution setting forth a methodology that considers the cost of the existing facility or facilities, prior contributions by existing users, the value of unused capacity, ratemaking principles employed to finance publicly owned capital improvements and other relevant factors identified by the local government imposing the fee. The methodology shall promote the objective of future system users contributing no more than an equitable share to the cost of existing facilities."

Existing stormwater facilities in Medford were evaluated to assess their available additional capacity, and it was concluded that there is insufficient data currently available to calculate a reimbursement fee. Although the City has made investments in infrastructure to provide service, many of these investments have been for planning, repair, and replacement of infrastructure to address existing deficiencies in the system.

Improvement Fee Calculation Methodology

The improvement element of the SDC is based on the cost of facilities that are needed only to accommodate growth, either by expanding the stormwater system's capacity or by increasing its level of performance. Figure 10-2 shows the procedure for calculating the improvement element.

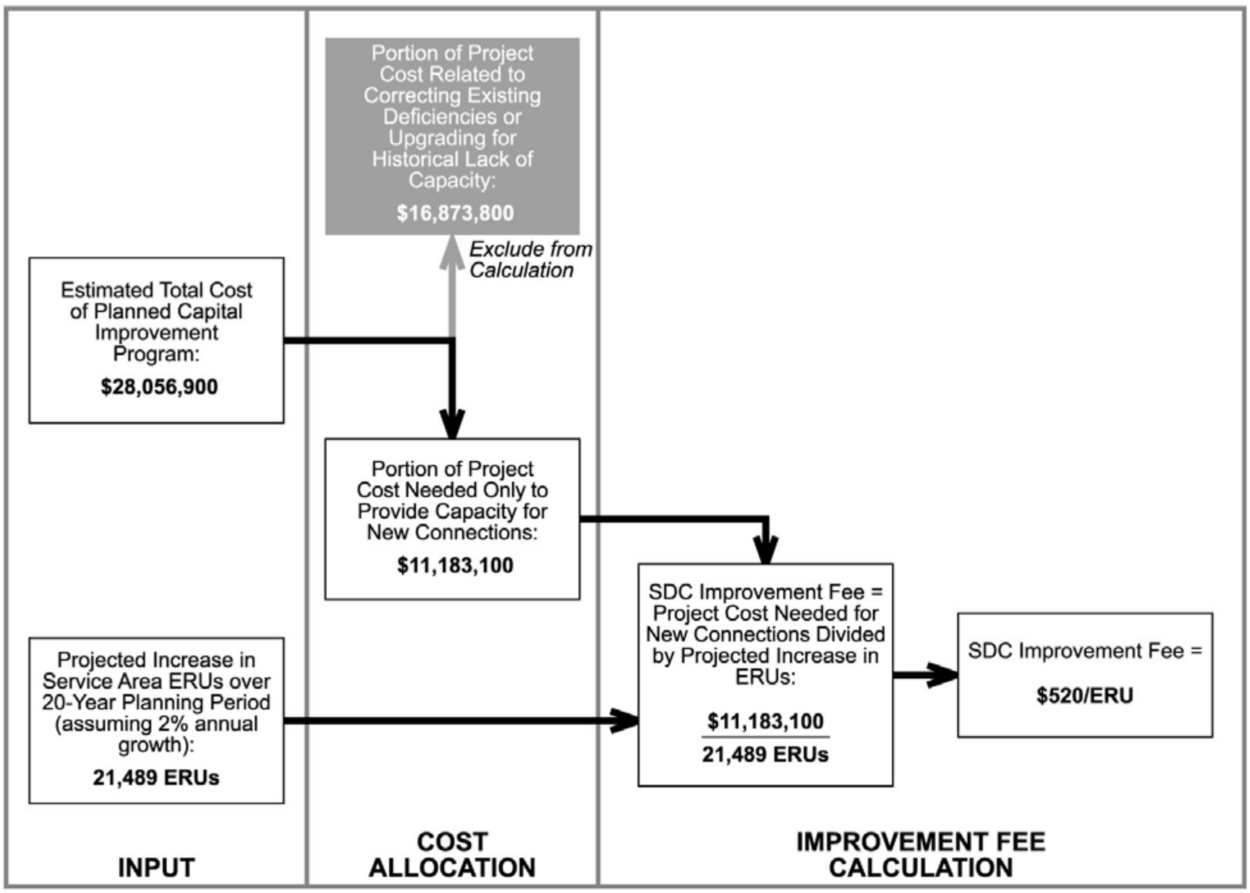

Figure 10-2. Procedure for Calculating Improvement SDC

To develop the improvement portion of the fee for the City of Medford, each project in the proposed CIP was evaluated in a two-step analysis to identify and exclude all costs related to correcting existing system deficiencies or upgrading for historical lack of capacity. The first step assessed the existing condition of the stormwater facility. Where this assessment determined that the existing facility is deficient to accommodate existing customers and flows, either in terms of design or current operating condition, the costs associated with correcting the existing deficiencies were deleted from the total project cost. This analysis isolated the costs associated with improving the system in order to accommodate anticipated future customers. The improvement costs necessary to store, treat, or convey future flows became the sole basis for the improvement portion of the SDC. The resulting capital improvement list and allocation of cost is detailed in Table 10-3.

TABLE 10-3.
CIP COST ALLOCATION FOR IMPROVEMENT ELEMENT OF SDC

	Estimated Improvement Cost		
	Total	Required for Existing Capacity/WQ	Required for Future Capacity/WQ
Citywide Activities			
NPDES (cost over 20 years)	$1,219,900	$1,219,900	$0
Bear Creek East			
Drainage Projects			
Sunrise	$376,000	$376,000	$0
Brookhurst	$1,219,000	$1,219,000	$0
Oregon Ave	$311,500	$311,500	$0
Basin Plan	**$60,000**	**$0**	**$60,000**
Water Quality Projects			
Tabby Lane Detention/WQ Facility	$186,300	$186,300	$0
Install WQ Vault/Facility on Sunrise Project	$75,000	$0	$75,000
Install WQ Vault/Facility on Brookhurst Project	$75,000	$0	$75,000
Install WQ Vault/Facility on Oregon Ave Project	$75,000	$0	$75,000
Bear Creek South			
Drainage Projects			
Center Dr.	$106,400	$48,200	$58,200
Basin Plan	**$40,000**	**$0**	**$40,000**
Water Quality Projects			
Install WQ Vault/Facility on Center Dr Project	$75,000	$75,000	$0
Bear Creek West			
Drainage Projects			
Earhart	$1,467,200	$1,467,200	$0
Washington	$1,073,800	$905,100	$168,700
6th Street	$521,700	$521,700	$0
Basin Plan	**$60,000**	**$0**	**$60,000**
Water Quality Projects			
Earhart Street Water Quality Wetland	$400,000	$400,000	$0
Washington Water Quality Facility	$75,000	$75,000	$0
6th Street Water Quality Facility	$75,000	$75,000	$0

TABLE 10-3 (continued).
CIP COST ALLOCATION FOR IMPROVEMENT ELEMENT OF SDC

	Estimated Improvement Cost		
	Total	Required for Existing Capacity/WQ	Required for Future Capacity/WQ
Crooked Creek			
Drainage Projects			
Crooked near Stewart Ave	$439,600	$306,400	$133,200
Crooked near Dove Lane	$256,000	$128,000	$128,000
Basin Plan	**$60,000**	**$0**	**$60,000**
Water Quality Projects			
Regional WQ Facility near Stewart Ave Drainage Project	$300,000	$300,000	$0
S. Holly St. Extension WQ Facility	$22,000	$0	$22,000
Elk Creek			
Drainage Projects			
Berrydale	$186,000	$79,000	$107,000
Elk Miscellaneous	$1,231,000	$0	$1,231,000
Howard Ave	$757,400	$638,100	$119,300
Highway 99	$799,300	$552,200	$247,100
Stowe Ave	$3,824,000	$1,568,500	$2,255,500
Ehrman Way	$626,400	$434,700	$191,700
Basin Plan	**$75,000**	**$0**	**$75,000**
Water Quality Projects			
WQ Facilities with Stowe Ave Drainage Projects	$300,000	$300,000	$0
WQ Facilities with Howard Ave Drainage Projects	$300,000	$300,000	$0
Columbus Ave Extension WQ Facility	$30,000	$0	$30,000
Lozier Lane Extension WQ Facility	$15,000	$0	$15,000
Larson Creek			
Drainage Projects			
North Fork	$1,198,400	$748,200	$450,200
Larson Central	$594,600	$323,900	$270,700
Black Oak	$299,300	$181,100	$118,200
Murphy Rd. Bypass - Juanipero to Larson Ck.	$250,000	$0	$250,000
Basin Plan	**$60,000**	**$0**	**$60,000**
Water Quality Projects			
Regional detention/WQ facility u/s of Phoenix Road	$500,000	$0	$500,000
Restoration/Protection Areas			
Restore Creek between Olympic Ave & Murphy Rd	$250,000	$250,000	$0
Separate East Main Canal and Larson Creek	$100,000	$100,000	$0

TABLE 10-3 (continued).
CIP COST ALLOCATION FOR IMPROVEMENT ELEMENT OF SDC

	Estimated Improvement Cost		
	Total	Required for Existing Capacity/WQ	Required for Future Capacity/WQ
Lazy Creek			
Drainage Projects			
Eagle Trace	$82,900	$0	$82,900
Lazy Creek at Murphy Rd	$78,900	$64,100	$14,800
Lazy Creek at Crestbrook Rd	$213,900	$186,300	$27,600
Lazy Creek at Burgundy	$258,700	$231,100	$27,600
North Phoenix	$488,100	$50,800	$437,300
Lazy Creek at Siskiyou	$319,300	$271,900	$47,400
Lazy Creek at Ellendale Drive	$220,700	$193,100	$27,600
Lazy Creek at Oak Drive	$181,000	$136,100	$44,900
Basin Plan	**$60,000**	**$0**	**$60,000**
Water Quality Projects			
McAndrews Detentions Facility with WQ Treatment	$1,000,000	$500,000	$500,000
Restoration/Protection Areas			
Restore Creek in Bear Creek Park	$120,000	$120,000	$0
Lone Pine Creek			
Drainage Projects			
Lone Pine Central	$823,700	$651,300	$172,400
Other Structural Cost	$555,000	$0	$555,000
Middle Fork	$401,200	$50,700	$350,500
Basin Plan	**$60,000**	**$0**	**$60,000**
Water Quality Projects			
Regional detention/WQ facility u/s of Foothill Road	$100,000	$0	$100,000
WQ Facilities with Lone Pine Central Drainage Projects	$75,000	$75,000	$0
Restoration/Protection Areas			
Separate East Canal and Lone Pine Creek	$100,000	$0	$100,000
Separate Hopkins Canal and Lone Pine Creek.	$100,000	$0	$100,000
Midway Drainage			
Drainage Projects			
King Center Upgrade	$2,064,700	$535,400	$1,529,300
Delta Waters Upgrade	$538,000	$528,000	$10,000
Basin Plan	**$60,000**	**$0**	**$60,000**
Water Quality Projects			
WQ Facilities with King Center Upgrade	$75,000	$75,000	$0
WQ Facilities with Delta Waters Upgrade	$75,000	$75,000	$0
Restoration/Protection Areas			
Revegetate streams outside of the Airport	$40,000	$40,000	$0
Total	**$28,056,900**	**$16,873,800**	**$11,183,100**

The total capital cost for new investment in the stormwater system over Phases 1 through 4 is estimated to be $28.06 million in current dollars. This figure is reduced based on the amount of the facility cost most equitably recovered through existing customers, giving a total cost associated with growth of $11.18 million which is recovered through SDCs.

The next step in the process of developing the improvement fee is to determine the total number of ERUs to be served by the future investment in stormwater facilities. Based on the City's calculation of existing impervious surface within the City and a query of its water/sewer billing system for single-family residential customers, it has been determined that Medford has a current inventory of 44,237 ERUs. In order to estimate the future number of ERUs, a growth factor of 2 percent per year was assumed. Applying this annual growth rate to the current ERU figure results in the City's stormwater system serving 65,726 ERUs by the end of the planning period. Therefore, the estimated increase in ERUs from the current base to the end of 2025 is 21,489.

The SDC improvement fee is the result of dividing the growth-related element of the capital improvement program by the overall growth in ERUs, to establish a fee of $520 per ERU.

SDC Calculation Summary

Table 10-4 shows the current and proposed values for the two SDC elements for the City of Medford.

TABLE 10-4.
CURRENT AND PROPOSED SDC ELEMENTS
FOR THE CITY OF MEDFORD

SDC Element	Current SDC	Proposed SDC
Reimbursement	0	0
Improvement	$486	$520
Total SDC for the City	**$486**	**$520**

OTHER FUNDING MECHANISMS

Public and Private Partnerships

Public and private sector partnership is another method that will be actively sought. The City of Medford and interested businesses could share the cost of building or oversizing capital improvement facilities that promote flood and erosion control and water quality protection. Interested businesses will have the option to provide land and/or help construct stormwater facilities. In turn, the City may provide wetland banking credits and/or offer "latecomer" agreements, in which the initial developer constructs a regional facility and is reimbursed by subsequent development that will make use of the facility. This should lower stormwater management costs to the community.

Conventional Debt Instruments

The most commonly used long-term debt instruments are revenue and general obligation bonds. Bond anticipation notes are available for short-term interim capital financing.

Revenue Bonds

Revenue bonds are the most common source of funds for construction of major utility improvements. There are no statutory limitations on the amount of revenue bonds a City can issue; however, the utility is required to meet a yearly net operating income requirement of up to 1.5 times the annual debt service.

Revenue bond debt service is paid out of rate and SDC revenues. The terms on revenue bonds are not as favorable as those on general obligation bonds, but revenue bonds carry the advantage of leaving the City's debt capacity unaffected. Interest rates vary depending on market conditions.

General Obligation Bonds

General obligation bonds are secured by the taxing power of the City, and are typically paid through property tax revenues. However, the City may choose to repay the debt from utility revenues and increase property taxes only if the utility fails to meet its debt obligation.

The financing costs of general obligation bonds are lower than revenue bonds due to lower available interest rates, the lack of coverage requirements, and the lack of reserve requirements.

By statute, a City may issue general obligation bonds without the assent of voters as long as the total amount of indebtedness from such issues does not exceed 0.75 percent of the value of taxable property in the City. With the assent of three-fifths of the voters, a City may incur a total amount of indebtedness up to 2.5 percent of the value of taxable property.

Short-Term Debt Instruments

Short-term interim financing mechanisms are also available for capital costs. Bond anticipation notes can provide interim financing during construction, while allowing flexibility in the choice of long-term financing instruments. Typically, bond anticipation notes have lower interest rates than bonds, but add to issuance costs.

Direct Service Offsets

The City may wish to consider additional funding from direct charges and contract agreements for services performed for a customer or class of customers not generally related to the overall service charge. Special maintenance and operation contract agreements could allow the City to service private facilities without encumbering a liability of ownership.

APPENDIX A.
WATER QUALITY MONITORING

City of Medford Stormwater Management Plan
February 2005

APPENDIX B.
POLLUTANT LOADING ESTIMATION

City of Medford Stormwater Management Plan
February 2005

APPENDIX C.
STORMWATER STRUCTURAL BMP DESCRIPTIONS

City of Medford Stormwater Management Plan
February 2005

APPENDIX D.
DETAILED FUNDING MODELING RESULTS

City of Medford Stormwater Management Plan
February 2005

APPENDIX A.

WATER QUALITY MONITORING DATA

RVCOG Monitoring Data

RVCOG routinely monitors creeks within Medford and throughout Jackson County. Figures comparing monitored data within the city of Medford were presented in Chapter 4, a table of the actual data is provided in this appendix.

Temperature is under study to become a TMDL in 2005 and should be addressed in all creeks throughout Medford. In the area RVCOG has implemented a monitoring program Bear Creek water temperatures increase as the Creek flows toward the Rogue River. This holds true as the Creek flows through Medford. Table A-1 presents the average measured July and August temperatures for Bear Creek and tributaries within Medford. The average summer temperature in Bear Creek increases 6.3ºF as it flows through Medford. The monitoring data indicates that Lone Pine Creek is the warmest tributary to Bear Creek within the City of Medford.

TABLE A-1.
AVERAGE SUMMER TEMPERATURE IN MEDFORD

Sampling Location	Average July-August Temperature (2000-03)
Bear Creek, upstream of Medford	65.3 ºF
Larson Creek	68.9 ºF
Lazy Creek	67.4 ºF
Bear Creek at 9th Street	67.6 ºF
Lone Pine Creek	73.2 ºF
Bear Creek, downstream of Medford	71.6 ºF

TABLE A-2.
BEAR CREEK TMDL'S

	Low Flow Summer (May 1 – Nov 30)	High Flow Winter (Dec 1 – April 30)
Total Phosphorus	0.08 mg/L	N/A
Dissolved Oxygen	8 mg/L or 90% saturation	11 mg/L or 90% saturation
E.coli	406 E.coli/100 mL absolute 123 E.coli/100 mL average	N/A
Temperature	64ºF	N/A
Sedimentation	Narrative Standard	Narrative Standard
Habitat Modification	No numerical standard	No numerical standard
Flow modification	No numerical standard	No numerical standard

Total phosphorus, dissolved oxygen and bacteria (E. coli) are established TMDLs on Bear Creek and are monitored as part of the RVCOG monitoring program. Total phosphorus is monitored in Larson Creek, the Rogue River Valley Irrigation District (RRVID), and Lone Pine Creek; in all these location the TMDL is exceeded at least part of the time. Dissolved oxygen was monitored in Larson Creek, the RRVID, and Lone Pine Creek; in all these locations the TMDL is exceeded at least part of the time. Monitoring data for E. coli shows that both the average and maximum TMDL are exceeded in a majority of samples. Although TSS is not a TMDL, monitoring shows that Medford does contribute to the TSS in the creek systems; significant spikes in the suspended solids are shown at all monitoring locations.

Monitoring data for temperature, total suspended solids, and bacteria in Bear Creek were reviewed from the headwaters to the Rouge River. Figures A-1, A-2, and A-3 present a graphical comparison of the monitoring data. With the exception of the reach between Ashland and Talent water temperatures increase as Bear Creek flows towards the Rouge River, Table A-3 shows the average July and August temperatures for 2000-2003.

TSS and E. coli are very dependent on recent rainfall events and therefore the data is scattered when plotting limited monitoring samples over a few years. No conclusion could be made for TSS and E.coli levels in different reaches of the creek. Even though no conclusions were drawn from this information the continuation of this monitoring program is important for future investigation into pollutant sources and Bear Creek's long term trends. When rainfall and creek flows are compared with TSS the sampling data might fall into a trend.

In the future it would be beneficial to monitor TMDL parameters upstream and downstream of each city along Bear Creek in an effort to track where pollutants are coming from and where improvement and treatment efforts should be focused.

TABLE A-3.
AVERAGE SUMMER TEMPERATURE IN BEAR CREEK

Sampling Location	Average July-August Temperature (2000-03)	Temperature Difference
Bear Creek Headwaters	62.8 ºF	+0.6 ºF
Downstream of Ashland	63.4 ºF	-1.0 ºF
In Talent	62.4 ºF	+2.9 ºF
In Phoenix (near downstream end of town)	65.3 ºF	+2.3 ºF
Downtown Medford	67.6 ºF	+4.0 ºF
In Central Point (downstream of Medford)	71.6 ºF	+4.2 ºF
At Rogue River (downstream of Central Point	75.8 ºF	

RVCOG Water Quality Monitoring Data 2000-2003

Sample Date	Temp. (F)	Dissolved Oxygen (mg/l)	Dissolved Oxygen (% saturation)	e.coli (mpn)	Fecal Coliform cfu/100mL	Total Suspended Solids (mg/L)	Total phosphorous (mg/l)
Larson Creek at Ellendale Rd (Site T10)							
1/12/00	42.8	11.1	93.0		300	14	0.160
2/23/00	48.4	11.9	107.7		466	12	0.134
3/23/00	51.3	11.6	109.7		33	10	0.070
4/13/00	58.3	9.4	95.3		450	37	0.140
4/28/00	53.2	10.7	104.0		150	28	0.065
5/11/00	55.8	10.1	99.6		50	7	0.048
5/18/00	61.5	10.1	107.0		100	5	0.051
6/8/00	64.6	9.4			267	7	0.072
6/28/00	71.2	8.9	99.0		400	3	0.108
7/6/00	64.0	8.5	93.0		550	19	0.087
7/21/00	71.6	7.9	94.0		350	10	0.078
8/3/00	70.5	8.1	96.0		600	7	0.069
8/16/00	66.4	9.2	103.0		2419	11	0.119
9/20/00	67.6	8.4	96.0		100	6	0.075
9/29/00	61.0	9.7	102.0		700	46	
10/16/00	53.4	8.7	84.0		350	4	0.070
10/30/00	55.6	9.8	97.0		133	6	0.060
11/27/00	47.7	8.6	100.0		100	6	
12/11/00	41.4	12.3	99.0			2	
1/22/01	43.5	12.2	104.0		60	5	0.049
2/21/01	48.6	12.9	117.0		30	4	0.025
3/29/01	59.5	11.6	121.0		200	5	0.031
4/16/01	58.3	9.9	101.0			6	
4/30/01		6.8	67.0		133	5	0.042
5/23/01	65.7			59		12	0.103
5/30/01	57.9	6.4	65.0	105		4	0.060
6/13/01	56.7	6.6	66.0	152		4	0.127
6/27/01	63.0	6.6	71.0	105		12	0.093
7/11/01	66.4	5.7	64.0	613		33	
7/26/01		5.2		727		20	
8/9/01	68.5	5.3	61.0	172		48	0.135
8/30/01	69.3	7.1	82.0	1553		18	0.090
9/18/01	65.5	8.5	94.0	461		16	0.090
9/24/01	61.9	8.3	87.0	727		16	0.130
10/11/01	58.1	9.0	91.0	2419		24	0.170
10/29/01	53.8	10.0	96.0	88		5	0.070
11/26/01	48.4	10.2	92.0	192		3	
12/17/01	46.2	10.8	95.0	248		10	0.124
1/28/02	39.6	13.6	111.0	27			
2/19/02	48.6	10.3	93.0	548		43	0.053
3/5/02	46.0			19		4	0.041
4/9/02	56.5	10.6	106.0	132		19	0.464
4/23/02	57.2	10.0	101.0	291		19	0.215
5/7/02	56.7	11.3	113.0	131		11	0.490
5/21/02	59.5	9.9	103.0	199		20	0.739
6/5/02	73.6	8.8	106.0	326		17	0.098
6/18/02	65.8	7.9	88.0	185		18	0.155
7/1/02	75.6	8.1	100.0	228		20	0.245
7/10/02	78.8	7.2	92.0	206		48	0.309
8/22/02	66.2	8.2	92.0	272		30	0.108
8/28/02	66.2	8.0	88.0	185		28	0.155
9/24/02	67.5	8.2	93.0	2419		19	0.190

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Sample Date	Temp. (F)	Dissolved Oxygen (mg/l)	Dissolved Oxygen (% saturation)	e.coli (mpn)	Fecal Coliform cfu/100mL	Total Suspended Solids (mg/L)	Total phosphorous (mg/l)
9/30/02	60.3	9.1	95.0	488		14	0.095
10/7/02	60.1	9.6	100.0	238		9	0.067
10/25/02	51.4	11.1	105.0	613		6	0.084
11/13/02	53.2	9.1	88.0	866		13	0.089
12/17/02	47.1			816		13	0.098
1/29/03	45.3	10.8	94.0	150		4	0.216
2/20/03	43.5	9.7	82.0	70		3	0.201
3/25/03	50.7	10.4	98.0	2419		19	0.219
4/16/03	46.9	11.0	98.0	921		7	0.146
4/24/03	50.5	10.0	94.0	1414		24	0.167
5/20/03	59.7	9.8	102.0	161		13	0.065
5/29/03	65.7	9.1	101.0	291		14	0.188
6/11/03	68.2	8.8	100.0	689		25	0.240
6/30/03	69.3	7.9	91.0	980		51	0.192
7/15/03	65.7	8.7	97.0	649		34	0.158
7/23/03	70.5	7.0	83.0	649		42	0.143
8/5/03	67.5	7.4	84.0	461		31	0.120
8/20/03	66.6	8.3	93.0	687		7	0.064
9/4/03	67.3	8.4	94.0	1120		16	0.079
9/17/03	59.7	10.0	104.0	125		5	0.082
10/8/03	59.9	8.8	91.0	2419		138	0.247
10/21/03	58.1	9.7	99.0	457		4	0.169
11/25/03	44.1	11.2	95.0	649		3	0.053
12/8/03	47.8	10.6	96.0	1046		4	0.089
Lazy Cr. at Highland Rd (Site R6)							
1/26/00	47.5				67	16	
2/10/00	48.9				100	6	
3/15/00	49.1				80	27	
4/20/00	55.9				lab error	12	
5/24/00	72.3					11	
6/15/00	71.8					15	
7/11/00	67.8				500	9	
8/1/00	71.4				4600	14	
9/7/00	66.4				100	7	
10/27/00	52.2				300	8	
11/20/00	41.0					3	
12/18/00	40.1					2	
1/29/01	43.0				20	1	
2/28/01	41.2				0	1	
3/28/01	58.8				320	8	
4/23/01	59.2				633	2	
5/9/01	62.1				33		
6/22/01	66.7			179	233	5	
7/18/01	72.3			276		6	
8/24/01	63.7			387		17	
9/12/01	64.0			378	833	25	0.261
10/23/01	53.8			727	733	10	
11/7/01	43.5			122	200	6	
12/19/01	46.8			866	1680	895	
1/30/02	34.5			184		3	
2/12/02	44.2			91	0	10	

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Sample Date	*Temp. (F)*	*Dissolved Oxygen (mg/l)*	*Dissolved Oxygen (% saturation)*	*e.coli (mpn)*	*Fecal Coliform cfu/100mL*	*Total Suspended Solids (mg/L)*	*Total phosphorous (mg/l)*
3/27/02	48.6			36	0		
4/16/02	50.2			161		5	
5/30/02	62.2			1203	LE	2	
6/12/02	63.5			1203	1033	10	
7/3/02	64.4			435	367	4	
8/29/02	67.8			613		39	
9/25/02	59.4			770		53	
10/16/02	50.2			365		20	
11/27/02	44.4			1120		2	
12/19/02	45.5			236		13	
1/7/03	44.1			461		3	
2/26/03	40.8			326		1	
3/20/03	54.0			80		1	
4/8/03	52.3			179		12	
5/15/03	56.1			108		10	
6/5/03	70.2			141			
6/5/03	70.2			141		2	
7/28/03	68.9			980		25	
8/12/03	62.8			1300		27	
9/24/03	60.6			613		5	
10/11/03	54.3			1300		9	
11/19/03	47.3			1046			
12/2/03	50.4			184		1	
Bear Cr. at 9th St, Medford (Site R7)							
1/26/00	44.2				67	8	
2/10/00	47.1				160	6	
3/15/00	46.4				60	13	
4/20/00	49.1				lab error	76	
5/24/00	66.4					7	
6/15/00	70.9				600	14	
7/11/00	66.6				800	14	
8/1/00	71.4				700	12	
9/7/00	65.7				250	10	
10/27/00	52.5				66	7	
11/20/00	39.9					5	
12/18/00	39.2					4	
1/29/01	41.5				40	9	
2/28/01	41.5				10	1	
3/28/01	53.8				1280	208	
4/23/01	57.7				133	98	
5/9/01	64.0				267		
6/22/01	68.4			135	500	14	
7/18/01	74.5			285		5	
8/24/01	66.0			222	2200	3	
9/12/01	64.4			435	600	9	
10/23/01	54.9			816	1100	9	
11/7/01	45.3			192	267	1	
12/19/01	44.1			649	920	937	
1/30/02	35.8			115		2	
2/12/02	46.9			43	100	2	
3/27/02	46.6			79	100	5	

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Sample Date	*Temp. (F)*	*Dissolved Oxygen (mg/l)*	*Dissolved Oxygen (% saturation)*	*e.coli (mpn)*	*Fecal Coliform cfu/100mL*	*Total Suspended Solids (mg/L)*	*Total phosphorous (mg/l)*
4/16/02	47.8			345		10	
5/30/02	62.8			816	LE	14	
6/12/02	63.5			488	233	1	
7/3/02	63.5			387	433	20	
8/29/02	67.1			344		13	
9/25/02	58.8			770		19	
10/16/02	50.4			365		6	
11/27/02	41.2			250		3	
12/19/02	42.1			328		8	
1/7/03	41.2			86		1	
2/26/03	42.6			57		3	
3/20/03	49.5			46		2	
4/8/03	48.9			107		15	
5/15/03	54.5			19		12	
6/5/03	64.8			387		3	
7/28/03	68.5			365		13	
8/12/03	63.0			1046		19	
9/24/03	61.7			313		3	
10/11/03	54.9			345		12	
11/19/03	45.9			308		3	
12/2/03	48.4			148		3	
Lone Pine Cr at Table Rock Rd. (Site T14)							
1/12/00	45.9	11.5	100.0		26		
2/23/00	47.7	11.0	97.9		33	3	0.124
3/23/00	54.1	10.9	107.0		33	2	0.100
4/13/00	57.7	10.4	106.0		2400	36	0.170
4/28/00	52.9	10.5	101.0		100	29	0.117
5/11/00	54.9	11.2	109.9		25	4	0.090
5/18/00	65.5	10.2	113.0		267	24	0.096
6/8/00	67.1				400	7	0.120
6/28/00	79.3				833	7	0.176
7/6/00	69.8	9.3	95.0		1250	11	0.140
7/21/00	79.5	7.7	83.0		700	12	0.186
8/3/00	78.6	7.7	98.0		900	5	0.134
8/16/00	74.5	8.0	98.0		9300	12	0.194
9/20/00	72.5	8.2	98.0		500	24	0.129
9/29/00	66.7	9.2	104.0		700	14	
10/16/00	53.6	10.2	106.0			4	0.105
10/30/00	52.9	9.9	95.0			4	0.093
11/27/00	48.9	10.9	92.0			8	
12/11/00	44.6	11.8	100.0		167	3	
1/22/01	48.9	9.4	94.0		0	5	
2/21/01	55.2	10.6	101.0		20	1	
3/29/01	62.1	9.0	109.0		100	6	
4/16/01	60.6	8.6	74.0			16	
4/30/01	61.5	8.2	72.0		1067		
5/23/01	74.8			378		17	
5/30/01	67.3	7.8	129.0	579		3	
6/13/01	67.1	7.7	103.0	146		7	
6/27/01	65.5	6.9	84.0	260		3	
7/11/01	70.0	6.5	83.0	435		14	
7/26/01	74.7	6.1	134.0	308		3	

RVCOG Water Quality Monitoring Data 2000-2003

Sample Date	Temp. (F)	Dissolved Oxygen (mg/l)	Dissolved Oxygen (% saturation)	e.coli (mpn)	Fecal Coliform cfu/100mL	Total Suspended Solids (mg/L)	Total phosphorous (mg/l)
8/9/01	77.5	6.2	78.0	218		2	0.108
8/30/01	78.4	9.8	125.0	326		9	0.120
9/18/01	71.4	8.2	98.0	461		14	0.170
9/24/01	68.7	10.7	122.0	461		4	0.080
10/11/01	59.7	10.9	112.0	1553		9	0.140
10/29/01	51.6	10.0	94.0	26		9	0.160
11/26/01	48.4	10.8	98.0	44		4	
12/17/01	48.7	11.0	101.0	48		7	0.131
1/28/02	43.5	12.2	105.0	10		4	
2/19/02	49.3	10.4	95.0	291		75	0.032
3/5/02	48.9	12.1	111.0	248		9	0.073
4/9/02	56.3	11.6	116.0	49		2	0.572
4/23/02	64.8	9.5	105.0	127		8	0.206
5/7/02	63.3			326		12	0.500
5/21/02	61.3	12.3	124.0	649		3	0.615
6/5/02	79.3	10.5	130.0	411		5	0.085
6/18/02	72.0	8.5	101.0	260		5	0.124
7/1/02	75.6	8.4	104.0	1120		3	0.196
7/10/02	79.9	7.0	90.0	1203		4	0.227
8/22/02	67.6	8.3	95.0	2419		5	0.093
8/28/02	67.3	8.2	101.0	260		5	0.124
9/24/02	70.9	8.5	100.0	326		23	0.267
9/30/02	60.4	9.1	96.0	308		23	0.167
10/7/02	59.7	9.2	96.0	219		11	0.144
10/25/02	51.1	11.2	105.0	148		3	0.126
11/13/02	49.5	10.6	97.0	18		6	0.117
12/17/02	47.8			192		2	0.129
1/29/03	48.2	11.0	100.0	66		4	0.225
2/20/03	46.4	11.2	99.0	99		2	0.199
3/25/03	50.7	10.7	100.0	649		38	0.377
4/16/03	50.4	9.7	90.0	1300		5	0.232
4/24/03	53.1	9.9	95.0	1733		14	0.216
5/20/03	54.7	9.6	94.0	727		13	0.103
5/29/03	65.5	9.3	103.0	387		2	0.172
6/11/03	68.5	9.3	107.0	206		34	0.347
6/30/03	72.5	8.7	104.0	185		20	0.255
7/15/03	72.0	7.8	93.0	525		28	0.154
7/23/03	73.0			488		23	0.264
8/5/03	67.6	7.3	83.0	727		5	0.127
8/20/03	64.9	8.0	89.0	1046		8	0.120
9/4/03	71.1	7.7	91.0	1120		4	0.191
9/17/03	64.6	8.7	96.0	2419		15	0.210
10/8/03	62.8	9.8	106.0	387		0	0.166
10/21/03	59.7	11.3	117.0	1300		3	0.177
11/25/03	45.3	10.6	92.0	26		4	0.133
12/8/03	47.8	11.4	103.0	57		1	0.108
RRVID canal at Biddle Rd, Medford (Site T13)							
1/12/00							
2/23/00							
3/23/00							

RVCOG Water Quality Monitoring Data 2000-2003

Sample Date	Temp. (F)	Dissolved Oxygen (mg/l)	Dissolved Oxygen (% saturation)	e.coli (mpn)	Fecal Coliform cfu/100mL	Total Suspended Solids (mg/L)	Total phosphorous (mg/l)
4/13/00	56.7	9.8			1950	64	0.230
4/28/00	51.8	11.1			400	12	0.109
5/11/00	53.4	11.5			250	5	0.052
5/18/00	60.1	11.6			167	8	0.063
6/8/00	63.9				433	10	0.156
6/28/00	73.0	9.4			800	8	0.207
7/6/00	64.4	9.7			1350	14	0.172
7/21/00	74.1	9.0			700	9	0.162
8/3/00	71.6	9.6			900	6	0.150
8/16/00	68.4	8.9			900	14	0.186
9/20/00	68.7	9.1			700	6	0.176
9/29/00	62.8	10.1			850	13	
10/16/00							
10/30/00							
11/27/00							
12/11/00							
1/22/01							
2/21/01							
3/29/01							
4/16/01	57.9	7.3	81.0			10	
4/30/01	61.5	6.8	69.0		367	16	
5/23/01	75.7			1011		14	
5/30/01	73.8	10.7	67.0	1046		17	
6/13/01	71.1	8.7	61.0	210		5	
6/27/01	70.0	7.2	70.0	173		32	
7/11/01	74.3	6.8	58.0	2419		16	
7/26/01	78.4	10.5	90.0	105		12	
8/9/01	76.6	5.5	66.0	281		14	
8/30/01	72.7	8.9	107.0	488		3	0.220
9/18/01	74.7	8.2	99.0	99		8	0.160
9/24/01							
10/11/01							
10/29/01							
11/26/01							
12/17/01							
1/28/02							
2/19/02							
3/5/02							
4/9/02							
4/23/02	61.5	9.4	100.0	326		10	0.191
5/7/02	58.6	10.3	106.0	308		3	0.500
5/21/02	58.6	9.4	100.0	1733		21	0.735
6/5/02	73.0	9.0	116.0	387		14	0.141
6/18/02	67.6	10.2	116.0	240		6	0.147
7/1/02	74.5	7.4	90.0	687		10	0.176
7/10/02	78.6	8.5	109.0	613		9	0.196
8/22/02	67.5	9.0	102.0	219		3	0.120
8/28/02	66.7	8.9	116.0	240		2	0.147
9/24/02	67.3	8.8	99.0	304		4	0.222
9/30/02	58.6	9.5	98.0	488		1	0.123
10/7/02	62.6	9.9	107.0	387		18	0.141
10/25/02							
11/13/02							

RVCOG Water Quality Monitoring Data 2000-2003

Sample Date	Temp. (F)	Dissolved Oxygen (mg/l)	Dissolved Oxygen (% saturation)	e.coli (mpn)	Fecal Coliform cfu/100mL	Total Suspended Solids (mg/L)	Total phosphorous (mg/l)
12/17/02							
1/29/03							
2/20/03							
3/25/03							
4/16/03	48.4	11.2	101.0	238	21	0	
4/24/03	49.6	10.5	98.0	1414	20	0	
5/20/03	53.6	10.3	100.0	411	15	0	
5/29/03	65.7	9.5	106.0	326	14	0	
6/11/03	66.6	10.1	113.0	313	8	0	
6/30/03	67.6	8.8	100.0	299	9	0	
7/15/03	68.4	8.5	97.0	397	12	0	
7/23/03	69.8	6.9	81.0	816	14	0	
8/5/03	66.7	7.5	85.0	219	11	0	
8/20/03	64.9	7.8	87.0	461	7	LE	
9/4/03	67.5	7.9	89.0	1733	10	0	
9/17/03	61.2	9.5	100.0	921	6	0	
10/8/03	61.7	8.5	91.0	1300	19	0	
10/21/03							
11/25/03							
12/8/03							
Baby Bear Cr in Bear Cr. Park playground (Site R10)							
1/26/00					16		
2/10/00							
3/15/00					400		
4/20/00					lab error		
5/24/00					820		
6/15/00					33		
7/11/00					1000		
8/1/00					2050		
9/7/00					350		
10/27/00					33		
11/20/00					0		
12/18/00					0		
1/30/02				1			
2/12/02				1			
3/27/02				2			
4/16/02				15			
5/30/02				548			
6/12/02				50			
7/3/02				133			
8/29/02				56			
9/25/02				31			
10/16/02				5			
11/27/02				4			
12/19/02				5			
1/7/03				6			
2/26/03				12			
3/20/03				4			
4/8/03				13			
5/15/03				866			

RVCOG Water Quality Monitoring Data 2000-2003

Sample Date	*Temp. (F)*	*Dissolved Oxygen (mg/l)*	*Dissolved Oxygen (% saturation)*	*e.coli (mpn)*	*Fecal Coliform cfu/100mL*	*Total Suspended Solids (mg/L)*	*Total phosphorous (mg/l)*
6/5/03				57			
7/28/03				58			
8/12/03				52			
9/24/03				3			
10/11/03				2			
11/19/03				3			
12/2/03				7			
Bear Creek at Fern Valley Rd. (Site R5)							
1/26/00	44.4				167	4	
2/10/00	46.0				220	5	
3/15/00	48.9				120	10	
4/20/00	48.6				lab error	77	
5/24/00	68.5					7	
6/15/00	69.4				233	9	
7/11/00	65.8				533	9	
8/1/00	68.5				450	6	
9/7/00	66.4				750	6	
10/27/00	52.2				833	3	
11/20/00	39.9				50	3	
12/18/00	38.7					5	
1/29/01	41.4				240	8	
2/28/01	40.5				30	1	
3/28/01	51.6				860	178	
4/23/01	55.6				100	5	
5/9/01	60.3				500		
6/22/01	64.8			192	67	8	
7/18/01				816	L.E.	31	
8/24/01	65.1			249	633	2	
9/12/01	63.3			816	1000	9	0.105
10/23/01	54.0			461	767	2	
11/7/01	45.3			142	100	2	
12/19/01	43.3			411	560	191	
1/30/02	34.3			128		5	
2/12/02	46.2			9	33	4	
3/27/02	46.4			87	133	9	
4/16/02	46.9			291		6	
5/30/02	63.0			613	LE	11	
6/12/02	63.9			461	433	12	
7/3/02	62.2			345	133	10	
8/29/02	67.5			328		14	
9/25/02	59.4			866		5	
10/16/02	53.8			231		1	
11/27/02	42.3			99		5	
12/19/02	41.0			285		6	
1/7/03	40.8			96		4	
2/26/03	43.5			80		3	
3/20/03	48.7			54		3	
4/8/03	47.3			150		17	
5/15/03	53.1			126			

RVCOG Water Quality Monitoring Data 2000-2003

Sample Date	*Temp. (F)*	*Dissolved Oxygen (mg/l)*	*Dissolved Oxygen (% saturation)*	*e.coli (mpn)*	*Fecal Coliform cfu/100mL*	*Total Suspended Solids (mg/L)*	*Total phosphorous (mg/l)*
6/5/03	60.3			649		5	
7/28/03	65.3			488		4	
8/12/03	62.4			1300		4	
9/24/03	60.3			236		3	
10/11/03	53.8			1120		15	
11/19/03	46.2			770			
12/2/03	48.4			1553			
Bear Cr at Pine St., Central Point (Site R8)							
1/26/00	44.6				67	14	
2/10/00	51.1				220	5	
3/15/00	44.6				40	15	
4/20/00	52.3				lab error	111	
5/24/00	68.2					10	
6/15/00	75.2				300	20	
7/11/00	74.1				567	11	
8/1/00	79.2				500	9	
9/7/00	65.1				450	15	
10/27/00	55.0				66	1	
11/20/00	41.0				50	2	
12/18/00	41.5					7	
1/29/01	42.4				60	1	
2/28/01	47.5				30	3	
3/28/01	54.5				1180	232	
4/23/01	63.5				100	45	
5/9/01	68.5				33		
6/22/01	81.5			61	233	8	
7/18/01	78.3			435	L.E.	6	
8/24/01	73.9			548	800		
9/12/01	66.6			1414	1067	5	0.252
10/23/01	56.5			1414	1133	6	
11/7/01	48.9			365	334	3	
12/19/01	44.4			2419	2000	191	
1/30/02	39.2			41		1	
2/12/02	48.2			2419	2067	4	
3/27/02	46.9			172	233	5	
4/16/02	48.4			313		11	
5/30/02	64.4			308	LE	6	
6/12/02	65.1			308	67	5	
7/3/02	66.0			613	233	5	
8/29/02	65.8			980		8	
9/25/02	58.8			866		11	
10/16/02	49.3			461		10	
11/27/02	41.9			238		4	
12/19/02	42.8			219		2	
1/7/03	41.9			36		2	
2/26/03	43.2			29		4	
3/20/03	48.7			38		4	
4/8/03	55.0			112		10	
5/15/03	55.8			111		11	

RVCOG Water Quality Monitoring Data 2000-2003

Sample Date	***Temp. (F)***	***Dissolved Oxygen (mg/l)***	***Dissolved Oxygen (% saturation)***	***e.coli (mpn)***	***Fecal Coliform cfu/100mL***	***Total Suspended Solids (mg/L)***	***Total phosphorous (mg/l)***
6/5/03	69.1			62		3	
7/28/03	70.5			649		9	
8/12/03	64.8			770		8	
9/24/03	65.1			613		0	
10/11/03	55.4			548		28	
11/19/03	49.8			60		2	
12/2/03	49.1			70			

RVCOG Water Quality Monitoring Data 2000-2003

Sample Date	*Temp. (F)*	*e.coli (mpn)*	*Total Suspended Solids (mg/L)*
Bear Creek at Headwaters (R1)			
1/26/00			
2/10/00			
3/15/00			
4/20/00			
5/24/00			
6/15/00			
7/11/00			
8/1/00			
9/7/00			
10/27/00			
11/20/00			
12/18/00			
1/29/01			
2/28/01			
3/28/01	51.3		77
4/23/01	49.8		2
5/9/01	53.4		
6/22/01	56.3	81	5
7/18/01	56.3	107	2
8/24/01	67.1	46	2
9/12/01	64.9	40	7
10/23/01	51.3	770	10
11/7/01	40.6	99	5
12/19/01	41.4	61	2
1/30/02	34.0	27	5
2/12/02	41.7	9	3
3/27/02	50.2	50	6
4/16/02	45.0	25	
5/30/02	66.0	1414	
6/12/02	67.5	130	16
7/3/02	57.9	68	6
8/29/02	70.3	17	4
9/25/02	63.9	54	1
10/16/02	51.8	365	2
11/27/02	39.7	75	1
12/19/02	40.1	84	2
1/7/03	40.3	127	6
2/26/03	36.1	59	2
3/20/03	45.0	42	3
4/8/03	43.3	96	16
5/15/03	53.8	179	2
6/5/03	63.1	308	1
6/5/03	63.1	308	1
7/28/03	59.7	104	1
8/12/03	65.7	87	4
9/24/03	61.5	105	4
10/11/03	55.6	53	6
11/19/03	45.8	105	
12/2/03	45.7	105	

RVCOG Water Quality Monitoring Data 2000-2003

Sample Date	*Temp. (F)*	*e.coli (mpn)*	*Total Suspended Solids (mg/L)*
Bear Cr. at S. Valley View Rd, Ashland (R3)			
1/26/00	43.7		12
2/10/00	43.7		12
3/15/00	40.5		16
4/15/00	47.7		48
5/20/00	56.5		5
6/15/00	63.1		7
7/11/00	62.1		8
8/1/00	65.7		9
9/7/00	60.1		8
10/27/00	50.9		1
11/20/00	39.7		2
12/18/00	37.6		3
1/29/01	40.3		28
2/28/01	37.9		2
3/28/01	50.4		90
4/23/01	51.8		1
5/9/01	55.6		
6/22/01	59.5		8
7/18/01	59.5		5
8/24/01	64.6		
9/12/01	63.0		9
10/23/01	53.2		2
11/7/01	43.5		
12/19/01	42.4		882
1/30/02	34.2		4
2/12/02	42.6		
3/27/02	45.7		2
4/16/02	45.7		2
5/30/02	60.6		19
6/12/02	62.2		4
7/3/02	60.4		7
8/29/02	68.0		8
9/25/02	60.3		3
10/16/02	55.6		4
11/27/02	42.1		4
12/19/02	41.0		1
1/7/03	41.4		6
2/26/03	37.6		1
3/20/03	47.1		1
4/8/03	45.1		17
5/15/03	52.2		10
6/5/03	57.9		3
7/28/03	64.0		7
8/12/03	63.0		0
9/24/03	59.9		1
10/11/03	53.2		10
11/19/03	45.5		
12/2/03	47.8		

RVCOG Water Quality Monitoring Data 2000-2003

Sample Date	*Temp. (F)*	*e.coli (mpn)*	*Total Suspended Solids (mg/L)*
Bear Creek at Lynn (R4)			
1/26/00	44.6		5
2/10/00	45.9		7
3/15/00	48.6		3
4/20/00	48.0		ND
5/24/00	67.1		2
6/15/00	64.0		1
7/11/00	61.5		4
8/1/00	66.2		4
9/7/00	59.4		138
10/27/00	51.4		32
11/20/00	39.2		16
12/18/00	38.1		24
1/29/01	40.8		4
2/28/01	39.0		10
3/28/01	50.2		1
4/23/01	52.0		2
5/9/01	55.8		
6/22/01	60.4	579	
7/18/01	60.4	548	
8/24/01	62.8	579	9
9/12/01	62.2	613	8
10/23/01	54.1	326	5
11/7/01	43.7	167	4
12/19/01	42.6	238	2
1/30/02	34.0	75	2
2/12/02	42.8	411	6
3/27/02	45.9	89	2
4/16/02	46.0	185	9
5/30/02	62.2	866	34
6/12/02	61.0	152	9
7/3/02	58.8	201	8
8/29/02	65.8	870	18
9/25/02	59.5	365	5
10/16/02	54.0	219	7
11/27/02	41.5	101	3
12/19/02	40.6	365	
1/7/03	40.8	50	5
2/26/03	39.0	36	1
3/20/03	48.2	41	2
4/8/03	46.2	36	15
5/15/03	49.6	69	5
6/5/03	58.3	2419	2
7/28/03	61.9	687	8
8/12/03	61.5	411	3
9/24/03	59.5	435	4
10/11/03	53.1	206	4
11/19/03	46.8	96	2
12/2/03	47.3	35	5

RVCOG Water Quality Monitoring Data 2000-2003

Sample Date	*Temp. (F)*	*e.coli (mpn)*	*Total Suspended Solids (mg/L)*
Bear Cr at Kirkland Road, Mouth of Rouge River (Site T17)			
1/12/00	42.6		
2/23/00	47.3		29
3/23/00	54.3		17
4/13/00			113
4/28/00			
5/11/00	57.9		9
5/18/00	66.6		15
6/8/00	66.0		17
6/28/00	80.8		3
7/6/00	71.1		28
7/21/00	78.1		10
8/3/00	77.9		11
8/16/00	73.8		24
9/20/00	73.2		17
9/29/00	66.7		7
10/16/00	57.0		7
10/30/00	55.6		13
11/27/00	48.6		3
12/11/00	42.6		3
1/22/01			3
2/21/01			4
3/29/01			32
4/16/01			21
4/30/01			11
5/23/01			7
5/30/01			5
6/13/01			3
6/27/01			13
7/11/01			7
7/26/01			4
8/9/01		66	0
8/30/01	76.8		4
9/18/01	70.5	461	19
9/24/01	68.7	86	1
10/11/01	62.1	2419	6
10/29/01	54.9	118	2
11/26/01	48.2	142	10
12/17/01	47.7	579	17
1/28/02	42.3	32	6
2/19/02	48.4	345	11
3/5/02	47.1	816	9
4/9/02	57.6	154	10
4/23/02	64.8	117	14
5/7/02	62.6	299	14
5/21/02	59.2	980	22
6/5/02	73.0	131	7
6/18/02	73.4	74	3
7/1/02	79.3	135	2
7/10/02	82.8	118	2

RVCOG Water Quality Monitoring Data 2000-2003

Sample Date	***Temp. (F)***	***e.coli (mpn)***	***Total Suspended Solids (mg/L)***
8/22/02	70.5	201	12
8/28/02	69.8	74	20
9/24/02	66.9	73	4
9/30/02	59.7	345	13
10/7/02	65.5	272	17
10/25/02	54.3	488	6
11/13/02	52.2	93	7
12/17/02	46.2	461	35
1/29/03	46.2	206	17
2/20/03	48.2	63	3
3/25/03	49.8	1553	15
4/16/03	48.7	238	25
4/24/03	51.6	2419	35
5/20/03	57.2	114	
5/29/03	73.0	127	24
6/11/03	73.0	96	11
6/30/03	77.4	76	9
7/15/03	77.4	101	1
7/23/03	82.6	361	1
8/5/03	68.2	435	9
8/20/03	77.4	56	6
9/4/03	72.3	291	16
9/17/03	64.4	326	3
10/8/03	63.5	326	0
10/21/03	60.8	101	4
11/25/03	45.5	61	3
12/8/03	48.0	345	6

APPRENDIX B.

POLLUTANT LOADING ESTIMATION

Pollutant Loading Estimation

A spreadsheet model was used to estimate pollutant loading in each basin. The tables presented in this appendix represent the results of these spreadsheet estimates. An estimate of pollutant loading rates based on land use was applied to each of the Medford drainage basins. Average annual loading rates for TSS, total nitrogen (TN), total phosphorus (TP), and oil and grease (O&G), obtained from *Stormwater Treatment* (Minton 2002), were used for the analysis. The loading rates are summarized in Table B-1. The annual pollutant load generated within each basin was estimated for existing and future conditions. Land use was roughly estimated from aerial photographs for existing conditions and the General Land Use Plan for buildout conditions.

TABLE B-1.
POLLUTANT LOADING RATES

	Pollutant Loading Rate (pounds/acre/year)			
Land Use	TSS	TN	TP	O&G
Commercial	725	4.7	0.72	0.000890
Multifamily	400	5.0	0.63	0.000080
Single Family High Density	290	5.2	0.59	0.000080
Single Family Low Density	180	3.6	0.50	0.000080
Roads	452	2.2	1.00	0.010867

For calculation purposes each basin was divided into areas with similar land use as shown in Figure B-1.

The data shows that the land use in Midway, Bear Creek East and Elk Creek drainage basins yield the highest pollutant contribution. As shown in table B-1 commercial/industrial areas and roads have the highest pollutant loading rates. The three basins with greatest pollutant loadings also have the largest areas of commercial and industrial development.

With the exception of Bear Creek East and Bear Creek West developed land is expected to increase in the future. The spreadsheets estimate the increase in pollutant load between existing and build out conditions. The city could focus efforts to reduce pollutant loads at the source in the areas where pollutant loading is expected to increase. Based on this analysis the largest increases in pollutants are expected in Lazy Creek and Larson Creek basins. Chapter 4 discusses the results and possible methods for minimizing the increase in pollutants predicted by these spreadsheets models.

Pollutant removal was estimated for BMPs currently implemented or have been recommended for each basin. Table B-2 summarizes the percentage removal for the pollutants for each BMP included in the spreadsheet model. Stormwater in the City of Medford currently flows through several existing natural wetlands; therefore they have been included as existing BMPs, it is not recommended that the city increase stormwater flow and in turn pollutant loadings to existing natural wetlands.

TABLE B-2.
POLLUTANT REMOVAL PERCENTAGES USED IN MODELING

	Estimated Pollutant Removal (%)			
	TSS	TN	TP	O&G
Street Sweeping: Residential Streets	43%	0%	20%	0%
Street Sweeping: Arterial Streets	15%	0%	20%	0%
Detention Facility	75%	50%	50%	0%
Wetlands	65%	20%	65%	0%
Water Quality Vaults	80%	50%	50%	60%
Redevelopment BMPs	80%	0%	0%	0%

Monitoring data presented in Appendix A can not be directly compared with the results of the spreadsheets since monitoring data is reported as a concentration in the creek at the time of sampling and the modeled data is an estimated mass of pollutant generated within the basin over the whole year. The instantaneous concentrations from the sampling program fluctuate depending on many conditions. The conditions include rainfall and flow rates, time between rainfall events which allow pollutants to build up in the basin, events in the basin such as construction activity.

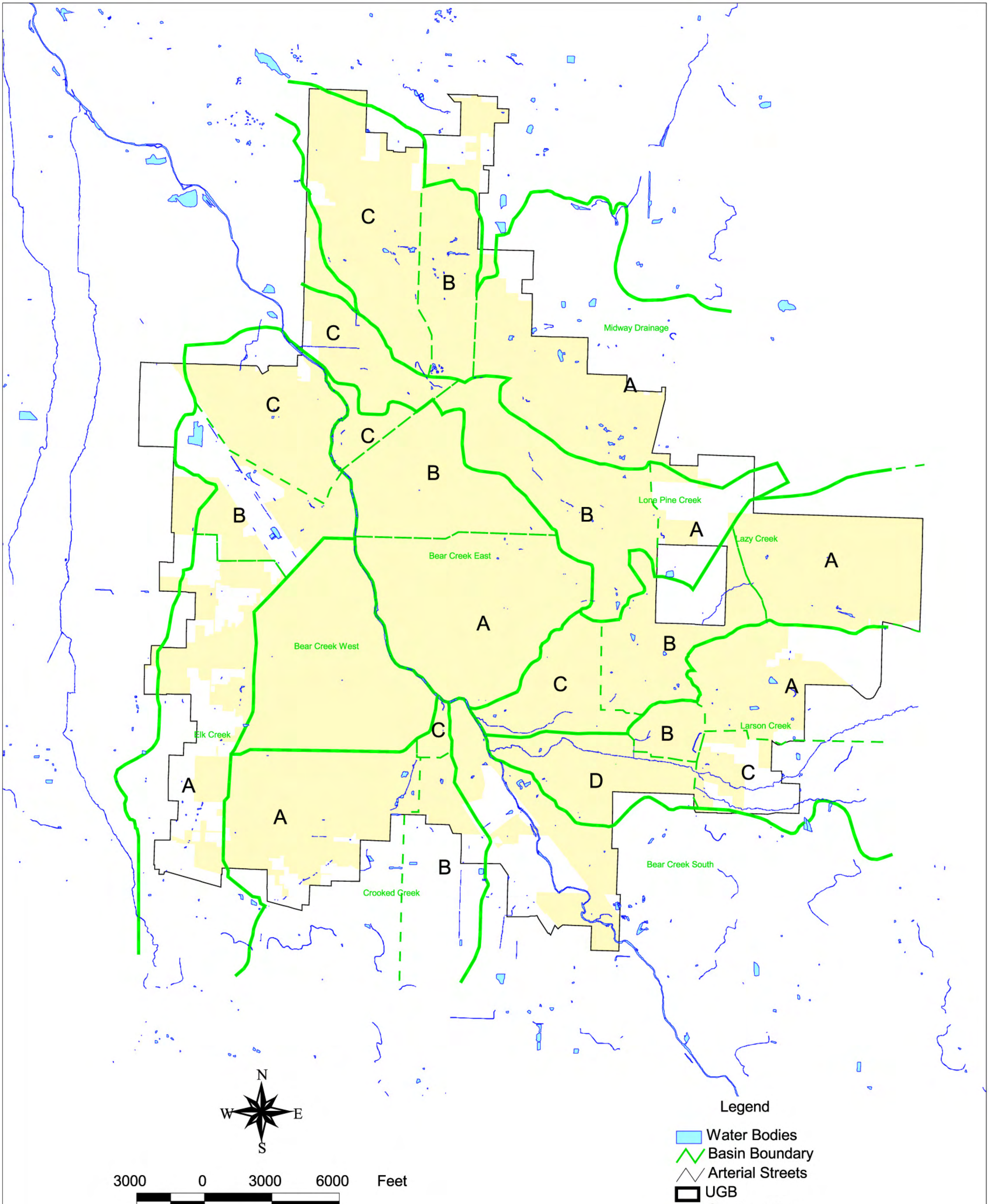

Figure B-1
Medford Drainage Basins
Pollution Loading Index Map

WATER QUALITY FLOWS BY BASIN						
Basin	Tributary Area (ac)	EIA (%)	Pervious Area (ac)	EIA (ac)	Flow (cfs)	WQ Flow (cfs)
Bear Creek East						
A	1442	54%	1434	779	139.6	37.7
B	836	60%	831	502	84.1	23.5
C	166	70%	165	116	20.3	5.9
						67.1
Bear Creek South						
	2491	40%	2481	996	187.1	44.9
Bear Creek West						
	1399	70%	1389	979	163.5	47.4
Crooked Creek						
A	1944	40%	1936	778	128.1	30.7
B	785	35%	782	275	47.7	11.0
C	66	80%	66	53	9.2	2.8
						44.5
Elk Creek						
A	2015	50%	2004	1007	148.1	38.5
B	713	75%	708	535	112.4	33.7
C	891	60%	886	535	95.5	26.7
						98.9
Larson Creek						
A	1060	30%	1057	318	80.1	17.6
B	184	50%	183	92	19.7	5.1
C	824	20%	822	165	19.3	3.9
D	616	50%	613	308	56.2	14.6
						41.2
Lazy Creek						
A	1259	30%	1255	378	93.4	20.5
B	802	25%	800	200	61.9	13.0
C	516	30%	515	155	46.0	10.1
						43.7
Lone Pine Creek						
A	428	25%	427	107	30.0	6.3
B	1021	50%	1016	511	91.5	23.8
C	503	80%	499	402	75.8	22.7
						52.8
Midway Drainage						
A	3272	30%	3262	982	185.5	40.8
B	527	80%	523	421	84.2	25.2
C	1257	80%	1247	1006	190.5	57.1
						123.2

Notes:
1. Per methodology from 2001 Stormwater Management Manual for Western Washington (Vol V)
2. Water Quality Storm = 0.8 inches in 24 hours

Bear Creek East, Pollutant Loading Estimations

Notes:
1) Loading per Stormwater Treatment, G. Minton, Table 2.16
2) Estimated future landuse from GLUP map
3) Wetlands assumed to treat 10 times the wetlands area
4) Assumed redevelopment BMP TSS removal efficiency **80%**
5) Existing street sweeping - Regenerative every 3-4 weeks; 20% TP removal
6) Existing street sweeping - Regenerative every 3-4 weeks; 43% TSS removal in residential & 15% TSS removal in arterial (R)

Landuse	TSS (lb/ac/yr)	TN (lb/ac/yr)	TSS (lb/ac/yr)	O & G (lb/ac/yr)
Comm	725	4.7	0.72	0.00089
MF	400	5.0	0.63	0.0008
SF-hi	290	5.2	0.59	0.0008
SF-lo	180	3.6	0.5	0.0008
Roads	452	2.2	1.00	0.010867

Total Suspended Solids (TSS)

Existing

		Estimated Current Landuse (%)						Loading	Redev. Area (ac) w/ BMP		Removal	Maintenance Sweeping		Removal	Structural BMP Type		Removal	Total Removal
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	(lb/yr)	Comm	MF	(lb/yr)	Res	Art	(lb/yr)			(lb/yr)	(lb/yr)
A	1442	15%	10%	0%	58%	5%	6%	399,343			-	43%	15%	20,309			-	20,309
B	836	20%	12%	0%	49%	5%	5%	253,193			-	43%	15%	10,765			-	10,765
C	166	65%	0%	0%	0%	3%	7%	80,899			-	43%	15%	1,910			-	1,910
	2444							733,435	0.0	0.0	-			32,985			-	32,985
									Removal efficiency		0%			4.5%			0%	4%

Build out

		Estimated Current Landuse (%)						Loading	Redev. Area (ac) w/ BMP		Removal	Maintenance Sweeping		Removal	Structural BMP Type		Removal	Total Removal
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	(lb/yr)	Comm	MF	(lb/yr)	Res	Art	(lb/yr)			(lb/yr)	(lb/yr)
A	1442	15%	10%	0%	58%	5%	6%	399,343	0	0	-	43%	15%	20,309	Vault on Brookhurst	80%	27,360	47,669
B	836	20%	12%	0%	49%	5%	5%	253,193	0	0	-	43%	15%	10,765			-	10,765
C	166	65%	0%	0%	0%	3%	7%	80,899	0	0	-	43%	15%	1,910			-	1,910
	2444							733,435	0.0	0.0	-			32,985			27,360	60,345
									Removal efficiency		0%			4.5%			4%	8%

Total Nitrogen (TN)

Existing

		Estimated Current Landuse (%)						Loading	Redev. Area (ac) w/ BMP		Removal	Maintenance Sweeping		Removal	Structural BMP Type		Removal	Total Removal
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	(lb/yr)	Comm	MF	(lb/yr)	Res	Art	(lb/yr)			(lb/yr)	(lb/yr)
A	1442	15%	10%	0%	58%	5%	6%	4,915			-	0%	0%	-			-	-
B	836	20%	12%	0%	49%	5%	5%	2,851			-	0%	0%	-			-	-
C	166	65%	0%	0%	0%	3%	7%	520			-	0%	0%	-			-	-
	2444							8,286	0.0	0.0	-			-			-	-
									Removal efficiency		0%			0%			0%	0%

Future

		Estimated Current Landuse (%)						Loading	Redev. Area (ac) w/ BMP		Removal	Maintenance Sweeping		Removal	Structural BMP Type		Removal	Total Removal
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	(lb/yr)	Comm	MF	(lb/yr)	Res	Art	(lb/yr)			(lb/yr)	(lb/yr)
A	1442	15%	10%	0%	58%	5%	6%	4,915	0	0	-	0%	0%	-	Vault on Brookhurst	50%	2,458	2,458
B	836	20%	12%	0%	49%	5%	5%	2,851	0	0	-	0%	0%	-			-	-
C	166	65%	0%	0%	0%	3%	7%	520	0	0	-	0%	0%	-			-	-
	2444							8,286	0.0	0.0	-			-			2,458	2,458
									Removal efficiency		0%			0%			30%	30%

Bear Creek East, Pollutant Loading Estimations

Notes:
1) Loading per Stormwater Treatment, G. Minton, Table 2.16
2) Estimated future landuse from GLUP map
3) Wetlands assumed to treat 10 times the wetlands area
4) Assumed redevelopment BMP TSS removal efficiency **80%**
5) Existing street sweeping - Regenerative every 3-4 weeks; 20% TP removal
6) Existing street sweeping - Regenerative every 3-4 weeks; 43% TSS removal in residential & 15% TSS removal in arterial (R)

Landuse	TSS (lb/ac/yr)	TN (lb/ac/yr)	TSS (lb/ac/yr)	O & G (lb/ac/yr)
Comm	725	4.7	0.72	0.00089
MF	400	5.0	0.63	0.0008
SF-hi	290	5.2	0.59	0.0008
SF-lo	180	3.6	0.5	0.0008
Roads	452	2.2	1.00	0.010867

Total Phosphorous (TP)

Existing

		Estimated Current Landuse (%)							Redev. Area (ac) w/ BMP			Maintenance Sweeping			Structural BMP			Total
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	Loading (lb/yr)	Comm	MF	Removal (lb/yr)	Res	Art	Removal (lb/yr)	Type		Removal (lb/yr)	Removal (lb/yr)
A	1442	15%	10%	0%	58%	5%	6%	741			-	20%	20%	32			-	32
B	836	20%	12%	0%	49%	5%	5%	428			-	20%	20%	17			-	17
C	166	65%	0%	0%	0%	3%	7%	83			-	20%	20%	4			-	4
	2444							1,252	0.0	0.0	-			52			-	52
									Removal efficiency		0%			0.1%			0%	4%

Future

		Estimated Current Landuse (%)							Redev. Area (ac) w/ BMP			Maintenance Sweeping			Structural BMP			Total
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	Loading (lb/yr)	Comm	MF	Removal (lb/yr)	Res	Art	Removal (lb/yr)	Type		Removal (lb/yr)	Removal (lb/yr)
A	1442	15%	10%	0%	58%	5%	6%	741	0	0	-	20%	20%	32	Vault on Brookhurst	50%	355	386
B	836	20%	12%	0%	49%	5%	5%	428	0	0	-	20%	20%	17			-	17
C	166	65%	0%	0%	0%	3%	7%	83	0	0	-	20%	20%	4			-	4
	2444							1,252	0.0	0.0	-			52			355	407
									Removal efficiency		0%			4.2%			28%	32%

Oil and Grease (O&G)

Existing

		Estimated Current Landuse (%)						Redev. Area (ac) w/ BMP			Maintenance Sweep & Vactor			Structural BMP			Total
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Roads	Loading (lb/yr)	Comm	MF	Removal (lb/yr)	Type		Removal (lb/yr)	Type		Removal (lb/yr)	Removal (lb/yr)
A	1442	15%	10%	0%	58%	11%	2.70			-	R	0%	0.00			-	0.00
B	836	20%	12%	0%	49%	10%	1.47			-	R	0%	0.00			-	0.00
C	166	65%	0%	0%	0%	10%	0.28			-	R	0%	0.00			-	0.00
	2444						4.44	0.0	0.0	-			0.00			-	0.00
								Removal efficiency		0%			0%			0%	0%

Future

		Estimated Current Landuse (%)						Redev. Area (ac) w/ BMP			Maintenance Sweep & Vactor			Structural BMP			Total
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Roads	Loading (lb/yr)	Comm	MF	Removal (lb/yr)	Type		Removal (lb/yr)	Type		Removal (lb/yr)	Removal (lb/yr)
A	1442	15%	10%	0%	58%	11%	2.70	0	0	-	R	0%	0.00	Vault on Brookhurst	60%	0.22	0.22
B	836	20%	12%	0%	49%	10%	1.47	0	0	-	R	0%	0.00			0.00	0.00
C	166	65%	0%	0%	0%	10%	0.28	0	0	-	R	0%	0.00			0.00	0.00
	2444						4.44	0.0	0.0	-			0.00			0	0.22
								Removal efficiency		0%			0%			5%	5%

Bear Creek South, Pollutant Loading Estimations

Notes:
1) Loading per Stormwater Treatment, G. Minton, Table 2.16
2) Estimated future landuse from GLUP map
3) Wetlands assumed to treat 10 times the wetlands area
4) Assumed redevelopment BMP TSS removal efficiency **80%**
5) Existing street sweeping - Regenerative every 3-4 weeks; 20% TP removal
6) Existing street sweeping - Regenerative every 3-4 weeks; 43% TSS removal in residential & 15% TSS removal in arterial (R)

Landuse	TSS (lb/ac/yr)	TN (lb/ac/yr)	TSS (lb/ac/yr)	O & G (lb/ac/yr)
Comm	725	4.7	0.72	0.00089
MF	400	5.0	0.63	0.0008
SF-hi	290	5.2	0.59	0.0008
SF-lo	180	3.6	0.5	0.0008
Roads	452	2.2	1.00	0.010867

Total Suspended Solids (TSS)

Existing

		Estimated							Redev. Area (ac)			Maintenance			Structural		Total
		Current Landuse (%)						Loading	w/ BMP		Removal	Sweeping		Removal	BMP	Removal	Removal
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	(lb/yr)	Comm	MF	(lb/yr)	Res	Art	(lb/yr)	Type	(lb/yr)	(lb/yr)
	2491	22%	0%	0%	2%	1%	1%	417,478			-	43%	15%	6,529		-	6,529
	2491							417,478	0	0	-			6,529		-	6,529
									Removal efficiency		0%			1.6%		0%	2%

Future

		Estimated							Redev. Area (ac)			Maintenance			Structural		Total
		Current Landuse (%)						Loading	w/ BMP		Removal	Sweeping		Removal	BMP	Removal	Removal
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	(lb/yr)	Comm	MF	(lb/yr)	Res	Art	(lb/yr)	Type	(lb/yr)	(lb/yr)
	2491	25%	0%	0%	11%	1%	1%	511,997	75	0	43,337	43%	15%	6,529		-	49,866
	2491							511,997	75	0	43,337			6,529		-	49,866
									Removal efficiency		8.5%			1.3%		0%	10%

Total Nitrogen (TN)

Existing

		Estimated							Redev. Area (ac)			Maintenance			Structural		Total
		Current Landuse (%)						Loading	w/ BMP		Removal	Sweeping		Removal	BMP	Removal	Removal
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	(lb/yr)	Comm	MF	(lb/yr)	Res	Art	(lb/yr)	Type	(lb/yr)	(lb/yr)
	2491	22%	0%	0%	2%	1%	1%	2,849			-	0%	0%	-		-	-
	2491							2,849	0	0	-			-		-	-
									Removal efficiency		0%			0%		0%	0%

Future

		Estimated							Redev. Area (ac)			Maintenance			Structural		Total
		Current Landuse (%)						Loading	w/ BMP		Removal	Sweeping		Removal	BMP	Removal	Removal
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	(lb/yr)	Comm	MF	(lb/yr)	Res	Art	(lb/yr)	Type	(lb/yr)	(lb/yr)
	2491	25%	0%	0%	11%	1%	1%	3,716	75	0	-	0%	0%	-		-	-
	2491							3,716	75	0	-			-		-	-
									Removal efficiency		0%			0%		0%	0%

Bear Creek South, Pollutant Loading Estimations

Notes:
1) Loading per Stormwater Treatment, G. Minton, Table 2.16
2) Estimated future landuse from GLUP map
3) Wetlands assumed to treat 10 times the wetlands area
4) Assumed redevelopment BMP TSS removal efficiency **80%**
5) Existing street sweeping - Regenerative every 3-4 weeks; 20% TP removal
6) Existing street sweeping - Regenerative every 3-4 weeks; 43% TSS removal in residential & 15% TSS removal in arterial (R)

Landuse	TSS (lb/ac/yr)	TN (lb/ac/yr)	TSS (lb/ac/yr)	O & G (lb/ac/yr)
Comm	725	4.7	0.72	0.00089
MF	400	5.0	0.63	0.0008
SF-hi	290	5.2	0.59	0.0008
SF-lo	180	3.6	0.5	0.0008
Roads	452	2.2	1.00	0.010867

Total Phosphorous (TP)

Existing

Subbasin	Acre	Estimated Current Landuse (%) Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	Loading (lb/yr)	Redev. Area (ac) w/ BMP Comm	MF	Removal (lb/yr)	Maintenance Sweeping Res	Art	Removal (lb/yr)	Structural BMP Type	Removal (lb/yr)	Total Removal (lb/yr)
	2491	22%	0%	0%	2%	1%	1%	444			-	20%	20%	10		-	10
	2491							444	0	0	-			10		-	10
									Removal efficiency		0%			0.0%		0%	2%

Future

Subbasin	Acre	Estimated Current Landuse (%) Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	Loading (lb/yr)	Redev. Area (ac) w/ BMP Comm	MF	Removal (lb/yr)	Maintenance Sweeping Res	Art	Removal (lb/yr)	Structural BMP Type	Removal (lb/yr)	Total Removal (lb/yr)
	2491	25%	0%	0%	11%	1%	1%	610	75	0	-	20%	20%	10		-	10
	2491							610	75	0	-			10		-	10
									Removal efficiency		0%			1.6%		0%	2%

Oil and Grease (O&G)

Existing

Subbasin	Acre	Estimated Current Landuse (%) Comm	MF	SF-hi	SF-lo	Roads	Loading (lb/yr)	Redev. Area (ac) w/ BMP Comm	MF	Removal (lb/yr)	Maintenance Sweep & Vactor Type		Removal (lb/yr)	Structural BMP Type	Removal (lb/yr)	Total Removal (lb/yr)
	2491	21%	0%	0%	2%	2%	1.05			-	R	0%	0.00		-	0.00
	2491						1.05	0	0	-			0.00		-	0.00
								Removal efficiency		0%			0%		0%	0%

Future

Subbasin	Acre	Estimated Current Landuse (%) Comm	MF	SF-hi	SF-lo	Roads	Loading (lb/yr)	Redev. Area (ac) w/ BMP Comm	MF	Removal (lb/yr)	Maintenance Sweep & Vactor Type		Removal (lb/yr)	Structural BMP Type	Removal (lb/yr)	Total Removal (lb/yr)
	2491	25%	0%	0%	11%	2%	1.31	100	0	-	R	0%	0.00		-	0.00
	2491						1.31	100	0	-			0.00		-	0.00
								Removal efficiency		0%			0%		0%	0%

Bear Creek West, Pollutant Loading Estimations

Notes:
1) Loading per Stormwater Treatment, G. Minton, Table 2.16
2) Estimated future landuse from GLUP map
3) Wetlands assumed to treat 10 times the wetlands area
4) Assumed redevelopment BMP TSS removal efficiency **80%**
5) Existing street sweeping - Regenerative every 3-4 weeks; 20% TP removal
6) Existing street sweeping - Regenerative every 3-4 weeks; 43% TSS removal in residential & 15% TSS removal in arterial (R)

Landuse	TSS (lb/ac/yr)	TN (lb/ac/yr)	TSS (lb/ac/yr)	O & G (lb/ac/yr)
Comm	725	4.7	0.72	0.00089
MF	400	5.0	0.63	0.0008
SF-hi	290	5.2	0.59	0.0008
SF-lo	180	3.6	0.5	0.0008
Roads	452	2.2	1.00	0.010867

Total Suspended Solids (TSS)

Existing

		Estimated							Redev. Area (ac)			Maintenance			Structural			Total
		Current Landuse (%)						Loading	w/ BMP		Removal	Sweeping		Removal	BMP		Removal	Removal
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	(lb/yr)	Comm	MF	(lb/yr)	Res	Art	(lb/yr)	Type		(lb/yr)	(lb/yr)
	1399	36%	7%	0%	34%	7%	7%	534,298	0	0	-	43%	15%	25,678			-	25,678
	1399							534,298	0	0	-			25,678			-	25,678
									Removal efficiency		0%			4.8%			0%	5%

Future

		Estimated							Redev. Area (ac)			Maintenance			Structural			Total
		Current Landuse (%)						Loading	w/ BMP		Removal	Sweeping		Removal	BMP		Removal	Removal
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	(lb/yr)	Comm	MF	(lb/yr)	Res	Art	(lb/yr)	Type		(lb/yr)	(lb/yr)
	1399	36%	7%	0%	34%	7%	7%	534,298	0	0	-	43%	15%	25,678	Vault on 6th	80%	28,051	53,730
															Vault on Earheart	80%	66,236	66,236
	1399							534,298	0	0	-			25,678			94,287	119,966
									Removal efficiency		0%			4.8%			18%	22%

Total Nitrogen (TN)

Existing

		Estimated							Redev. Area (ac)			Maintenance			Structural			Total
		Current Landuse (%)						Loading	w/ BMP		Removal	Sweeping		Removal	BMP		Removal	Removal
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	(lb/yr)	Comm	MF	(lb/yr)	Res	Art	(lb/yr)	Type		(lb/yr)	(lb/yr)
	1399	36%	7%	0%	34%	7%	7%	4,786	0	0	-	0%	0%	-			-	-
	1399							4,786	0	0	-			-			-	-
									Removal efficiency		0%			0%			0%	0%

Future

		Estimated							Redev. Area (ac)			Maintenance			Structural			Total
		Current Landuse (%)						Loading	w/ BMP		Removal	Sweeping		Removal	BMP		Removal	Removal
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	(lb/yr)	Comm	MF	(lb/yr)	Res	Art	(lb/yr)	Type		(lb/yr)	(lb/yr)
	1399	36%	7%	0%	34%	7%	7%	4,786	0	0	-	0%	0%	-	Vault on 6th	50%	111	111
															Vault on Earheart	50%	355	355
	1399							4,786	0	0	-			-			466	466
									Removal efficiency		0%			0%			10%	10%

Bear Creek West, Pollutant Loading Estimations

Notes:
1) Loading per Stormwater Treatment, G. Minton, Table 2.16
2) Estimated future landuse from GLUP map
3) Wetlands assumed to treat 10 times the wetlands area
4) Assumed redevelopment BMP TSS removal efficiency — 80%
5) Existing street sweeping - Regenerative every 3-4 weeks; 20% TP removal
6) Existing street sweeping - Regenerative every 3-4 weeks; 43% TSS removal in residential & 15% TSS removal in arterial (R)

Landuse	TSS (lb/ac/yr)	TN (lb/ac/yr)	TSS (lb/ac/yr)	O & G (lb/ac/yr)
Comm	725	4.7	0.72	0.00089
MF	400	5.0	0.63	0.0008
SF-hi	290	5.2	0.59	0.0008
SF-lo	180	3.6	0.5	0.0008
Roads	452	2.2	1.00	0.010867

Total Phosphorous (TP)

Existing

Subbasin	Acre	Estimated Current Landuse (%) Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	Loading (lb/yr)	Redev. Area (ac) w/ BMP Comm	MF	Removal (lb/yr)	Maintenance Sweeping Res	Art	Removal (lb/yr)	Structural BMP Type		Removal (lb/yr)	Total Removal (lb/yr)
	1399	36%	7%	0%	34%	7%	7%	760	0	0	-	20%	20%	39			-	39
	1399							760	0	0	-			39			-	39
									Removal efficiency		0%			0.0%			0%	5%

Future

Subbasin	Acre	Estimated Current Landuse (%) Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	Loading (lb/yr)	Redev. Area (ac) w/ BMP Comm	MF	Removal (lb/yr)	Maintenance Sweeping Res	Art	Removal (lb/yr)	Structural BMP Type		Removal (lb/yr)	Total Removal (lb/yr)
	1399	36%	7%	0%	34%	7%	7%	760	0	0	-	20%	20%	39	Vault on 6th	50%	19	59
															Vault on Earheart	50%	61	61
	1399							760	0	0	-			39			80	119
									Removal efficiency		0%			5.2%			11%	16%

Oil and Grease (O&G)

Subbasin	Acre	Estimated Current Landuse (%) Comm	MF	SF-hi	SF-lo	Roads	Loading (lb/yr)	Redev. Area (ac) w/ BMP Comm	MF	Removal (lb/yr)	Maintenance Sweep & Vactor Type		Removal (lb/yr)	Structural BMP Type		Removal (lb/yr)	Total Removal (lb/yr)
	1399	36%	7%	0%	34%	14%	3.04	0	0	-	R	0%	0.00			-	0.00
	1399						3.04	0	0	-			0.00			-	0.00
								Removal efficiency		0%			0%			0%	0%

Future

Subbasin	Acre	Estimated Current Landuse (%) Comm	MF	SF-hi	SF-lo	Roads	Loading (lb/yr)	Redev. Area (ac) w/ BMP Comm	MF	Removal (lb/yr)	Maintenance Sweep & Vactor Type		Removal (lb/yr)	Structural BMP Type		Removal (lb/yr)	Total Removal (lb/yr)
	1399	36%	7%	0%	34%	14%	3.04	0	0	-	R	0%	0.00	Vault on 6th	60%	0.07	0.07
														Vault on Earheart	60%	0.24	0.24
	1399						3.04	0	0	-			0.00			0.31	0.31
								Removal efficiency		0%			0%			10%	10%

Crooked Creek, Pollutant Loading Estimations

Notes: 1) Loading per Stormwater Treatment, G. Minton, Table 2.16
2) Estimated future landuse from GLUP map
3) Wetlands assumed to treat 10 times the wetlands area
4) Assumed redevelopment BMP TSS removal efficiency **80%**
5) Existing street sweeping - Regenerative every 3-4 weeks; 20% TP removal
6) Existing street sweeping - Regenerative every 3-4 weeks; 43% TSS removal in residential & 15% TSS removal in arterial (R)

Landuse	TSS (lb/ac/yr)	TN (lb/ac/yr)	TSS (lb/ac/yr)	O & G (lb/ac/yr)
Comm	725	4.7	0.72	0.00089
MF	400	5.0	0.63	0.0008
SF-hi	290	5.2	0.59	0.0008
SF-lo	180	3.6	0.5	0.0008
Roads	452	2.2	1.00	0.010867

Total Suspended Solids (TSS)

Existing

		Estimated Current Landuse (%)							Redev. Area (ac) w/ BMP			Maintenance Sweeping			Structural BMP			Total
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	Loading (lb/yr)	Comm	MF	Removal (lb/yr)	Res	Art	Removal (lb/yr)	Type		Removal (lb/yr)	Removal (lb/yr)
A	1944	2%	0%	0%	42%	3%	3%	201,517	0	0	-	43%	15%	15,289			-	15,289
B	785	16%	0%	0%	2%	1%	1%	97,384	0	0	-	43%	15%	2,057			-	2,057
C	66	78%	0%	0%	0%	1%	9%	37,734	0	0	-	43%	15%	533			-	533
	2795							336,634	0	0	-			17,879			-	17,879
									Removal efficiency		0.0%			5.3%			0.0%	5%

Future

		Estimated Current Landuse (%)							Redev. Area (ac) w/ BMP			Maintenance Sweeping			Structural BMP			Total
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	Loading (lb/yr)	Comm	MF	Removal (lb/yr)	Res	Art	Removal (lb/yr)	Type		Removal (lb/yr)	Removal (lb/yr)
A	1944	2%	0%	0%	49%	3%	3%	226,011	0	0	-	43%	15%	15,289	Vault on Stewart	80%	48765.60	64,055
B	785	23%	0%	0%	2%	1%	1%	137,202	55	0	31,855	43%	15%	2,057			-	33,911
C	66	78%	0%	0%	0%	1%	9%	37,734	0	0	-	43%	15%	533			-	533
	2795							400,947	55	0	31,855			17,879			48,766	98,499
									Removal efficiency		7.9%			4.5%			12.2%	25%

Total Nitrogen (TN)

Existing

		Estimated Current Landuse (%)							Redev. Area (ac) w/ BMP			Maintenance Sweeping			Structural BMP			Total
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	Loading (lb/yr)	Comm	MF	Removal (lb/yr)	Res	Art	Removal (lb/yr)	Type		Removal (lb/yr)	Removal (lb/yr)
A	1944	2%	0%	0%	42%	3%	3%	3,250	0	0	-	0%	0%	-			-	-
B	785	16%	0%	0%	2%	1%	1%	664	0	0	-	0%	0%	-			-	-
C	66	78%	0%	0%	0%	1%	9%	244	0	0	-	0%	0%	-			-	-
	2795							4,158	0	0	-			-			-	-
									Removal efficiency		0%			0%			0%	0%

Future

		Estimated Current Landuse (%)							Redev. Area (ac) w/ BMP			Maintenance Sweeping			Structural BMP			Total
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	Loading (lb/yr)	Comm	MF	Removal (lb/yr)	Res	Art	Removal (lb/yr)	Type		Removal (lb/yr)	Removal (lb/yr)
A	1944	2%	0%	0%	49%	3%	3%	3,740	0	0	-	0%	0%	-	Vault on Stewart	50%	471.55	472
B	785	23%	0%	0%	2%	1%	1%	922	55	0	-	0%	0%	-			-	-
C	66	78%	0%	0%	0%	1%	9%	244	0	0	-	0%	0%	-			-	-
	2795							4,906	55	0	-			-			472	472
									Removal efficiency		0%			0%			10%	10%

Crooked Creek, Pollutant Loading Estimations

Notes:
1) Loading per Stormwater Treatment, G. Minton, Table 2.16
2) Estimated future landuse from GLUP map
3) Wetlands assumed to treat 10 times the wetlands area
4) Assumed redevelopment BMP TSS removal efficiency **80%**
5) Existing street sweeping - Regenerative every 3-4 weeks; 20% TP removal
6) Existing street sweeping - Regenerative every 3-4 weeks; 43% TSS removal in residential & 15% TSS removal in arterial (R)

Landuse	TSS (lb/ac/yr)	TN (lb/ac/yr)	TSS (lb/ac/yr)	O & G (lb/ac/yr)
Comm	725	4.7	0.72	0.00089
MF	400	5.0	0.63	0.0008
SF-hi	290	5.2	0.59	0.0008
SF-lo	180	3.6	0.5	0.0008
Roads	452	2.2	1.00	0.010867

Total Phosphorous (TP)

Existing

Subbasin	Acre	Estimated Current Landuse (%) Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	Loading (lb/yr)	Redev. Area (ac) w/ BMP Comm	MF	Removal (lb/yr)	Maintenance Sweeping Res	Art	Removal (lb/yr)	Structural BMP Type		Removal (lb/yr)	Total Removal (lb/yr)
A	1944	2%	0%	0%	42%	3%	3%	495	0	0	-	20%	20%	23			-	23
B	785	16%	0%	0%	2%	1%	1%	106	0	0	-	20%	20%	3			-	3
C	66	78%	0%	0%	0%	1%	9%	38	0	0	-	20%	20%	1			-	1
	2795							638	0	0	-			28			-	28
									Removal efficiency		0%			0.1%			0%	4%

Future

Subbasin	Acre	Estimated Current Landuse (%) Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	Loading (lb/yr)	Redev. Area (ac) w/ BMP Comm	MF	Removal (lb/yr)	Maintenance Sweeping Res	Art	Removal (lb/yr)	Structural BMP Type		Removal (lb/yr)	Total Removal (lb/yr)
A	1944	2%	0%	0%	49%	3%	3%	563	0	0	-	20%	20%	23	Vault on Stewart	50%	71.62	95
B	785	23%	0%	0%	2%	1%	1%	146	55	0	-	20%	20%	3			-	3
C	66	78%	0%	0%	0%	1%	9%	38	0	0	-	20%	20%	1			-	1
	2795							746	55	0	-			28			72	99
									Removal efficiency		0%			3.7%			10%	13%

Oil and Grease (O&G)

Existing

Subbasin	Acre	Estimated Current Landuse (%) Comm	MF	SF-hi	SF-lo	Roads	Loading (lb/yr)	Redev. Area (ac) w/ BMP Comm	MF	Removal (lb/yr)	Maintenance Sweep & Vactor Type		Removal (lb/yr)	Structural BMP Type		Removal (lb/yr)	Total Removal (lb/yr)
A	1944	2%	0%	0%	42%	6%	1.96	0	0	-	R	0%	0.00			-	0.00
B	785	16%	0%	0%	2%	2%	0.29	0	0	-	R	0%	0.00			-	0.00
C	66	78%	0%	0%	0%	10%	0.12	0	0	-	R	0%	0.00			-	0.00
	2795						2.37	0	0	-			0.00			-	0.00
								Removal efficiency		0%			0%			0%	0%

Future

Subbasin	Acre	Estimated Current Landuse (%) Comm	MF	SF-hi	SF-lo	Roads	Loading (lb/yr)	Redev. Area (ac) w/ BMP Comm	MF	Removal (lb/yr)	Maintenance Sweep & Vactor Type		Removal (lb/yr)	Structural BMP Type		Removal (lb/yr)	Total Removal (lb/yr)
A	1944	2%	0%	0%	49%	6%	2.06	0	0	-	R	0%	0.00	Vault on priority upgrade	60%	0.22	0.22
B	785	23%	0%	0%	2%	2%	0.34	55	0	-	R	0%	0.00			-	0.00
C	66	78%	0%	0%	0%	10%	0.12	0	0	-	R	0%	0.00			-	0.00
	2795						2.53	55	0	-			0.00			0	0.22
								Removal efficiency		0%			0%			9%	9%

Elk Creek, Pollutant Loading Estimations

Notes: 1) Loading per Stormwater Treatment, G. Minton, Table 2.16
2) Estimated future landuse from GLUP map
3) Wetlands assumed to treat 10 times the wetlands area
4) Assumed redevelopment BMP TSS removal efficiency **80%**
5) Existing street sweeping - Regenerative every 3-4 weeks; 20% TP removal
6) Existing street sweeping - Regenerative every 3-4 weeks; 43% TSS removal in residential & 15% TSS removal in arterial (R)

Landuse	TSS (lb/ac/yr)	TN (lb/ac/yr)	TSS (lb/ac/yr)	O & G (lb/ac/yr)
Comm	725	4.7	0.72	0.00089
MF	400	5.0	0.63	0.0008
SF-hi	290	5.2	0.59	0.0008
SF-lo	180	3.6	0.5	0.0008
Roads	452	2.2	1.00	0.010867

Total Suspended Solids (TSS)

Existing

Subbasin	Acre	Estimated Current Landuse (%) Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	Loading (lb/yr)	Redev. Area (ac) w/ BMP Comm	MF	Removal (lb/yr)	Maintenance Sweeping Res	Art	Removal (lb/yr)	Structural BMP Type	Removal (lb/yr)	Wetlands		Removal (lb/yr)	Total Removal (lb/yr)
A	2015	9%	2%	0%	33%	2%	3%	285,443	0	0	-	43%	15%	11,929		-	9	65%	10,530	22,459
B	713	76%	0%	0%	3%	2%	4%	403,104	0	0	-	43%	15%	4,705		-				4,705
C	891	12%	6%	0%	37%	4%	2%	174,321	0	0	-	43%	15%	8,134		-				8,134
	3618							862,868	0	0	-			24,767		-			10,530	35,297
									Removal efficiency		0%			2.9%		0.0%			1.2%	4%

Future

Subbasin	Acre	Estimated Current Landuse (%) Comm	MF	SF-hi	SF-lo	Roads		Loading (lb/yr)	Redev. Area (ac) w/ BMP Comm	MF	Removal (lb/yr)	Maintenance Sweeping Res	Art	Removal (lb/yr)	Structural BMP Type	Removal (lb/yr)	Wetlands (acre)		Removal (lb/yr)	Total Removal (lb/yr)
A	2015	9%	2%	0%	42%	2%	3%	318,079	0	0	-	43%	15%	11,929		-	9	65%	10,530	22,459
B	713	92%	0%	0%	3%	2%	4%	485,801	114	0	66,157	43%	15%	4,705		-				70,862
C	891	12%	17%	0%	38%	4%	4%	215,122	0	98	31,358	43%	15%	9,342		-				40,700
	3618							1,019,001	114	98	97,515			25,975		-			10,530	134,020
									Removal efficiency		9.6%			2.5%		0%			1.0%	13%

Total Nitrogen (TN)

Existing

Subbasin	Acre	Estimated Current Landuse (%) Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	Loading (lb/yr)	Redev. Area (ac) w/ BMP Comm	MF	Removal (lb/yr)	Maintenance Sweeping Res	Art	Removal (lb/yr)	Structural BMP Type	Removal (lb/yr)	Wetlands		Removal (lb/yr)	Total Removal (lb/yr)
A	2015	9%	2%	0%	33%	2%	3%	3,536	0	0	-	0%	0%	-		-	9	20%	65	65
B	713	76%	0%	0%	3%	2%	4%	2,655	0	0	-	0%	0%	-		-				-
C	891	12%	6%	0%	37%	4%	2%	2,035	0	0	-	0%	0%	-		-				-
	3618							8,225	0	0	-			-		-			65	65
									Removal efficiency		0%			0%		0%			0.8%	1%

Future

Subbasin	Acre	Estimated Current Landuse (%) Comm	MF	SF-hi	SF-lo	Roads		Loading (lb/yr)	Redev. Area (ac) w/ BMP Comm	MF	Removal (lb/yr)	Maintenance Sweeping Res	Art	Removal (lb/yr)	Structural BMP Type	Removal (lb/yr)	Wetlands (acre)		Removal (lb/yr)	Total Removal (lb/yr)
A	2015	9%	2%	0%	42%	2%	3%	4,188	0	0	-	0%	0%	-		-	9	20%	65	65
B	713	92%	0%	0%	3%	2%	3%	3,191	114	0	-	0%	0%	-		-				-
C	891	12%	17%	0%	38%	4%	4%	2,557	0	98	-	0%	0%	-		-				-
	3618							9,936	114	98	-			-		-			65	65
									Removal efficiency		0%			0%		0%			0.7%	1%

Elk Creek, Pollutant Loading Estimations

Notes:
1) Loading per Stormwater Treatment, G. Minton, Table 2.16
2) Estimated future landuse from GLUP map
3) Wetlands assumed to treat 10 times the wetlands area
4) Assumed redevelopment BMP TSS removal efficiency **80%**
5) Existing street sweeping - Regenerative every 3-4 weeks; 20% TP removal
6) Existing street sweeping - Regenerative every 3-4 weeks; 43% TSS removal in residential & 15% TSS removal in arterial (R)

Landuse	TSS (lb/ac/yr)	TN (lb/ac/yr)	TSS (lb/ac/yr)	O & G (lb/ac/yr)
Comm	725	4.7	0.72	0.00089
MF	400	5.0	0.63	0.0008
SF-hi	290	5.2	0.59	0.0008
SF-lo	180	3.6	0.5	0.0008
Roads	452	2.2	1.00	0.010867

Total Phosphorous (TP)

Existing

		Estimated Current Landuse (%)							Redev. Area (ac) w/ BMP			Maintenance Sweeping			Structural BMP		Wetlands			Total
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	Loading (lb/yr)	Comm	MF	Removal (lb/yr)	Res	Art	Removal (lb/yr)	Type	Removal (lb/yr)			Removal (lb/yr)	Removal (lb/yr)
A	2015	9%	2%	0%	33%	2%	3%	529	0	0	-	20%	20%	20		-	9	65%	29	49
B	713	76%	0%	0%	3%	2%	4%	415	0	0	-	20%	20%	9		-				9
C	891	12%	6%	0%	37%	4%	2%	311	0	0	-	20%	20%	11		-				11
	3618							1,255	0	0	-			39		-			29	69
									Removal efficiency		0%			0.0%		0%			2.3%	5%

Future

		Estimated Current Landuse (%)							Redev. Area (ac) w/ BMP			Maintenance Sweeping			Structural BMP		Wetlands			Total
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Roads		Loading (lb/yr)	Comm	MF	Removal (lb/yr)	Res	Art	Removal (lb/yr)	Type	Removal (lb/yr)	(acre)		Removal (lb/yr)	Removal (lb/yr)
A	2015	9%	2%	0%	42%	2%	3%	619	0	0	-	20%	20%	20		-	9	65%	29	49
B	713	92%	0%	0%	3%	2%	3%	497	114	0	-	20%	20%	7		-				7
C	891	12%	17%	0%	38%	4%	4%	377	0	98	-	20%	20%	14		-				14
	3618							1,494	114	98	-			42		-			29	71
									Removal efficiency		0%			2.8%		0%			2.0%	5%

Oil and Grease (O&G)

Existing

		Estimated Current Landuse (%)					Loading	Redev. Area (ac) w/ BMP			Maintenance Sweep & Vactor			Structural BMP		Wetlands			Total
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Roads	(lb/yr)	Comm	MF	Removal (lb/yr)	Type		Removal (lb/yr)	Type	Removal (lb/yr)			Removal (lb/yr)	Removal (lb/yr)
A	2015	9%	2%	0%	33%	5%	1.82	0	0	-	R	0%	0.00		-	9	0%	-	0.00
B	713	76%	0%	0%	3%	6%	0.96	0	0	-	R	0%	0.00		-				0.00
C	891	12%	6%	0%	37%	6%	0.98	0	0	-	R	0%	0.00		-				0.00
	3618						3.77	0	0	-			0.00		-			-	0.00
								Removal efficiency		0%			0%		0%			0%	0%

Future

		Estimated Current Landuse (%)					Loading	Redev. Area (ac) w/ BMP			Maintenance Sweep & Vactor			Structural BMP		Wetlands			Total
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Roads	(lb/yr)	Comm	MF	Removal (lb/yr)	Type		Removal (lb/yr)	Type	Removal (lb/yr)	(acre)		Removal (lb/yr)	Removal (lb/yr)
A	2015	9%	2%	0%	42%	5%	1.97	0	0	-	R	0%	0.00		-	9	0%	-	0.00
B	713	92%	0%	0%	3%	6%	1.07	114	0	-	R	0%	0.00		-				0.00
C	891	12%	17%	0%	38%	8%	1.26	0	98	-	R	0%	0.00		-				0.00
	3618						4.29	114	98	-			0.00		-			-	0.00
								Removal efficiency		0%			0%		0%			0%	0%

Larson Creek, Pollutant Loading Estimations

Notes:
1) Loading per Stormwater Treatment, G. Minton, Table 2.16
2) Estimated future landuse from GLUP map
3) Wetlands assumed to treat 10 times the wetlands area
4) Assumed redevelopment BMP TSS removal efficiency **80%**
5) Existing street sweeping - Regenerative every 3-4 weeks; 20% TP removal
6) Existing street sweeping - Regenerative every 3-4 weeks; 43% TSS removal in residential & 15% TSS removal in arterial (R)

Landuse	TSS (lb/ac/yr)	TN (lb/ac/yr)	TSS (lb/ac/yr)	O & G (lb/ac/yr)
Comm	725	4.7	0.72	0.00089
MF	400	5.0	0.63	0.0008
SF-hi	290	5.2	0.59	0.0008
SF-lo	180	3.6	0.5	0.0008
Roads	452	2.2	1.00	0.010867

Total Suspended Solids (TSS)

Existing

		Estimated							Redev. Area (ac)			Maintenance			Structural		Existing Wetlands			Total
		Current Landuse (%)						Loading	w/ BMP		Removal	Sweeping		Removal	BMP	Removal			Removal	Removal
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	(lb/yr)	Comm	MF	(lb/yr)	Res	Art	(lb/yr)	Type	(lb/yr)			(lb/yr)	(lb/yr)
A	1060	4%	0%	0%	11%	2%	2%	61,314	0	0	-	43%	15%	5,558		-				5,558
B	184	17%	0%	0%	60%	6%	5%	47,642	0	0	-	43%	15%	2,775		-				2,775
C	824	0%	2%	0%	0%	1%	2%	10,313	0	0	-	43%	15%	2,718		-				2,718
D	616	11%	5%	0%	56%	4%	4%	134,620	0	0	-	43%	15%	6,457		-	5.6	65%	6,552	13,009
	2068							253,889	0	0	-			17,508		-			6,552	24,060
									Removal efficiency		0%			6.9%		0%			2.6%	9%

Future

		Estimated							Redev. Area (ac)			Maintenance			Structural		Existing Wetlands			Total
		Current Landuse (%)						Loading	.		Removal	Sweeping		Removal	BMP	Removal			Removal	Removal
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	(lb/yr)	Comm	MF	(lb/yr)	Res	Art	(lb/yr)	Type	(lb/yr)	(acre)		(lb/yr)	(lb/yr)
A	1060	4%	6%	5%	58%	2%	2%	191,807	0	64	-	43%	15%	5,558		-				5,558
B	184	17%	12%	0%	60%	6%	5%	56,492	0	22	-	43%	15%	2,775		-				2,775
C	824	0%	2%	2%	35%	1%	2%	66,986	0	0	-	43%	15%	2,718		-				2,718
D	616	11%	7%	0%	64%	4%	4%	148,413	0	12	-	43%	15%	6,457		-	5.6	65%	6,552	13,009
	2068							463,699	0	98	-			17,508		-			6,552	24,060
									Removal efficiency		0.0%			3.8%		0%			1.4%	5%

Total Nitrogen (TN)

Existing

		Estimated							Redev. Area (ac)			Maintenance			Structural		Existing Wetlands			Total
		Current Landuse (%)						Loading	w/ BMP		Removal	Sweeping		Removal	BMP	Removal			Removal	Removal
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	(lb/yr)	Comm	MF	(lb/yr)	Res	Art	(lb/yr)	Type	(lb/yr)			(lb/yr)	(lb/yr)
A	1060	4%	0%	0%	11%	2%	2%	666	0	0	-	0%	0%	-		-				-
B	184	17%	0%	0%	60%	6%	5%	570	0	0	-	0%	0%	-		-				-
C	824	0%	2%	0%	0%	1%	2%	100	0	0	-	0%	0%	-		-				-
D	616	11%	5%	0%	56%	4%	4%	1,768	0	0	-	0%	0%	-		-	5.6	20%	40	40
	2068							3,104	0	0	-			-		-			40	40
									Removal efficiency		0%			0%		0%			1.3%	1%

Future

		Estimated							Redev. Area (ac)			Maintenance			Structural		Existing Wetlands			Total
		Current Landuse (%)						Loading	.		Removal	Sweeping		Removal	BMP	Removal			Removal	Removal
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	(lb/yr)	Comm	MF	(lb/yr)	Res	Art	(lb/yr)	Type	(lb/yr)	(acre)		(lb/yr)	(lb/yr)
A	1060	4%	6%	5%	58%	2%	2%	3,053	0	64	-	0%	0%	-		-				-
B	184	17%	12%	0%	60%	6%	5%	681	0	22	-	0%	0%	-		-				-
C	824	0%	2%	2%	35%	1%	2%	1,224	0	0	-	0%	0%	-		-				-
D	616	11%	7%	0%	64%	4%	4%	2,007	0	12	-	0%	0%	-		-	5.6	20%	40	40
	2068							6,964	0	98	-			-		-			40	40
									Removal efficiency		0%			0%		0%			0.6%	1%

Larson Creek, Pollutant Loading Estimations

Notes:
1) Loading per Stormwater Treatment, G. Minton, Table 2.16
2) Estimated future landuse from GLUP map
3) Wetlands assumed to treat 10 times the wetlands area
4) Assumed redevelopment BMP TSS removal efficiency **80%**
5) Existing street sweeping - Regenerative every 3-4 weeks; 20% TP removal
6) Existing street sweeping - Regenerative every 3-4 weeks; 43% TSS removal in residential & 15% TSS removal in arterial (R)

Landuse	TSS (lb/ac/yr)	TN (lb/ac/yr)	TSS (lb/ac/yr)	O & G (lb/ac/yr)
Comm	725	4.7	0.72	0.00089
MF	400	5.0	0.63	0.0008
SF-hi	290	5.2	0.59	0.0008
SF-lo	180	3.6	0.5	0.0008
Roads	452	2.2	1.00	0.010867

Total Phosphorous (TP)

Existing

		Estimated Current Landuse (%)							Redev. Area (ac) w/ BMP			Maintenance Sweeping			Structural BMP		Existing Wetlands			Total
Subbasir	Acre	Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	Loading (lb/yr)	Comm	MF	Removal (lb/yr)	Res	Art	Removal (lb/yr)	Type	Removal (lb/yr)			Removal (lb/yr)	Removal (lb/yr)
A	1060	4%	0%	0%	11%	2%	2%	110	0	0	-	20%	20%	8		-				8
B	184	17%	0%	0%	60%	6%	5%	89	0	0	-	20%	20%	4		-				4
C	824	0%	2%	0%	0%	1%	2%	19	0	0	-	20%	20%	5		-				5
D	616	11%	5%	0%	56%	4%	4%	265	0	0	-	20%	20%	10		-	5.6	65%	18	28
	2068							483	0	0	-			27		-			18	46
									Removal efficiency		0%			0.3%		0%			3.8%	9%

Future

		Estimated Current Landuse (%)							Redev. Area (ac) .			Maintenance Sweeping			Structural BMP		Existing Wetlands			Total
Subbasir	Acre	Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	Loading (lb/yr)	Comm	MF	Removal (lb/yr)	Res	Art	Removal (lb/yr)	Type	Removal (lb/yr)	(acre)		Removal (lb/yr)	Removal (lb/yr)
A	1060	4%	6%	5%	58%	2%	2%	430	0	64	-	20%	20%	8		-				8
B	184	17%	12%	0%	60%	6%	5%	103	0	22	-	20%	20%	4		-				4
C	824	0%	2%	2%	35%	1%	2%	172	0	0	-	20%	20%	5		-				5
D	616	11%	7%	0%	64%	4%	4%	298	0	12	-	20%	20%	10		-	5.6	65%	18	28
	2068							1,003	0	98	-			27		-			18	46
									Removal efficiency		0%			2.7%		0%			1.8%	5%

Oil and Grease (O&G)

Existing

		Estimated Current Landuse (%)						Redev. Area (ac) w/ BMP			Maintenance Sweep & Vactor			Structural BMP		Existing Wetlands			Total
Subbasir	Acre	Comm	MF	SF-hi	SF-lo	Roads	Loading (lb/yr)	Comm	MF	Removal (lb/yr)	Type		Removal (lb/yr)	Type	Removal (lb/yr)			Removal (lb/yr)	Removal (lb/yr)
A	1060	4%	0%	0%	11%	4%	0.59	0	0	-	R	0%	0.00		-				0.00
B	184	17%	0%	0%	60%	11%	0.34	0	0	-	R	0%	0.00		-				0.00
C	824	0%	2%	0%	0%	3%	0.28	0	0	-	R	0%	0.00		-				0.00
D	616	11%	5%	0%	56%	8%	0.90	0	0	-	R	0%	0.00		-	5.6	0%	-	0.00
	2068						2.11	0	0	-			0.00		-			-	0.00
								Removal efficiency		0%			0%		0%			0%	0%

Future

		Estimated Current Landuse (%)						Redev. Area (ac) .			Maintenance Sweep & Vactor			Structural BMP		Existing Wetlands			Total
Subbasir	Acre	Comm	MF	SF-hi	SF-lo	Roads	Loading (lb/yr)	Comm	MF	Removal (lb/yr)	Type		Removal (lb/yr)	Type	Removal (lb/yr)	(acre)		Removal (lb/yr)	Removal (lb/yr)
A	1060	4%	6%	5%	58%	4%	1.08	0	64	-	R	0%	0.00		-				0.00
B	184	17%	12%	0%	60%	11%	0.35	0	22	-	R	0%	0.00		-				0.00
C	824	0%	2%	2%	35%	3%	0.53	0	0	-	R	0%	0.00		-				0.00
D	616	11%	7%	0%	64%	8%	0.95	0	12	-	R	0%	0.00		-	5.6	0%	-	0.00
	2068						2.91	0	98	-			0.00		-			-	0.00
								Removal efficiency		0%			0%		0%			0%	0%

Lazy Creek, Pollutant Loading Estimations

Notes:
1) Loading per Stormwater Treatment, G. Minton, Table 2.16
2) Estimated future landuse from GLUP map
3) Wetlands assumed to treat 10 times the wetlands area
4) Assumed redevelopment BMP TSS removal efficiency **80%**
5) Existing street sweeping - Regenerative every 3-4 weeks; 20% TP removal
6) Existing street sweeping - Regenerative every 3-4 weeks; 43% TSS removal in residential & 15% TSS removal in arterial (R)

Landuse	TSS (lb/ac/yr)	TN (lb/ac/yr)	TSS (lb/ac/yr)	O & G (lb/ac/yr)
Comm	725	4.7	0.72	0.00089
MF	400	5.0	0.63	0.0008
SF-hi	290	5.2	0.59	0.0008
SF-lo	180	3.6	0.5	0.0008
Roads	452	2.2	1.00	0.010867

Total Suspended Solids (TSS)

Existing

Subbasin	Acre	Estimated Current Landuse (%) Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	Loading (lb/yr)	Redev. Area (ac) w/ BMP Comm	MF	Removal (lb/yr)	Maintenance Sweeping Res	Art	Removal (lb/yr)	Structural BMP Type		Removal (lb/yr)	Existing Wetlands		Removal (lb/yr)	Total Removal (lb/yr)
A	1259	0%	0%	0%	28%	2%	1%	74,816	0	0	-	43%	15%	5,746			-	4.9	65%	5,733	11,479
B	802	2%	0%	0%	4%	3%	3%	28,278	0	0	-	43%	15%	6,307			-				6,307
C	516	0%	3%	0%	47%	4%	3%	59,198	0	0	-	43%	15%	5,063			-				5,063
	2577							162,292	0	0	-			17,117			-			5,733	22,850
									Removal efficiency		0%			10.5%			0%			3.5%	14%

Future

Subbasin	Acre	Estimated Current Landuse (%) Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	Loading (lb/yr)	Redev. Area (ac) w/ BMP Comm	MF	Removal (lb/yr)	Maintenance Sweeping Res	Art	Removal (lb/yr)	Structural BMP Type		Removal (lb/yr)	Existing Wetlands (acre)		Removal (lb/yr)	Total Removal (lb/yr)
A	1259	0%	0%	0%	75%	2%	1%	181,301	0	0	-	43%	15%	5,746	Det. Facility	75%	127,367	4.9	65%	5,733	138,846
B	802	2%	0%	0%	72%	3%	3%	126,439	0	0	-	43%	15%	6,307			-				6,307
C	516	11%	3%	0%	67%	4%	3%	118,949	57	0	32,934	43%	15%	5,063			-				37,997
	2577							426,689	57	0	32,934			17,117			127,367			5,733	183,150
									Removal efficiency		7.7%			4.0%			29.9%			1.3%	42.9%

Total Nitrogen (TN)

Existing

Subbasin	Acre	Estimated Current Landuse (%) Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	Loading (lb/yr)	Redev. Area (ac) w/ BMP Comm	MF	Removal (lb/yr)	Maintenance Sweeping Res	Art	Removal (lb/yr)	Structural BMP Type		Removal (lb/yr)	Existing Wetlands		Removal (lb/yr)	Total Removal (lb/yr)
A	1259	0%	0%	0%	28%	2%	1%	1,324	0	0	-	0%	0%	-			-	4.9	20%	35	35
B	802	2%	0%	0%	4%	3%	3%	244	0	0	-	0%	0%	-			-				-
C	516	0%	3%	0%	47%	4%	3%	996	0	0	-	0%	0%	-			-				-
	2577							2,564	0	0	-			-			-			35	35
									Removal efficiency		0%			0%			0%			1.4%	1%

Future

Subbasin	Acre	Estimated Current Landuse (%) Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	Loading (lb/yr)	Redev. Area (ac) w/ BMP Comm	MF	Removal (lb/yr)	Maintenance Sweeping Res	Art	Removal (lb/yr)	Structural BMP Type		Removal (lb/yr)	Existing Wetlands (acre)		Removal (lb/yr)	Total Removal (lb/yr)
A	1259	0%	0%	0%	75%	2%	1%	3,454	0	0	-	0%	0%	-	Det. Facility	50%	1,709	4.9	20%	35	1,745
B	802	2%	0%	0%	72%	3%	3%	2,207	0	0	-	0%	0%	-			-				-
C	516	11%	3%	0%	67%	4%	3%	1,635	57	0	-	0%	0%	-			-				-
	2577							7,296	57	0	-			-			1,709			35	1,745
									Removal efficiency		0%			0%			1.4%			0.0%	1%

Lazy Creek, Pollutant Loading Estimations

Notes:
1) Loading per Stormwater Treatment, G. Minton, Table 2.16
2) Estimated future landuse from GLUP map
3) Wetlands assumed to treat 10 times the wetlands area
4) Assumed redevelopment BMP TSS removal efficiency **80%**
5) Existing street sweeping - Regenerative every 3-4 weeks; 20% TP removal
6) Existing street sweeping - Regenerative every 3-4 weeks; 43% TSS removal in residential & 15% TSS removal in arterial (R)

Landuse	TSS (lb/ac/yr)	TN (lb/ac/yr)	TSS (lb/ac/yr)	O & G (lb/ac/yr)
Comm	725	4.7	0.72	0.00089
MF	400	5.0	0.63	0.0008
SF-hi	290	5.2	0.59	0.0008
SF-lo	180	3.6	0.5	0.0008
Roads	452	2.2	1.00	0.010867

Total Phosphorous (TP)

Existing

Subbasin	Acre	Estimated Current Landuse (%) Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	Loading (lb/yr)	Redev. Area (ac) w/ BMP Comm	MF	Removal (lb/yr)	Maintenance Sweeping Res	Art	Removal (lb/yr)	Structural BMP Type		Removal (lb/yr)	Existing Wetlands		Removal (lb/yr)	Total Removal (lb/yr)
A	1259	0%	0%	0%	28%	2%	1%	201	0	0	-	20%	20%	8			-	4.9	65%	16	23
B	802	2%	0%	0%	4%	3%	3%	52	0	0	-	20%	20%	10			-				10
C	516	0%	3%	0%	47%	4%	3%	152	0	0	-	20%	20%	7			-				7
	2577							405	0	0	-			24			-			16	40
									Removal efficiency		0%			0.0%			0.0%			3.9%	10%

Future

Subbasin	Acre	Estimated Current Landuse (%) Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	Loading (lb/yr)	Redev. Area (ac) w/ BMP Comm	MF	Removal (lb/yr)	Maintenance Sweeping Res	Art	Removal (lb/yr)	Structural BMP Type		Removal (lb/yr)	Existing Wetlands (acre)		Removal (lb/yr)	Total Removal (lb/yr)
A	1259	0%	0%	0%	75%	2%	1%	497	0	0	-	20%	20%	8	Det. Facility	50%	237	4.9	65%	16	260
B	802	2%	0%	0%	72%	3%	3%	324	0	0	-	20%	20%	10			-				10
C	516	11%	3%	0%	67%	4%	3%	244	57	0	-	20%	20%	7			-				7
	2577							1,066	57	0	-			24			237			16	277
									Removal efficiency		0%			0.0%			0.2%			1.5%	26.0%

Oil and Grease (O&G)

Existing

Subbasin	Acre	Estimated Current Landuse (%) Comm	MF	SF-hi	SF-lo	Roads	Loading (lb/yr)	Redev. Area (ac) w/ BMP Comm	MF	Removal (lb/yr)	Maintenance Sweep & Vactor Type		Removal (lb/yr)	Structural BMP Type		Removal (lb/yr)	Existing Wetlands		Removal (lb/yr)	Total Removal (lb/yr)
A	1259	0%	0%	0%	28%	3%	0.69	0	0	-	R	0%	0.00			-	4.9	0%	-	0.00
B	802	2%	0%	0%	4%	6%	0.56	0	0	-	R	0%	0.00			-				0.00
C	516	0%	3%	0%	47%	7%	0.60	0	0	-	R	0%	0.00			-				0.00
	2577						1.85	0	0	-			0.00			-			-	0.00
								Removal efficiency		0%			0%			0%			0%	0%

Future

Subbasin	Acre	Estimated Current Landuse (%) Comm	MF	SF-hi	SF-lo	Roads	Loading (lb/yr)	Redev. Area (ac) w/ BMP Comm	MF	Removal (lb/yr)	Maintenance Sweep & Vactor Type		Removal (lb/yr)	Structural BMP Type		Removal (lb/yr)	Existing Wetlands (acre)		Removal (lb/yr)	Total Removal (lb/yr)
A	1259	0%	0%	0%	75%	3%	1.17	0	0	-	R	0%	0.00	Det. Facility	0%	-	4.9	0%	-	0.00
B	802	2%	0%	0%	72%	6%	1.00	0	0	-	R	0%	0.00			-				0.00
C	516	11%	3%	0%	67%	7%	0.73	57	0	-	R	0%	0.00			-				0.00
	2577						2.90	57	0	-			0.00			-			-	0.00
								Removal efficiency		0%			0%			0%			0%	0%

Lone Pine Creek, Pollutant Loading Estimations

Notes:
1) Loading per Stormwater Treatment, G. Minton, Table 2.16
2) Estimated future landuse from GLUP map
3) Wetlands assumed to treat 10 times the wetlands area
4) Assumed redevelopment BMP TSS removal efficiency **80%**
5) Existing street sweeping - Regenerative every 3-4 weeks; 20% TP removal
6) Existing street sweeping - Regenerative every 3-4 weeks; 43% TSS removal in residential & 15% TSS removal in arterial (R)

Landuse	TSS (lb/ac/yr)	TN (lb/ac/yr)	TSS (lb/ac/yr)	O & G (lb/ac/yr)
Comm	725	4.7	0.72	0.00089
MF	400	5.0	0.63	0.0008
SF-hi	290	5.2	0.59	0.0008
SF-lo	180	3.6	0.5	0.0008
Roads	452	2.2	1.00	0.010867

Total Suspended Solids (TSS)

Existing

		Estimated Current Landuse (%)							Redev. Area (ac) w/ BMP			Maintenance Sweeping			Structural BMP		Existing Wetlands			Total
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	Loading (lb/yr)	Comm	MF	Removal (lb/yr)	Res	Art	Removal (lb/yr)	Type	Removal (lb/yr)			Removal (lb/yr)	Removal (lb/yr)
A	428	0%	0%	0%	4%	0%	2%	3,084	0	0	-	43%	15%	581		-				581
B	1021	5%	4%	0%	71%	5%	5%	206,985	0	0	-	43%	15%	13,388		-	10.6	65%	12,402	25,790
C	503	69%	0%	0%	0%	2%	3%	256,179	0	0	-	43%	15%	2,978		-				2,978
	1953							466,248	0	0	-			16,948		-			12,402	29,350
									Removal efficiency		0%			3.6%		0.0%			2.7%	6%

Future

		Estimated Current Landuse (%)							Redev. Area (ac) w/ BMP			Maintenance Sweeping			Structural BMP		Existing Wetlands			Total
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	Loading (lb/yr)	Comm	MF	Removal (lb/yr)	Res	Art	Removal (lb/yr)	Type	Removal (lb/yr)	(acre)		Removal (lb/yr)	Removal (lb/yr)
A	428	0%	0%	0%	63%	0%	2%	48,573	0	0	-	43%	15%	581		-				581
B	1021	5%	4%	0%	78%	5%	5%	219,855	0	0	-	43%	15%	13,388		-	10.6	65%	12,402	25,790
C	503	86%	0%	0%	0%	2%	3%	318,175	86	0	49,597	43%	15%	2,978		-				52,575
	1953							586,603	86	0	49,597			16,948		-			12,402	78,947
									Removal efficiency		8.5%			2.9%		0.0%			2.1%	13%

Total Nitrogen (TN)

Existing

		Estimated Current Landuse (%)							Redev. Area (ac) w/ BMP			Maintenance Sweeping			Structural BMP		Existing Wetlands			Total
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	Loading (lb/yr)	Comm	MF	Removal (lb/yr)	Res	Art	Removal (lb/yr)	Type	Removal (lb/yr)			Removal (lb/yr)	Removal (lb/yr)
A	428	0%	0%	0%	4%	0%	2%	62	0	0	-	0%	0%	-		-				-
B	1021	5%	4%	0%	71%	5%	5%	3,167	0	0	-	0%	0%	-		-	10.6	20%	76	76
C	503	69%	0%	0%	0%	2%	3%	1,653	0	0	-	0%	0%	-		-				-
	1953							4,882	0	0	-			-		-			76	76
									Removal efficiency		0%			0%		0%			1.6%	2%

Future

		Estimated Current Landuse (%)							Redev. Area (ac) w/ BMP			Maintenance Sweeping			Structural BMP		Existing Wetlands			Total
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	Loading (lb/yr)	Comm	MF	Removal (lb/yr)	Res	Art	Removal (lb/yr)	Type	Removal (lb/yr)	(acre)		Removal (lb/yr)	Removal (lb/yr)
A	428	0%	0%	0%	63%	0%	2%	971	0	0	-	0%	0%	-		-				-
B	1021	5%	4%	0%	78%	5%	5%	3,425	0	0	-	0%	0%	-		-	10.6	20%	76	76
C	503	86%	0%	0%	0%	2%	3%	2,055	86	0	-	0%	0%	-		-				-
	1953							6,451	86	0	-			-		-			76	76
									Removal efficiency		0%			0%		0%			1.2%	1%

Lone Pine Creek, Pollutant Loading Estimations

Notes:
1) Loading per Stormwater Treatment, G. Minton, Table 2.16
2) Estimated future landuse from GLUP map
3) Wetlands assumed to treat 10 times the wetlands area
4) Assumed redevelopment BMP TSS removal efficiency **80%**
5) Existing street sweeping - Regenerative every 3-4 weeks; 20% TP removal
6) Existing street sweeping - Regenerative every 3-4 weeks; 43% TSS removal in residential & 15% TSS removal in arterial (R)

Landuse	TSS (lb/ac/yr)	TN (lb/ac/yr)	TSS (lb/ac/yr)	O & G (lb/ac/yr)
Comm	725	4.7	0.72	0.00089
MF	400	5.0	0.63	0.0008
SF-hi	290	5.2	0.59	0.0008
SF-lo	180	3.6	0.5	0.0008
Roads	452	2.2	1.00	0.010867

Total Phosphorous (TP)

Existing

Subbasin	Acre	Estimated Current Landuse (%) Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	Loading (lb/yr)	Redev. Area (ac) w/ BMP Comm	MF	Removal (lb/yr)	Maintenance Sweeping Res	Art	Removal (lb/yr)	Structural BMP Type	Removal (lb/yr)	Existing Wetlands		Removal (lb/yr)	Total Removal (lb/yr)
A	428	0%	0%	0%	4%	0%	2%	9	0	0	-	20%	20%	2		-				2
B	1021	5%	4%	0%	71%	5%	5%	476	0	0	-	20%	20%	20		-	10.6	25%	13	34
C	503	69%	0%	0%	0%	2%	3%	260	0	0	-	20%	20%	5		-				5
	1953							745	0	0	-			27		-			13	40
									Removal efficiency		0%			0.0%		0%			1.8%	5%

Future

Subbasin	Acre	Estimated Current Landuse (%) Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	Loading (lb/yr)	Redev. Area (ac) w/ BMP Comm	MF	Removal (lb/yr)	Maintenance Sweeping Res	Art	Removal (lb/yr)	Structural BMP Type	Removal (lb/yr)	Existing Wetlands (acre)		Removal (lb/yr)	Total Removal (lb/yr)
A	428	0%	0%	0%	63%	0%	2%	135	0	0	-	20%	20%	2		-				2
B	1021	5%	4%	0%	78%	5%	5%	512	0	0	-	20%	20%	20		-	10.6	25%	13	34
C	503	86%	0%	0%	0%	2%	3%	322	86	0	-	20%	20%	5		-				5
	1953							968	86	0	-			27		-			13	40
									Removal efficiency		0%			0.0%		0%			1.4%	4%

Oil and Grease (O&G)

Existing

Subbasin	Acre	Estimated Current Landuse (%) Comm	MF	SF-hi	SF-lo	Roads	Loading (lb/yr)	Redev. Area (ac) w/ BMP Comm	MF	Removal (lb/yr)	Maintenance Sweep & Vactor Type		Removal (lb/yr)	Structural BMP Type	Removal (lb/yr)	Existing Wetlands		Removal (lb/yr)	Total Removal (lb/yr)
A	428	0%	0%	0%	4%	2%	0.11	0	0	-	R	0%	0.00		-				0.00
B	1021	5%	4%	0%	71%	10%	1.77	0	0	-	R	0%	0.00		-	10.6	40%	0.03	0.03
C	503	69%	0%	0%	0%	5%	0.58	0	0	-	R	0%	0.00		-				0.00
	1953						2.46	0	0	-			0.00		-			0.03	0.03
								Removal efficiency		-			0%		0%			1%	1%

Future

Subbasin	Acre	Estimated Current Landuse (%) Comm	MF	SF-hi	SF-lo	Roads	Loading (lb/yr)	Redev. Area (ac) w/ BMP Comm	MF	Removal (lb/yr)	Maintenance Sweep & Vactor Type		Removal (lb/yr)	Structural BMP Type	Removal (lb/yr)	Existing Wetlands (acre)		Removal (lb/yr)	Total Removal (lb/yr)
A	428	0%	0%	0%	63%	2%	0.31	0	0	-	R	0%	0.00		-				-
B	1021	5%	4%	0%	78%	10%	1.83	0	0	-	R	0%	0.00		-	10.6	40%	0.03	0.03
C	503	86%	0%	0%	0%	5%	0.66	86	0	-	R	0%	0.00		-				0.00
	1953						2.79	86	0	-			0.00		-			0.03	0.03
								Removal efficiency		-			0%		0%			1%	1%

Midway Drainage, Pollutant Loading Estimations

Notes:
1) Loading per Stormwater Treatment, G. Minton, Table 2.16
2) Estimated future landuse from GLUP map
3) Wetlands assumed to treat 10 times the wetlands area
4) Assumed redevelopment BMP TSS removal efficiency **80%**
5) Existing street sweeping - Regenerative every 3-4 weeks; 20% TP removal
6) Existing street sweeping - Regenerative every 3-4 weeks; 43% TSS removal in residential & 15% TSS removal in arterial (R)

Landuse	TSS (lb/ac/yr)	TN (lb/ac/yr)	TSS (lb/ac/yr)	O & G (lb/ac/yr)
Comm	725	4.7	0.72	0.00089
MF	400	5.0	0.63	0.0008
SF-hi	290	5.2	0.59	0.0008
SF-lo	180	3.6	0.5	0.0008
Roads	452	2.2	1.00	0.010867

Total Suspended Solids (TSS)

Existing

		Estimated Current Landuse (%)							Redev. Area (ac) w/ BMP			Maintenance Sweeping			Structural BMP			Existing Wetlands			Total Removal
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	Loading (lb/yr)	Comm	MF	Removal (lb/yr)	Res	Art	Removal (lb/yr)	Type		Removal (lb/yr)			Removal (lb/yr)	(lb/yr)
A	3272	3%	2%	0%	20%	2%	1%	244,720	0	0	-	43%	15%	14,938			-				14,938
B	527	76%	0%	0%	0%	4%	8%	299,800	0	0	-	43%	15%	6,953			-	5.2	65%	24,411	31,364
C	1257	76%	0%	0%	0%	1%	1%	698,474	0	0	-	43%	15%	3,296			-				3,296
	5056							1,242,993	0	0	-			25,187			-			24,411	49,598
									Removal efficiency		0.0%			2.0%			0.0%			2.0%	4%

Future

		Estimated Current Landuse (%)							Redev. Area (ac) w/ BMP			Maintenance Sweeping			Structural BMP			Existing Wetlands			Total Removal
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	Loading (lb/yr)	Comm	MF	Removal (lb/yr)	Res	Art	Removal (lb/yr)	Type		Removal (lb/yr)	(acre)		Removal (lb/yr)	(lb/yr)
A	3272	3%	2%	0%	27%	2%	1%	285,948	0	0	-	43%	15%	14,938	Vault on Delta Waters	80%	10768.00			-	25,706
B	527	87%	0%	0%	0%	4%	8%	341,813	58	0	33,611	43%	15%	6,953			-	5.2	65%	24,411	64,975
C	1257	86%	0%	0%	0%	1%	1%	789,630	126	0	72,925	43%	15%	3,296			-				76,222
	5056							1,417,391	184	0	106,536			25,187			10,768			24,411	166,902
									Removal efficiency		7.5%			1.8%			0.8%			1.7%	12%

Total Nitrogen (TN)

Existing

		Estimated Current Landuse (%)							Redev. Area (ac) w/ BMP			Maintenance Sweeping			Structural BMP			Existing Wetlands			Total Removal
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	Loading (lb/yr)	Comm	MF	Removal (lb/yr)	Res	Art	Removal (lb/yr)	Type		Removal (lb/yr)			Removal (lb/yr)	(lb/yr)
A	3272	3%	2%	0%	20%	2%	1%	3,288	0	0	-	0%	0%	-			-				-
B	527	76%	0%	0%	0%	4%	8%	1,928	0	0	-	0%	0%	-			-	5.2	20%	49	49
C	1257	76%	0%	0%	0%	1%	1%	4,519	0	0	-	0%	0%	-			-				-
	5056							9,735	0	0	-			-			-			49	49
									Removal efficiency		0%			0%			0%			0.5%	1%

Future

		Estimated Current Landuse (%)							Redev. Area (ac) w/ BMP			Maintenance Sweeping			Structural BMP			Existing Wetlands			Total Removal
Subbasin	Acre	Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	Loading (lb/yr)	Comm	MF	Removal (lb/yr)	Res	Art	Removal (lb/yr)	Type		Removal (lb/yr)	(acre)		Removal (lb/yr)	(lb/yr)
A	3272	3%	2%	0%	27%	2%	1%	4,113	0	0	-	0%	0%	-	Vault on Delta Waters	50%	126.05			-	126
B	527	87%	0%	0%	0%	4%	8%	2,201	58	0	-	0%	0%	-			-	5.2	20%	49	49
C	1257	86%	0%	0%	0%	1%	1%	5,110	126	0	-	0%	0%	-			-				-
	5056							11,423	184	0	-			-			126			49	175
									Removal efficiency		0%			0%			1%			0.4%	2%

Midway Drainage, Pollutant Loading Estimations

Notes:
1) Loading per Stormwater Treatment, G. Minton, Table 2.16
2) Estimated future landuse from GLUP map
3) Wetlands assumed to treat 10 times the wetlands area
4) Assumed redevelopment BMP TSS removal efficiency **80%**
5) Existing street sweeping - Regenerative every 3-4 weeks; 20% TP removal
6) Existing street sweeping - Regenerative every 3-4 weeks; 43% TSS removal in residential & 15% TSS removal in arterial (R)

Landuse	TSS (lb/ac/yr)	TN (lb/ac/yr)	TSS (lb/ac/yr)	O & G (lb/ac/yr)
Comm	725	4.7	0.72	0.00089
MF	400	5.0	0.63	0.0008
SF-hi	290	5.2	0.59	0.0008
SF-lo	180	3.6	0.5	0.0008
Roads	452	2.2	1.00	0.010867

Total Phosphorous (TP)

Existing

Subbasin	Acre	Estimated Current Landuse (%) Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	Loading (lb/yr)	Redev. Area (ac) w/ BMP Comm	MF	Removal (lb/yr)	Maintenance Sweeping Res	Art	Removal (lb/yr)	Structural BMP Type		Removal (lb/yr)	Existing Wetlands		Removal (lb/yr)	Total Removal (lb/yr)
A	3272	3%	2%	0%	20%	2%	1%	505	0	0	-	20%	20%	20			-				20
B	527	76%	0%	0%	0%	4%	8%	309	0	0	-	20%	20%	13			-	5.2	25%	9	22
C	1257	76%	0%	0%	0%	1%	1%	701	0	0	-	20%	20%	5			-				5
	5056							1,514	0	0	-			37			-			9	47
									Removal efficiency		0%			0.0%			0%			0.6%	3%

Future

Subbasin	Acre	Estimated Current Landuse (%) Comm	MF	SF-hi	SF-lo	Res. Roads	Art. Roads	Loading (lb/yr)	Redev. Area (ac) w/ BMP Comm	MF	Removal (lb/yr)	Maintenance Sweeping Res	Art	Removal (lb/yr)	Structural BMP Type		Removal (lb/yr)	Existing Wetlands (acre)		Removal (lb/yr)	Total Removal (lb/yr)
A	3272	3%	2%	0%	27%	2%	1%	619	0	0	-	20%	20%	20	Vault on Delta Waters	50%	18.38			-	38
B	527	87%	0%	0%	0%	4%	8%	351	58	0	-	20%	20%	13			-	5.2	25%	9	22
C	1257	86%	0%	0%	0%	1%	1%	791	126	0	-	20%	20%	5			-				5
	5056							1,761	184	0	-			37			18			9	65
									Removal efficiency		0%			2.1%			1%			0.5%	4%

Oil and Grease (O&G)

Subbasin	Acre	Estimated Current Landuse (%) Comm	MF	SF-hi	SF-lo	Roads	Loading (lb/yr)	Redev. Area (ac) w/ BMP Comm	MF	Removal (lb/yr)	Maintenance Sweep & Vactor Type		Removal (lb/yr)	Structural BMP Type		Removal (lb/yr)	Existing Wetlands		Removal (lb/yr)	Total Removal (lb/yr)
A	428	0%	0%	0%	4%	2%	0.11	0	0	-	R	0%	0.00			-				0.00
B	1021	5%	4%	0%	71%	10%	1.77	0	0	-	R	0%	0.00			-	10.6	0%	0.00	0.00
C	503	69%	0%	0%	0%	5%	0.58	0	0	-	R	0%	0.00			-				0.00
	1953						2.46	0	0	-			0.00			-			0.00	0.00
								Removal efficiency		0%			0%			0%			0%	0%

Future

Subbasin	Acre	Estimated Current Landuse (%) Comm	MF	SF-hi	SF-lo	Roads	Loading (lb/yr)	Redev. Area (ac) w/ BMP Comm	MF	Removal (lb/yr)	Maintenance Sweep & Vactor Type		Removal (lb/yr)	Structural BMP Type		Removal (lb/yr)	Existing Wetlands (acre)		Removal (lb/yr)	Total Removal (lb/yr)
A	428	0%	0%	0%	63%	2%	0.31	0	0	-	R	0%	0.00	Vault on Delta Waters	60%	0.05				0.05
B	1021	5%	4%	0%	78%	10%	1.83	0	0	-	R	0%	0.00			-	10.6	0%	0.00	0.00
C	503	86%	0%	0%	0%	5%	0.66	86	0	-	R	0%	0.00			-				0.00
	1953						2.79	86	0	-			0.00			0			0.00	0.05
								Removal efficiency		0%			0%			0%			0%	2%

APPENDIX C.
STORMWATER STRUCTURAL BMP DESCRIPTIONS

DETENTION PONDS

Historically, detention ponds were designed for stormwater quantity control only. Extended detention of stormwater, with slow release over time, maintains flow rates and frequencies similar to those under natural, predevelopment hydrologic conditions. This controlled release reduces streambank erosion and flooding of downstream areas. Today, however, ponds designed for water quality enhancement as well as detention are commonplace. Properly designed detention ponds can provide effective treatment of pollutants contained in stormwater by providing quiescent conditions that allow particulates to settle. Extended detention ponds are designed to either empty completely or dry out between storms ("dry" ponds) or to maintain a permanent pool ("wet" pond). Permanent pools help to dissipate energy and prevent scour of the pond bottom. Pools also provide sites for aquatic vegetation to grow, increasing sedimentation and pollutant uptake, similar to wetlands.

The City of Medford currently requires that all new commercial and industrial development in the Midway Drainage and Elk Creek Basins include detention facilities.

Extended detention ponds remove pollutants primarily by gravitational settling. Their effectiveness is determined by detention time and the fraction of annual runoff volume that is effectively detained. Vegetation provides physical filtration of sediment and biological uptake of dissolved pollutants.

Well-maintained detention ponds can remove the majority of suspended sediments and particulate pollutants in stormwater. Design factors that can improve pollutant removal include long detention times, a permanent pool area, small treatment volumes and incorporation of a constructed wetland in the lower stage.

Applicable Locations: Larger Commercial or residential projects where land is available to treat a large drainage area. These are typical City CIP projects to address existing drainage problems.

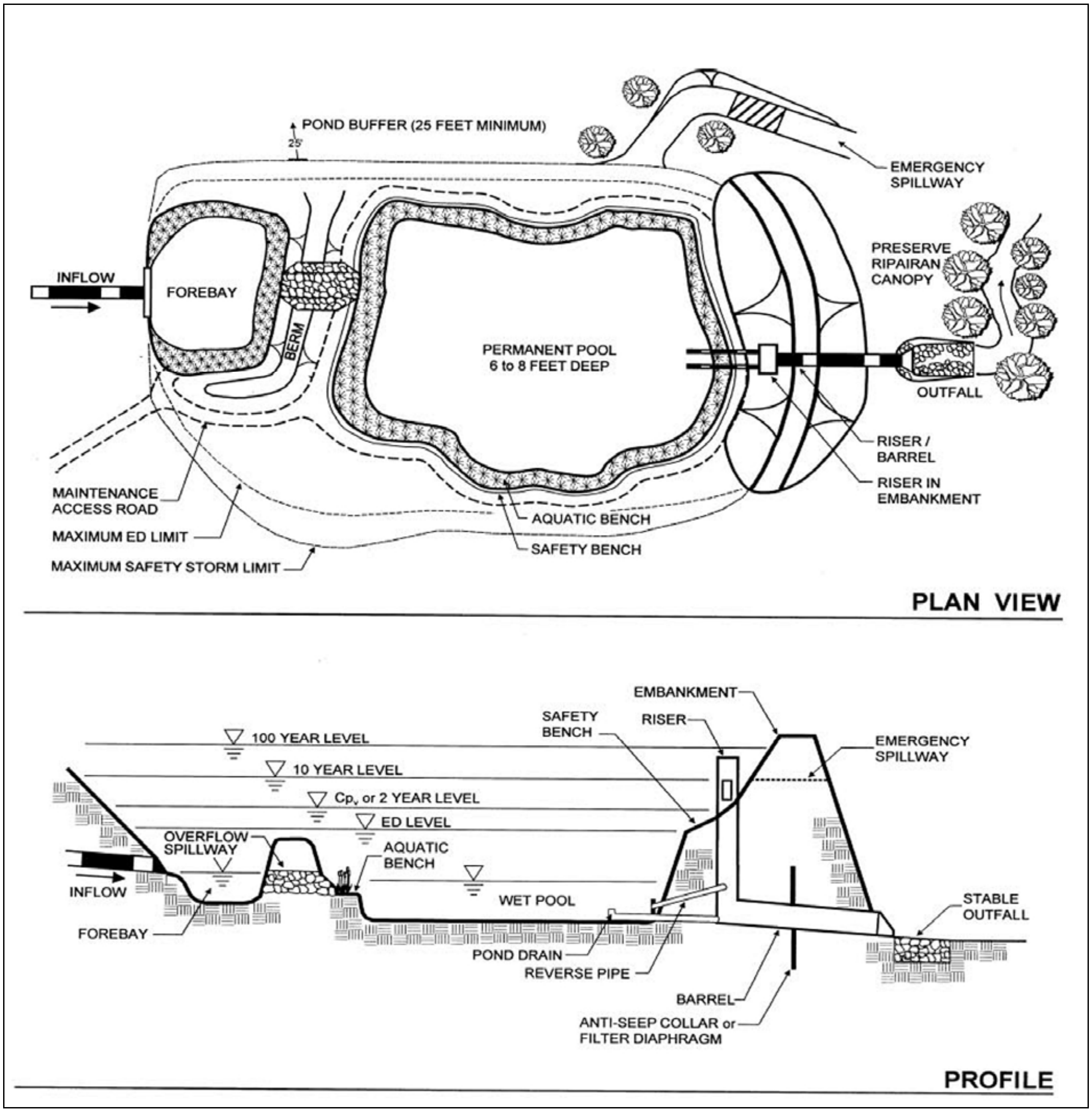

Figure C-1. Wet Extended Detention Pond (Source Maryland Stormwater Design Manual)

DETENTION VAULTS/TANKS/PIPES

Detention vaults, tanks, and pipes are underground storage facilities used to collect and store surface water. These facilities are used primarily for stormwater quantity management in drainage areas containing less than 3 acres of impervious area. They are typically constructed of reinforced concrete (vaults) or corrugated metal pipe (tanks or pipes). A permanent pool of water is often maintained in wet tanks and vaults to provide quiescent settling conditions for pollutant removal.

Pollutant removal processes in tanks and vaults are for the most part limited to removal of large sediment particles. Pollutant reduction occurs through gravity settling of particulates. Due to a lack of vegetation, detention vaults are incapable of removing dissolved pollutants.

Wet vaults and tanks can remove only a small fraction of the sediment load and have insufficient volume to provide efficient removal of smaller soil particles. Their underground location precludes biological assimilation processes.

Applicable Locations: In areas where flooding is a problem or where the downstream portion of the storm system is not large enough to handle flows all at once. Typically used for smaller commercial developments however, detention vaults do not provide sufficient water quality treatment and additional source control measures should be required.

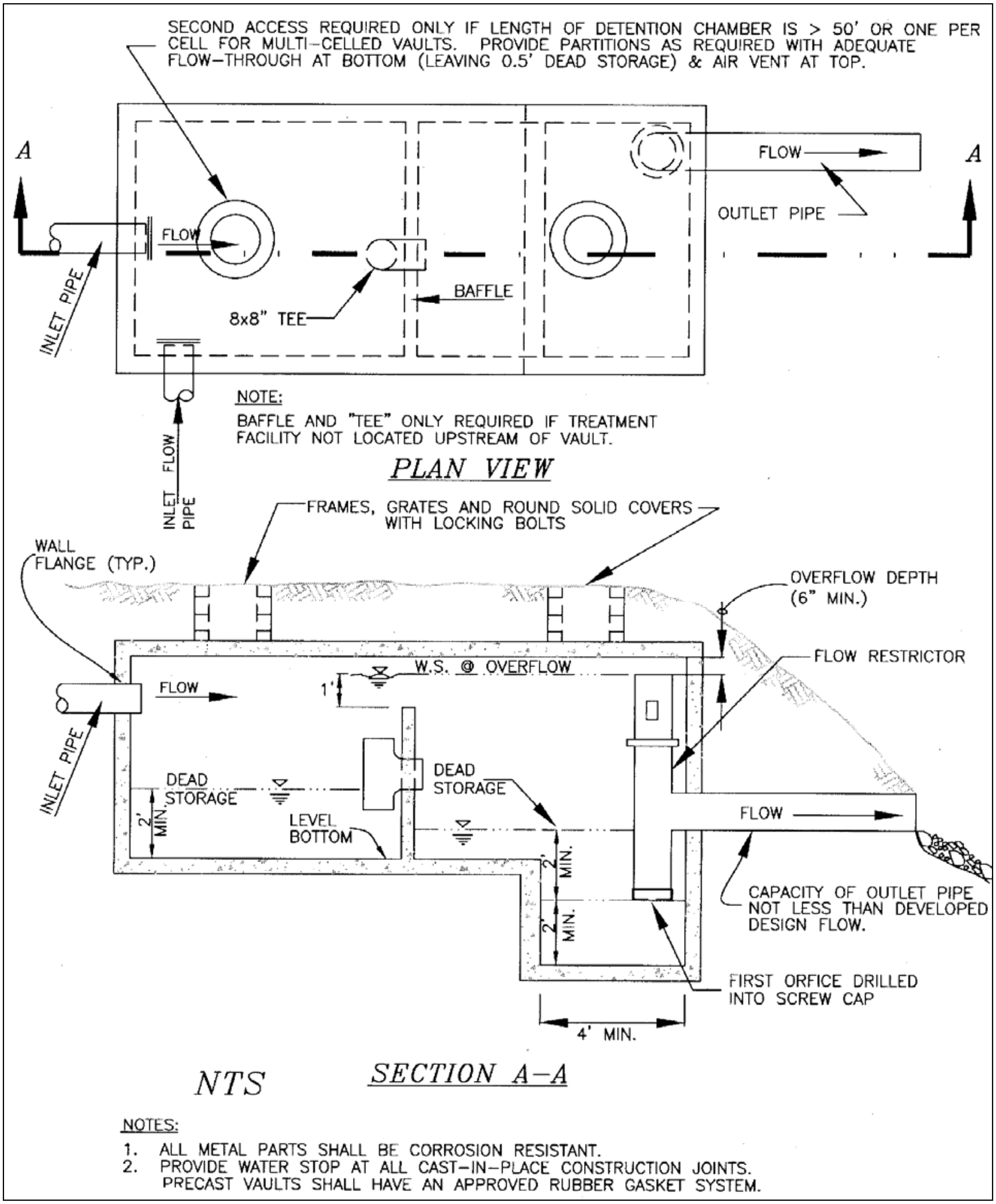

Figure C-2. Detention Vault (City of Portland, Stormwater Management Manual)

INFILTRATION BASINS/TRENCHES/BIORETENTION

Infiltration can be provided by a variety of facilities, including dry wells, vaults, ponds, roof downspout systems, porous pavement, and modular pavement. The most common infiltration facilities are basins and trenches. Infiltration technologies use the interaction of chemical, physical, and biological processes between soil and water to filter sediments and soluble pollutants from runoff. As the stormwater percolates into the ground, fine material suspended in the stormwater is captured in the soil. The resulting treated runoff percolates through to the groundwater rather than to surface water. They have a high treatment efficiency and the ability to recharge groundwater; however, proper siting, design, construction, and maintenance are critical in order to maximize their effectiveness, avoid clogging problems, avoid accumulations of metals, and prevent groundwater contamination.

Infiltration basins are impoundments where incoming stormwater runoff is stored until it gradually exfiltrates through the soil of the basin floor.

A conventional **infiltration trench** is a shallow, excavated trench that has been backfilled with stone to create an underground reservoir. Stormwater runoff diverted into the trench gradually exfiltrates from the bottom of the trench into the subsoil and eventually into groundwater. Enhanced infiltration trenches have extensive pretreatment systems to remove sediment and oil.

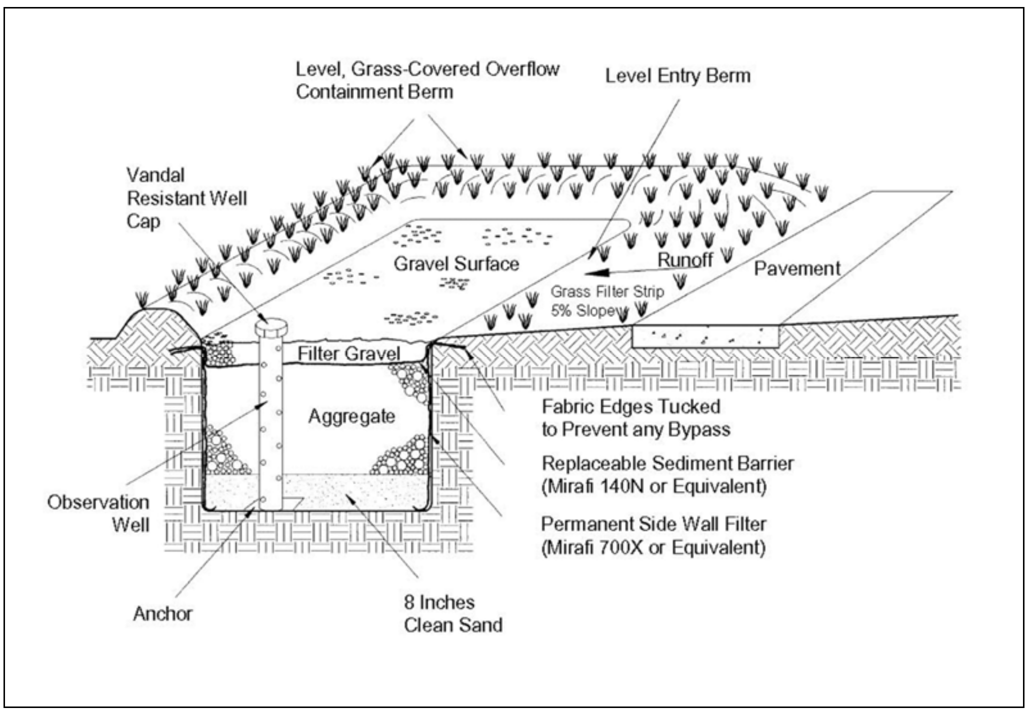

Figure C-3. Infiltration Trench (Source Northern Virginia BMP Handbook)

Bioretention includes a combination of biofiltration and infiltration. A bioretention facility primarily consists of a porous planting soil covered with a mulched layer and vegetated to encourage evapotranspiration. Stormwater sheet flows to the facility and is allowed to pond to provide storage and allow for slow infiltration. Stormwater can either be collected in an underdrain or allowed to infiltrate directly into the native soil. A vegetated buffer strip can also be used for additional treatment prior to stormwater entering the facility.

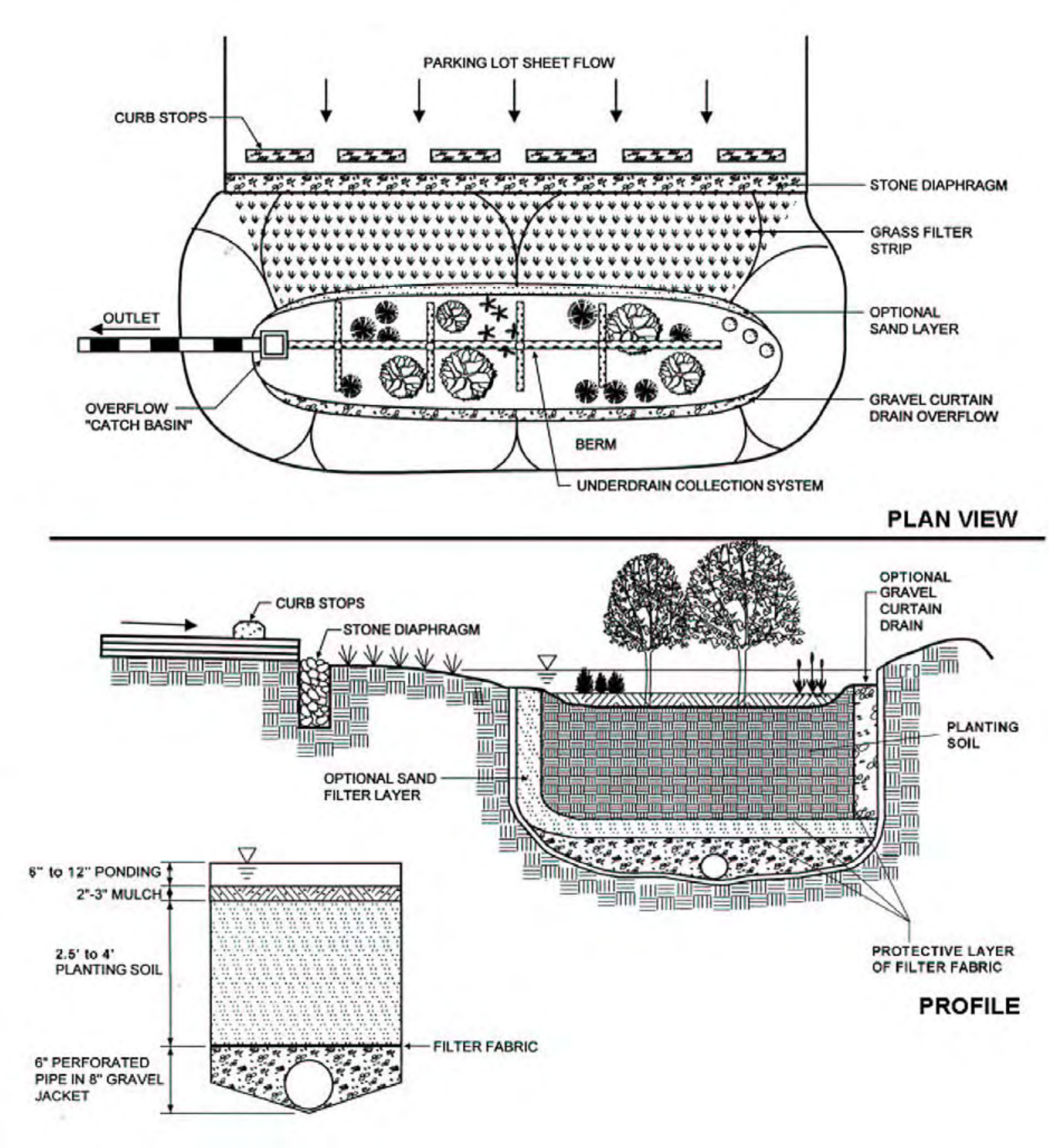

Figure C-4. Bioretention (Source Maryland Stormwater Design Manual)

Infiltration facilities improve water quality by percolating runoff through soil. Organic matter and small amounts of clay adsorb both soluble and insoluble pollutants as the runoff travels through the soil. Pollutant removal mechanisms include adsorption, straining, and microbial decomposition in soil. Vegetative cover improves pollutant removal through filtration, trapping, and biological uptake.

Actual performance data on infiltration facilities is rare; however, basins and trenches are believed to have high removal efficiencies for particulates and moderate removal for soluble pollutants.

Applicable Locations: Commercial or residential projects or small Citywide basins. Not suitable in locations where the depth to groundwater is less than 5 feet. Areas of low permeability may require facilities to be constructed using soils that allow infiltration and collected stormwater at the downstream end with an underdrain.

CATCH BASINS AND INLETS

Grated and curb inlet type catch basins are designed to catch debris carried by street surface runoff. Most "trapped" catch basins for enclosed stormwater systems have a few feet of storage in the bottom that never drains to an outflow pipe. This permanent storage area is intended to trap sediments, debris, and other particles that can settle out of stormwater, to prevent clogging of downstream pipes and washing of these solids into receiving waters.

Catch basin inserts can be installed to filter stormwater entering the catchbasin. Inserts typically consist of a suspended structure with filter medium such as sand, carbon, or fabric. Inserts have a small volume and require frequent clean out. They are not practical for citywide use in all catch basin; however, they can be used temporary sediment control and pretreatment at construction sites and may be appropriate in small drainage areas for specific target pollutants.

Catch basins collect large sediment particles and debris. Large debris is collected on the grate while smaller nonfloatable debris, grit, and sediment that pass through the grate are caught in the sump portion of the catch basin.

Well-maintained catch basins remove the majority of suspended sediments and particulate pollutants in stormwater. The small size of trapped catch basins limits pollutant removal to larger particles such as grit and sediment. Sediment deposits must be removed at least twice a year to prevent sediment resuspension.

Applicable Locations: Temporary sediment control and pretreatment at construction sites, and may be appropriate in small drainage areas for specific target pollutants.

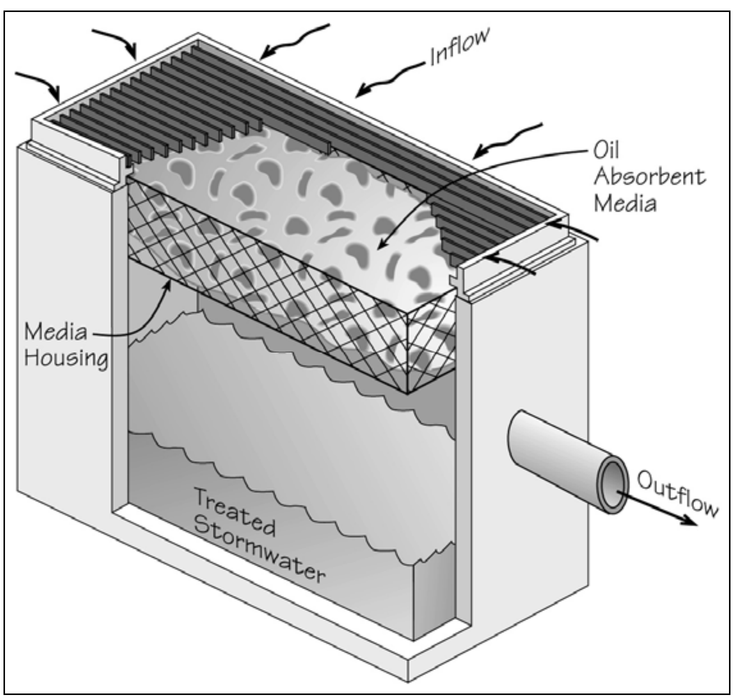

Figure C-5. Catchbasin Insert

MANUFACTURED FACILITIES

Innovative manufactured systems are continually being developed as BMPs to reduce specific pollutants in stormwater runoff. Such facilities include oil/water separators, catch basin inserts, multichamber treatment trains, and water quality vaults.

Two general types of oil/water separators are used for stormwater treatment: conventional gravity API (American Petroleum Institute) separators, and coalescing plate separators (CPS). Both types are used to treat stormwater runoff from high-use developments and facilities that produce relatively high concentrations of oil and grease. A spill control separator is an underground vault with a "T" outlet and is effective at retaining only small, undiluted spills not normally associated with stormwater.

Gravity (API) oil/water separators consist of vaults, typically constructed of steel or concrete, with multiple chambers separated by baffles extending down from the top, blocking oil flow out of the vault and reducing turbulence. Baffles may also be installed at the bottom of the vault to trap solids and sludge that accumulate over time. Oil absorbent pillows and floating or mechanical oil skimmers are often installed in the vaults to remove the separated oil.

Coalescing plate separators are typically manufactured units consisting of a baffled vault containing several inclined corrugated plates bundled together. The plates may be made of fiberglass, stainless steel, or polypropylene. The closely spaced plates improve the hydraulic conditions for oil removal. CPS-separators are often smaller than API separators.

Oil/water separators employ the mechanism of oil, being lighter than water, rising to the surface and being periodically removed. They are designed to remove free oil, and are not generally effective in separating oil that has become either chemically or mechanically emulsified and dissolved in water. They must be cleaned frequently to keep accumulated oil from escaping during storms.

A multi-chamber treatment train (MCTT) consists of a series of treatment units that mimic those found in wastewater treatment plants. Pollutant removal mechanisms vary with each type of treatment facility.

Applicable Locations: In commercial or residential area; to treat runoff from roads and parking areas, small footprint and underground construction allows for installation in areas where land availability is limited. These facilities can also be used as fore-bays in wetland treatment ponds.

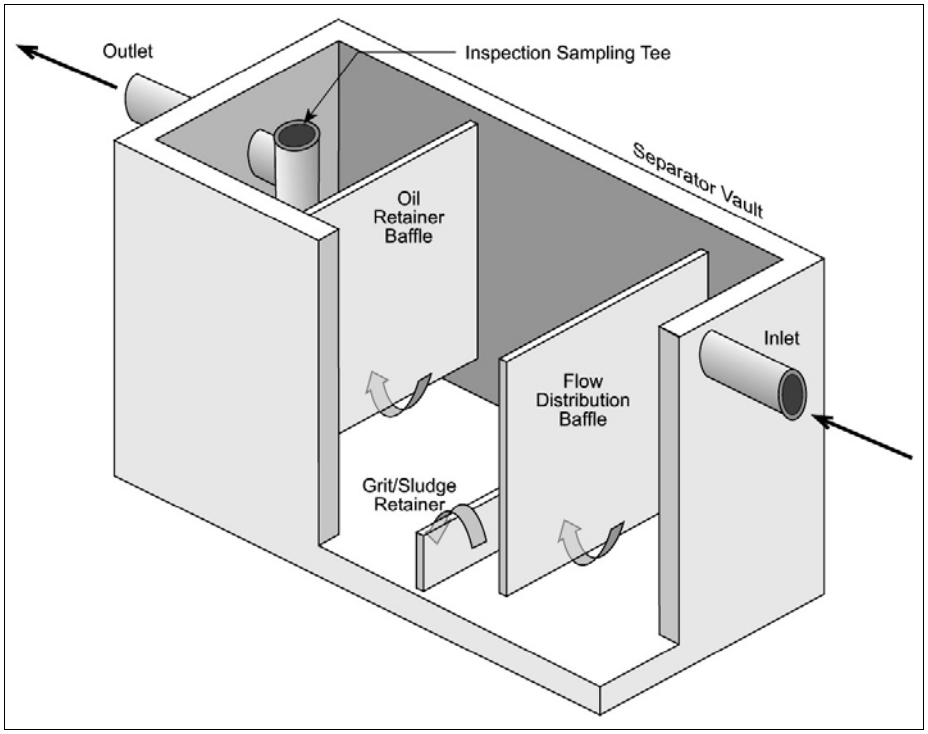

Figure C-6. American Petroleum Institute Oil-Water Separator

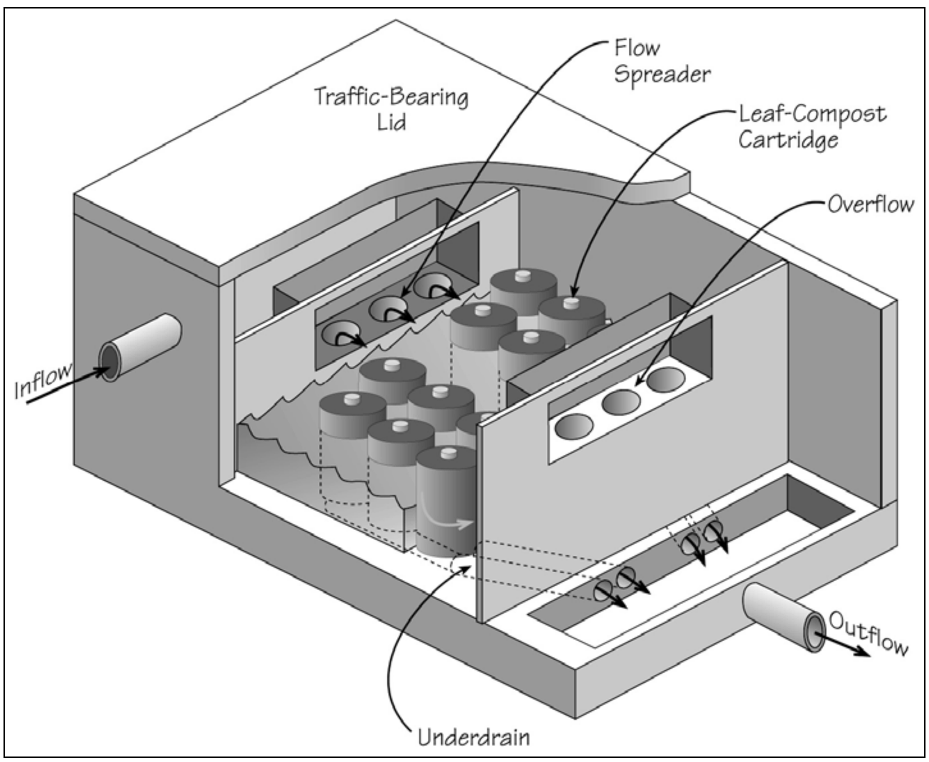

Figure C-7. StormFilter Leaf Compost Filter

BIOFILTERS (SWALES, FILTER STRIPS)

Biofiltration swales are long, gently sloped conveyance ditches with flattened side slopes, designed to remove pollutants by filtering stormwater through vegetation. Grass is the most common vegetation, but other vegetation types, such as emergent wetland species, are often used, depending on site conditions. Swales are designed to distribute flow evenly across the entire width of the densely vegetated bottom, and may employ check dams and wide depressions to increase runoff storage and promote greater settling of pollutants. Often providing both treatment and conveyance of peak design flows, swales can reduce development costs by eliminating the need for separate conveyance systems. Biofiltration swales are best applied on a relatively small scale (generally less than 5 acres of impervious surface). They work well along roadways, driveways, and parking lots.

Filter strips are vegetated sections of land designed to accept runoff as overland sheet flow from upstream development. They may adopt any naturally vegetated form, from grassy meadow to emergent wetland to small forest. The dense vegetative cover facilitates pollutant removal. Filter strips differ from swales in that swales are concave conveyance systems, while filter strips are located parallel to the contributing area, have fairly level surfaces, and provide treatment of sheet flow.

Biofilters remove pollutants primarily by the filtering action of vegetation trapping particulates. Other pollutant removal mechanisms include sediment deposition in low-velocity areas, infiltration into the subsoil, and surface adhesion of pollutants to vegetation, biological assimilation, and soil adsorption.

Well-designed and -maintained biofilters have been known to remove the majority of suspended sediments and particulate pollutants in stormwater. Swales appear to be more effective at removing metals than nutrients; however, accumulations of trace metals in biofilter sediments may occur. Resuspension or remobilization of nutrients may occur, particularly if maintenance is not performed regularly.

Applicable Locations: Parking lots, residential or small business streets. Treats stormwater from small drainage areas and provides detention.

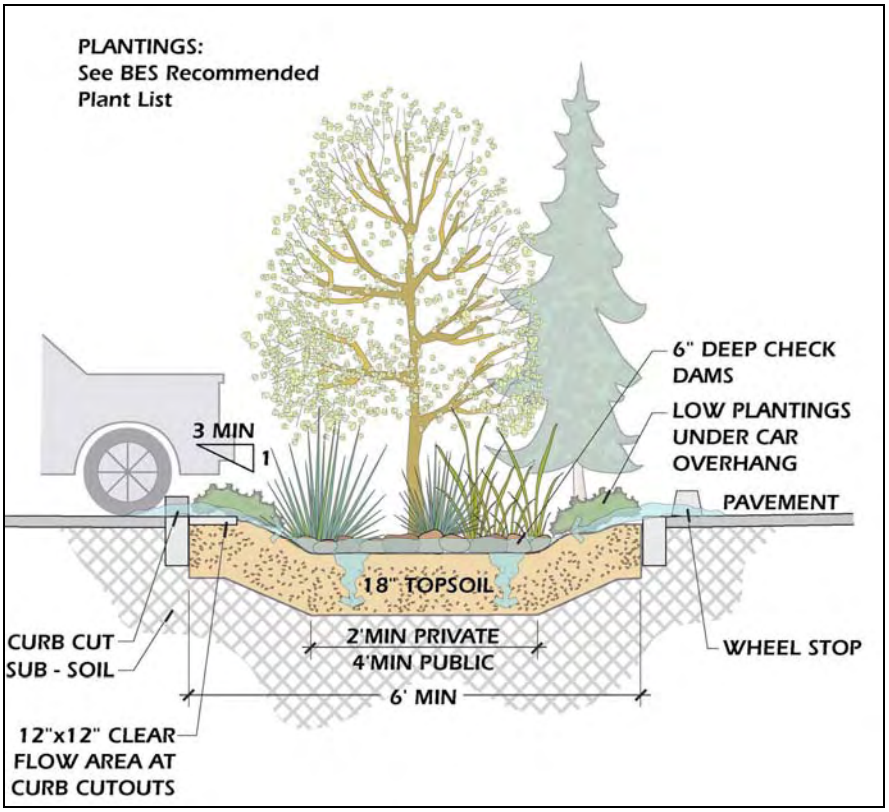

Figure C-8. Vegetated Swale (Source City of Portland Stormwater Management Manual)

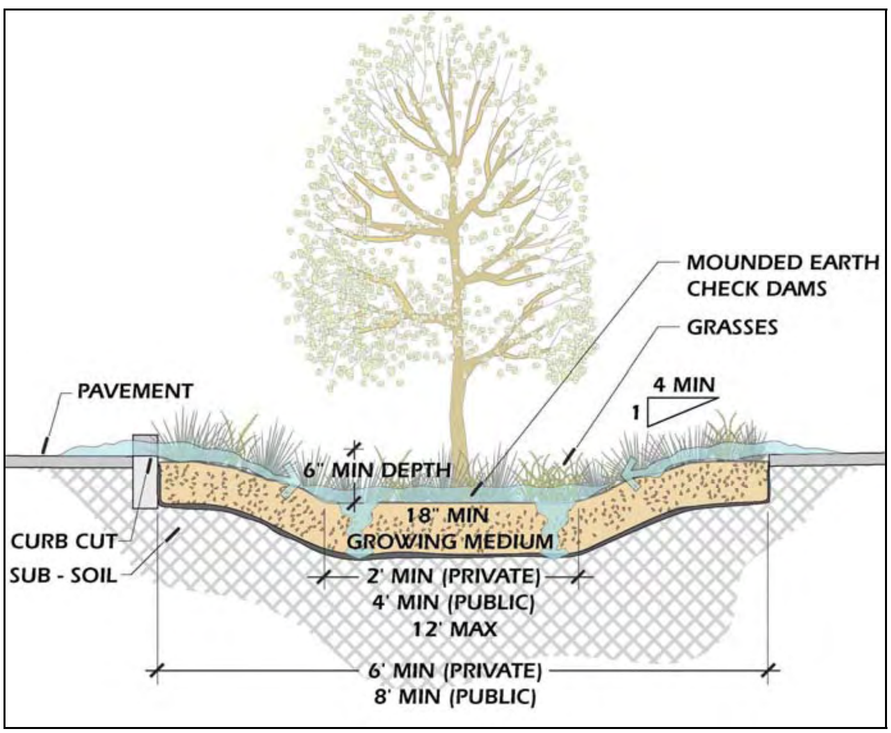

Figure C-9. Grassy Swale (Source City of Portland Stormwater Management Manual)

CONSTRUCTED WETLANDS, WET PONDS

A constructed wetland is a shallow, sometimes intermittent, pool constructed to provide suitable conditions for the growth of wetland plants for the purposes of stormwater management. Constructed wetlands often consist of a combination of shallow trenches, marshes, and ponded sections, with a wide variety of vegetation types. Stormwater wetlands are designed to maximize pollutant removal through uptake by plants, retention, and settling.

Created wetlands, as distinct from constructed wetlands, are considered mitigation for an activity, and are not used for stormwater management. They are treated as natural wetlands, and are subject to the same protections. See “Streams & Wetlands.”

A wet pond is a basin with a permanent pool of water, normally too deep for rooted wetland plants but often containing aquatic vegetation, with wetland species growing along the margins. The pool depth typically ranges from three to six feet, providing “dead” storage of stormwater. Wet ponds are often constructed to address both water quality and reduction of runoff peaks.

Both types of facilities can be sources of wildlife habitat, enhancing the aesthetic value of an area and providing opportunities for passive recreation and public education.

Constructed wetlands, natural wetlands, and wet ponds remove pollutants through gravitational settling, wetland plant uptake, adsorption, filtration, and microbial decomposition. Deep-water areas such as wet ponds improve the sedimentation, photosynthetic, biological, and chemical removal of pollutants.

The actual pollutant removal efficiency of any constructed wetland or wet pond depends on many variables, most of which are poorly understood in terms of actual facility performance. Numerous field studies indicate these systems are able to remove the majority of the settleable solids and particulate pollutants in stormwater.

Applicable Locations: Larger commercial or residential projects or regional CIP projects where land is available to treat a large drainage area.

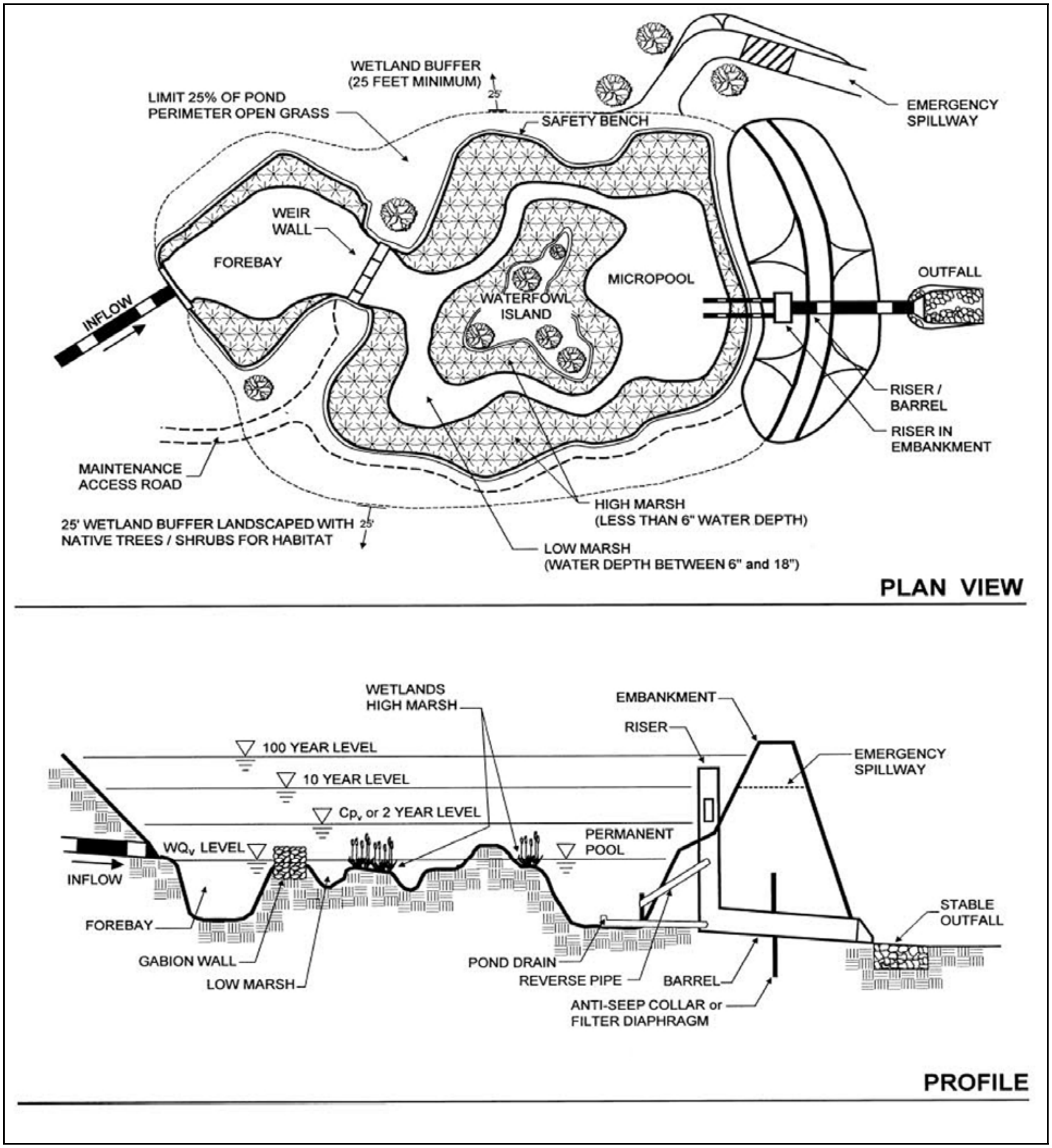

Figure C-10. Shallow Wetland (Source Maryland Stormwater Design Manual)

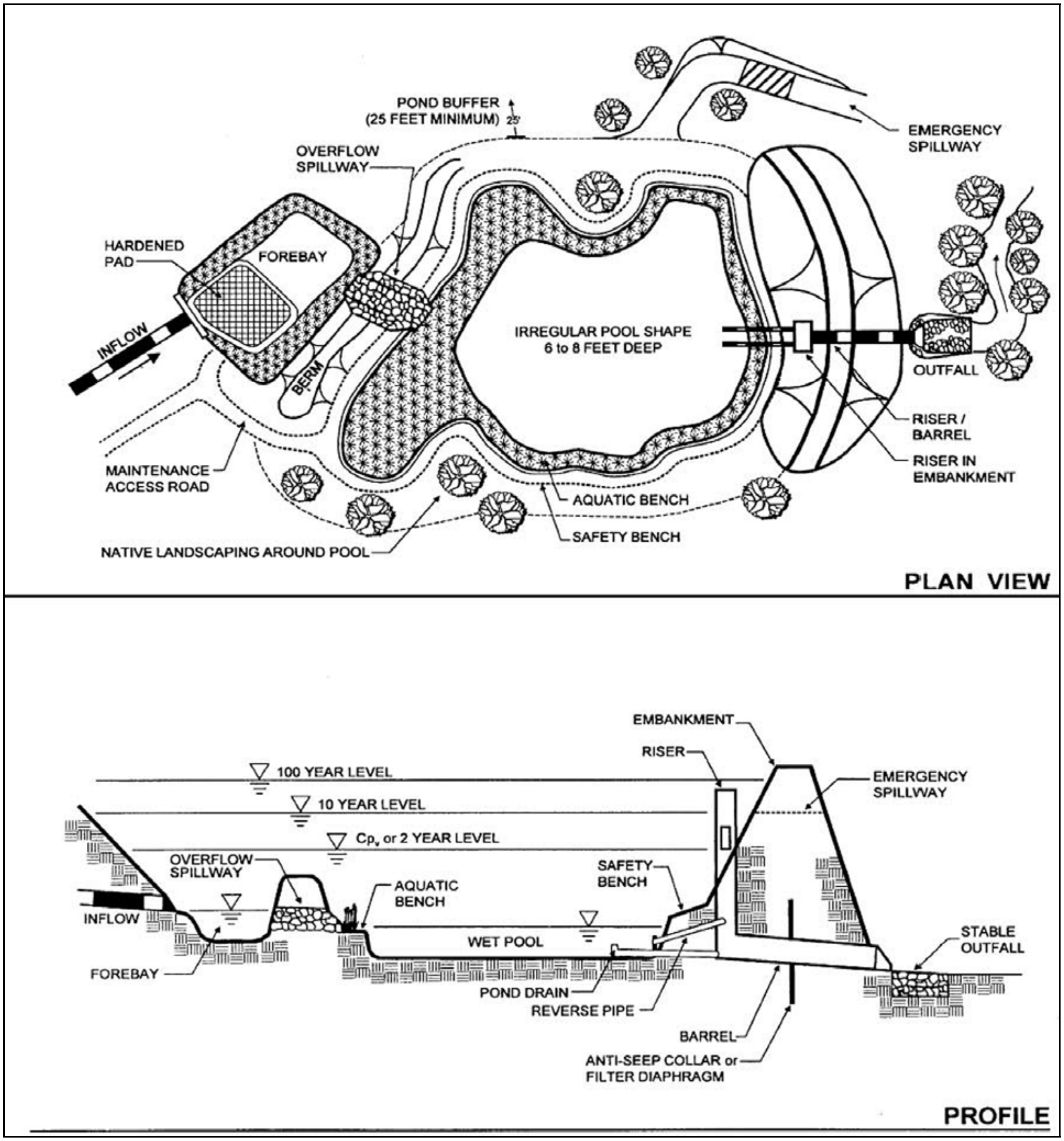

Figure C-11. Wet Pond (Source Maryland Stormwater Design Manual)

STREAMS AND WETLANDS

Natural streams and wetlands perform a variety of vital functions related to stormwater conveyance, attenuation, groundwater recharge, and treatment. Their existence in urban settings however, does not imply their use as receivers and conveyors of additional and often polluted stormwater runoff. Streams and wetlands are affected by development even if not specifically "used" in stormwater management. Therefore, the management of natural streams and wetlands must anticipate these incidental effects to protect their general functioning.

Natural streams and wetlands are sensitive to changes in stormwater flow velocities, volumes, and duration. Impervious area and land use changes within the basin affect not only surface water runoff, but also shallow and deep groundwater, which are often critical to the maintenance of base flow and wetland conditions. Many seemingly unrelated stormwater management activities eventually affect natural systems. It is therefore important to fully evaluate the potential and long-term effects of all activities in order to eliminate, minimize, mitigate, or monitor their impact on streams, wetlands, and all natural systems. These inevitable effects of urbanization and stormwater management necessitate specific maintenance activities in streams and wetlands to preserve their ecological integrity, function, and value.

Streams and wetlands, in conjunction with their riparian or buffer areas, remove pollutants through physical mechanisms of sedimentation, filtration, and adsorption. They are also capable of removing pollutants through biological and chemical mechanisms such as plant adsorption, uptake and metabolism by bacteria and plants, precipitation, and adsorption by soil particles.

The pollutant removal efficiency of natural streams and wetlands is widely variable due to the variety of physical, chemical, and biological characteristics and configurations in these systems. In addition, studies have shown that removal rates for phosphorus may, at times, be negative due to biological degradation. Biological degradation typically occurs during the winter months, phosphorus is not a concern in Bear Creek during this time.

Applicable Locations: Where natural streams and wetlands exist.

FILTERING

Stormwater filtering systems have been used successfully in ultra-urban areas due to their relatively small footprint and moderate physical and head drop requirements. A number of filtering systems have been developed for use in heavily urbanized areas. Filters typically contain the same basic components: a sedimentation area to retain the largest particles and a chamber containing the filter medium that captures soluble pollutants.

Vegetated rock filters have long been used to treat wastewater. A typical design consists of a series of tanks filled with several feet of aggregate.

A typical sand filter consists of a flow spreader, sand bed, and an underdrain. Pretreatment is required for removal of larger particulates and reduce velocities. Sand filters can be used in residential, commercial and industrial area, where debris, large particulates, and oil & grease will not clog the filter. Sand filters can be located either above or below ground.

Media filters include media such as leaf compost, pleated fabric, activated charcoal, perlite, amended sand and perlite, and zeolite in a cartridge. Stormwater is routed through the media cartridge for treatment. Pretreatment may be required in areas of high suspended solids and hydrocarbon loading.

Pollutant removal occurs by filtration or adsorption onto the filter media. Treatment using a vegetated rock filter is primarily by biological action and root uptake.

Applicable Locations: This is a great source control for any location however is very suited for commercial and industrial areas where a limited area footprint is available.

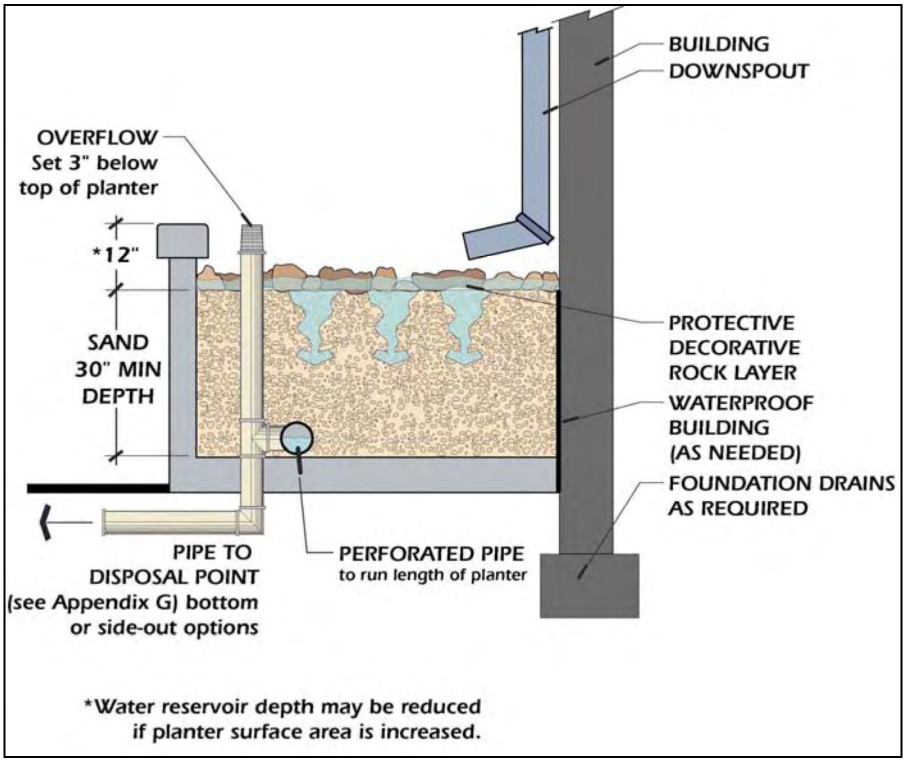

Figure C-12. Downspout Sandfilter (Source City of Portland Stormwater Management Manual)

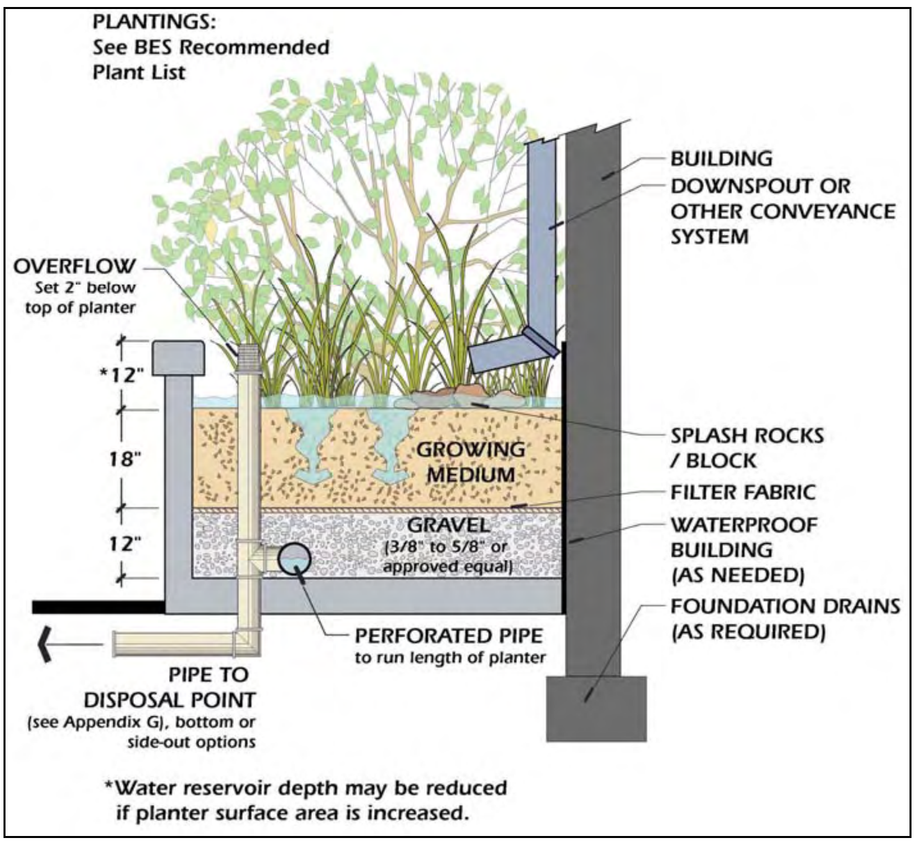

Figure C-13. Flow through Planter (Source City of Portland Stormwater Management Manual)

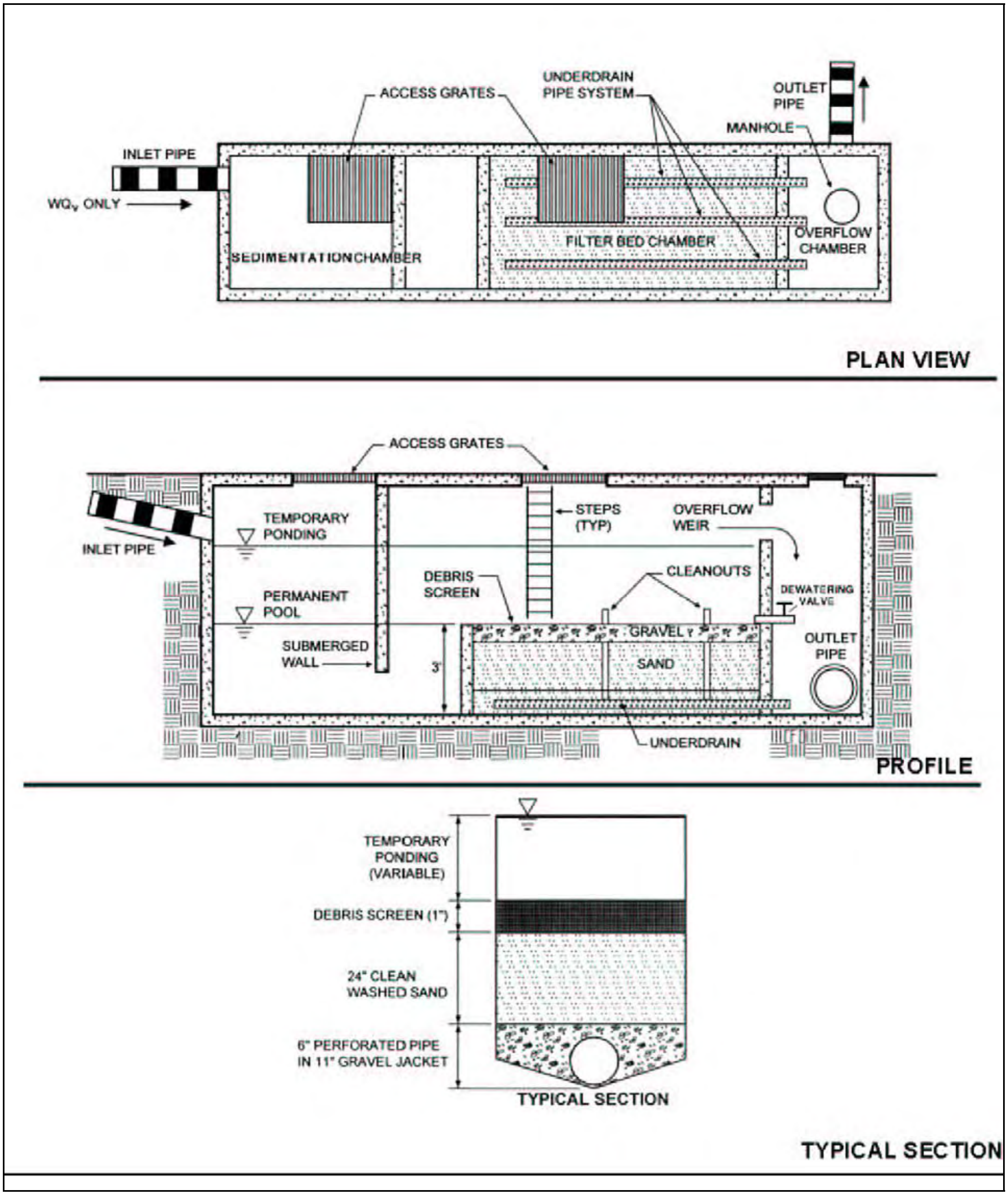

Figure C14. Underground Sand Filter (Source Maryland Stormwater Design Manual)

Case I – Funding of the Current Service Level

City of Medford
Storm Water Master Plan
Storm Drain Fund (046) Preliminary Statement of Revenues & Expenditures
Case I - Status Quo (Adopted Fiscal 2004-05 Budget) Funding the Current Service Level

Economic Assumptions:

Monthly ESU Charge - FY05	$3.59
% Growth in ESU's per Year	2.00%
Annual O&M Cost Inflation	3.00%

FISCAL YEARS

Revenue & Expense Category	2005	2006	2007	2008	2009	2010
Required Monthly Rate - $/ESU/Month	**$ 4.41**	**$ 3.63**	**$ 4.56**	**$ 4.61**	**$ 4.66**	**$ 4.71**
Equivalent Service Units	44,237	45,122	46,024	46,945	47,884	48,841
Resources:						
Beginning Fund Balance	1,035,437	599,432	131,432	135,432	139,432	143,432
Operating Revenue:						
Charges for Services	1,905,730	1,967,489	2,520,809	2,598,494	2,678,513	2,760,936
General Government	71,500	71,500	71,500	71,500	71,500	71,500
Intergovernmental Revenues	1,200	1,200	1,200	1,200	1,200	1,200
Interest Income	29,570	9,136	3,336	3,436	3,536	3,636
Subtotal Operating Revenues	2,008,000	2,049,325	2,596,845	2,674,630	2,754,749	2,837,272
Total Resources	$ 3,043,437	$ 2,648,757	$ 2,728,277	$ 2,810,062	$ 2,894,181	$ 2,980,704
Requirements:						
Personal Services	1,181,030	1,216,461	1,252,955	1,290,543	1,329,260	1,369,137
Materials & Services	369,045	380,116	391,520	403,265	415,363	427,824
Capital Outlay	227,500	234,325	241,355	248,595	256,053	263,735
Capital Improvements	526,025	541,806	558,060	574,802	592,046	609,807
Other	140,405	144,617	148,956	153,424	158,027	162,768
Subtotal Operating & Maintenance Expenses	2,444,005	2,517,325	2,592,845	2,670,630	2,750,749	2,833,272
Contingency						
Unappropriated Ending Fund Balance						
Ending Fund Balance	599,432	131,432	135,432	139,432	143,432	147,432
Total Requirements	$3,043,437	$2,648,757	$2,728,277	$2,810,062	$2,894,181	$2,980,704

Case II – Funding of the Current Service Level Plus NPDES Part II

City of Medford
Storm Water Master Plan
Storm Drain Fund (046) Preliminary Statement of Revenues & Expenditures
Case II - Fund Current Service Level and NPDES Part II City Wide Costs

Economic Assumptions:

Monthly ESU Charge - FY05	$3.59
% Growth in ESU's per Year	2.00%
Annual O&M Cost Inflation	3.00%

FISCAL YEARS

Revenue & Expense Category	2005	2006	2007	2008	2009	2010
Required Monthly Rate - $/ESU/Month	$ 4.41	$ 3.81	$ 4.74	$ 4.79	$ 4.84	$ 4.89
Equivalent Service Units	44,237	45,122	46,024	46,945	47,884	48,841
Resources:						
Beginning Fund Balance	1,035,437	599,432	131,432	135,432	139,432	143,432
Operating Revenue:						
Charges for Services	1,905,730	2,060,309	2,616,414	2,696,967	2,779,940	2,865,406
General Government	71,500	71,500	71,500	71,500	71,500	71,500
Intergovernmental Revenues	1,200	1,200	1,200	1,200	1,200	1,200
Interest Income	29,570	9,136	3,336	3,436	3,536	3,636
Subtotal Operating Revenues	2,008,000	2,142,145	2,692,450	2,773,103	2,856,176	2,941,741
Total Resources	$ 3,043,437	$ 2,741,577	$ 2,823,882	$ 2,908,535	$ 2,995,608	$ 3,085,173
Requirements:						
Personal Services	1,181,030	1,216,461	1,252,955	1,290,543	1,329,260	1,369,137
Materials & Services	369,045	380,116	391,520	403,265	415,363	427,824
Capital Outlay	227,500	234,325	241,355	248,595	256,053	263,735
Capital Improvements	526,025	541,806	558,060	574,802	592,046	609,807
Other	140,405	144,617	148,956	153,424	158,027	162,768
NPDES Part II City Wide Activities:						
Stormwater Ordinance	-	6,000	6,180	6,365	6,556	6,753
NPDES Public Education and Outreach	-	5,200	5,356	5,517	5,682	5,853
NPDES Public Involvement and Participation	-	3,620	3,729	3,840	3,956	4,074
NPDES Illicit Discharge Detection and Elimination	-	57,600	59,328	61,108	62,941	64,829
NPDES Construction Site Runoff Control	-	5,620	5,789	5,962	6,141	6,325
NPDES Post Construction Management	-	4,580	4,717	4,859	5,005	5,155
NPDES Pollution Prevention in Municipal Operations	-	10,200	10,506	10,821	11,146	11,480
Subtotal Operating & Maintenance Expenses	2,444,005	2,610,145	2,688,450	2,769,103	2,852,176	2,937,741
Contingency						
Unappropriated Ending Fund Balance						
Ending Fund Balance	599,432	131,432	135,432	139,432	143,432	147,432
Total Requirements	$3,043,437	$2,741,577	$2,823,882	$2,908,535	$2,995,608	$3,085,173

Case III – Funding of the Current Service Level, NPDES Part II City Wide Expenditures, and Phase I of Mid-Range CIP Program (Revenue Bond)

City of Medford
Storm Water Master Plan
Storm Drain Fund (046) Preliminary Statement of Revenues & Expenditures
Case III - Funding of Current Service Level, NPDES Part II Costs, and Phase I Mid-Range CIP (Revenue Bond Funding)

Economic Assumptions:

Monthly ESU Charge - FY05	$3.59
% Growth in ESU's per Year	2.00%
Annual O&M Cost Inflation	3.00%

FISCAL YEARS

Revenue & Expense Category	2005	2006	2007	2008	2009	2010
Required Monthly Rate - $/ESU/Month	$ 4.41	$ 3.59	$ 3.59	$ 3.59	$ 3.59	$ 4.44
Equivalent Service Units	44,237	45,122	46,024	46,945	47,884	48,841
Resources:						
Beginning Fund Balance	1,035,437	881,673	994,025	937,319	700,897	275,991
System Development Charges	282,241	287,886	293,644	299,516	305,507	311,617
Operating Revenue:						
Charges for Services	1,905,730	1,943,845	1,982,721	2,022,376	2,065,186	2,599,910
General Government	71,500	71,500	71,500	71,500	71,500	71,500
Intergovernmental Revenues	1,200	1,200	1,200	1,200	1,200	1,200
Interest Income	29,570	23,446	24,142	20,478	12,211	5,304
Subtotal Operating Revenues	2,008,000	2,039,991	2,079,563	2,115,554	2,150,097	2,677,914
Total Resources	$ 3,325,678	$ 3,209,550	$ 3,367,232	$ 3,352,389	$ 3,156,500	$ 3,265,522
Requirements;						
Personal Services	1,181,030	1,216,461	1,252,955	1,290,543	1,329,260	1,369,137
Materials & Services	369,045	380,116	391,520	403,265	415,363	427,824
Capital Outlay	227,500	234,325	241,355	248,595	256,053	263,735
Capital Improvements	526,025	0	0	0	0	0
Other	140,405	144,617	148,956	153,424	158,027	162,768
NPDES Part II City Wide Activities:						
Stormwater Ordinance	-	6,000	6,180	6,365	6,556	6,753
NPDES Public Education and Outreach	-	5,200	5,356	5,517	5,682	5,853
NPDES Public Involvement and Participation	-	3,620	3,729	3,840	3,956	4,074
NPDES Illicit Discharge Detection and Elimination	-	57,600	59,328	61,108	62,941	64,829
NPDES Construction Site Runoff Control	-	5,620	5,789	5,962	6,141	6,325
NPDES Post Construction Management	-	4,580	4,717	4,859	5,005	5,155
NPDES Pollution Prevention in Municipal Operations	-	10,200	10,506	10,821	11,146	11,480
Subtotal Operating & Maintenance Expenses	2,444,005	2,068,339	2,130,390	2,194,301	2,260,130	2,327,934
Debt Service on Master Plan Projects	0	147,186	299,523	457,191	620,379	789,277
Contingency						
Unappropriated Ending Fund Balance						
Ending Fund Balance	881,673	994,025	937,319	700,897	275,991	148,311
Total Requirements	$3,325,678	$3,209,550	$3,367,232	$3,352,380	$3,156,500	$3,265,522

Case IV – Funding of the Current Service Level, NPDES Part II City Wide Expenditures, and Phase I of Mid-Range CIP Program (Pay-As-You-Go Funding)

City of Medford
Storm Water Master Plan
Storm Drain Fund (046) Preliminary Statement of Revenues & Expenditures
Case IV - Funding of Current Service Level, NPDES Part II Costs, and Phase I Mid-Range CIP (Pay-as-you-go funding)

Economic Assumptions:

Monthly ESU Charge - FY05	$3.59
% Growth in ESU's per Year	2.00%
Annual O&M Cost Inflation	3.00%

FISCAL YEARS

Revenue & Expense Category	2005	2006	2007	2008	2009	2010
Required Monthly Rate - $/ESU/Month	$ 3.88	$ 4.83	$ 6.31	$ 6.38	$ 6.45	$ 6.53
Equivalent Service Units	44,237	45,122	46,024	46,945	47,884	48,841
Resources:						
Beginning Fund Balance	1,035,437	881,673	131,673	135,673	139,673	143,673
System Development Charges	282,241	287,886	293,644	299,516	305,507	311,617
Operating Revenue:						
Charges for Services	1,905,730	2,615,718	3,485,454	3,595,015	3,707,925	3,824,285
General Government	71,500	71,500	71,500	71,500	71,500	71,500
Intergovernmental Revenues	1,200	1,200	1,200	1,200	1,200	1,200
Interest Income	29,570	12,667	3,342	3,442	3,542	3,642
Subtotal Operating Revenues	2,008,000	2,701,085	3,561,496	3,671,157	3,784,167	3,900,627
Total Resources	$ 3,325,678	$ 3,870,643	$ 3,986,813	$ 4,106,347	$ 4,229,347	$ 4,355,917
Requirements:						
Personal Services	1,181,030	1,216,461	1,252,955	1,290,543	1,329,260	1,369,137
Materials & Services	369,045	380,116	391,520	403,265	415,363	427,824
Capital Outlay	227,500	234,325	241,355	248,595	256,053	263,735
Capital Improvements	526,025	1,670,631	1,720,750	1,772,372	1,825,544	1,880,310
Other	140,405	144,617	148,956	153,424	158,027	162,768
NPDES Part II City Wide Activities:						
Stormwater Ordinance	-	6,000	6,180	6,365	6,556	6,753
NPDES Public Education and Outreach	-	5,200	5,356	5,517	5,682	5,853
NPDES Public Involvement and Participation	-	3,620	3,729	3,840	3,956	4,074
NPDES Illicit Discharge Detection and Elimination	-	57,600	59,328	61,108	62,941	64,829
NPDES Construction Site Runoff Control	-	5,620	5,789	5,962	6,141	6,325
NPDES Post Construction Management	-	4,580	4,717	4,859	5,005	5,155
NPDES Pollution Prevention in Municipal Operations	-	10,200	10,506	10,821	11,146	11,480
Subtotal Operating & Maintenance Expenses	2,444,005	3,738,970	3,851,140	3,966,674	4,085,674	4,208,244
Debt Service on Master Plan Projects	0	0	0	0	0	0
Contingency						
Unappropriated Ending Fund Balance						
Ending Fund Balance	881,673	131,673	135,673	139,673	143,673	147,673
Total Requirements	$3,325,678	$3,870,643	$3,986,813	$4,106,347	$4,229,347	$4,355,917

Case V – Funding of the Current Service Level, NPDES Part II City Wide Expenditures, and Phase I of Top Level CIP Program (Pay-As-You-Go Funding)

City of Medford
Storm Water Master Plan
Storm Drain Fund (046) Preliminary Statement of Revenues & Expenditures
Case V - Funding of Current Service Level, NPDES Part II Costs, and Phase I Top Level CIP (Pay-as-you-go funding)

Economic Assumptions:

Monthly ESU Charge - FY05	$3.59
% Growth in ESU's per Year	2.00%
Annual O&M Cost Inflation	3.00%

FISCAL YEARS

Revenue & Expense Category	2005	2006	2007	2008	2009	2010
Required Monthly Rate - $/ESU/Month	$ 3.88	$ 6.00	$ 7.49	$ 7.58	$ 7.66	$ 7.74
Equivalent Service Units	44,237	45,122	46,024	46,945	47,884	48,841
Resources:						
Beginning Fund Balance	1,035,437	881,673	131,673	135,673	139,673	143,673
System Development Charges	282,241	287,886	293,644	299,516	305,507	311,617
Operating Revenue:						
Charges for Services	1,905,730	3,249,809	4,138,568	4,267,723	4,400,814	4,537,961
General Government	71,500	71,500	71,500	71,500	71,500	71,500
Intergovernmental Revenues	1,200	1,200	1,200	1,200	1,200	1,200
Interest Income	29,570	12,667	3,342	3,442	3,542	3,642
Subtotal Operating Revenues	2,008,000	3,335,176	4,214,610	4,343,865	4,477,056	4,614,303
Total Resources	$ 3,325,678	$ 4,504,735	$ 4,639,927	$ 4,779,054	$ 4,922,236	$ 5,069,593
Requirements:						
Personal Services	1,181,030	1,216,461	1,252,955	1,290,543	1,329,260	1,369,137
Materials & Services	369,045	380,116	391,520	403,265	415,363	427,824
Capital Outlay	227,500	234,325	241,355	248,595	256,053	263,735
Capital Improvements	526,025	2,304,722	2,373,864	2,445,080	2,518,432	2,593,985
Other	140,405	144,617	148,956	153,424	158,027	162,768
NPDES Part II City Wide Activities:						
Stormwater Ordinance	-	6,000	6,180	6,365	6,556	6,753
NPDES Public Education and Outreach	-	5,200	5,356	5,517	5,682	5,853
NPDES Public Involvement and Participation	-	3,620	3,729	3,840	3,956	4,074
NPDES Illicit Discharge Detection and Elimination	-	57,600	59,328	61,108	62,941	64,829
NPDES Construction Site Runoff Control	-	5,620	5,789	5,962	6,141	6,325
NPDES Post Construction Management	-	4,580	4,717	4,859	5,005	5,155
NPDES Pollution Prevention in Municipal Operations	-	10,200	10,506	10,821	11,146	11,480
Subtotal Operating & Maintenance Expenses	2,444,005	4,373,062	4,504,254	4,639,381	4,778,563	4,921,920
Debt Service on Master Plan Projects	0	0	0	0	0	0
Contingency						
Unappropriated Ending Fund Balance						
Ending Fund Balance	881,673	131,673	135,673	139,673	143,673	147,673
Total Requirements	$3,325,678	$4,504,735	$4,639,927	$4,779,054	$4,922,236	$5,069,593

Case VI – Funding of the Current Service Level, NPDES Part II City Wide Expenditures, and Phase I of Top Level CIP Program (Revenue Bond Funding)

City of Medford
Storm Water Master Plan
Storm Drain Fund (046) Preliminary Statement of Revenues & Expenditures
Case VI - Funding of Current Service Level, NPDES Part II Costs, and Phase I Top Level CIP (Revenue Bond Funding)

Economic Assumptions:

Monthly ESU Charge - FY05	$3.59
% Growth in ESU's per Year	2.00%
Annual O&M Cost Inflation	3.00%

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FISCAL YEARS

Revenue & Expense Category	2005	2006	2007	2008	2009	2010
Required Monthly Rate - $/ESU/Month	$ 3.88	$ 3.59	$ 3.59	$ 3.81	$ 4.17	$ 5.26
Equivalent Service Units	44,237	45,122	46,024	46,945	47,884	48,841
Resources:						
Beginning Fund Balance	1,035,437	881,673	937,453	764,192	472,355	140,810
System Development Charges	282,241	287,886	293,644	299,516	305,507	311,617
Operating Revenue:						
Charges for Services	1,905,730	1,943,845	1,982,721	2,145,511	2,398,558	3,078,909
General Government	71,500	71,500	71,500	71,500	71,500	71,500
Intergovernmental Revenues	1,200	1,200	1,200	1,200	1,200	1,200
Interest Income	29,570	22,739	21,271	15,457	7,665	4,153
Subtotal Operating Revenues	2,008,000	2,039,284	2,076,692	2,233,668	2,478,923	3,155,762
Total Resources	$ 3,325,678	$ 3,208,842	$ 3,307,789	$ 3,297,376	$ 3,256,785	$ 3,608,189
Requirements:						
Personal Services	1,181,030	1,216,461	1,252,955	1,290,543	1,329,260	1,369,137
Materials & Services	369,045	380,116	391,520	403,265	415,363	427,824
Capital Outlay	227,500	234,325	241,355	248,595	256,053	263,735
Capital Improvements	526,025	0	0	0	0	0
Other	140,405	144,617	148,956	153,424	158,027	162,768
NPDES Part II City Wide Activities						
Stormwater Ordinance	-	6,000	6,180	6,365	6,556	6,753
NPDES Public Education and Outreach	-	5,200	5,356	5,517	5,682	5,853
NPDES Public Involvement and Participation	-	3,620	3,729	3,840	3,956	4,074
NPDES Illicit Discharge Detection and Elimination	-	57,600	59,328	61,108	62,941	64,829
NPDES Construction Site Runoff Control	-	5,620	5,789	5,962	6,141	6,325
NPDES Post Construction Management	-	4,580	4,717	4,859	5,005	5,155
NPDES Pollution Prevention in Municipal Operations	-	10,200	10,506	10,821	11,146	11,480
Subtotal Operating & Maintenance Expenses	2,444,005	2,068,339	2,130,390	2,194,301	2,260,130	2,327,934
Debt Service on Master Plan Projects	0	203,050	413,207	630,719	855,845	1,088,849
Contingency						
Unappropriated Ending Fund Balance						
Ending Fund Balance	881,673	937,453	764,192	472,355	140,810	191,405
Total Requirements	$3,325,678	$3,208,842	$3,307,789	$3,297,376	$3,256,785	$3,608,189