FINAL

Pringle Creek Watershed Management Plan

June 2008

CITY OF Salem
AT YOUR SERVICE

HDR

Pringle Creek Watershed Management Plan

June 2008

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Executive Summary

The City of Salem (City) initiated a watershed planning program for its urban watersheds with the goal of developing a framework for improving the City's urban watershed health and fostering community support for and ownership of watershed protection and restoration. The Pringle Creek watershed is one of thirteen urban watersheds delineated within the Salem-Keizer boundaries. The Pringle Creek watershed was selected for development of the first watershed management plan because it has the most available data to date and has an active watershed council. The Pringle Creek watershed covers an area of 13.3 square miles and is located in south Salem almost entirely within the City of Salem's urban growth boundary (UGB).

The goals for the pilot *Pringle Creek Watershed Management Plan* (Plan) include:

- Use Pringle Creek as a model stream to show "early" success to the community as a way to promote support from citizens and city leaders for funding urban watershed improvements.
- Create short-term and long-term visions for a "healthy" urban watershed to restore/improve as many watershed functions as practicable in an urban environment.
- Demonstrate what can be accomplished and determine what tools, information, and permits are required to implement restoration and protection actions.

Approach

The development of the Pringle Creek watershed management plan has eight major components:

- *Conduct public outreach* - focus on defining the vision and values that will guide watershed planning and implementation and assure citizen support.
- *Summarize baseline environmental conditions* - characterize the current conditions in the watershed to define the environmental baseline from which costs and benefits of proposed restoration and mitigation activities will be evaluated.
- *Complete the bioassessment study* - identify the watershed conditions (e.g. functioning, not properly functioning, or at-risk) and associated stressors that are most in need of restoration or enhancement for specific reaches within the watershed.
- *Characterize flow and drainage improvement opportunities* - identify opportunities for improving streamflow and drainage conditions using information from the existing Drainage System Improvement Plan and recent flooding and drainage issues.
- *Develop a water quality improvement plan* - characterize the water quality conditions in Pringle Creek and identify opportunities for improving conditions, emphasizing stormwater constituents and TMDL/303(d) listed parameters.

- *Characterize instream and riparian area improvement opportunities* - identify opportunities for improving instream habitat and riparian conditions relying primarily on the Bioasssessment Study data and site surveys.

- *Review the monitoring program* – identify any potential deficiencies in the City's existing stream flow and water quality monitoring program.

- *Review implementation considerations* – develop a framework to implement the management strategies and early action projects that complement the City's existing and anticipated future mitigation and compliance activities to meet the goals and objectives of the watershed plan.

Management Recommendations

The watershed management plan provides recommendations and guidance to City departments to meet the City's long-term vision for watershed health. In addition, the watershed plan will be used by City departments to collaborate with developers, non-profit environmental organizations, and public agencies that may conduct restoration projects. The goal is to incorporate multiple objectives into restoration and stormwater management projects wherever feasible and to identify projects to be implemented as opportunities arise. The general management recommendations developed in this plan are summarized in **Table ES-1**.

Table ES-1. Summary of General Management Recommendations
Programmatic/Policy (Institutional)
• Continue to implement the strategies and best management practices as described in the current *Stormwater Management Plan (SWMP)*. The SWMP has many effective BMPs in place to improve watershed health. Updates to the SWMP should be integrated with the watershed plan. • Protect existing watershed features that provide drainage and habitat benefits (riparian zones, wetlands, selected stream reaches). As part of this effort, prioritize continued development of the existing Wetlands Program, Watershed Protection and Preservation Program, and development of a Waterways Protection / Riparian Buffer Program; and also consider land acquisition program for critical areas. • Augment current public outreach and involvement activities being conducted under the stormwater management program to promote overall watershed health concepts to develop a stewardship mentality and help implement the management actions in this Plan. • Work with and educate streamside landowners to identify opportunities for stream enhancement projects. As part of this process, identify ownership of weirs and barriers to facilitate opportunities for fish passage improvements. • Develop incentives (and ultimately standards) for low impact development for long-term watershed health. Leverage current low impact developments occurring in the City as opportunities to promote the benefits of minimizing imperviousness with new development and redevelopment. • Require water quality facilities/BMPs for new developments. Continue on-going efforts under the stormwater management program to develop formal requirements and design criteria for water quality facilities. • Review the Comprehensive Plan and look for ways to integrate it with this watershed management plan.
On-the-ground Projects

Table ES-1. Summary of General Management Recommendations
• Leverage funding identified for capital improvement projects to the extent possible to include habitat enhancement components. Coordinate efforts among the Utilities Planning, Water Resources and Community Planning sections to identify opportunities for multi-benefit projects. • Continue to implement low-risk, high visibility projects such as riparian plantings/revegetation and stream cleaning to promote watershed health benefits.
Monitoring and O&M
• Bioassessment (EMAP) methods are most useful for long-term watershed health monitoring. Stream surveys are needed to develop reach-specific stream enhancement projects. • Review operation and maintenance protocols focusing on improving operations and maintenance standards to use fewer resources and less damaging processes, especially with respect to streets, stormwater facilities and parks maintenance. • Continue monitoring for TMDL and 303(d) listed parameters as key components of the water quality improvement and TMDL implementation plans. • Updating the drainage system model (XP-SWMM) is critical to evaluate planned and proposed improvements. • Maintain geodatabase for effective data management and data sharing/transfer with developers/agencies.

Implementation Considerations

Table ES-2 provides additional detail on implementation considerations for the specific categories of management actions for the following topics:

- *Priority:* refers to the priority of the action relative to other management actions identified in the watershed plan; ranking considers implementability and cost/benefit factors.

- *Priority action areas:* areas where the actions should be implemented first; does not imply that other areas would not also benefit from these actions.

- *Implementers:* identifies key City departments and other stakeholders, or agencies to implement the action. "Lead" implementer would take responsibility for organizing efforts under this action, including pursuing funding sources.

- *Financial/economic costs:* preliminary, generalized estimates of financial or economic costs to the community or project owner. High: greater than $500,000; Medium: $50,000 to $500,000; Low: less than $50,000; total cost per project or annual cost.

- *Funding sources:* general funding source (county, City, private, state or federal grants, legislative appropriations, permitting fees).

In addition to the considerations listed in **Table ES-2**, specific steps need to be taken to implement the management actions in the near-term and over the long-term. The most important implementation action is to assign the principal lead within the City to track and coordinate the actions in the watershed plan. Because many of the actions already have an established framework within the Public Works Department, it is recommended that a division manager from this department be designated as the principal lead. In the near-term, the following participants and activities are needed to *initiate* the implementation of the plan:

- *City Council members* and top managers should be involved at the plan review and approval ("adoption") stage.
- *Resource agencies (ODFW, DEQ, Marion County, MCSWCD)* should be given an opportunity to review the Watershed Plan for input and to allow the agencies to plan for any coordination on proposed projects or actions. An intergovernmental agreement (IGA) may be useful in defining coordination and oversight responsibilities with ODFW, DEQ, and Marion County.
- *City departments and other coordinating entities* will need to budget for Plan actions and identify funding sources. This should be incorporated in the budget process each year.
- Identify staff that will be responsible for carrying out proposed actions/commitments in the Plan, and for reporting back to management.

Similarly, many activities are needed to coordinate the long-term implementation of this plan:

- Tracking implementation of Plan actions by the many organizations involved (City and other parties, e.g. non-governmental organizations, watershed groups, resource agencies), to ensure that actions are being carried out in a timely fashion and that the priorities identified in the Plan are being addressed.
- Coordinating efforts to seek funding for Plan actions and ensure that funding agencies see an organized and unified support for funding requests.
- Providing information to the public on Plan implementation and improvements in watershed conditions.
- Monitoring watershed conditions, data management and providing data access.
- Periodic review of the Plan, and updating when appropriate.

It is recommended that the City form an internal "watershed planning committee" to conduct the activities listed above. Furthermore, it is recommended that a division manager from Public Works Department be designated as the lead. Representatives from other City departments should be selected to participate in the watershed planning committee. At a minimum, members from the following divisions/sections should be involved in the watershed planning committee:

- Community Development: Planning Division, GIS mapping
- Community Services: Community Involvement, Parks Operations
- Urban Development: Urban Renewal
- Public Works: Utilities Planning, Engineering Administration, Water Resources, Development Services, Environmental Services, Stormwater Services, Transportation, and Wastewater Collection

Conclusion

The overall goal of the project is to develop a plan that can be implemented despite the constraints of funding limitations by taking advantage of opportunities for partnerships and

public participation. The Pringle Creek Watershed Management Plan is a tool for the City, and other stakeholders, to identify collaboration opportunities and is intended to be a model for the City's other urban watersheds. Lessons learned from this pilot project will also be used to help define future monitoring objectives directed toward managing the other urban watersheds. It is recommended that the Watershed Plan be reviewed on a regular basis to determine whether a formal update is needed. The first review should occur within 5 years of the date of the "approval" of this plan by the City Council.

Table ES-2. Implementation Considerations for Management Actions					
Management Action	Priority[1]	Priority Action Areas	Implementers[2]	Financial/ Economic Costs[3]	Funding Sources
Category: Stormwater Management					
Modify storm drain system to increase infiltration and detention (local detention facilities)	High	*Priority Areas:* See Figure 4-3 for priority drainage improvement projects	Lead: Public Works Department (Stormwater) Others: none	High (per project)	Main: City CIP/sewer funds Additional: City permitting fees; Developer, SDCs
Modify storm drain system to treat stormwater (water quality treatment)	High	*Priority Areas:* Discharges to Clark Creek and Pringle Creek mainstem *Other Areas:* Watershed-wide	Lead: Public Works Department (Stormwater) Others: none	Medium – High (per project)	Main: City CIP/sewer funds Additional: City permitting fees; Developer, SDCs
Increase stormwater conveyance capacity (culverts/pipelines/bridges)	Moderate	*Priority Areas:* See Figure 4-3 for priority drainage improvement projects	Lead: Public Works Department (Stormwater) Others: none	Medium – High (per project)	Main: City CIP/sewer funds Additional: City permitting fees; Developer, SDCs
Category: Stream Repair/ Protection					
Fish Passage Improvements	High	*Priority Areas:* See Figure 6-7 for priority fish passage barriers *Other Areas:* Barriers on Clark Creek; West Fork Pringle Creek; Lower East Fork Pringle Creek	Lead: Public Works Department Others: Private landowner; Developer	Medium (per project)	Main: City CIP/sewer funds Additional: Grants; Private landowner, Developer, SDCs
Channel and floodplain redesign / construction	Moderate	*Priority Areas:* West Fork Pringle Creek in Woodmansee Park and lower reach; middle reach of Clark Creek; lower reach of East Fork Pringle Creek *Other Areas:* East Fork and Middle Fork Pringle Creek along railroad tracks	Lead: Public Works Department Others: Private landowner; Developer; industrial landowner	Medium – High (per project)	Main: City CIP/sewer funds Additional: Grants; Private landowner; Developer, SDCs
Streambank stabilization	Moderate	*Priority Areas:* Lower Pringle Creek mainstem; Lower East Fork Pringle Creek; Lower West Fork Pringle Creek *Other Areas:* East Fork Pringle Creek; West Middle Fork Pringle Creek	Lead: Public Works Department Others: Private landowner; Developer, Industrial landowner	Medium (per project)	Main: City CIP/sewer funds Additional: Grants; Private landowner; Developer, SDCs
Instream flow controls	Low	*Priority Areas: same as row above*	Lead: Public Works Department Others: Private landowner; Developer	Medium (per project)	Main: City CIP/sewer funds Additional: Grants; Private landowner; Developer, SDCs

Table ES-2. Implementation Considerations for Management Actions					
Management Action	Priority[1]	Priority Action Areas	Implementers[2]	Financial/ Economic Costs[3]	Funding Sources
Instream habitat structures	Moderate	*Priority Areas: same as row above* *Other Areas:*	Lead: Public Works Department Others: Private landowner; Developer	Medium (per project)	Main: City funds Additional: Grants
Category: Wetlands					
Wetland enhancement	Moderate	*Priority Areas: See Figure 4-5 for priority wetland enhancement potential.* *Other Areas:*	Lead: Public Works Department (Water Resources) Others: Private landowner; Developer	Medium – High (per project)	Main: City funds Additional: Grants; Private landowner; Developer
Category: Riparian Management					
Increase quantity and quality of canopy and other vegetative cover (includes removing invasive species)	High	*Priority Areas:* Lower Pringle Creek mainstem; Lower East Fork Pringle Creek; Lower West Fork Pringle Creek *Other Areas:* East Fork Pringle Creek; West Middle Fork Pringle Creek	Lead: Public Works Department (Water Resources) Others: Private landowner; Developer	Low – Medium (per project)	Main: Grants Additional: City funds; Private landowner; Developer
Create riparian buffer	Moderate	*Priority Areas:* same as row above *Other Areas:*	Lead: Public Works Department (Water Resources) Others: Parks and Recreation; Private landowner; Developer	Low – High (per project; depends on area)	Main: City funds Additional: Grants; private landowner; Developer
Category: Protection and Policy					
Promote low impact development practices in development and redevelopment projects	High	*Priority Areas:* East Fork Pringle Creek subwatershed; West Fork Pringle Creek subwatershed *Other Areas:* All redevelopment areas	Lead: Public Works Department (Development Services) Others: Community Development/ Planning Department, Urban Renewal	Low – Medium (annual)	Main: City funds Additional: Grants
Protect sites/features with high watershed value	High	*Priority Areas:* See Figure 4-5 for priority wetland areas. *Other Areas:* All other Wetlands, floodplains, riparian areas	Lead: Community Development/ Planning Department Others: Public Works Department	Low – Medium (annual)	Main: City funds Additional: Grants
Revise or update zoning ordinances to provide incentive-, performance- or watershed-based zoning	Moderate	*Priority Areas:* East Fork Pringle subwatershed; Upper East Fork Pringle subwatershed *Other Areas:* Clark Creek subwatershed; West Fork Pringle subwatershed;	Lead: Community Development/ Planning Department Others: Public Works Department	Low – Medium (annual)	Main: City funds Additional: Grants

Table ES-2. Implementation Considerations for Management Actions					
Management Action	Priority(1)	Priority Action Areas	Implementers(2)	Financial/ Economic Costs(3)	Funding Sources
Category: Education, Involvement, Stewardship					
Provide education, involvement and stewardship on watershed function to organizations and public	High	*Priority Areas:* Watershed-wide *Other Areas:* NA	Lead: Public Works Department Others: Community Services Department	Low – Medium (annual)	Main: City funds Additional: Grants
Category: Monitoring					
Water quality (stormwater-based)	High	*Priority Areas:* Pringle Creek and Clark Creek *Other Areas:* Mouths of all tributaries	Lead: Public Works Department Others: none	Medium (annual)	Main: City funds Additional: City CIP/sewer funds; Grants
Habitat	Moderate	*Priority Areas:* Lower Pringle Creek mainstem; Lower East Fork Pringle Creek; Lower West Fork Pringle Creek *Other Areas:* All locations where habitat enhancement projects are implemented.	Lead: Public Works Department Others: none	Medium (annual)	Main: City funds Additional: Grants
Category: Implementation					
Assign Lead Implementation Coordinator	High	*NA*	Lead: Public Works Department Others: none	Low (annual)	Main: City Funds Additional: Grants
Form "Watershed Planning Committee"	High	*NA*	Lead: Public Works Department Others: Other City departments, resource agencies, potentially the public	Low (annual)	Main: City Funds Additional: Grants

(1) Priority in context of all actions in the Watershed Management Plan.
(2) "Lead" implementer would take responsibility for organizing efforts under this action, including pursuing funding sources.
(3) Preliminary, generalized estimates of financial or economic costs to the community or project owner. High: greater than $500,000; Medium: $50,000 to $500,000; Low: less than $50,000. Total cost, whether up-front or over a period of time up to 10 years.

Chapter 1. Introduction and Purpose

As with many communities across the country, the City of Salem is facing the challenge of balancing growth and development with quality of life and environmental stewardship. In addition to complying with regulatory requirements, primarily under the Clean Water Act (CWA) and Endangered Species Act (ESA), the City is trying to be a good steward of the land and water for future generations. At the same time, City leaders are aware of the limited financial resources available to implement all of the desired projects and activities to meet these demands. With this in mind, the City initiated a watershed planning program for its urban watersheds with the goal of developing a framework for improving the City's urban watershed health and fostering community support for, and ownership of, watershed protection and restoration.

The Pringle Creek watershed is one of thirteen urban watersheds delineated within the Salem-Keizer boundaries (refer to **Figure 1-1**). The Pringle Creek watershed covers an area of 13.3 square miles and is located in South Salem, almost entirely within the City of Salem's urban growth boundary (UGB). The Pringle Creek watershed was selected for development of the first watershed management plan because it has the most available data to date, has an active watershed council, and is listed on DEQ's 303(d) list and addressed by the recently adopted TMDL program.

As with many urban streams, the Pringle Creek watershed and its tributaries have undergone many changes through the course of rural and then urban development. Approximately 60% of the watershed is urbanized, while another 27% of the watershed is in agricultural use, primarily in the very southeast portion of the watershed. The remaining natural areas in the Pringle Creek watershed are mostly publicly owned: parks and city property, school sites and state lands. The Pringle Creek watershed contains a variety of land uses ranging from a portion of the City's central business district to single family residential and agriculture uses. The southern portion of the watershed contains currently undeveloped tracts, which are zoned for industrial, commercial, and residential uses.

1.1 Basis for Planning

The State of Oregon does not have a legal requirement to develop watershed management plans. The *Oregon Plan for Salmon and Watersheds* (Oregon Plan) provides a framework for watershed planning, but it is not a regulatory requirement and lacks a reliable funding source for implementing many of the actions developed by local watershed councils or desired by the City. Nevertheless, the City of Salem has developed various programs to comply with regulatory requirements of the CWA and ESA: including managing and issuing permits, implementing best management practices (BMPs), and conducting environmental monitoring and enforcement activities. The City is developing a watershed management program to coordinate many of these programs and improve implementation and effectiveness in achieving overall watershed health. The City believes that if the goal of optimizing overall watershed health is achieved, then compliance with specific regulatory requirements will be met. The City's key programs integrated into the watershed planning program are listed in Table 1-1.

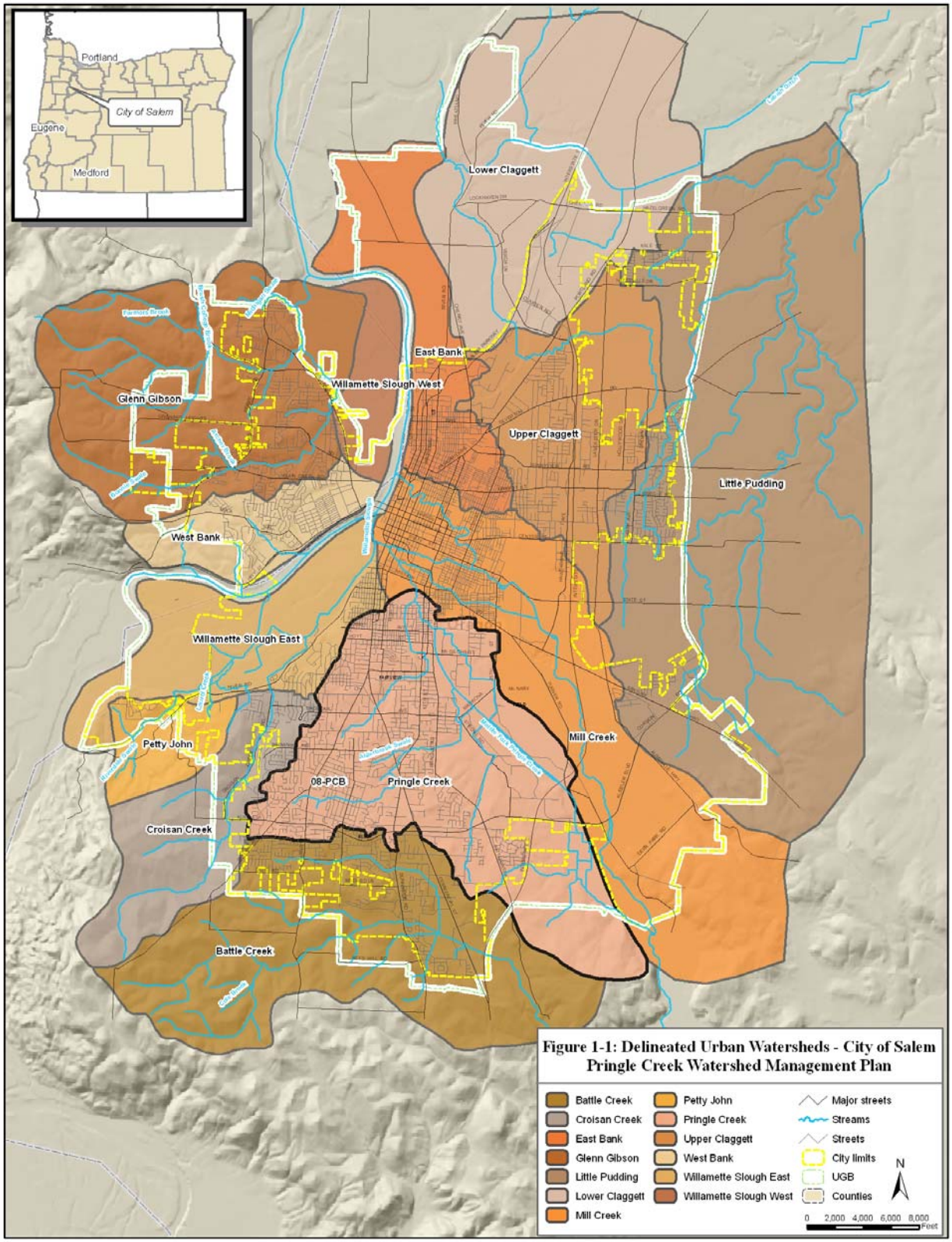


Figure 1-1: Delineated Urban Watersheds - City of Salem Pringle Creek Watershed Management Plan

Table 1-1. City Programs and Services Benefiting from Watershed Management Program
▪ National Pollutant Discharge Elimination System (NPDES) permit program (1200C, 1200CA, and 1200Z)
▪ NPDES Municipal Separate Stormwater Sewer System (MS4) Permit Management Program
▪ Total Maximum Daily Load (TMDL) Implementation Program
▪ Wetlands Program
▪ Willamette Greenway Program
▪ Tree and Native Plants Program
▪ Watershed Protection and Preservation Program, including Waterways Protection Program
▪ Capital Improvement Program
▪ ESA Response Efforts

1.2 Planning Goals and Objectives

The City has three primary goals in initiating a watershed program:

- Define the long-term vision for a “healthy urban stream” and restoration goals for Salem’s urban environment over the next 20 years.

- Develop a framework for partnering with state and Federal funding sources for improving urban watersheds.

- Foster community support for, and ownership of, watershed protection and restoration.

With this in mind, the Pringle Creek Watershed Management Plan was conceived as a “pilot” for the City to base its overall watershed management program. The methods and lessons learned from the development of the Pringle Creek Watershed Management Plan will be applied to watershed plan development of the City’s other urban watersheds. The overall goal of the Pringle Creek Watershed Plan is to create the “road map” for the urban watershed program. The goals for the pilot Pringle Creek watershed plan include:

- Use Pringle Creek as a model stream to show “early” success to the community as a way to promote support from citizens and city leaders for funding urban watershed improvements.

- Create short-term and long-term visions for a "healthy" urban watershed to restore/improve as many watershed functions as practicable in an urban environment.

- Demonstrate what can be accomplished and determine what tools, information, and permits are required to implement restoration and protection actions.

The watershed management plan will identify impaired watershed functions and describe management actions and implementation strategies to improve drainage, water quality, and habitat to meet the City’s long-term vision for watershed health. The specific objectives of the watershed plan for Pringle Creek are listed in Table 1-2.

The watershed plan will be used by City departments to collaborate with developers, non-profit environmental organizations, and public agencies. The intent is to incorporate multiple objectives into restoration and stormwater management projects wherever feasible and to identify projects to be implemented as opportunities arise. Specific restoration objectives and success criteria will be defined on a project-specific basis as projects are developed.

Table 1-2. Objectives of the Pringle Creek Watershed Management Plan
▪ Integrate environmental studies and watershed characterization work completed by the City to establish baseline environmental conditions within the Pringle Creek Watershed.
▪ Define opportunities and constraints to improve drainage and reduce magnitude and frequency of flooding events.
▪ Define opportunities and constraints to reduce erosion and sedimentation and improve bank stability of urban streams.
▪ Define opportunities and constraints for improving water quality parameters, targeting specific Total Maximum Daily Load (TMDL) and 303(d) listed contaminants in Pringle Creek and Clark Creek.
▪ Define opportunities and constraints for enhancing or protecting stream habitat for aquatic species, including fish passage.
▪ Define opportunities and constraints to restore stream and riparian habitat and function.
▪ Define opportunities and constraints for improving aesthetics of the urban stream corridor and improving recreational facilities and features.
▪ Define opportunities and constraints to provide educational facilities and features to promote watershed health.

1.3 Plan Organization and Limitations

1.3.1 Plan Organization

The watershed plan focuses on three primary components: (1) flow and drainage; (2) water quality ; and (3) habitat (aquatic and riparian). In addition, the plan considers public outreach and involvement, water quality, and habitat monitoring as part of the implementation activities. Chapter 2 summarizes the management plan policies, opportunities and constraints for watershed planning, and previous studies conducted for Pringle Creek. Chapter 2 also covers the public input and participation program being developed. Chapter 3 includes an overview of watershed processes that relate the characterization and management actions proposed in the subsequent chapters. Chapters 4-7 of the plan focus on the drainage, water quality components, and habitat and monitoring programs, respectively. The chapters summarize the conditions and priority restoration opportunities and present management alternatives and key project areas. Chapter 8 presents the “early-action” projects that are intended to demonstrate “early successes.” Chapter 9 presents the recommended implementation strategy. Figure 1-2 illustrates the different components of the watershed plan.

In addition, a geodatabase has been developed as part of the project that compiles the environmental and geographic data used to develop the management plan. This geodatabase is intended to be used by the City as the building block for maintaining the City’s environmental data, as well as a tool for promoting the management strategies and any recommended projects to other stakeholders, or resource agencies, for partnering or regulatory acceptance. Further description of the geodatabase construction is included in Appendix A.

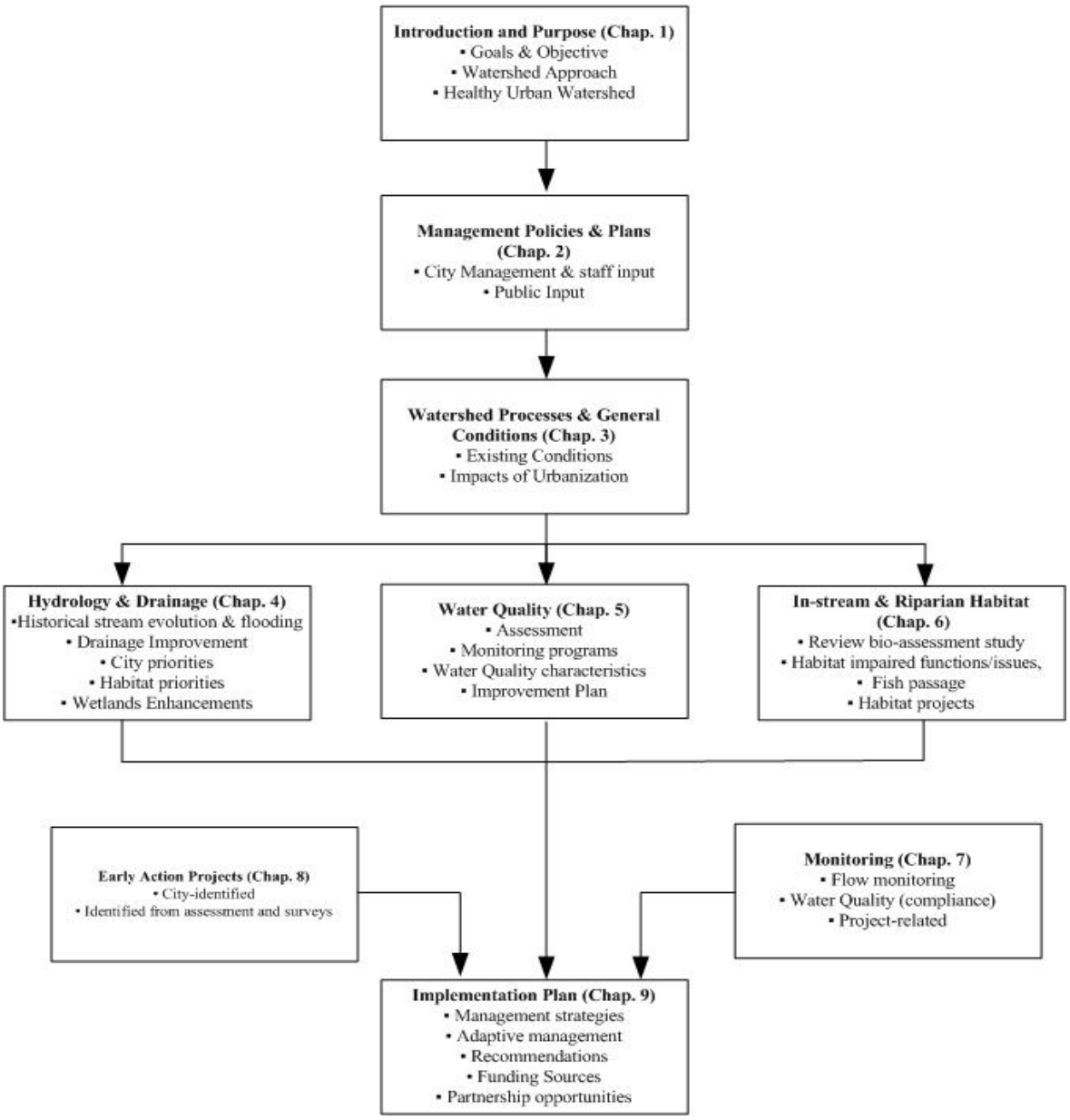


Figure 1-2. Pringle Creek Watershed Plan Components

1.3.2 Plan Limitations

The scope of work for the watershed plan calls for use of existing studies and plans to characterize the watershed. No additional water quantity or water quality sampling, or monitoring was conducted for this project to assist in characterization. Only a limited number of site visits were conducted to field verify stream conditions or assist in defining potential restoration projects.

Drainage problems and flood-prone areas were identified using information from the Drainage System Improvement Plan (DSIP), a technical supplement to the Stormwater Master Plan, (Montgomery-Watson, 2000) and more recent information compiled by the City from problems reported by the public. The capital improvement projects to address the drainage and flood problems were derived from the DSIP and reprioritized in this plan based on consideration of other watershed habitat and water quality priorities. No additional hydrologic or hydraulic modeling was conducted to confirm the drainage problem areas.

The habitat conditions were characterized based primarily on data collected as part of the 2000 and 2001 "Bioassessment Study" (Salem, 2000; Salem, 2001). A methodology for interpreting the Bioassessment Study data was developed as part of this project. The methods and findings are discussed in detail in Chapter 5. No stream surveys or assessments were conducted specifically for this project other than specific site visits for select reaches.

Water quality data was compiled from the City's existing water quality monitoring stations within Pringle Creek. No other water quality data was collected for this project. Review of water quality data is based primarily on data collected to meet the NPDES-MS4 permit.

The management tools and actions are general in nature and specific project objectives and success criteria should be developed by stakeholders once specific projects and partners have been identified. The "early action projects" developed in this plan are conceptual planning level designs. Further site assessment and surveys should be conducted to refine costs and to prepare engineering designs, where appropriate.

1.3.3 Previous Studies

The City has conducted numerous watershed characterization studies over the past six years. The focus of the watershed plan is to integrate information from these studies to develop management actions and priorities for restoration and identify opportunities for implementing these strategies. The watershed plan is "implementation-oriented" and references much of its characterization discussion to the previous plans and studies. The key plans and studies are listed in Table 1-2.

Table 1-2. Key Plans and Studies Used in the Development of the Pringle Creek Watershed Plan
▪ Stormwater Master Plan and Supplemental Drainage System Improvement Plan (DSIP), September 2000
▪ Impervious Surface Project, August 2001
▪ Regional Ecosystem Analysis for the Willamette River/Lower Columbia Region, October 2001
▪ Tree Canopy Analysis, December 2001
▪ 2000 Bioassessment Draft Report; Pringle Creek River Basin EMAP 2000 Physical Habitat Metrics Summary Report
▪ 2001 Bioassessment Metric Results.
▪ Pringle, Glenn-Gibson, Claggett, and Mill Creeks Watershed Assessment, January 2002
▪ Stream Temperature Monitoring Report: Salem Area Watersheds, August 2002
▪ Historic Salmon Distribution Study in Marion County Oregon Vol. 1-Technical Report, July 2003
▪ Stormwater Regional Detention Facilities Study, June 2004
▪ Fish Passage Study, June 2001 and Fish Passage Prioritization, August 2003

1.4 Healthy Urban Watershed

One of the first questions the City posed at the beginning of this project was, "What is the definition of a healthy urban watershed (or stream)?" As mentioned above, the CWA and ESA are regulatory drivers for developing a watershed plan, but there are no established methods or standard benchmarks that define what a healthy urban watershed should be. Nevertheless, the City did not want to approach the problem of watershed health as a reaction to regulatory requirements, but rather from the perspective of balanced stewardship of the urban environment. As mentioned previously, the City believes that if the goal of optimizing overall watershed health is achieved, then compliance with specific regulatory requirements will be met. In this way, the City hopes to coordinate their existing compliance programs in a more effective and efficient manner.

One general definition is that a healthy watershed has hydrologic, habitat and water quality conditions suitable to protect human health and safety, maintain viable ecological functions and processes, and support self-sustaining populations of native fish and wildlife species. Applying this definition to urban watersheds is difficult because different beneficial uses of urban streams and riparian areas often seemingly conflict with one another (i.e. flood management versus riparian protection and restoration). These conflicts place constraints on what can realistically be achieved.

In many areas development has occurred right up to the edge of the river bank where the floodplains have been impacted or completely removed. In these areas, restoration to historic conditions is not possible. Returning a stream channel or floodplain to its historic conditions may not be possible, but it may be possible to improve channel conditions to an appropriate level on a site-by-site basis. Appropriate restoration may include such activities as the elimination of small impoundments or weirs that are no longer in use, tolerating the activities of beavers, or modifying stream crossings to provide space for a natural channel width and allow fish passage. In the less developed or more rural areas of the urban setting, options for channel modifications may include restoring the surface water connection between streams and isolated wetlands, restoring flow from channelized ditches to their historic channels, and tolerating large wood in streams (in appropriate locations).

The watershed plan is intended to have the support, not only of resource agencies, but more importantly of the public, stakeholders, streamside property owners, and developers – those who would most likely help implement the plan. Therefore, the vision of a healthy urban watershed is conceived as "opportunity-based" and adaptable, but at the same time grounded in a landscape context and sound management principles for improving ecological function. With this in mind the vision begins with a framework that includes four watershed health components:

- *Hydrology*: Move toward normative[*] flow conditions to protect and improve watershed and stream health, channel functions, and public health and safety.

[*] Normative flow has the magnitude, frequency, duration, and timing which approximate the natural environment.

- *Physical Habitat*: Protect, enhance and restore aquatic and terrestrial habitat conditions to support key ecological functions and improved productivity, diversity, capacity and distribution of native fish and wildlife populations and biological communities.

- *Water Quality:* Protect and improve surface water and groundwater quality to protect public health and support native fish and wildlife populations and biological communities.

- *Biological Communities:* Protect, enhance and restore native aquatic and terrestrial species and biological communities to improve and maintain biodiversity in Salem's watersheds.

An iterative process is used where "benchmarks" used by resource agencies are evaluated to identify impaired functions. Input from public outreach helps define the beneficial uses and prioritize the functions that might be restored or protected based on the public's values of watershed protection. The intent is to define the vision for the City's Pringle Creek watershed in this pilot project, and then see how this vision might be applied to the rest of the City's urban watersheds, and ultimately how this vision addresses the regulatory issues.

Chapter 2. Management Guidelines and Plans

This chapter includes a discussion of the guiding principles and management guidelines the City is utilizing for the Pringle Creek Watershed Plan. General restoration opportunities and constraints are described with respect to the areas in Pringle Creek where restoration activities can be implemented. These opportunities and constraints are considered during development of the management recommendations in subsequent chapters. Finally, a description of the public input and participation program developed for the watershed plan is presented, along with a summary of the existing plans and programs completed by the City that are associated with watershed planning.

2.1 Restoration Program Guiding Principles and Management Guidelines

In conjunction with the overall plan goals and objectives, the watershed management guidelines and guiding principles described in this section are intended to guide the City in developing the management strategies and prioritizing the restoration activities. The guidelines and principles also serve to inform persons/groups not involved in the project (developers, watershed councils, landowners/general public) of the rationale or basis for the City's approach to improving watershed health.

2.1.1 Guiding Principles

The City of Salem conducted an in-depth process to develop a vision statement and associated guiding principles for their Stormwater Master Plan in 2000. The City then reaffirmed these guiding principles under their updated Stormwater Management Plan in 2005. The City decided to use these same principles as the starting point to guide the watershed planning process for the Pringle Creek Watershed Management Plan. The guiding principles in summary are:

- Promote proactive environmental stewardship
- Preserve and enhance stream corridors
- Balance water quantity and water quality considerations
- Seek cost-effective solutions
- Educate and involve the public
- Meet /exceed regulatory requirements

Table 2-1 lists the complete statements of the "Values and Guiding Principles" as adopted in the Salem Stormwater Management Plan (November 2005).

Table 2-1. Values and Guiding Principles Based on Stormwater Management Plan(1)
Manage the City's stormwater infrastructure to minimize flood damage, and protect life and property. Assign highest priority to the safety and security of persons and property potentially affected by flooding, but apply a balanced perspective between water quantity and quality issues.
Implement prudent planning to meet the community's existing and long-range needs for cost-effective stormwater management.
Continue sound environmental stewardship, acting as proactive stewards for Salem's urban watersheds as natural amenities in the urban environment.
Improve water quality in, and the beneficial uses of, Salem's urban streams. Sustain and enhance these streams as naturally occurring watercourses. Preserve stream riparian corridors to protect native plant and animal life.
Promote public awareness and education on stormwater management and urban watershed issues. Disseminate timely and accurate information.
Provide responsive customer service in the area of stormwater management.
Provide a long-term vision and feasible implementation strategy for system improvements and expansion, and ongoing operation and maintenance coordinated with land-use plans.
Anchor stormwater planning and management in sound principles of environmental science, economics, engineering and public works management.
Identify cost-effective solutions for flood control, water quality, improvements and stormwater management services.
Assure compliance with current and anticipated regulations, meeting at least the minimum Federal and State regulatory requirements for Salem's stormwater program.

(1) Adopted from the City of Salem Stormwater Management Plan, November 2005.

2.1.2 Management Guidelines

The City has defined general management "guidelines" for evaluating and developing the restoration activities in this watershed management plan. These "guidelines" are developed in part based on the guiding principles from the Stormwater Management Plan, and also by the overall watershed plan goals discussed in Chapter 1. The guidelines are listed in **Table 2-2**. These guidelines are for guidance purposes only and are not adopted into municipal code, rule or directive by the City.

Table 2-2. Watershed Management Guidelines
Policy 1: Urban streams will not be managed to return the watershed to pre-development conditions. Community needs and objectives, such as flood control, storm and sanitary sewer locations, recreation, and safety, may take precedence over biological objectives.
Policy 2: Both a systematic and opportunity- based approach should be used for selecting restoration projects that are consistent with the management plan.. Whenever possible, preference will be given for upland or upstream practices or conditions to be restored to affect a larger fraction of the subwatershed. However, because of the urban nature of the watershed, it is recognized that restoration benefits may be limited to a defined point or reach and have limited ecological benefit.
Policy 3: Restoration activities will consider current and future land uses and development based on existing land use planning information.
Policy 4: Watershed management activities associated with stormwater will be consistent with or compliment the best management practices developed and maintained under the City's existing Stormwater Management Plan (November 2005).
Policy 5: Based on previous work completed by the City, widespread use of regional detention facilities is not considered part of the management strategy. However, retrofitting local detention facilities is considered an option.
Policy 6: Priorities and needs identified by watershed planning groups and other public interests will be considered in developing restoration priorities.

Policy 6 involves incorporating public interests in developing restoration priorities in the watershed plan. As part of the plan development, the City of Salem is conducting public outreach. This is described further in **Section 2.3**.

2.1.3 Categories for Restoration Objectives

The Center for Watershed Protection has developed a method to categorize urban watersheds into three main levels of "health" and potential for future restoration[1] (Schueler, 2005a). The classifications are based primarily on the level of impervious cover[2]. **Table 2-3** lists the three classifications. For the purposes of this Plan, these classifications are used as a basis for defining appropriate restoration objectives and to define restoration opportunities for a given area or stream reach in the watershed. This does not preclude any restoration technique, but rather helps to organize the screening of the myriad of techniques that exist. Chapter 3 includes a more detailed discussion of the impacts of urbanization on watershed processes. The management actions recommended in subsequent chapters (Chapters 4, 5, and 6) are based in part on these restoration objective classifications.

Table 2-3. Urban Watershed Classifications and Restoration Objectives

Classification	General Stream/Watershed Character	General Restoration Objective	Impervious Cover
Impacted	Most indicators of stream health are in the "fair" range; moderate degradation; intact stream corridor; enough land available to install restoration practices.	Attempt to systematically restore habitat throughout the stream network.	10-25%
Non-supporting	No longer supports designated beneficial uses; cannot attain pre-development conditions for most indicators.	Repair specific stream problem(s) at a defined point or reach within the stream network; may or may not have associated ecological benefits to the watershed.	25-60%
Urban drainage	Stream corridor is essentially eliminated or physically altered and the stream functions merely as a conduit for flood waters; stream health indicators are "poor."	Focus on pollutant reductions; no further damage or harm; seek retrofit opportunities whenever available.	>60%

2.2 Opportunities and Constraints

This section describes the general opportunities and constraints associated with restoration activities in an urban watershed. The opportunities and constraints are discussed in terms of: (i) areas or features in the watershed where restoration activities may be developed, and (ii) types of restoration activities that may be implemented in urban watersheds.

2.2.1 Watershed Features with Opportunities for Restoration

[1] *A fourth category ("sensitive") is not discussed here since it generally does not apply to urban watersheds. The sensitive category is defined for more natural and undisturbed watersheds where the percentage of impervious area is typically less than 10%.*

[2] *Land surface in the watershed covered by materials impenetrable to water such as roads, buildings, parking lots, sidewalks, etc.*

In a landscape dominated by the built environment, it is important to envision where the best potential for restoration opportunities exists and the constraints that may limit their implementability or long-term effectiveness. In a highly urbanized watershed, opportunities for restoration may be more difficult to identify because significant land areas (e.g. 3% - 5% of a subwatershed) may need to have improved conditions. Furthermore, available land for projects needs to be ecologically connected to have significant benefits. These watershed features are considered specifically in the analysis described in the drainage, water quality, and habitat sections of the plan for potential restoration activities. **Figures 2-1 and 2-2** illustrate the locations of some of the listed key watershed features. The watershed features or areas of focus for restoration activities are listed in **Table 2-4**. Other features such as wetlands and low impervious areas are discussed further in Chapter 4.

In many instances, simply reviewing maps is not enough to define specific restoration activities for the key watershed features listed in **Table 2-4**. Therefore, the opportunities identified in this watershed plan (Chapters 4, 5, and 6) are considered a first step in developing the restoration projects. The plan links the impaired watershed process and potential opportunities for restoration. Detailed site investigations are needed at each potential restoration area to develop the conceptual and detailed designs. The early action projects developed in Chapter 8 are examples of the types of projects that can be developed in these areas.

It should also be noted that stormwater "hotspots", sanitary and storm sewer system infrastructure, and street and storm drain inlets (the last three watershed features listed in **Table 2-4**) are already managed under the best management practices in the Stormwater Management Plan (November 2005) (refer to **Section 2.4.1**). These features, although key in improving overall watershed health, are considered in this plan by integrating the Stormwater Management Plan with the Watershed Plan strategies. This is discussed further in implementation strategies in Chapter 9.

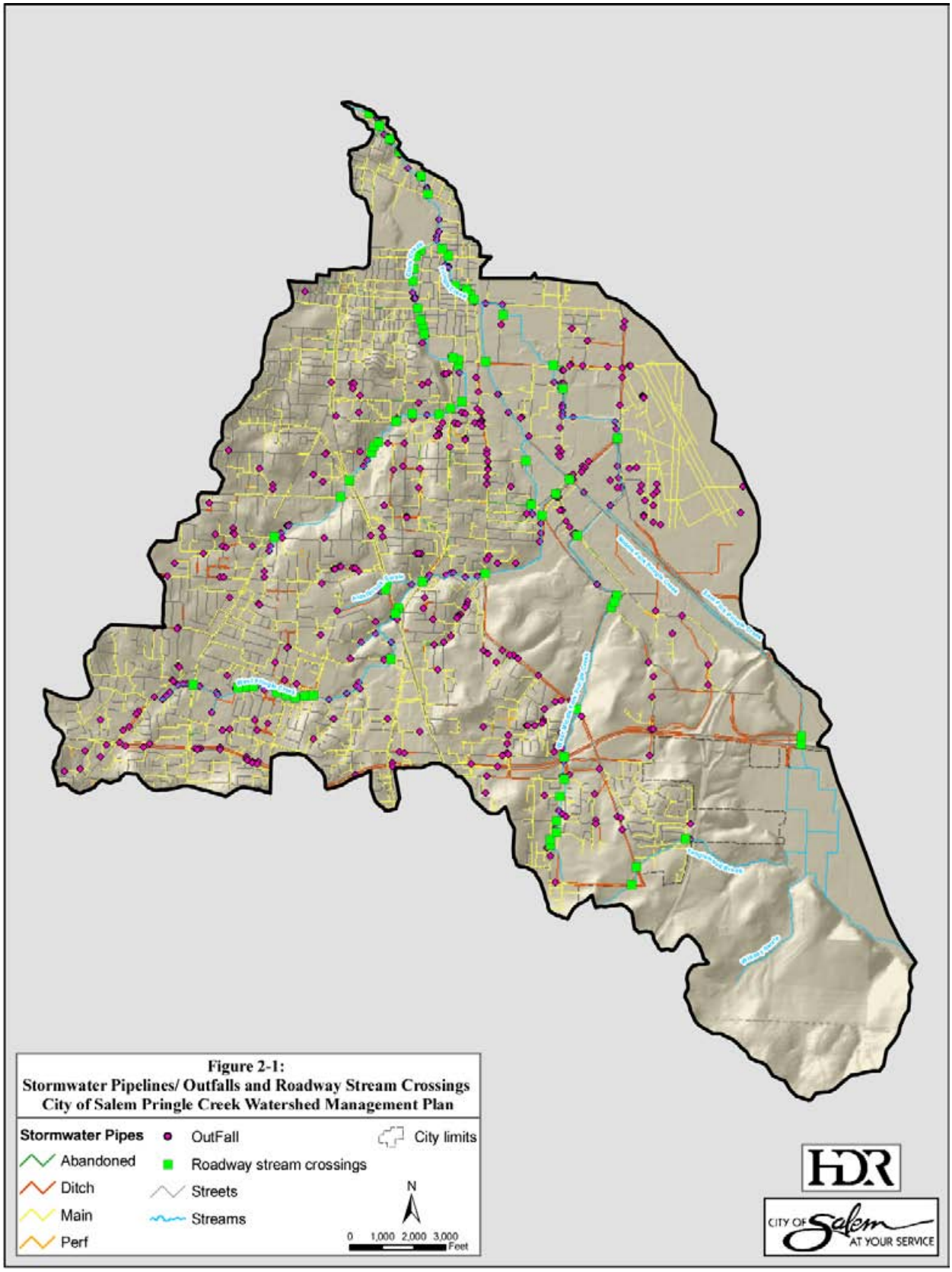


Figure 2-1:
Stormwater Pipelines/ Outfalls and Roadway Stream Crossings
City of Salem Pringle Creek Watershed Management Plan

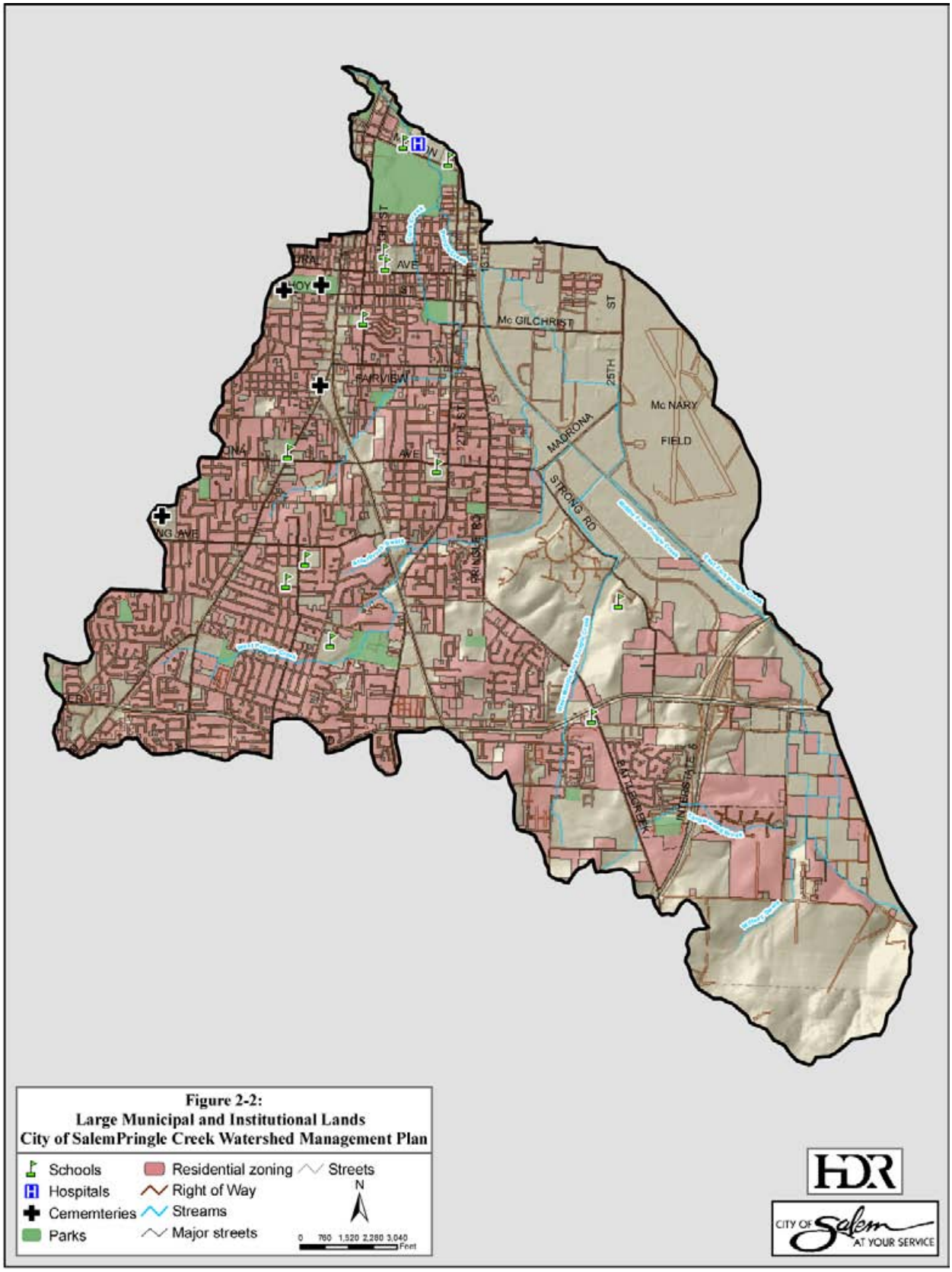


Figure 2-2:
Large Municipal and Institutional Lands
City of SalemPringle Creek Watershed Management Plan

Table 2-4. Urban Watershed Features with Opportunities for Restoration			
Watershed Features	Description	Opportunities	Constraints
Remaining stream corridor (aquatic corridor)	▪ Transition zone between the upland storm drain system and the urban stream	▪ Often enough available land to install restoration practices to improve stream conditions. ▪ Storage retrofits, riparian management, discharge prevention practices	▪ Some stream corridors have been eliminated or significantly reduced in Pringle Creek watershed. ▪ Easements and private property issues.
Existing storm water infrastructure	▪ Stormwater conveyance structures: catch basins, pipes, open drainage, outfalls, detention ponds	▪ Land is already devoted to stormwater management ▪ Outfalls, open land adjacent to outfalls, and detention facilities are candidates for storage retrofit and managing discharges	▪ Stormwater conveyance network may be difficult to identify or delineate on maps.
Open municipal land (critical habitat, hydrologic reserve)	▪ Parks, public golf courses, schools, rights-of-way, protected open spaces	▪ Generally provide large size and accessible land ownership.	▪ Potentially conflicting/competing municipal uses.
Remaining natural area	▪ Forest and wetland fragments	▪ Expanding natural areas and linking stream corridors or other natural areas.	▪ Not preferred for intrusive restoration projects.
Road crossings and rights-of-way	▪ Points where roads cross streams and large rights-of-way (e.g. highway access maps)	▪ Bridges and culverts are typically suspected fish migration barriers ▪ Road crossings provide excellent access to the stream corridor.	▪ Bridges and culverts may also act as useful grade control along incising streams. ▪ Crossings are sometimes modified to provide temporary storage and treatment of stormwater
Large parking lots	▪ Large parking lots in commercial or industrial areas.	▪ Significant source of stormwater runoff and pollution ▪ Generally includes large clusters of stormwater "hotspots."	▪ May be difficult to spend local funds to improve private lands. ▪ Landowners may be reluctant to pay for restoration projects; incentives needed.
Residential neighborhoods	▪ Residential land use/zoning	▪ On-site retrofits; residential stewardship practices ▪ Future low-impact development	▪ Each neighborhood has its own distinctive physical character and public interest in restoration
Large parcels of institutional land	▪ Hospitals, colleges, corporate parks, private golf courses, cemeteries, private schools and institutional facilities.	▪ Potential for large areas of unused land for locating restoration practices ▪ Retrofit opportunities ▪ Opportunities for alternative stormwater management if sanitary sewer infiltration/inflow is a problem and institutions are paying large sewer bills.	▪ May be difficult to spend local funds to improve private lands. ▪ Landowners may be reluctant to pay for restoration projects—incentives needed.

Table 2-4. Urban Watershed Features with Opportunities for Restoration			
Watershed Features	Description	Opportunities	Constraints
Stormwater hotspots[1]	▪ Commercial, industrial, municipal, and impervious related land uses that generate higher levels of runoff and pollution	▪ Pollution prevention practices	▪ Difficult to find on maps and may require database or field surveys.
Storm Sewer infrastructure[1]	▪ Sewer pipe network and septic systems	▪ Potential to eliminate sewage discharges via cross connections and sewer system overflows.	▪ Reliability of mapping information.
Streets and storm drains[1]	▪ *Miles of streets*	▪ Pollutants tend to accumulate on street surfaces, inlets and catch basins ▪ Well-suited for highly urbanized subwatersheds with few options for other restoration activities.	▪ Reliability of storm drain inlet maps.

[1]This watershed feature is addressed under the City's Stormwater Management Plan (November 2005). Management of this feature is not considered specifically in this Watershed Plan, except through integration of the Stormwater Management Plan best management practices.

2.2.2 Restoration Activities

This section lists the types of restoration activities that can be implemented in the watershed areas discussed in the previous section. Restoration opportunities include structural or non-structural applications to improve stream health through physical, hydrological, ecological, chemical, or social means. The restoration practices are classified into broad categories in **Table 2-5**. Specific restoration activities are discussed further in subsequent chapters as they relate specifically to hydrology/drainage, water quality impairments, and habitat in the subwatersheds.

Table 2-5. Management Action Effectiveness to meet Watershed Objectives

		Watershed Objectives								
		Improve drainage conditions	Reduce magnitude and frequency of flooding events	Reduce erosion and sedimentation; improve bank stability	Improve riparian and floodplain function	Improve aquatic habitat	Improve water quality (temperature)	Improve water quality (bacteria)	Improve water quality (other urban pollutants)	Stream corridor aesthetics and recreation
	Management Actions									
Stormwater Management	Modify storm drain system to increase infiltration	●	●	●		○	○	○	○	
	Modify storm drain system to increase detention (local detention facilities)	●	●	●		○	○	○	○	
	Modify storm drain system to treat stormwater (water quality treatment)	○	○	○		●	●	●	●	
	Increase stormwater conveyance capacity (culverts/pipelines/bridges)	●	●	●						
Wetlands	Wetland enhancement	●	●	●	●		●	●	●	●
Stream and Habitat Repair/ Protection	Streambank stabilization	○	○	●	●	●	○	○	○	●
	Instream flow controls	○	○	●	●	●	○	○	○	●
	Instream habitat structures	○	○	●	●	●	○	○	○	●
	Channel and floodplain redesign/construction	●	●	●	●	●				●
	Fish passage improvement	○		○		●				●
Riparian Mgmt.	Increase quantity and quality of canopy and other vegetative cover (including removing invasive species)	○		●	●		●	○	●	●
	Protect/ Create riparian buffer	○	○	○	●	○	●	○	●	●
Discharge Prevention	Operate and maintain storm drainage system to remove and prevent pollutant discharges					●	○	●	●	

Table 2-5. Management Action Effectiveness to meet Watershed Objectives

		Watershed Objectives								
		Improve drainage conditions	Reduce magnitude and frequency of flooding events	Reduce erosion and sedimentation; improve bank stability	Improve riparian and floodplain function	Improve aquatic habitat	Improve water quality (temperature)	Improve water quality (bacteria)	Improve water quality (other urban pollutants)	Stream corridor aesthetics and recreation
	Management Actions									
	Reduce illicit and non-stormwater discharges					●	○	●	●	
Protection and Policy	Promote low impact development practices in development and redevelopment projects	●	●	○		○	●	●	●	
Protection and Policy	Manage/enforce pollutant discharge requirements for industrial and commercial sites					●	○	●	●	
Protection and Policy	Manage/enforce erosion, sediment, pollutant discharge from construction sites					●	○	●	●	
Protection and Policy	Protect sites/features with high watershed value (wetlands, floodplains, riparian areas)	●	●	●	●	●	●	●	●	●
Protection and Policy	Revise or update zoning ordinances to provide incentive-, performance- or watershed-based zoning	●	●	●	●	●	●	●	●	●
Education, Involvement, Stewardship	Provide education and technical assistance to city staff and industrial/commercial facilities on pollution prevention					●	○	●	●	
Education, Involvement, Stewardship	Provide education, involvement and stewardship on pollution prevention to organizations and public					●	○	●	●	
Education, Involvement, Stewardship	Provide education, involvement and stewardship on watershed function to organizations and public	●	●	●	●	●	●	●	●	●
Education, Involvement, Stewardship	Fund and implement stream cleanup programs and specific restoration projects					○		●	●	●

● *– Management action directly addresses objective*

○ *– Management action indirectly addresses objective*

-- - Management action generally does not address objective

The Watershed Management Plan focuses on the stormwater retrofits, stream repair, riparian management, pervious area restoration, and nonstormwater-specific related municipal practices (e.g. parks maintenance along streambanks). The Stormwater Management Plan (discussed in **Section 2.4.1**) lays out specific best management practices related to pollution prevention, pollution source control, and municipal practices and programs related to stormwater. Stormwater-related activities are incorporated by integrating the Stormwater Management Plan with the Watershed Plan strategies. This is discussed further in implementation strategies in Chapter 9.

2.2.3 Protection Activities

This section lists the types of protection activities that can be implemented in the watershed areas discussed in the previous section. Protection opportunities generally involve developing ordinances or regulations or modifying planning approaches within the watershed. Some of the protection activities are inherently linked or required components of restoration activities. The protection activities are classified into broad categories in **Table 2-6**. Specific restoration activities are discussed further in subsequent chapters as they relate specifically to hydrology/drainage, habitat, and water quality impairments in the subwatersheds.

Table 2-6. Categories of Protection Practices

Restoration Category	Examples	Functions
Ordinances or regulations for new development or redevelopment	▪ Require source control BMPs and establish performance requirements ▪ Protection for stream channels and wetlands	Control nonpoint source pollution resulting from development activities
Infrastructure planning	▪ Long-term comprehensive plans ▪ Capital improvement program integration	Help guide development patterns away from areas that provide water quality benefits or environmentally sensitive areas.
Revise local zoning ordinances	▪ Performance-based zoning ▪ Overlay zones ▪ Bonus or incentive zoning ▪ Watershed-based zoning	Ensure that development and re-development has a minimal impact on watershed function.
Establish setback (buffer zone) standards	▪ Buffer ordinance ▪ Vegetative use strategies with management zones ▪ Buffer education and awareness programs	Provide a transition between upland development and water bodies.
Administrative review/approval requirements	▪ Site plan reviews and approval ▪ Official mapping for managed resources ▪ Environmental impact assessment statements	Ensures consistency with laws and regulations of local government jurisdiction and preserves natural resources for protecting water quality and habitat.

2.3 Public Outreach

The public outreach goals for Pringle Creek watershed planning are to educate the public and to foster community partnerships to help implement watershed protection and restoration activities. The goals include:

- Design and implement an effective public outreach program to inform, educate, and involve citizens in watershed planning, preparing them to accept stewardship responsibilities in their watershed.

- Through lasting community partnerships, enlist an informed and reliable group of "watershed stewards" – residents, property owners, business owners, students and other volunteers in the Pringle Creek area who are ready and willing to initiate and continue watershed protection activities well beyond the current Pringle Creek planning effort.

- Develop and conduct public outreach for Pringle Creek watershed planning as a prototype for other watersheds. Use the Pringle Creek Watershed Management Plan to promote city-wide

awareness of community-wide watershed issues and activities – as an example for Salem's other urban watersheds.

- Conduct the public education in phases: first raising awareness regarding stream health and the effects of urbanization; then promoting cost effective watershed restoration and best management practices.

2.3.1 Stakeholders

The pilot watershed plan is intended to be the primary platform to help develop a common vision for watershed health and to allow input from a broad group of stakeholders. The Plan will also be used as the basis for the City to receive input from stakeholders and adapt the watershed plan for the City's other watersheds.

The stakeholders that the City will work with include the general public, agencies, watershed partners, and potential funding sources. The list of stakeholders identified by the City for Pringle Creek is listed in **Table 2-7**. Other watershed-specific stakeholders may be identified for the City's other watersheds.

Table 2-7. List of Pringle Creek Watershed Stakeholders
Streamside Property Owners
Salem Chamber of Commerce
Pringle Creek Watershed Council
Salem-Keizer School District (specific schools)
Salem Board of Realtors
Salem Planning Commission
Neighborhood Associations
Regulatory Agencies (DEQ, ODFW, DSL)
City Departments (Community Development, Community Services (Parks), Urban Development, Public Works)
Environmental Groups (Willamette Riverkeepers, Salem Audubon)
Major land owners/industries

Specifically, the Pringle Creek Watershed Plan will be used by the Public Works Department to:

- Inform elected City officials about watershed restoration needs and priorities as part of the budget approval process for restoration activities.

- Coordinate with other City departments (e.g. Community Development., Community Services, Parks, Urban Development, etc.) to contribute to watershed restoration through their respective missions.

- Coordinate with watershed groups and the public to coordinate their watershed restoration priorities and activities with the City's overall restoration program.

- Involve other "watershed partners" (e.g. media, local businesses, landowners, and developers) to identify stewardship opportunities on their lands.

- Provide a forum for the public to inform the City of their values with respect to watershed restoration.

For the Pringle Creek Plan, the City is especially focused on working with the Pringle Creek Watershed Council (PCWC) and streamside landowners. The PCWC was formed in 1995 and is served by a board of directors who represent major stakeholders in the watershed, including educational/academic, business/economic, environmental, government, residential/property owners, scientific/technical advisors, five Neighborhood Associations, and others. They are among the most knowledgeable about the needs of their watershed and have already identified specific projects that they would like implemented to improve watershed health. Cooperation with the watershed council is key for identifying and pursuing realistic and implementable, citizen-driven projects that improve the health of the watershed and streams. In addition, the streamside landowners are most likely familiar with stream processes and how stream conditions are impacted by natural and man-made occurrences and features. They are most likely to act to benefit the resource "in their backyards."

2.3.2 Public Outreach Work Plan

To accomplish the above objectives and coordinate with project stakeholders, the City has developed a public outreach work plan. The public outreach plan is divided into two phases. The first phase focuses on the education component and the second phase focuses on developing the partnerships.

Phase 1 of the public outreach program uses the Pringle Creek watershed analysis and planning to educate area residents, agencies and other key stakeholders, raising awareness about stream health, watershed issues, and priorities for protection. Besides the activities developed specifically for the watershed planning program, the City leverages its other outreach activities under its drinking water source water protection and stormwater management programs.

The two main products developed under Phase 1 are the public survey and various information materials. Information materials include project fact sheets, utility bill inserts, watershed maps, and presentation materials for community briefings, as well as a watershed protection video. The content of the materials focus on providing an overview of the watershed management plan objectives, the planning process, schedule, key issues for watershed restoration, and information on how to get involved. Examples of the materials are included in **Appendix B**.

A key component of Phase 1 is to conduct a series of public surveys to learn more about the public's current awareness of watershed issues and interest in participating in stewardship activities. The survey is intended to promote "two-way" communication in terms of educating the public about the City's plans as well as receiving input on the values of the public with respect to watershed protection. A phone survey was conducted of a random sample of the general public living within Pringle Creek watershed, and a separate phone survey was conducted for streamside property owners within Pringle Creek watershed. Copies of the surveys are included in **Appendix B.** The findings from the surveys are discussed in **Section 2.3.3.**

Phase 2 of the public outreach program focuses on developing partnerships with interested groups and the public to help implement the watershed plan activities and projects. In order to foster these partnerships, the City wants to emphasize prioritized cost-effective watershed protection and best management practices that will minimize future public expenditures for watershed protection while addressing both water quantity and quality. The intent is to maximize program effectiveness by partnering with interested organizations and key stakeholders, getting their buy-in and enlisting their full participation. Interested organizations and stakeholders are also expected to raise awareness within the watershed. Phase 2 of the program is also intended to inform Pringle Creek residents and interested stakeholders about Salem's planned watershed improvements and those already underway. Finally, Phase 2 of the program will involve stakeholders in additional early priorities and action projects for watershed protection.

In order to seed these potential partnerships, the public outreach program includes community briefings and media outreach that will occur once the City completes the draft Pringle Creek Watershed Management Plan. The City will schedule presentations with interested community organizations within the Pringle Creek watershed and beyond its boundaries to review watershed management issues, seek public input on priorities, and enlist active participation in stewardship programs. The City will also schedule an open house during the public review period of the watershed plan. After the briefings and public review period, the City will incorporate the public input as appropriate before finalizing the Plan.

2.3.3 Public Survey Findings from Stormwater Management Plan

Findings from the stormwater management plan public survey conducted in September 2005 indicate there is relatively equal concern for stormwater quantity issues (flooding), stormwater quality issues (pollution), and protecting rivers, streams, and habitat. With respect to stormwater management and watershed protection, the survey indicates that public education is considered one of the most important ways to manage stormwater and protect the watershed. This is followed by physical means to control runoff; development practices to reduce impervious surfaces; constructing or maintaining natural/environmental controls such as wetlands, open spaces, and bioswales; and finally careful maintenance of the stormwater system.

2.4 Key Project Area Programs and Plans

The timing for developing the urban watershed management plans present several opportunities for the City. The City has been in the process of implementing several watershed "characterization" -related programs. These recent activities are key opportunities for data and information collection the City can use to develop a formal watershed planning program. As discussed in Chapter 1, the City is relying on several studies already completed by the City to characterize the Pringle Creek watershed. The City is also using this opportunity to attempt to integrate its other programs to address common issues associated with CWA and ESA compliance.

2.4.1 NPDES MS4 Permit and Stormwater Management Program

The City of Salem is a Phase I community under the National Pollutant Discharge Elimination System (NPDES) stormwater regulations of the Clean Water Act. As such, the City is required to obtain a municipal separate storm sewer system (MS4) permit from the Oregon Department of Environmental Quality (DEQ) and to maintain an updated Stormwater Management Plan (SWMP) as part of permit compliance. The City's MS4 permit was originally issued in 1997 and the SWMP has since been updated in 2002 and most recently in November 2005. The 2005 SWMP is currently under review by DEQ.

The SWMP includes best management practices (BMPs) the City believes will reduce the pollutants discharged from the MS4 to the "maximum extent practicable" as required by NPDES regulations. **Appendix C** includes a summary of the 25 specific BMPs as described in the 2005 SWMP. These 25 BMPs satisfy one or more of the four main required elements of the SWMP:

- Structural and source controls for residential and commercial areas.
- Program for the control of illicit discharges and improper disposal into the storm drainage system.
- Program to monitor and control pollutants from industrial facilities; hazardous waste treatment, storage and disposal (TSD) facilities; and municipal landfills.
- Program to implement and maintain structural and non-structural BMPs to reduce pollutants from construction sites.

The City is also required to develop a stormwater monitoring program under its MS4 permit. The City's stormwater quality monitoring program consists of monitoring: (i) Willamette River; (ii) urban streams; (iii) BMP treatment efficiency; and (iv) stormwater outfalls. At the time the SWMP was last updated in 2005, the City did not have to address TMDL-related monitoring requirements, but did have to start addressing its 303(d) listed streams. However, the City is reviewing its TMDL implementation plan needs and will likely develop the implementation plan during the 2006-2007 period with guidance from DEQ, with ultimate adoption sometime in 2008.

2.4.2 TMDL Implementation Program

The Total Maximum Daily Load (TMDL) is the maximum amount of a pollutant a water body can assimilate without violating a water quality standard. DEQ has adopted (as of September 21, 2006) TMDLs for the Willamette Basin for mercury, bacteria, and temperature. Designated management agencies (DMAs), which include the City of Salem, are then required to prepare TMDL Implementation Plans that document how the waste load allocations or load allocations[3] will be met. At this time, DEQ is developing an internal management directive (IMD) to guide

[3] *The amount of a given pollutant that has a point source with an NPDES permit is allowed to discharge is called a wasteload allocation; non-point sources are given a load allocation.*

the development of the TMDL implementation plans. The City is expecting that the submittal deadline for the implementation plan for temperature and bacteria will be sometime in early 2008 (18 months after the TMDL is adopted by the DEQ as an order). The City intends to integrate the appropriate strategies developed under the watershed plans and the BMPs in the SWMP into the TMDL implementation plans.

2.4.3 Wetlands Program

Under the Statewide Planning Goal 5, local governments are required to develop programs to protect wetlands. The City of Salem has taken the initiative to begin a wetlands management program to provide for long-term protection of these valuable resources. The first step towards compliance with Goal 5 was completion of the Local Wetland Inventory (LWI) in the late 1990s, whereby over 1,400 acres of wetlands were identified within the study area. The next steps for Goal 5 include determining which wetlands are significant using an approved process, and designing a protection program for those wetlands. These are the wetlands for which regulatory ordinances will be developed in order to comply with the Statewide Planning Goals. It was beyond the scope of developing this watershed plan to characterize the wetlands in the LWI. However, the restoration opportunities take into consideration their presence.

2.4.4 Willamette Greenway Program

The Willamette Greenway is the area that immediately abuts the Willamette River from Eugene to Portland. In the 1970's, Oregonians decided to create a program that would maintain and enhance the scenic, recreational, and historical features of the river, while protecting existing activities on both public and private lands. Salem City Council adopted code amendments (SRC 141) for the Greenway so that there can be an appropriate balance between providing for future urbanization along the Willamette's riparian fringe while preserving and enhancing its sensitive ecological areas and functions. The objectives of this program can be integrated with the restoration and protection needs identified in this plan.

2.4.5 Watershed Protection and Preservation Program

In 2001, the Salem City Council approved a grant program for protecting and preserving its urban watersheds. The purpose of the program is to provide small grants for volunteer and educational organizations to create innovative projects that involve as much of the community as possible. Grants can be awarded to government agencies, non-profit organizations, and individuals. This program can be leveraged for project needs identified in this Plan. It is administered by the City’s Public Works Department.

2.4.6 Stormwater Master Plan and Drainage System Improvement Plan (September 2000)

The Stormwater Master Plan was completed in 2000 to satisfy one of the BMPs developed in the initial 1996 SWMP (under the City’s initial NPDES MS4 Permit). The overall goal of the Stormwater Master Plan was to develop a stormwater management program that cost effectively balances reductions in flood damages with improvements in stream water quality, while

reflecting the City's financial resources to support the program. As part of the Master Plan, the City developed a supplemental Drainage System Improvement Plan (DSIP) and a Stormwater Management Program Plan (SMPP). The DSIP focused on identifying the recommended construction projects through computer hydraulic modeling (XP-SWMM) of the existing and future drainage system. The SMPP outlined the policy and institutional aspects of the City's stormwater management program, including program funding, operations and maintenance (O&M), and public education and involvement.

The DSIP is of particular interest for the development of the Pringle Creek Watershed Management Plan. The projects identified in the DSIP for the Pringle Creek watershed are reviewed and prioritized in this Plan based on an integrated review of current drainage, water quality and habitat conditions conducted under the Watershed Plan. This review is discussed further in Chapter 4.

2.4.7 Bioassessment Study (October 2000)

The City of Salem conducted a "bioassessment study" in 2000 in the Pringle Creek watershed. The objectives of the study were to determine the status, extent, changes and trends in indicators of stream condition and seek associations between human-induced stresses and ecological condition. The bioassessment surveys included collection of benthic macroinvertebrate samples, a rapid habitat assessment, and quantitative measurements of physical habitat. The City collected the data but did not conduct any interpretation or analysis of it. The Pringle Creek Watershed Plan project is using this data to determine which stream reaches are most in need of restoration or enhancement based on aquatic and riparian habitat conditions as well as identify those stream reaches that are in the best condition and need to be preserved ("save the best and enhance the rest"). In addition, the plan includes recommendations whether similar studies should be conducted in the City's other urban watersheds, and if not, what approach would be more appropriate to meet the planning objectives. The findings and recommendations based on this study are discussed in detail in Chapter 6.

2.4.8 Pringle, Glen-Gibson, Claggett, and Mill Creeks Watershed Assessment (January 2002)

A grant was secured through the Mid-Willamette Valley Council of Governments (MWVCOG) to develop a watershed assessment for Pringle, Glenn-Gibson, Claggett and Mill Creek watersheds (Hemesath and Nunez, 2002). The assessment was completed in January 2002. The assessment provides current and historic information on the physical, biological, and cultural landscape in the four watersheds. The main focus of the assessment was to synthesize existing data sets and studies pertaining to the watersheds. The assessment included discussion of the historical conditions, water quality and quantity, soils, aquatic and terrestrial habitats, and fish and wildlife. Although the discussions are general in nature, the information provides a basis for: identifying ecological functions and habitat types that would benefit from restoration and protection; and identifying data gaps.

2.4.9 Historic Salmon Distribution Study (July 2003)

The City of Salem, Marion County, and the Mid-Willamette Valley Council of Governments (MWVCOG) prepared an assessment of historic salmon distribution in Salem and Marion County. This was done in part to further progress in the City's mission to develop a unified response to the Endangered Species Act (ESA) listing of winter steelhead and spring Chinook salmon. The response is an integrated effort to assess the effect of City activities on salmon habitat and recommend actions for complying with ESA and working toward salmon recovery. The study collected and integrated GIS layers on historic fish distribution and barriers. The study also identified data gaps and strategies to obtain this information. Finally, the study prioritized basins for enhancement and restoration projects. This information is used in this watershed plan to identify historic fish presence and fish barriers in relation to degraded habitat and to assist in prioritizing restoration projects in the Pringle Creek watershed. **Stormwater Regional Detention Facility (June 2004)**

In June 2004, the City retained a consultant to develop the Stormwater Regional Detention Facilities Study. The purpose of the study was to assess the feasibility of regional stormwater detention within the City. Fourteen potential regional detention facilities previously identified in the City's Stormwater Master Plan (see Section 2.4.6) were screened to determine which facilities would be evaluated further in individual pilot studies. Three were eventually chosen based on flood protection value, immediate need, and varying types of site conditions/characteristics. The sites included: (i) Croisan Creek at Kuebler Blvd. S.; (ii) Glen Creek at Hidden Valley Drive NW; and (iii) West Pringle Creek at Leslie Middle School. However, after review with agencies, the proposed in-stream regional detention sites were deemed "not-permittable" by the fisheries resource agencies. No further work has been conducted by the City since then on regional facilities. At this time, the City is not actively considering regional detention in its stormwater program, and they are not considered in this Watershed Plan.

Chapter 3. Watershed Processes and General Conditions

This chapter provides a general description of the Pringle Creek watershed and each of its major subwatersheds. This chapter also provides an overview of key watershed processes and concepts. It is beyond the scope of this plan to provide a detailed discussion of watershed processes and functions, but the discussion is intended to provide context for how these concepts are used to develop the strategies outlined in the Watershed Plan. Additional focus is placed on impacts of urbanization on the watershed because of the highly urban nature of the Pringle Creek watershed. Additional details about the drainage, habitat and water quality conditions are included in Chapters 4, 5, and 6, respectively.

3.1 General Description of Pringle Creek Watershed

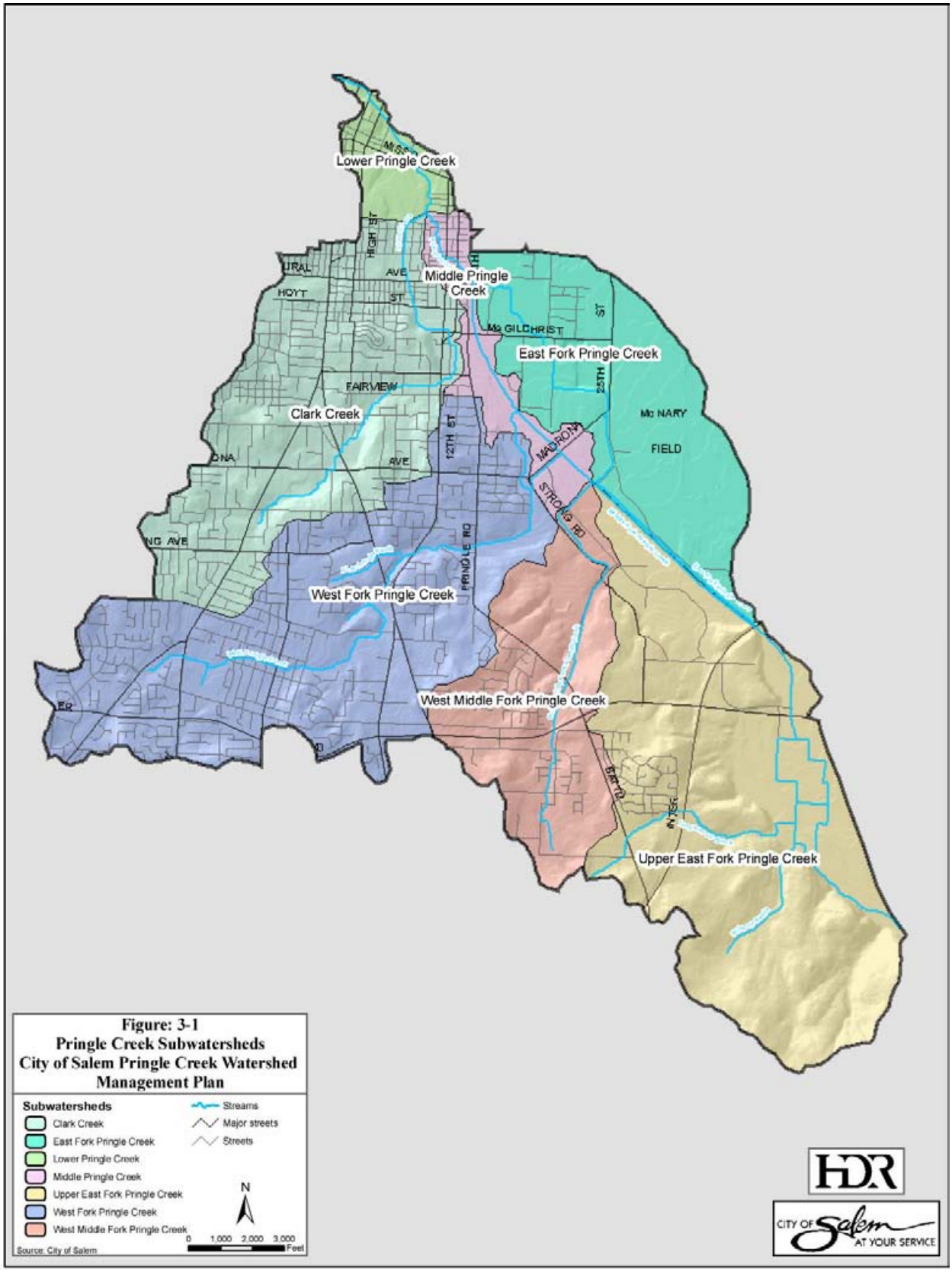
The Pringle Creek watershed covers an area of 13.3 square miles and is located in southeast Salem almost entirely within the City of Salem's urban growth boundary (UGB). The basin terrain is moderate in slope including flat lands and hillsides. Elevations in the basin range from approximately 120 feet above sea level at the mouth of the Pringle Creek to 521 feet in the southern eastern uplands. The Pringle Creek watershed is drained by five tributaries in the Pringle Creek system, including: Clark Creek, West Fork, West-Middle Fork, Middle Fork and East Fork.

For the purposes of this Plan, the Pringle Creek watershed has been divided into seven subwatersheds (tributary names shown):

- Lower Pringle Creek Subwatershed (mainstem Pringle Creek)
- Middle Pringle Creek Subwatershed (mainstem Pringle Creek and lower portion of Middle Fork)
- East Fork Pringle Creek Subwatershed (lower portion of East Fork)
- Upper East Fork Pringle Creek Subwatershed (upper portion of Middle Fork and East Fork)
- West Middle Fork Pringle Creek Subwatershed (West Middle Fork)
- West Fork Pringle Creek Subwatershed (upper portion of mainstem Pringle Creek)
- Clark Creek Subwatershed (Clark Creek)

These subwatersheds are based on the delineation conducted as part of the City's stormwater master plan (Montgomery Watson, 2000). Discussions in this Plan are generally presented in terms of the seven subwatersheds. **Figure 3-1** shows the boundaries of the subwatersheds and the tributaries. Descriptions of each subwatershed are provided in subsections below.

As with many urban streams, Pringle Creek and its tributaries have undergone many changes through the course of rural and then urban development. Historical maps show an array of streams threading and meandering their way through South Salem, sometimes changing course from season to season. According to the Pringle Creek Watershed Assessment (Hemesath and Nunez, 2002), additional complexities in the stream system arose when settlers began damming the creeks for waterpower and irrigation, creating millraces and flumes, digging ditches, splitting creeks, "straightening" channels, and finally filling in and paving over entire streams.


Lower Pringle Creek
Middle Pringle Creek
East Fork Pringle Creek
Clark Creek
West Fork Pringle Creek
West Middle Fork Pringle Creek
Upper East Fork Pringle Creek
HIGH ST
HOYT
ST
AVE
McGILCHRIST
FAIRVIEW
12TH ST
25TH
McNARY
FIELD
MADRONA
STRONG RD
PRINGLE RD
Figure: 3-1
Pringle Creek Subwatersheds
City of Salem Pringle Creek Watershed Management Plan
Subwatersheds
Clark Creek
East Fork Pringle Creek
Lower Pringle Creek
Middle Pringle Creek
Upper East Fork Pringle Creek
West Fork Pringle Creek
West Middle Fork Pringle Creek
Streams
Major streets
Streets
N
0 1,000 2,000 3,000 Feet
Source: City of Salem
HDR
CITY OF Salem AT YOUR SERVICE

With respect to land cover, approximately 60 percent of the watershed is urbanized, while another 27 percent of the watershed is in agricultural use, primarily in the very southeast portion of the watershed. The Pringle Creek basin contains a variety of land uses ranging from a portion of Salem's central business district to single family residential and agriculture uses. The southern portion of the basin contains currently undeveloped tracts, which are zoned for industrial, commercial, and residential uses. The remaining natural areas in the Pringle Creek watershed are mostly publicly owned: parks and city property, school sites and state lands. They offer the most promise for stream protection, enhancement and restoration, as described in the sections to follow. **Figure 3-2** shows the most current land use information. **Figure 3-3** shows the percent impervious area estimated for catchment areas used in the City's Stormwater Master Plan (Montgomery Watson, 2000).

Previous work done by the City and the Pringle Creek Watershed Council characterized the general condition of the watershed. Key issues in the Pringle Creek watershed include:

- Many streams or stream reaches have been subjected to some form of channelization. This activity often entails deepening, widening, relocating, splitting, or straightening streams. Because the watershed is mostly urban, the number of stream miles in which stream channels have been straightened and/or stream banks armored is extensive.

- Estimates of current imperviousness in the Pringle Creek watershed range from 19 to 25 percent according to the City of Salem's Impervious Surface Report (City of Salem, 2002). With over 20 percent of the watershed already covered with impervious surface (Hemesath and Nunez, 2002), Pringle Creek ranks as an "impacted stream" according to the index proposed by Schueler (1994). Future development will easily push this stream into the "non-supporting" category. Imperviousness is projected to ultimately increase to approximately 52 percent (Hemesath and Nunez, 2002).

- There is almost no place with intact riparian corridor vegetation, partly because of traditional stream cleaning methods that favor conveyance over water quality or habitat. In addition, over 50 percent of Pringle Creek and its tributaries have low – or less than 40 percent - shade cover (Hemesath and Nunez, 2002).

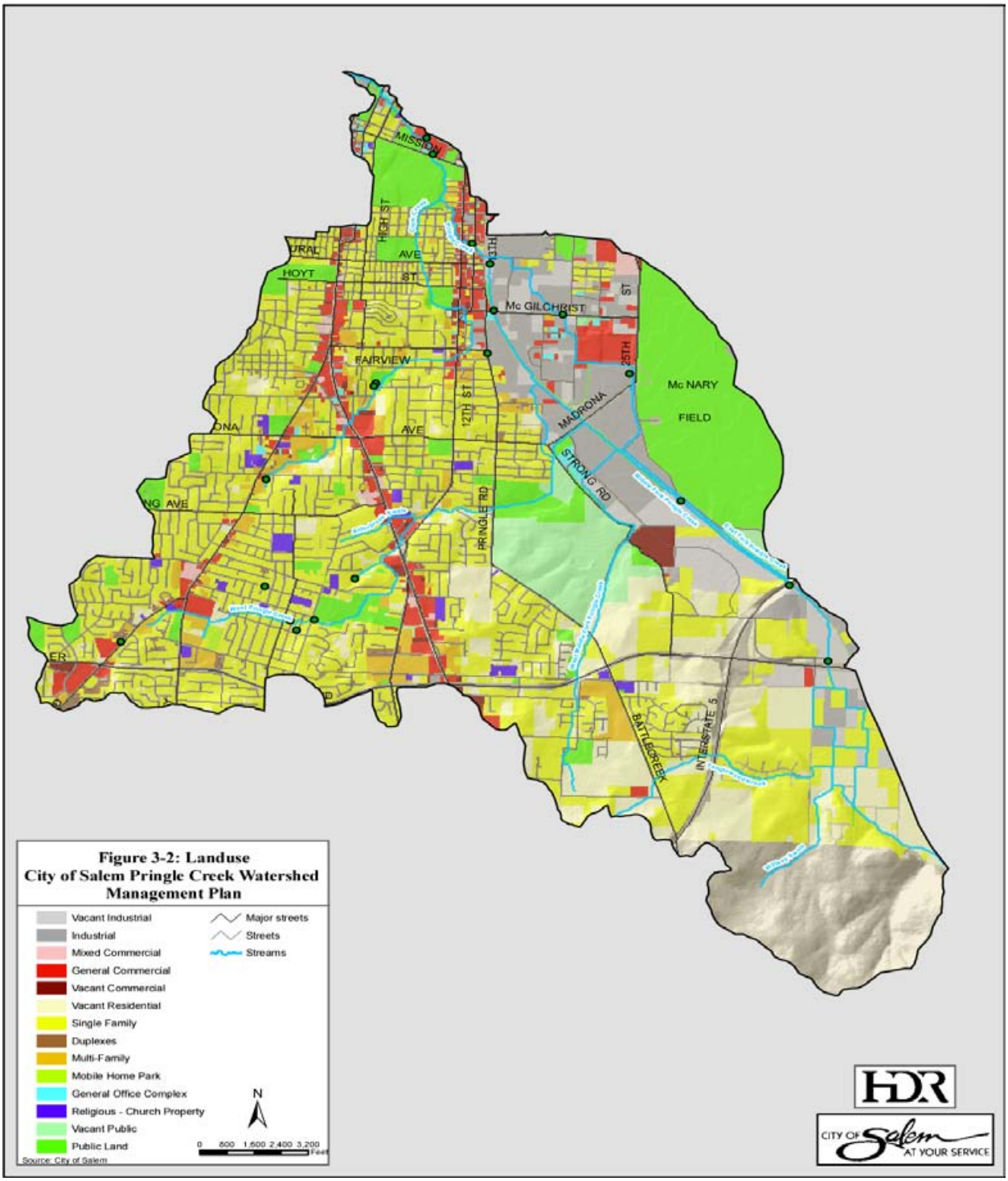
- A significant portion of riparian corridor vegetation is infested by invasive species, including Himalayan blackberries and reed canarygrass.

- The stormwater system has significantly altered water flow dynamics in many urban streams and has led to accelerated rates of bank erosion and channel scouring, and extremely low flows during summer months.

- Many individual streamside landowners have contributed various levels of protection to the creeks that run through or alongside their properties. But most have not provided for long-term protection through conservation easements or deed restrictions.

- Pringle Creek is listed for bacteria (E. coli), temperature and toxics (i.e., dieldrin) in the DEQ 2004 303(d) list of impaired waters. Copper, lead, zinc and mercury are also included in the 2004 list, as wells as dissolved oxygen, E. coli and heptachlor. **Chapter 5** includes additional information on water quality impairment and the 303(d) list.

- In addition to the non-point sources of pollution from the diffuse land uses, there are several point source dischargers, located primarily in the southeast section of the watershed (**Figure 3-4**).


MISSION
HIGH ST
AVE
ST
HOYT
Mc GILCHRIST
FAIRVIEW
AVE
12TH ST
PRINGLE RD
25TH
Mc NARY
FIELD
MADRONA
STRONG RD
BATTLEGREEK
INTERSTATE 5
Figure 3-2: Landuse
City of Salem Pringle Creek Watershed
Management Plan
Vacant Industrial
Industrial
Mixed Commercial
General Commercial
Vacant Commercial
Vacant Residential
Single Family
Duplexes
Multi-Family
Mobile Home Park
General Office Complex
Religious - Church Property
Vacant Public
Public Land
Major streets
Streets
Streams
N
0 800 1,600 2,400 3,200
Feet
Source: City of Salem
HDR
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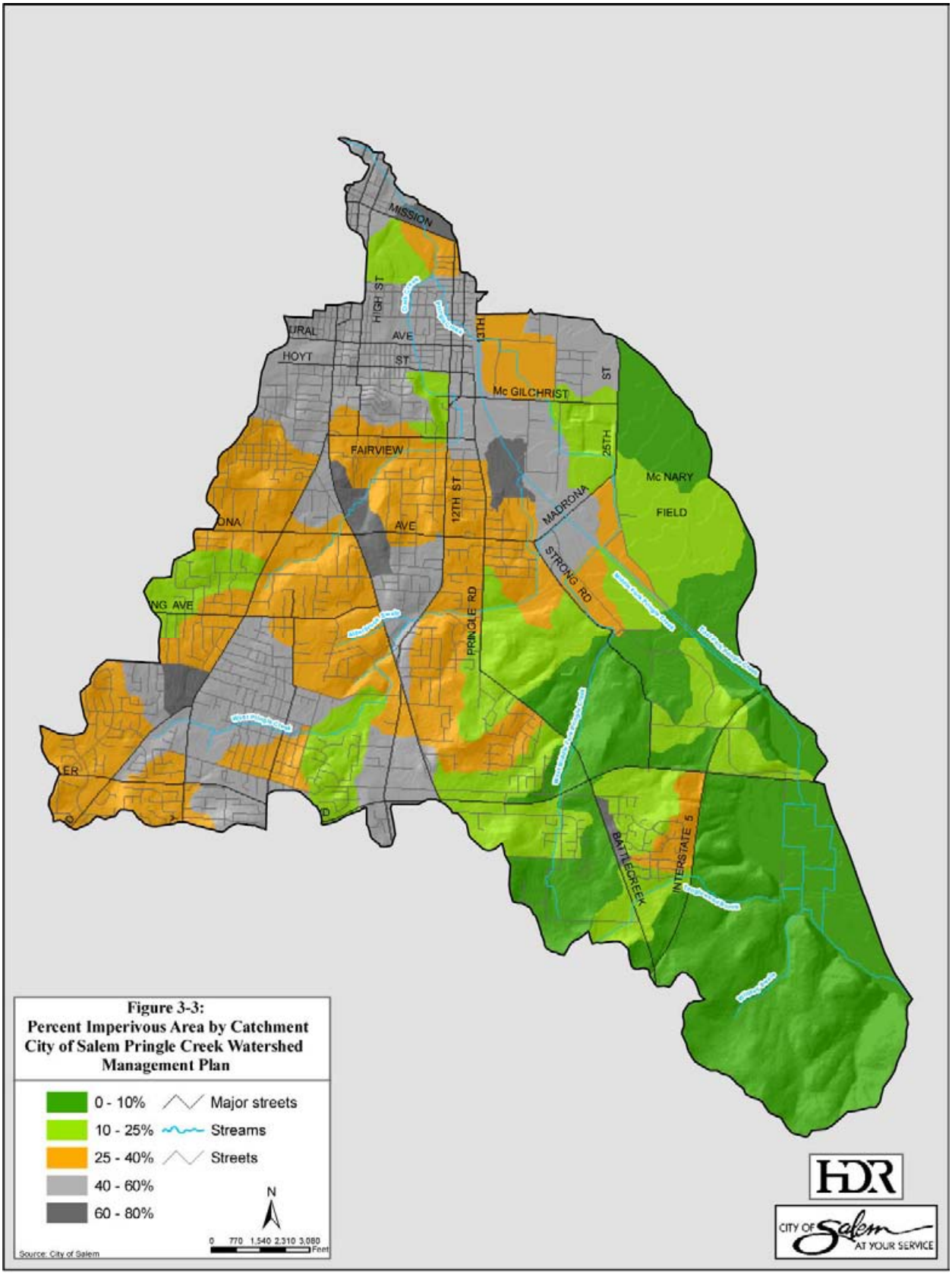
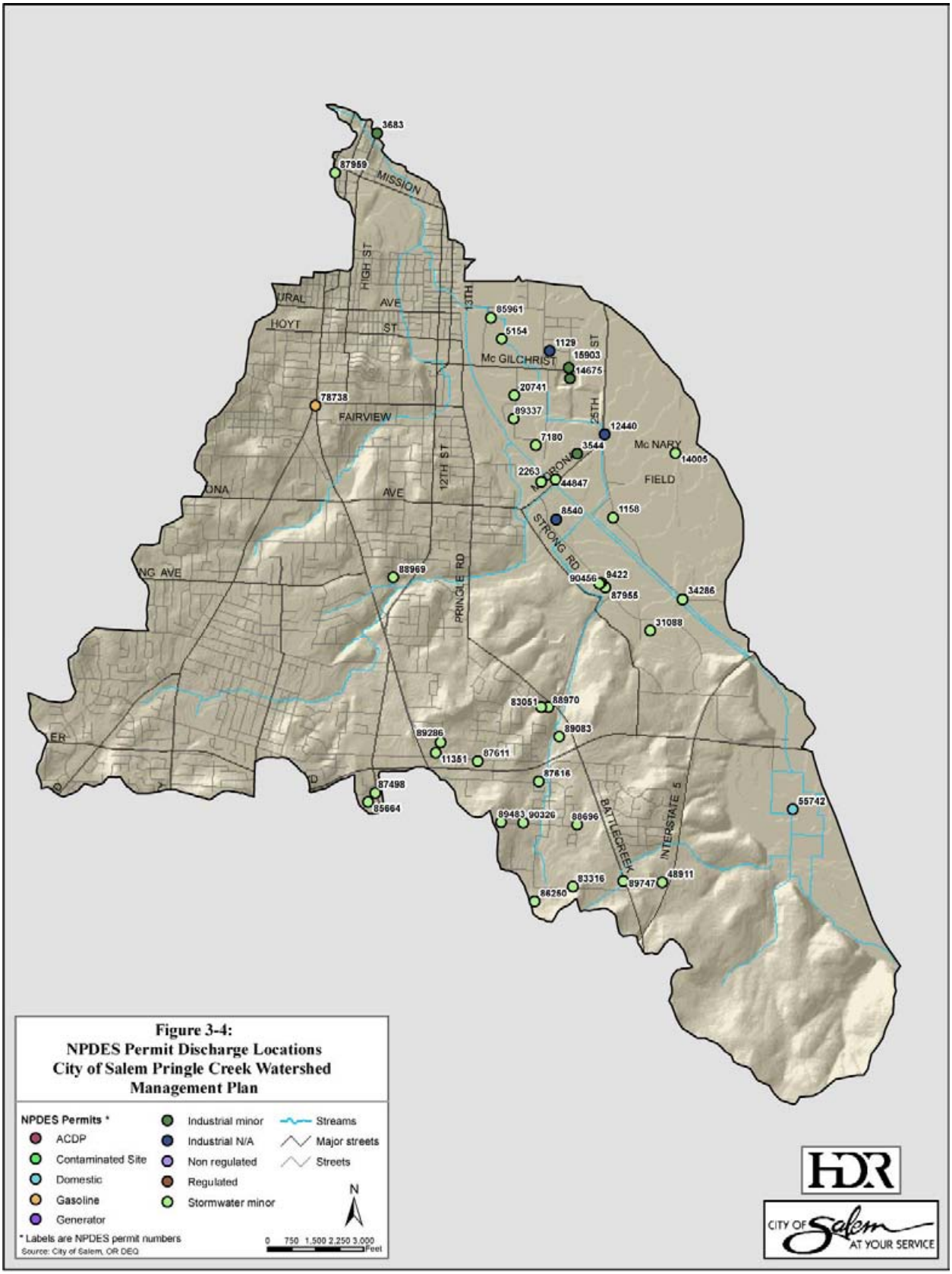

MISSION
HIGH ST
URAL
AVE
HOYT
ST
13TH
Mc GILCHRIST
ST
25TH
FAIRVIEW
Mc NARY
FIELD
12TH ST
MADRONA
ONA
AVE
STRONG RD
NG AVE
PRINGLE RD
ER
BATTLEGREEK
INTERSTATE 5
Figure 3-3:
Percent Imperivous Area by Catchment
City of Salem Pringle Creek Watershed
Management Plan
0 - 10%
10 - 25%
25 - 40%
40 - 60%
60 - 80%
Major streets
Streams
Streets
N
0 770 1,540 2,310 3,080
Feet
Source: City of Salem
HDR
CITY OF Salem AT YOUR SERVICE


3683
87959
MISSION
HIGH ST
URAL
AVE
HOYT
ST
13TH
85961
5154
1129
15903
14675
Mc GILCHRIST
ST
20741
89337
78738
FAIRVIEW
25TH
12440
7180
3544
Mc NARY
14005
2263
44847
FIELD
ONA
AVE
12TH ST
8540
1158
STRONG RD
NG AVE
88969
PRINGLE RD
90456
9422
87955
34286
31088
83051
88970
89083
89286
11351
87611
87616
87498
85664
89483
90326
88696
BATTLECREEK
INTERSTATE 5
55742
83316
89747
48911
86250
Figure 3-4:
NPDES Permit Discharge Locations
City of Salem Pringle Creek Watershed
Management Plan
NPDES Permits *
ACDP
Contaminated Site
Domestic
Gasoline
Generator
Industrial minor
Industrial N/A
Non regulated
Regulated
Stormwater minor
Streams
Major streets
Streets
N
* Labels are NPDES permit numbers
Source: City of Salem, OR DEQ
0 750 1,500 2,250 3,000
Feet
HDR
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The following subsections provide general descriptions of the subwatersheds in the Pringle Creek watershed. Additional details on characterization are included in subsequent chapters for drainage, habitat and water quality. The acreage and impervious estimate listed below are based on the data included in the 2000 Stormwater Master Plan modeling study (Montgomery Watson, 2000). This data is still considered accurate for the purposes of this Plan based on a comparison conducted in the Impervious Study Report (City of Salem, 2002). The NPDES (National Pollutant Discharge Elimination System) permits referenced in the descriptions below are shown in **Figure 3-4** along with the general category of permittee.

3.1.1 Clark Creek Subwatershed

Clark Creek subwatershed is 1,545 acres and is 39 percent impervious. The sub-basin is primarily residential with small commercial and public areas, and only a very limited number of industrial areas. Clark Creek has a significant fish barrier in the basin, the 1,600-foot double culvert from South Salem High School to the confluence with Pringle Creek. Clark Creek has one industrial NPDES (National Pollutant Discharge Elimination System) permitted source within its boundary located at the intersection of Liberty and Commercial Streets SE.

3.1.2 West Fork Pringle Creek Subwatershed

West Fork subwatershed is 2,136 acres and is 36 percent impervious. The sub-basin is primarily residential with a small amount of commercial and public areas and only a very small amount of industrial area. West Fork contains two fish passage barriers downstream of the diversion structure near Madrona Ave. The main channel that flows north to converge with the Middle Fork has two culverts, one a barrier to juvenile fish and the other a barrier to adult and juvenile fish. West Fork has discharges from three NPDES permitted sources, including two located south in the basin along Sunnyside Rd. and the third near the confluence of Alderbrook Swale at West Fork.

3.1.3 West Middle Fork Pringle Creek Subwatershed

West Middle Fork subwatershed is 954 acres and is 17 percent impervious. The sub-basin is primarily residential with a small amount of public areas. There are 15 NPDES permitted sources in this sub-basin.

3.1.4 Upper East Fork and East Fork Pringle Creek Subwatershed

The Middle and East Forks of Pringle Creek collect runoff from farm fields south of Kuebler Blvd and east of I-5; including receiving seasonal flow diverted from Mill Creek south of Kuebler Blvd by the Santiam Water Control District (SWWCD). Over 40 acres of mitigated wetlands exist in the forks' drainage basin in varying states of success. The forks combine under I-5 in a double culvert then split again, East Fork east and Middle Fork west of the Union Pacific Railroad tracks through the flat area between I-5 and the South Salem Hills. The forks stop paralleling each other just south of Madrona Ave. SE with Middle Fork flowing northwest to converge with the West and West Middle Forks. East Fork flows through more industrialized

areas to circumvent Webb Lake and Walling Pond and finally meets up with the rest of the forks at 14th and Oxford.

Upper East Fork and East Fork subwatersheds is 3,376 acres and 11 percent impervious. The subwatershed is primarily public and residential with a large amount of industrial area and only a small amount of commercial area. Although a significant area is industrial, much of the land is landscaped grass fields. There are four NPDES permitted sources in this sub-basin.

The East Fork subwatershed is east of the railroad tracks and is the drainage basin for East Fork alone. The sub-basin is primarily public and industrial with small amounts of residential and commercial area. A large amount of the public land in this sub-basin includes the City's municipal McNary Field airport. Two culverts block fish passage on East Fork near 25th Street SE. There are 12 NPDES permitted sources in this sub-basin.

3.1.5 Middle and Lower Pringle Creek Subwatershed

Downstream from 14th and Oxford Streets SE, all the forks (except for Clark Creek) are combined into the single mainstem Pringle Creek. The Pringle Creek mainstem downstream of this confluence flows in and out of culverts and open channels heading for Deepwood and Bush Park. At Bush Park, Clark Creek joins Pringle Creek for the relatively short distance prior to discharging to the Willamette River. This lowest reach is also a mix of culverts and open channels as the creek winds though parks and neighborhoods and even under the Salem Hospital and the Boise Cascade buildings at Commercial Street SE. Under the Boise Cascade building is a newly constructed fish ladder to assist fish in the climb from the Willamette River to Pringle Creek, a steep section of the stream. Flow and water quality data are currently being collected at two points on Pringle Creek as of January 2006. Analysis of this information will provide valuable insight into the hydrology and hydraulics of the sub-basin.

Lower Pringle Creek subwatershed is 209 acres and 36 percent impervious, while Middle Pringle Creek subwatershed is 305 acres and 52 percent impervious area. The sub-basin is primarily public and industrial with a large amount of commercial and residential area. There are five NPDES permits in this basin.

3.2 Overview of Watershed Processes

To effectively improve watershed conditions, the relationship between land use change and the resulting change in watershed functions should be understood. In general, the progression of stream corridor changes generally follows the following pattern:

- Changes in land use or stream corridor use (e.g. agriculture, urbanization)
- Changes in ecological processes (e.g. movement of water, materials [sediment], dissolved compounds [nutrients], organisms [bacteria], and energy [heat])
- Changes in physical structure (e.g. wetlands, urbanization, pools/riffles, large woody debris)

- Changes in function (providing habitat, acting as conduit, barrier/filter mechanisms, source/sink of materials and energy)

The alteration of ecological processes by land use changes results in changes to the physical structure that, in turn, result in changes to how a stream functions. Restoring the physical structures re-establishes the watershed functions necessary to recreate a more self-sustaining system.

3.2.1 Watershed Scale and Physical Structure

Scale is an important concept because it helps to identify the types of physical structures that need to be considered when developing the restoration or protection activities. Watersheds can be observed on many scales:

- Regional scale (i.e. the Columbia River basin)
- Landscape scale (i.e. the Willamette River basin)
- Stream corridor scale (i.e. Pringle Creek watershed)
- Stream scale (i.e. the Clark creek sub-basin)
- Reach scale (a longitudinal segment of the stream)

This watershed plan focuses primarily on the landscape, stream, and reach scales. The physical structures of interest at any scale are generally defined using four basic terms (SCR, 1998):

- Matrix – the land cover that is dominant and interconnected over the majority of the land surface (e.g. forest, agriculture, residential).
- Patch – an (nonlinear) area that is less abundant than and different from the matrix (e.g. wetland within agricultural fields, or forest within residential area).
- Corridor – a special type of patch that links other patches in the matrix. Typically, a corridor is linear or elongated in shape, such as a stream corridor.
- Mosaic – a collection of patches, none of which are dominant enough to be interconnected throughout the landscape.

As noted above, depending on the scale of interest, the physical structures of interest also vary. For example, at the stream corridor (or stream) scale, the physical structures include wetlands, forests, grasslands, residential developments, floodplains, and roads. At the reach scale, examples of physical structures of interest include pools, woody debris, alluvial deposits and aquatic plant patches.

A high degree of connectivity among the physical structures at the stream corridor or stream scale promotes valuable functions including transport of materials and energy and movement of flora and fauna. Therefore, one of the main considerations in developing the restoration and protection strategies at the stream corridor (or stream scale) is to improve connectivity among the physical structures. As mentioned in Chapter 2, however, the urban character of the Pringle Creek watershed oftentimes precludes opportunities for significant connectivity, and the best that can be achieved is for local improvements at the reach scale. Although the benefits are more limited in terms of upstream and downstream improvements, the local benefits can be enough to justify a project.

In this plan, characterization of stream health is based primarily on the reach scale. The reach scale information is then related to the character of upstream/downstream reaches and upland land uses and activities to identify the potential causes of impairment from physical structures at the stream scale. Based on this relationship, restoration activities are defined to provide benefits on the stream scale, wherever possible.

3.2.2 Watershed Functions

Watershed functions are the major ecological roles that a stream corridor plays within the environment. The major functions include (SCR, 1998): (i) providing habitat; (ii) acting as a barrier/filter; (iii) acting as a conduit (for delivery and routing); and (iv) acting as a source/sink. Each function is vital to the well-being of the watershed as they work together to maintain a self-sustaining character. The following paragraphs briefly describe each function which will be discussed further in Chapters 4, 5 and 6. The recommendations identified in this Plan are generally intended to improve the functions described below through the restoration or protection of the physical structures that yield these functions.

Habitat. Habitat is the environment where animals, plants, and humans live, grow, feed, and reproduce. Two important types of habitat exist in most stream corridors: edge and interior habitat. Both are essential to maintaining the animal and plant populations within the corridor. Often in urbanized basins where development has begun, interior habitat is cleared to make room for development creating more edge habitat. A balance is required to achieve the full range of sunlight, rainfall, wind and other factors that change depending on canopy cover that corridor organisms require. In addition to lateral habitat, vertical habitat is also essential with different habitats ranging from stream features to canopy density.

Stream corridor habitat is very dependent on connectivity and width. Remaining natural areas (discussed further in **Sections 3.3.4 and 3.3.5)** are most valuable when they contain the full range of edge and interior habitats and follow the stream uninterrupted. Corridors that are too narrow can act as much as barriers as a full gap in connectivity for some species.

Barrier and Filter. The barrier and filtering function are created primarily by the vegetation and soil in the corridor, both perpendicular and lateral to the stream. Energy, materials, and organisms may be transported, filtered, or stopped altogether depending on the width and connectedness of a stream corridor. The structure of native plant communities can also physically affect the amount of runoff entering a stream system through uptake, absorption, and

interruption. The best example of the filter function is the uptake of nutrients, sediment, and water from overland stormwater flow by the plants along the corridor, reducing loading in the stream.

Conduit. The conduit function is the ability to serve as a pathway for energy, materials, and organisms. Energy in the form of stream flow continually sculpts and modifies the landscape. Energy in the form of heat can also be transferred by the movement of air through stream valleys or heat from sunlight absorbed by water. Moving materials impacts the hydrology, habitat and structure of the stream as well as the terrestrial habitat and connections with the floodplain and uplands. Nutrient transfer by streams is also a key function that allows biomass to transfer to upland areas for terrestrial wildlife. With respect to the conduit function, width is a key characteristic. A wider corridor acts as a large conduit, while narrower or restricted corridors limit the conduit functions.

Source and Sink. Stream corridors or features within them can act as a source or a sink of environmental materials and energy. Some examples of source/sink functions include: decreased downstream flooding through floodwater moderations and/or uptake; containment of sediments and other materials during flood stage; and source of soil and organic matter. The most visual example of sources and sinks is the liberation of gravel from an upstream gravel bar that rolls downstream until it rolls into a scour hole that is atypical of the stream channel. More and more gravel rolls downstream and collects in the scour hole until equilibrium is reached between flow velocity and scour hole depth any new gravel will keep rolling downstream to fill the next depression.

3.3 Impacts of Urbanization

Natural disturbances such as floods, earthquakes, drought and landslides can cause significant impacts to the watershed, but are difficult, if not impossible, to manage. Therefore, the focus of the Watershed Plan is on human-induced disturbances, because these are impacts that can be managed and because of the highly urbanized character of Pringle Creek.

The current urban nature of Pringle Creek reflects past alterations to the watershed. The first land use in Salem, after Native American temporary camps, was the structured agriculture that the settlers from the east brought with them. Agriculture required that wetlands be drained, trees cut down, diversions dug to carry irrigation water, and roads built to connect the homesteads. These changes and farmers' successes drew more settlers to the Willamette Valley where soon Salem became a farming town with the average farm between 300 and 325 acres. More settlers meant more infrastructure was needed including roads and development of a ferry system. All these changes affected the watershed, beginning the conversion of Pringle Creek to an urban watershed. (Watershed Assessment, 2002).

As settlement continued over the decades, the most significant alterations to the watershed resulted from urbanization. From a broad general watershed health perspective, the eight major alterations resulted from (Schueler, 2005a):

- Conversion to impervious cover

- Construction of sanitary sewer, water, and stormwater infrastructure
- Intensive management of pervious areas
- Fragmentation of natural area remnants
- Interruption of the stream corridor
- Encroachment on and expansion in the floodplain
- Increased population density
- Increased density of stormwater "hotspots" (areas of high pollutant concentration)

The eight major alterations resulting from urbanization are described further in the following subsections.

3.3.1 Conversion to Impervious Cover

Historically, conversion to impervious cover begins with the cutting of trees and draining of wetlands to make way for farming. Eventually these farms are replaced by residential subdivisions, and commercial and industrial areas. As urban watersheds develop the amount of impervious cover increases and more of the natural system becomes degraded.

Increasing impervious cover changes the mechanisms that transport rainfall from the basin into the stream. Once a watershed is significantly impervious, infiltration of precipitation into the soil or interception by forest canopy cover becomes limited. Rainfall runs straight from rooftops and parking lots into storm sewer systems that quickly convey the water to the stream. Although this practice helps insure roads and parking lots do not get inundated, streams are forced to convey more water faster than they would naturally which places channel-changing stresses on the stream.

The importance of impervious area can be seen in **Figure 3-5**. The hydrograph represents a generalized portrayal of the rate of runoff entering Pringle Creek over time. In all three scenarios nearly equal volumes of water enter the stream, but the distribution over time differs among the three scenarios. One hydrograph represents a highly urbanized (or impacted) basin with no flow control (detention). As precipitation falls onto primarily impervious surfaces, the runoff very quickly runs into the creek. In the Low Impact Development (LID) scenario, the basin has less impervious area, and precipitation is intercepted in part by trees and grass and soil infiltration. Some of the precipitation continues as runoff. A planned mix of pervious and impervious areas (i.e. low-impact development) attempts to delay the peak of the hydrograph, and lowers the amount of runoff volume entering the stream at one time. The final scenario is a pre-development hydrograph, where nearly all the precipitation is intercepted for a time by plants and soils, creating a very slow, low flow hydrograph but with the same amount of total runoff as the other two scenarios.

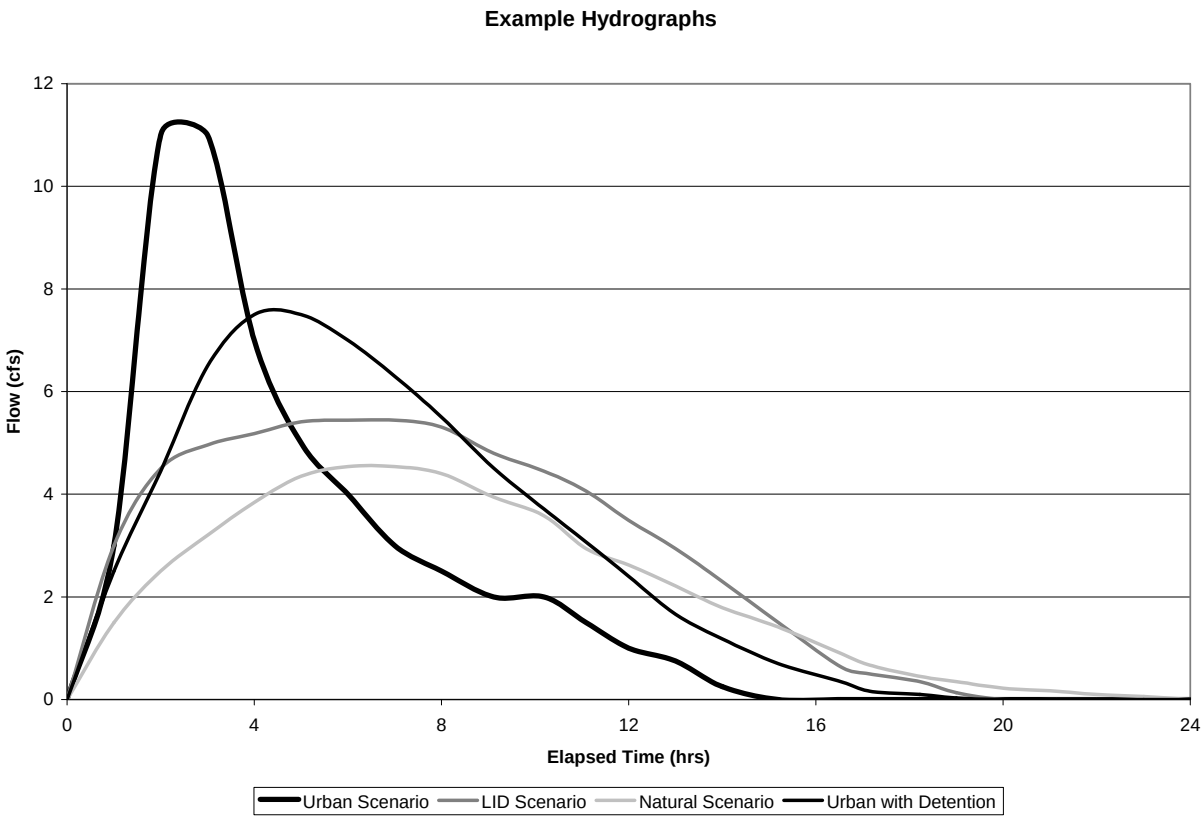


Figure 3-5. Example Conceptual Hydrographs for Urban, Urban with Detention, Low Impact Development and Natural Land Cover Conditions

Excess velocities and volumes of water moving down the channel generally do more harm than good. The increased kinetic energy of the water in the stream erodes the channel bottom and banks, incises or deepens the channel, removes loose gravel that fish use for spawning, and rips vegetation from the banks, which creates even more potential for scour and erosion during the next major event. The beneficial stream functions for habitat, such as large woody debris recruitment and avulsions (major channel migrations), that occur during high flow, high velocity events are usually not encouraged in urban streams settings. Although excellent for habitat, these two functions can cause major damage to homes and properties surrounding a creek – urban watersheds are not designed to allow the creek to evolve as it would in an unaltered setting.

Creating a healthy urban hydrograph like the LID scenario displayed in **Figure 3-5** above, is key in preventing catastrophic changes in stream behavior while maintaining original and rehabilitated habitat. By more effectively controlling the timing of runoff into the stream, the volume of water and velocity is restrained, limiting the degrading impacts of each major storm event.

Estimates for existing percent impervious surfaces for Pringle Creek watershed range from 22 to 25 percent, while future impervious area is estimated to be ~52 percent at build-out (Hemesath

and Nunez, 2002). Current acreage of impervious cover for each subwatershed is shown in **Table 3-1**. Based on the percent impervious, the Pringle Creek watershed is considered an urban watershed, and with proper planning, the full build-out impervious cover estimate can be lowered to preserve some of the natural functions of Pringle Creek.

Table 3-1. Impervious Area by Subwatershed

Pringle Creek Subwatershed	Total Impervious Area (acres)	Total Area (acres)	% Impervious
Clark Creek	600	1,545	39%
West Fork Pringle Creek	765	2,136	36%
West-Middle Fork Pringle Creek	163	954	17%
Middle Pringle Creek	159	305	52%
Upper East and East Fork Pringle Creek	386	3,376	11%
Lower Pringle stem	76	209	36%
Total	2,149	8,526	25%

3.3.2 Construction of Sanitary Sewer, Water and Stormwater Infrastructure

As cities develop, the need for adequate sewage management arises. Unfortunately pipes often contain leaks or other imperfections and sewage, water, and stormwater are lost to the stream. Sometimes the situation reverses and groundwater flows that would normally sustain a stream are captured by the municipal storm or sanitary sewer system. In addition, it is not uncommon for sewer pipes to cross streams which can create fish passage problems. This problem is compounded by incising channels whereby pipes that once were buried and protected are exposed. An additional problem created by storm drains is the lack of inherent natural treatment that used to occur as the runoff passed though wetlands and riparian zones. This has spurned the use of BMPs intended to restore some of the benefits of natural overland flow.

In Pringle Creek, there are over 160 miles of storm drainage conveyance systems within the basin. Unless development patterns and standards are changed to minimize impacts, this number will grow as the basin continues to develop to its full potential. This presents a unique opportunity to adequately plan for stormwater conveyance, detention, treatment, and fish passage protection.

3.3.3 Intensive Management of Pervious Areas

Although areas of pervious land remain in most watersheds at full build-out, these lands are generally so highly disturbed and groomed that they can act as impervious areas. Compaction of top- and sub-soils, filling of depressions, and removal of native riparian zone vegetation in favor of grassy lawn all contribute to the lack of complexity and storage that characterizes most urban pervious areas.

Even the functions of urban forests are degraded relative to their natural counterparts. Most urban forests have less than 50 percent canopy coverage. This is a result of clearing the natural understory, especially in parks, to allow access to the forests. The affect of this clearing is less interception of precipitation by vegetation and less roughness on the ground to slow the movement of runoff and encourage infiltration into the soil.

Many of Pringle Creek's pervious areas are managed parks along the stream network (see **Figure 2-2**). The largest parks are in the lowest portion of the watershed, and although they do have some tree cover, they are generally mowed lawn between trunks. Additionally in most of the Pringle Creek basin parks, grass is planted to the edge of the bank and mowed right to that edge. This eliminates any shading cover to protect stream temperatures, allows domestic animals access to the creek increasing bacterial loading, and does not help prevent bank erosion. Changing maintenance practices in Salem parks would go a long way to improve pervious area conditions. Public buy-off would be necessary to make this program a success.

3.3.4 Fragmentation of Natural Area Remnants

As urbanization continues in a developing watershed, parts of the original riparian and wetland structure become isolated from other natural areas. Often the remaining undeveloped areas are deemed "unsuitable" for construction purposes – steep slopes, for example – or regrowth of an older land use such as an old pond or continuously flooded areas behind road crossings. Natural area remnants are commonly surrounded by developments and are often very susceptible to non-native invasive flora and fauna, since they already exist in less than optimum conditions.

Nevertheless, natural remnant areas are an excellent place to focus stream repair efforts. In the Pringle Creek watershed, the natural area remnants are dominated by a non-native blackberry species that shades and kills bank-supporting vegetation. Other non-native ornamentals are very prevalent in the basin. Restoring and supporting native vegetation would be a major undertaking, but the benefits are numerous and include: (i) increased stream cover; (ii) increased fish habitat; (iii) more stable streambanks; and (iv) overall healthier natural remnants.

3.3.5 Interruption of the Stream Corridor

Although some remaining stream corridors exist in even the most developed watersheds, most of the stream corridors are highly interrupted as a result of road crossings, culverts, channelizations, ditches, and armoring. Each of these "improvement" techniques alters the natural flow of water to the streams. By re-routing streams, via ditches, flow that would normally supplement a section of the stream is completely diverted, changing local hydrology. Culverts and road crossings may not be designed to pass enough water so that they become constriction points that cause upstream flooding, potentially damaging the road bed, culvert, or habitat. Channelization and armoring are changes of the stream channel itself. They are usually implemented to reduce erosion due to high flow events or stormwater outfalls. They limit connection with groundwater and alter the system's sediment balance.

In Pringle Creek, all of these techniques were historically used at one time, altering the natural course of the stream. The alterations are discussed further in Chapter 4. The most notable interruption in the basin is the 1600-foot double culvert that conveys Clark Creek from South Salem High School to Bush Park. Immediately upstream of the culvert, the channel is a concrete ditch with absolutely no canopy cover. In addition to this example, most of the flooding that occurs in the basin is due to undersized culverts. It is important that these locations are noted so that when transportation projects arise near the road crossing or culvert it may be possible to upgrade to a larger culvert.

3.3.6 Encroachment on and Expansion in the Floodplain

The fertile soil and scenic location frequently make floodplains popular locations for development. However, streams are not static and it is often necessary to modify the floodplain to protect buildings and infrastructure. The most common protection mechanism is to fill the floodplain, raising the building elevation to beyond the reach of frequent flooding events. This solves the local flooding issue but the fill reduces the capacity of the floodplain and intensifies downstream problems. Other flood control measures such as levees, armoring, and channelization can all produce the same effect, as well as undersized culverts and bridges.

Pringle Creek contributes stormwater to the Willamette River just upstream of downtown Salem. On-site detention is already required of new development. However, additional flow controls including additional regional detention facilities could create a more natural hydrograph pattern for Pringle Creek and reduce backwater effects from the storm-swollen Pringle Creek flows trying to outfall into an equally swollen Willamette River. The City is not currently prioritizing regional detention facilities based on the findings from the Regional Detention Facilities Study (HHPR, 2004); however the most recent *Stormwater Management Plan* states that regional facilities would be considered as opportunities arise (HDR, 2005).

3.3.7 Increased Population Density

As the City of Salem's population grows, people have the power to either make a positive or negative influence on the watershed. Actions people make include littering, dumping, and over-fertilizing, along with wastes generated by pets. These actions degrade the watershed and increase pollutant and bacterial loading. To counter some of these detrimental activities, stewardship actions and programs have become necessary. These positive actions include homeowner riparian zone education, stream "adoption," installing rain barrels, planting trees, and campaigns against littering and dumping

The collective awareness and stewardship of the population in the watershed can directly influence the health of the watershed. Pringle Creek watershed is primarily residential and has a strong watershed council. These two factors can positively affect the basin. By instilling a sense of ownership of the creek throughout the basin, the watershed council and the City can begin multiple projects aimed at educating the public about proper lawn and landscape care and even restoration projects in the watershed's parks.

3.3.8 Increased Density of Stormwater "Hotspots"

As watersheds develop and the number of services available within it expands, the number of locations likely to contribute large pollutant loads ("hotspots") to the stormwater system increases. These locations can be identified through intensive detective work, but a better practice is monitoring and control to prevent unintentional and illegal pollution releases. Prevention of future events is key to protecting the watershed. The City is continually monitoring and tracking the condition of its underground conveyance systems to help prevent accidents from traveling far through the system.

The impacts from these hotspots are generally addressed by source control BMPs and an illicit discharge program, which are the focus of the Stormwater Management Plan. The protection and restoration activities covered in this Plan do not directly address these impacts, but integrate the stormwater management BMPs as discussed further in Chapter 5.

Chapter 4. Streamflow and Drainage

This chapter provides a general overview of the hydrologic and hydraulic features of the Pringle Creek watershed, including a discussion of flooding areas and other drainage issues. This chapter presents management actions that can be taken to improve, mitigate or restore conditions to meet the drainage objectives of the plan. These objectives are to define opportunities and constraints to:

- Improve drainage and reduce the magnitude and frequency of flooding events
- Reduce erosion and improve bank stability of urban streams
- Restore stream and riparian habitat and function

Management actions focus on the drainage system improvements from the 2000 Stormwater Master Plan, wetlands enhancement, and managing imperviousness. The drainage system improvements and management activities for drainage are coordinated with the management activities for habitat and water quality improvements in Chapters 5 and 6, respectively.

4.1 Hydrologic Features of the Watershed

As described in Chapter 3, the Pringle Creek watershed encompasses 13 square miles in the southwestern part of the city, and lies almost entirely within Salem's Urban Growth Boundary (UGB). The creek flows north from the South Salem hills to the Willamette River in central downtown, under the Boise Cascade structure. Elevation in the South Hills is approximately 550 feet above sea level to 125 feet at the Willamette River. Major geologic forces that shaped the valley include melting stranded icebergs and floods, including the powerful Missoula Floods. The soil in the Willamette Valley including those in the Salem and Pringle Creek area include silts and clays settling out of the massive flood events. The soils are rich, supporting lush vegetation and prosperous agriculture.

Climate in this portion of the Willamette Valley generally involve mild and wet winters, with infrequent snowfall events but frequent frosts. Summers are warm with cool nights. Average precipitation for Salem is approximately 40 inches per year, most of it occurring as rain from October through May.

As described in Section 3.1, the Pringle Creek watershed has been divided into seven subwatersheds, which are drained by four main tributaries to Pringle Creek (refer to **Figure 3-1 in Chapter 3):** Clark Creek, West Middle Fork, Middle Fork, and East Fork. The Pringle Creek mainstem includes the lower mainstem and upper mainstem, also known as West Fork Pringle Creek. Mill Creek overflows into the East and Middle Forks during high flow events. Shelton Ditch (as a diversion off of Mill Creek) contributes water year round from Mill Creek to Pringle Creek upstream of its confluence with the Willamette River.

4.1.1 Flow Paths of Major Tributaries

The following descriptions of the flow paths of the major tributaries in the Pringle Creek watershed have been taken directly from Hemesath and Nunez (2002).

Clark Creek. Clark Creek begins near Idylwood just east of Liberty Road S. and flows diagonally through the Faye Wright Neighborhood, under Browning, through Hidden Lakes Retirement Center, and under Madrona and Commercial. It is buried under a commercial store and comes to light south of Ratcliff, adjacent to backyards, to where it skirts around Gilmore Field. The creek then continues on to South Salem High School where it is reduced to a concrete lined channel at the eastern edge of the ball fields and then buried once again under backyards and the lower Lefelle parking lot. It surfaces for the last time to join Pringle Creek in Bush's Pasture Park.

West Middle Fork Pringle Creek. The West Middle Fork captures flows from the area around Pringle School and north along Reed Road, gathering flows from Hillcrest and along Strong Road, continuing in mitigated meanders on both sides of Fairview Industrial Drive, eventually joining the Middle Fork near the southwest side of the Union Pacific Railroad tracks which parallel the northern boundaries of the former SumcoUSA South Campus and Yamasa facilities. Having built in a wetland, SumcoUSA used to pump gallons of cold clear water daily from springs under its building into the West Middle Fork. The old Hillcrest Ditch, which drained agricultural fields prior to industrialization, was mitigated with a created meander between SumcoUSA and Yamasa. Planting projects continue in this area in an attempt to shade this part of the West Middle Fork.

Middle Fork and East Fork Pringle Creek. The Middle and East Forks drain farm fields south and east of Interstate-5, skirting or flowing out of wetlands around Fairview Industrial Park. Over 40 acres of complicated wetland mitigation projects continue with varying success in this area. The Middle and East Forks share waters via a double culvert on the east side of I-5 under the Union Pacific Railroad tracks and roughly parallel one another for a time -- one on each side of the UP Railroad tracks -- flowing northwest through flat, flood prone areas interspersed with railroad tracks and manufacturing plants. At this point, East Fork splits: the Middle Fork moving on to meet the West Fork downstream from Madrona, and the East Fork flowing north by the airport, past (not through)Webb (Spinnaker) Lake, crossing McGilchrist and through more heavily industrialized properties, through Walling Pond to its meeting with the West Fork at 14th and Oxford by the Union Pacific Rail yards

West Fork Pringle Creek (upper mainstem). The West Fork begins with springs near Liberty and Boone Roads, flows through Wendy Kroger Park, dives in and out of culverts and under streets and a few homes, daylighting in residential backyards above and below the open areas of Judson Middle School, Carson Springs Natural Area, Woodmansee Park, and the Pringle Creek Nature Preserve. Short tributaries such as Alder Brook and Stagecoach Brook are now piped to join the West Fork on the west side of Commercial Street.

West Fork Pringle Creek crosses under Commercial near the 12th Street intersection via a large reinforced concrete box culvert measuring five feet square by 230 feet long which Oregon Department of Transportation reports show was in the ground in 1968. The West Fork daylights again and flows through another patchwork of open stream and closed pipes to Leslie Middle School and former Fairview Training Center. After Fairview Training Center, the main stream continues northward as the West Fork with some flow (under high flow conditions) being diverted upstream of Madrona via a diversion channel to the Middle Fork. Middle Fork rejoins

the West Fork downstream of Madrona. All of these flows continue northward until they are joined by the East Fork at 14th and Oxford.

Pringle Creek (lower mainstem). The lower portion of Pringle Creek, after all of its forks have come together, picks up Clark Creek at Bush's Pasture Park just south of Mission Street. From there the mainstem of Pringle Creek flows between Bush's Pasture Park and Deepwood, crossing under Mission, flowing between the Oregon School for the Blind on the south side of the stream and Salem Hospital and Pringle Park on the north side. Pringle Creek flows under Salem Hospital. Shelton Ditch flows on the north side of Salem Hospital and Pringle Park while Pringle Creek flows on the south edges of the park. They come together just west of the Church Street bridge flowing northwest under Liberty Street to the Civic Center where they are joined by the Millrace. From there, the stream flows under Commercial Street and Boise Cascade to the Willamette Slough.

4.1.2 Historical Stream Path

Development in the Pringle Creek watershed is described briefly in Chapter 3 and in further detail in Hemesath and Nunez (2002). As settlers moved out to Oregon, creeks were re-routed to provide irrigation or power for flour and timber mills, wetlands were drained to become agricultural fields, and open channels were built to provide even more water from the Cascade Foothills. These developments have altered the flow path of Pringle Creek since pre-settlement days.

The first maps of the Willamette Valley, produced by the Government Land Office, were made in the 1850s, which included early mapping of land ownership, roads and flow paths of streams. Eventually aerial photos were taken of the Salem area and these also show differences in the stream path to the present-day Pringle Creek. As shown in **Figure 4-1**, the superimposed paths of Pringle Creek circa 1850s and 1970 indicate that the stream paths have changed dramatically for some tributaries and in some reaches. Most noticeable is the long straight portion of Middle and East Fork Pringle Creeks, which were constructed to drain fields in the south and east area of Pringle Creek watershed. Throughout the watershed, smaller projects have straightened, confined, and isolated Pringle Creek. The Shelton Ditch diverts water from Mill Creek year-round and was initially constructed to divert water into Pringle Creek during high water events. Even today, the courses of Pringle Creek and its tributaries are difficult to follow through its forks and tributaries, in and out of pipes and culverts and residential backyards from their various points of origin in the South Salem Hills.

4.1.3 Wetlands and Floodplains

Riparian areas, adjacent wetlands and local floodplains are important drainage features in a watershed because they decrease flood volumes and rates of flow. Well-vegetated riparian areas may also store floodwaters, thereby reducing associated flood damage downstream. Furthermore, the natural capacity of a watershed to manage flood events is reduced when channelization occurs, impervious surfaces increase and wetlands are filled in. Wetlands enhancement is discussed further in **Section 4.6**.

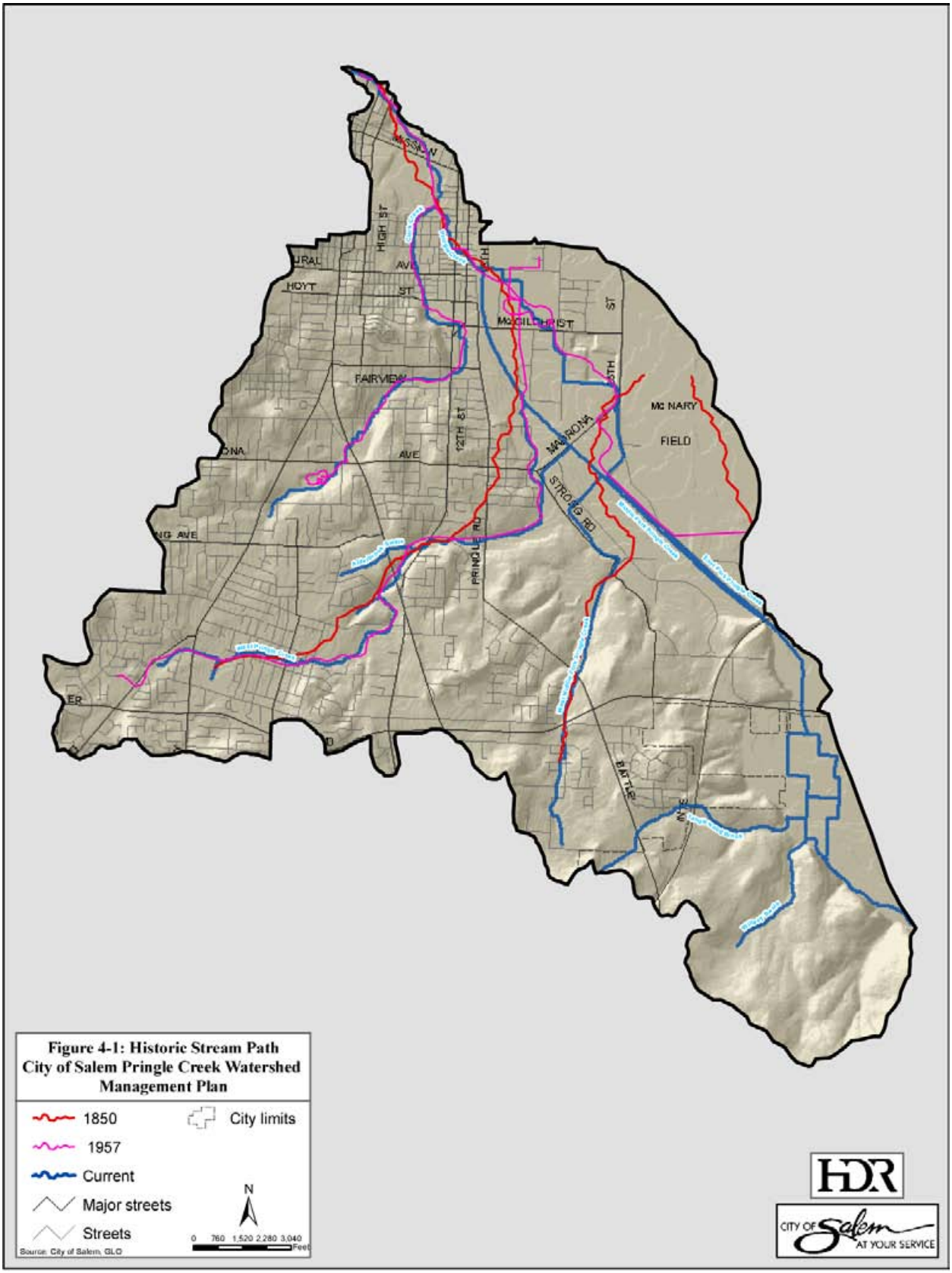


Figure 4-1: Historic Stream Path City of Salem Pringle Creek Watershed Management Plan

The Salem Local Wetland Inventory (LWI) (Schott and Lorenz 1999) shows that wetlands are typically located along streams in the Pringle Creek watershed. Larger areas of wetlands are located in the eastern portion of the watershed, where land use is primarily industrial (refer to **Figure 2-3 in Chapter 2**). There are isolated wetlands at the south end of the Salem airport and in the Fairview Industrial Park area. Pond areas created by past gravel mining are located north and south of McGilchrist Street. There are a total of 123.94 acres of inventoried wetlands in the Pringle Creek watershed. Much of the wetlands are unconsolidated bottom wetlands (66 acres) and mitigation wetlands (28 acres). Most of the remaining wetlands are wet meadow (12 acres) and forest wetlands (12 acres).

Most of the hydric soils in the Pringle Creek watershed are located in the flat area that makes up the eastern portion of the watershed. Areas containing extensive hydric soils in the Pringle Creek watershed include the following (Hemesath and Nunez, 2002):

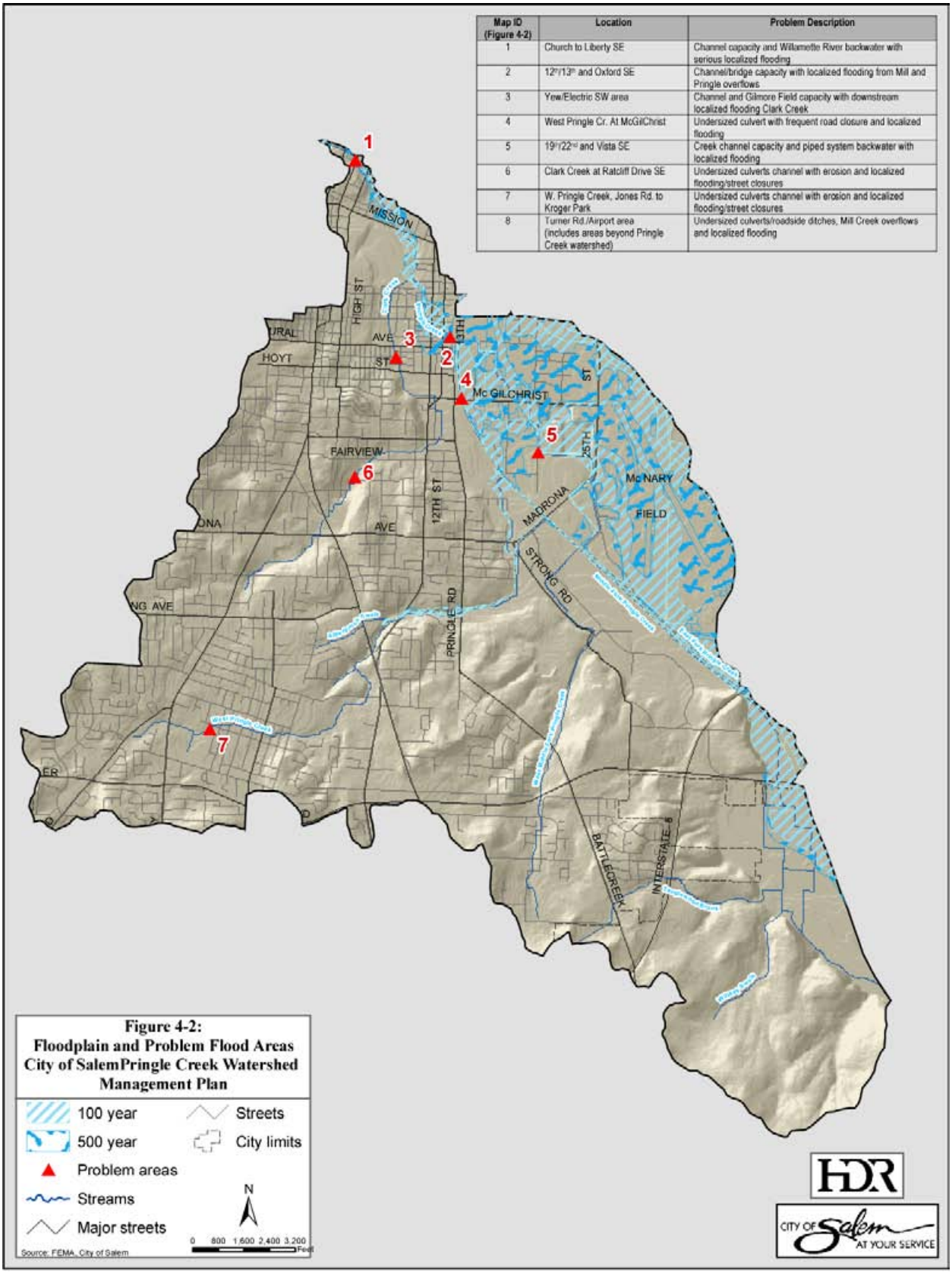
- A large belt of hydric soil is associated with Clark Creek. The belt extends from Gilmore Field, through the South Salem High School property and ends at Bush's Pasture Park. Land use in this area is mostly residential and public.

- A large complex of hydric soils extends south of Mission Street and parallels the west side of Turner Road. Land use in this area is mostly industrial or commercial. The Salem Airport is zoned public. The Fairview Industrial Park sits on top of a large historic wetland. Wetland mitigation is occurring in this area to compensate for the loss of wetlands due to the development of the park.

- South and east of the Kuebler Boulevard and I-5 exit, land use designations are mainly industrial and residential. This area of the watershed is currently under development and vacant land is still in abundance.

Most of the floodplains as determined by the Federal Emergency Management Agency (FEMA) are delineated in the eastern portion of the Pringle Creek watershed primarily in the East Fork and Upper East Fork Pringle subwatersheds. West Pringle is mapped and regulated up to Commercial Street. **Figure 4-2** shows the floodplain areas and the flood problems areas (discussed in **Section 4.2**). A comparison of the land use map (**Figure 3-2**) with the FEMA map shows that both industrial and public land in the eastern portion of the watershed lie completely within the FEMA floodplain. High and low density residential development is located adjacent to the floodplain just south and west of Turner Road. Commercial and public land use practices are found along the northern borders of the FEMA floodplain.

Map ID (Figure 4-2)	Location	Problem Description
1	Church to Liberty SE	Channel capacity and Willamette River backwater with serious localized flooding
2	12th/13th and Oxford SE	Channel/bridge capacity with localized flooding from Mill and Pringle overflows
3	Yew/Electric SW area	Channel and Gilmore Field capacity with downstream localized flooding Clark Creek
4	West Pringle Cr. At McGilChrist	Undersized culvert with frequent road closure and localized flooding
5	19th/22nd and Vista SE	Creek channel capacity and piped system backwater with localized flooding
6	Clark Creek at Ratcliff Drive SE	Undersized culverts channel with erosion and localized flooding/street closures
7	W. Pringle Creek, Jones Rd. to Kroger Park	Undersized culverts channel with erosion and localized flooding/street closures
8	Turner Rd./Airport area (includes areas beyond Pringle Creek watershed)	Undersized culverts/roadside ditches, Mill Creek overflows and localized flooding



4.1.4 Flow Control and Conveyance Structures

The main drainage features of interest in the Pringle Creek watershed include the different channels and other conveyance structures draining runoff within the watershed, as well as the wetlands and floodplain areas. The Pringle Creek watershed has undergone a significant amount of channelization, ditching and draining, and has suffered from historical use of drainage tiles, especially in the eastern portion of the watershed. **Table 4-1** details the channel types within Pringle Creek watershed, including storm water conveyance. Refer to **Figure 2-1 in Chapter 2** for a map of the stormwater conveyance system.

There are over a thousand culverts throughout the basin (see **Table 4-1**), but the most significant is the 1,600 foot double culvert (parallel 48- and 72-inch pipes conveying Clark Creek and stormwater flows) running underground from just north of South Salem High School to Bush's Pasture Park. This culvert is identified as a fish passage barrier, although the few degrees decrease in temperature from the underground passage likely beneficially affect Pringle Creek's cutthroat habitat.

Table 4-1. Channel types within Pringle Creek watershed	
Stream length, miles	24
Open ditches, miles	31
Storm drains, miles	170
Total length of culverts, miles	7
TOTAL LENGTH, miles	232
Number of culverts	1153
Number of bridges	19

The frequent flooding of Pringle Creek in its natural state frustrated early developers and farmers. As a result, flow controls such as berms, dikes, and other flow control devices were constructed. **Table 4-2** lists the number of dams, reservoirs, and bridges within Pringle Creek. The number of structures listed does not account for smaller weirs and other structures that are not included in state databases. These and other structures all contribute to the reduction and, in some reaches, elimination of historic fish habitat. Originally these devices were placed by nearby property owners to supply water for an irrigation diversion, re-route flow, or slow creek flows.

Table 4-2. Summary of Flow Control Structures	
Structure	Number
Dams	31
Reservoirs (registered)	6
Bridges	14

Data taken from Hemesath and Nunez (2002)

4.1.5 Flow Monitoring and Flood Flows

The City has recently installed four stream flow and water quality monitoring stations at four locations within the Pringle Creek watershed. However, data collection had just started in

January 2006, and not enough data was available to develop meaningful flow statistics for any period of time.

Peak flow data is available from the FEMA Flood Insurance Study (FIS) and City of Salem Drainage System Improvement Plan (September 2000). This data is presented in **Table 4-3**. As can be seen from the table, Pringle Creek is capable of conveying very large flows.

Table 4-3. Estimated peak flood flows for Pringle Creek

	Peak Flow Values (cfs)					
	10-year	25-year	50-year	100-year	500-year	Source
East Pringle downstream of Turner Rd.	--	--	--	990	--	DSIP, 2000
Middle Pringle downstream of Turner Rd.	--	--	--	400	--	DSIP, 2000
Pringle Creek at 12th Street SE	750	--	1010	1510	3120	FEMA FIS
Pringle Creek at confluence of Shelton Ditch	250	--	2000	2550	3820	DSIP, 2000
Pringle Creek downstream of confluence with Shelton Ditch	5600	--	--	8550	--	FEMA FIS

4.2 Key Drainage Issues

As described in Chapter 3, urbanization significantly impacts the way runoff travels across the land, how the land retains precipitation and runoff, and how it empties into a stream. The flow and drainage alterations are driven primarily by changes in type and density of vegetation and by infiltration rates and can affect the magnitude, duration and impact of floods. An increase in the amount of impervious surface (e.g., removing natural vegetation and replacing it with rooftops and transportation networks) and channel modifications (e.g., filling wetlands associated with a stream, channelization, placing streams in closed pipes) are the key causes for decreased infiltration rates and increased peak discharge for receiving streams. These increased flows, in turn, contribute to channel instability, stream bank erosion, and habitat degradation.

Even though Pringle Creek can convey very large flows, it frequently overtops its banks and floods the neighborhoods and businesses near it. Besides the increase in peak flows caused by increased imperviousness and channelization, flooding also results from undersized culverts that "back up" the flow into streets, parking lots and backyards. Additional causes of flooding, especially in the downtown area, are the narrow channels routed around property lines, creating streams with 90 degree turns and unnatural constrictions. **Table 4-4 and Figure 4-2** highlight the problem flooding areas throughout Pringle Creek watershed based on information presented in the 2000 Stormwater Master Plan (Montgomery Watson, 2000). Based on communications with City personnel, these areas represent the most current flooding problems in the watershed.

Table 4-4. Existing Drainage System Representative Problem Areas(1)

Map ID (Figure 4-2)	Location	Problem Description
1	Church to Liberty SE	Channel capacity and Willamette River backwater with serious localized flooding
2	12th/13th and Oxford SE	Channel/bridge capacity with localized flooding from Mill and Pringle overflows
3	Yew/Electric SW area	Channel and Gilmore Field capacity with downstream localized flooding (Clark Creek)

Table 4-4. Existing Drainage System Representative Problem Areas[1]		
Map ID (Figure 4-2)	Location	Problem Description
4	West Pringle Cr. At McGilChrist	Undersized culvert with frequent road closure and localized flooding
5	19th/22nd and Vista SE	Creek channel capacity and piped system backwater with localized flooding
6	Clark Creek at Ratcliff Drive SE	Undersized culverts, channel with erosion, and localized flooding/street closures
7	W. Pringle Creek, Jones Rd. to Kroger Park	Undersized culverts, channel with erosion, and localized flooding/street closures
8	Turner Rd./Airport area (includes areas beyond Pringle Creek watershed)	Undersized culverts/roadside ditches, Mill Creek overflows, and localized flooding

[1] *Taken from Stormwater Master Plan (Montgomery Watson, 2000).*

Other drainage issues include:

- *Lack of channel complexity.* Lack of channel complexity reduces diversity in habitat types and in-stream structure, and reduces or eliminates riffle and pool habitats, backwater areas, and stable (narrow and deep) baseflow channel. Channel complexity also decreases flow velocities and potential for scouring and improves channel stability. A lack of complexity could be addressed by stream reconfiguration projects in undeveloped areas in the watershed. Lack of channel complexity is especially an issue for Middle Fork and East Fork Pringle Creek.

- *Disconnected floodplains from bank armoring and channelization and reduced floodplain roughness (vegetation).* Disconnected floodplains limit the ability of the channel to slow down high flows and allow bank storage of water. Disconnected floodplains also result in stream channels that are narrow and deep and convey large flows quickly instead of overtopping banks and slowing due to heavily vegetated floodplains. This is especially important in the areas along Middle Fork and East Fork Pringle Creek and in the lower mainstem portion of Pringle Creek.

- *Lack of runoff detention to reduce the hydrograph peak (flows).* Peak flows scour away bed sediment or erode banks, or both. This could be addressed by identifying locations for detention facilities and performing hydraulic modeling to evaluate their effects. West Fork, Middle Fork, and East Fork Pringle have been identified as needing additional detention. A potential regional detention site on West Pringle Creek (at Leslie Middle School) was evaluated but found to be "unpermittable" in a City-funded study (HHPR June 2004). Existing detention facilities in Clark Creek have also been identified as needing upgrades based on the Stormwater Master Plan (2000).

- *Large amounts of impervious area and a lack of pervious areas.* Besides the obvious paved and roofed areas, heavily groomed parks often behave like impervious surfaces due to soil compaction, mowed grass, and few opportunities for detention. The highest percentages of impervious areas are in the Lower and Middle Pringle, Clark Creek and West Fork Pringle subwatersheds.

It was beyond the scope of this Plan development to conduct a hydrologic/hydraulic analysis for Pringle Creek watershed. Therefore, this Plan relies on the stormwater infrastructure improvements identified under the *Stormwater Management Plan* and associated *Drainage System Improvement Plan* (DSIP) completed in 2000 by Montgomery Watson to address the flooding and detention issues in Pringle Creek watershed listed in **Table 4-4**. Management alternatives to address these drainage issues are discussed in the next section **(Section 4.3)**. Problems associated with stream channel complexity and floodplain connection are also discussed in **Chapter 5,** as they relate to overall habitat restoration opportunities.

4.3 Management Actions for Drainage

The management options, described in **Section 2.2,** that address drainage issues are discussed further in this section. The management options for drainage are intended to meet the objectives listed at the beginning of this chapter. The options not included here are the "discharge prevention" alternatives; "protection and policy" options related to pollutant discharge; and "education and stewardship" options related to pollution prevention. These options are related to water quality control and are discussed in Chapter 6. In addition, fish passage improvements (barrier removal and construction of fish passage) are discussed in Chapter 5.

Table 4-5 lists the management actions along with their primary drainage-related objectives, secondary (non-drainage) objectives, and the areas in the watershed where the actions apply. The management actions include the drainage improvement priorities from the Stormwater Master Plan, impervious area management, and wetlands enhancement. These topics are discussed further in the following sections.

- *Stormwater Management.* The stormwater management options are the capital improvements identified for the stormwater conveyance system, which includes replacing/upgrading pipelines, culverts and bridges, and construction of detention facilities. The locations of these projects are based on the 2000 *Stormwater Master Plan.* Priorities for these projects are discussed in **Section 4.4.1**. The status of detention facilities is discussed separately in **Section 4.4.3**.

- *Stream Repair/Protection and Riparian Management.* The 2000 Stormwater Master Plan also identified areas for habitat enhancement, but did not specifically identify the types of projects or the problems being addressed. Therefore, the stream repair/protection options and riparian management options referred to in **Table 4-5** are covered in **Chapter 5**. **Section 4.4.2** discusses the areas where habitat enhancement was identified in the 2000 Stormwater Master Plan.

- *Protection and Policy.* The protection and policy options for drainage essentially focus on managing imperviousness through low impact development, protecting sensitive (pervious) areas, and providing incentives to control the increase in imperviousness. This is discussed further in **Section 4.5**.

- *Wetlands Enhancement.* For the purposes of this plan, wetlands enhancement opportunities are based on enhancement potential derived from the Local Wetlands Inventory. Opportunities for wetlands enhancement are discussed in **Section 4.6**.

- *Education, Involvement, Stewardship.* This management option is an important factor in gaining support and implementing some of the capital intensive options listed above.

Table 4-5. Management Actions Applicable to Drainage Issues.

	Management Action	Primary Drainage Objective	Other Objectives Addressed	Action Areas
Stormwater Management	Modify storm drain system to increase infiltration	▪ Reduces runoff volumes and peak flows from storm events ▪ Helps minimize or reduce streambank erosion or bed scour	▪ Provides indirect pollutant removal benefits through settling suspended materials	▪ Applies to existing stormwater infrastructure. ▪ Areas for storm drain system modifications are based on project locations identified in the 2000 Stormwater Master Plan.
	Modify storm drain system to increase detention (local detention facilities)	▪ Reduces runoff volumes and peak flows from storm events ▪ Helps minimize or reduce streambank erosion or bed scour	▪ Provides indirect pollutant removal benefits through settling suspended materials	
	Modify storm drain system to treat stormwater (water quality treatment)	▪ Can provide indirect reduction of runoff volumes as part of treatment process for some technologies.	▪ Provides pollutant removal benefits through settling suspended materials and/or surface skimming	
	Increase stormwater conveyance capacity (culverts/pipelines/bridges)	▪ Allows high flow events to be conveyed through system to prevent flooding conditions	▪ Improves fish passage conditions with the removal of culverts	
Stream Repair/ Protection	Streambank stabilization	▪ Helps minimize or reduce streambank erosion	▪ Improves habitat conditions by providing cover, pool habitat ▪ Provides filter barrier for sediment/pollutant removal ▪ Can provide aesthetic benefits to stream corridor	▪ Areas for streambank and stream channel repairs for drainage are based on projects identified in the 2000 Stormwater Master Plan. ▪ Stream repairs identified specifically for habitat improvements are based on those areas identified in Chapter 6.
	Instream flow controls	▪ Directs and manipulates flows or reduces stream velocities to minimize or reduce streambank erosion or bed scour	▪ Improves habitat conditions through creation of scour holes, pool habitat, reduces bed erosion ▪ Can provide aesthetic benefits to stream corridor	
	Instream habitat structures	▪ Helps minimize or reduce streambank erosion	▪ Improves habitat conditions by reducing bed erosion, collecting and retaining gravel ▪ Provides filter barrier for sediment/pollutant removal ▪ Can provide aesthetic benefits to stream corridor	

Table 4-5. Management Actions Applicable to Drainage Issues.

	Management Action	Primary Drainage Objective	Other Objectives Addressed	Action Areas
	Channel and floodplain redesign/ construction	▪ Introduces natural dynamics to improve channel stability	▪ Improves habitat quality and stream corridor aesthetics	
Wetlands	Wetland enhancement	▪ Reduces runoff volumes and peak flows from storm events ▪ Helps minimize or reduce streambank erosion or bed scour	▪ Provides removal /treatment of pollutants and sediment removal ▪ Provides aesthetic benefits to stream corridor	▪ Wetland enhancement priorities are based on wetlands enhancement potential assessment from LWI (Schott and Lorenz, 1999; Hemesath and Nunez, 2002)
Riparian Management	Increase quantity and quality of canopy and other vegetative cover (includes removing invasive species)	▪ Provides channel roughness to reduce stream velocities; plant roots improve bank stability	▪ Provides filter barrier for sediment/pollutant removal ▪ Provides aesthetic benefits to stream corridor	▪ Areas for increasing canopy and vegetative cover apply to riparian zones identified in Chapter 5.
	Create riparian buffer			
Protection and Policy	Promote low impact development practices in development and redevelopment projects	▪ Increase infiltration to reduce runoff volumes and peak flows during storm events	▪ Provides removal of stormwater runoff pollutants (suspended solids, nutrients)	▪ Areas for low impact development are targeted for public and private development/ redevelopment projects and vacant land
	Protect sites/features with high watershed value (wetlands, floodplains, riparian areas)	▪ Maintain the functions of watershed features that provide increased infiltration or storage for reducing runoff volumes and peak flows	▪ Maintain the functions of watershed features that provide habitat and pollutant removal benefits.	▪ Applies to all open municipal land, parks, rights-of-way where remnant natural areas exist.
	Revise or update zoning ordinances to provide incentive-, performance- or watershed-based zoning	▪ Provide legal/regulatory basis to enforce or give incentives to using development practices that conform with goals of improving watershed conditions.	▪ None	▪ Applies to public and private development/ redevelopment projects

Table 4-5. Management Actions Applicable to Drainage Issues.				
	Management Action	Primary Drainage Objective	Other Objectives Addressed	Action Areas
Education, Involvement, Stewardship	Provide education, involvement and stewardship on watershed function to organizations and public	▪ Increase interest and participation for indirectly (support for funding) or directly implementing on-the-ground measures to improve drainage and flow conditions.	▪ Increase interest and participation for indirectly (support for funding) or directly implementing on-the-ground measures to improve habitat and water quality conditions.	Watershed and community-wide

4.4 Drainage Improvements

The City of Salem's *Stormwater Master Plan* (Montgomery Watson, 2000) addresses issues of stormwater quantity (i.e. conveyance and flood damage reduction) and stormwater quality as it relates to the City's NPDES MS4 permit. Management of water quality issues is discussed in Chapter 6. The focus here is to review and prioritize the drainage improvements identified in the 2000 *Stormwater Master Plan* in conjunction with the other components of the watershed plan (habitat and water quality).

4.4.1 Prioritizing Drainage Projects List

As part of the development of the *Stormwater Master Plan* in 2000, the City developed a *Drainage System Improvement Plan* (DSIP). The DSIP includes a comprehensive list of recommended drainage system improvements. The recommended improvements are a product of: (i) the stormwater management policies developed in the Master Plan; (ii) results of hydrologic-hydraulic computer modeling; and (iii) City staff experience and records of past flood events. The DSIP includes a list of improvements for the storm drains, culverts, open channels, streams, detention storage, and conjunctive use water quality facilities. The purpose of this section is to prioritize those projects that incorporate stream restoration and enhancement with drainage and flood improvements. A total of 58 projects for Pringle Creek watershed were developed in the DSIP. The types of improvements are as follows (some projects utilize more than one type of improvement):

- 17 projects to add or improve bridges
- 12 projects to replace undersized pipes
- 18 projects to replace or remove undersized culverts
- 21 projects to address channelization, bioengineering, or special stream habitat improvements
- 3 projects to add regional detention facilities

Appendix D includes the complete project list and map of DSIP projects for Pringle Creek, as presented in the 2000 Stormwater Master Plan.

In 2001, City staff recognized the reality that the $217 million City-wide stormwater capital improvement program in the DSIP (including all watersheds) was extremely ambitious to implement both financially and physically (in terms of tolerable community disruption and staff's ability to design and construct). This reality is compounded when the stormwater capital needs are combined with other water-related utility needs. Consequently in 2002, staff developed a priority rating system by which each stormwater project was evaluated on the basis of seven criteria. This was done as part of the Stormwater System Development Charge (SDC) Study (CH2MHill/Galardi, March 2002). These criteria considered whether the project was needed for: (i) life safety, (ii) property safety, (iii) water quality or habitat enhancement, (iv) current regulatory requirements, (v) prospective regulatory requirements, (vi) avoiding increased cost, and (vii) condition of system or operation and maintenance. Based on the criteria, the City identified the top 15 projects that satisfied two or more of the criteria. However, the City subsequently removed from consideration the three regional detention facilities identified in the DSIP based on a study conducted in 2004 (see **Section 4.4.2**).

Furthermore, the City more recently in 2005 participated in a collaborative effort among Public Works divisions/sections (Operations, Water Resources and Utilities Planning) to prioritize the DSIP projects with respect to optimizing available stream enhancement funding. A formal ranking system was not used, but discussions were held among Public Works staff to identify the top 10 projects from the 2000 DSIP list. **Table 4-6** lists the DSIP projects based on these two prioritization processes. These projects are shown in **Figure 4-3**.

The four projects that were prioritized under both processes include:

- PCB42 – West Pringle Creek at McGilchrist: bridge
- PCB40 – Pringle Creek at 13th St.: bridge
- PCB43 – Drainage system on Pringle Rd. near Vista Avenue: replace undersized pipe
- PCB55 – Pipe/ditch along Skyline downstream of Kuebler: replaced undersized pipe

These are considered the highest priorities for implementation/construction in the Pringle Creek watershed to address the flooding/drainage issues. The remaining projects listed in **Table 4-6** are considered second tier priorities, while the other projects listed in the complete DSIP are considered the third tier priorities **(see Appendix D)**. While none of the first tier priority projects have a significant habitat enhancement component, several of the DSIP projects do address some habitat-related improvement. These projects are discussed in the following section.

4.4.2 Habitat-related Drainage Projects

As noted in the previous section, 21 of the DSIP projects for Pringle Creek watershed have a habitat enhancement component. The category of "channelization/bioengineering/special stream habitat" represents stream enhancement projects to improve aquatic habitat and water quality conditions for salmonids and other aquatic species. The specific type of projects were *not* developed in the DSIP, but were generalized as follows:

- "Channel improvement" refers to capacity-increasing and erosion-preventing types of projects in waterways and ditches: widening of channels; and removing obstructions or riprap which impede the free flow of water. Channel improvement will result in improved "capacity" but can have adverse ecological effects. While channel improvement is generally done in combination with bioengineering or stream habitat work, it can also be done as a stand alone project.

- "Bioengineering/Habitat" refers to restoration efforts primarily aimed at stabilizing waterway banks using: closely planted/densely rooted trees; placing tree trunks, larger rocks or constructing small flow-diverting structures at critical erosion-prone locations and creating velocity dissipaters or meanders in the waterway bed.

- "Special Stream Habitat" refers to more extensive waterway restoration efforts to restore or enhance both the stream channel and the riparian zones including: instream restoration of waterway channels (spawning gravels, riffles, backwaters, and woody debris cover areas), and stream shading through selected native tree planting, brush cover and habitat areas.

Table 4-6. Drainage System Improvement Plan Project Prioritization

DSIP Project ID	Location	Recommended Improvement	SDC Study Priority(1) (2002)	Stream Enhancement Funding Priority(2) (2005)
PCB7	Clark Creek at Ratcliff Dr.	Bridge (remove culverts, replace with bridge)	No	Yes (#4)
PCB8	Clark Creek upstream of Ratcliff Dr. and at intersections with Ratcliff Dr. and Salem Heights Ave. South	Replace undersized culverts; *Channel improvement/ bioengineering/ habitat*	No	Yes (#4)
PCB12	Clark Creek from Ewald to Halifax	Replace undersized pipe/culvert	No	Yes (#9)
PCB17	East Pringle Crossing McGilChrist; 22nd Ave SE	Bridges	Yes (4+)	No
PCB19	East Pringle at Madrona	Bridge	Yes (2)	No
PCB21	Culvert across Airway Drive draining Airport; near Airway Drive	Replace undersized culvert; Pringle Creek backs up into Airway Drive	No	Yes (#5)
PCB23	East Fork: Culvert under I-5; Middle Fork near I-5	New box culvert; *Channel improvement / bioengineering/ habitat*	Yes (2)	No
PCB25	East/Middle Fork at Treistad and Kuebler	New box culvert; *Channel improvement / bioengineering/ habitat*	Yes (2)	No
PCB37	Pringle Creek at Winter St.	Bridge	Yes (2)	No
PCB38	Pringle Creek at Mission St.	Bridge	Yes (2)	No
PCB40	Pringle Creek at 13th St.	Bridge; including crossing at McGilChrist	**Yes (2)**	**Yes (#2)**
PCB41	West Pringle Creek from Oxford to McGilChrist	Bridge; *Channel improvement / bioengineering/ habitat*	Yes (2+)	No
PCB42	West Pringle Creek at McGilChrist	Bridge	**Yes (4+)**	**Yes (#1)**
PCB43	Drainage system on Pringle Rd. near Vista	Replace undersized pipe	**Yes (2)**	**Yes (#6)**
PCB46	Drainage system upstream of Idylwood as well as Sunnyside Rd	Replace undersized pipe	No	Yes (#3)
PCB47	Drainage system upstream of Marietta Way and Coloma Dr.	Replace undersized pipe	No	Yes (#8)
PCB49	West Pringle, culvert across Jones Rd, upstream of Woodmansee Park	Bridge	Yes (2+)	No
PCB50	West Pringle Creek from Jones Rd. to Bristol Dr. and at Firdell and Lone Oak	Replace undersized culvert; *Channel improvement / bioengineering/ habitat*	No	Yes (#8)
PCB52	Closed system along Lone Oak and Gardner	Replace undersized pipe	No	Yes (#7)
PCB55	Pipe/ditch system along Skyline downstream of Kuebler	Replace undersized pipe	**Yes (2)**	**Yes (#10)**

Note: Bold denotes that the project was prioritized under both prioritization approaches.

(1) Number in parentheses refers to the number of screening criteria met.

(2) Number in parentheses is the rank order based on City staff prioritization. Lower number means higher priority.

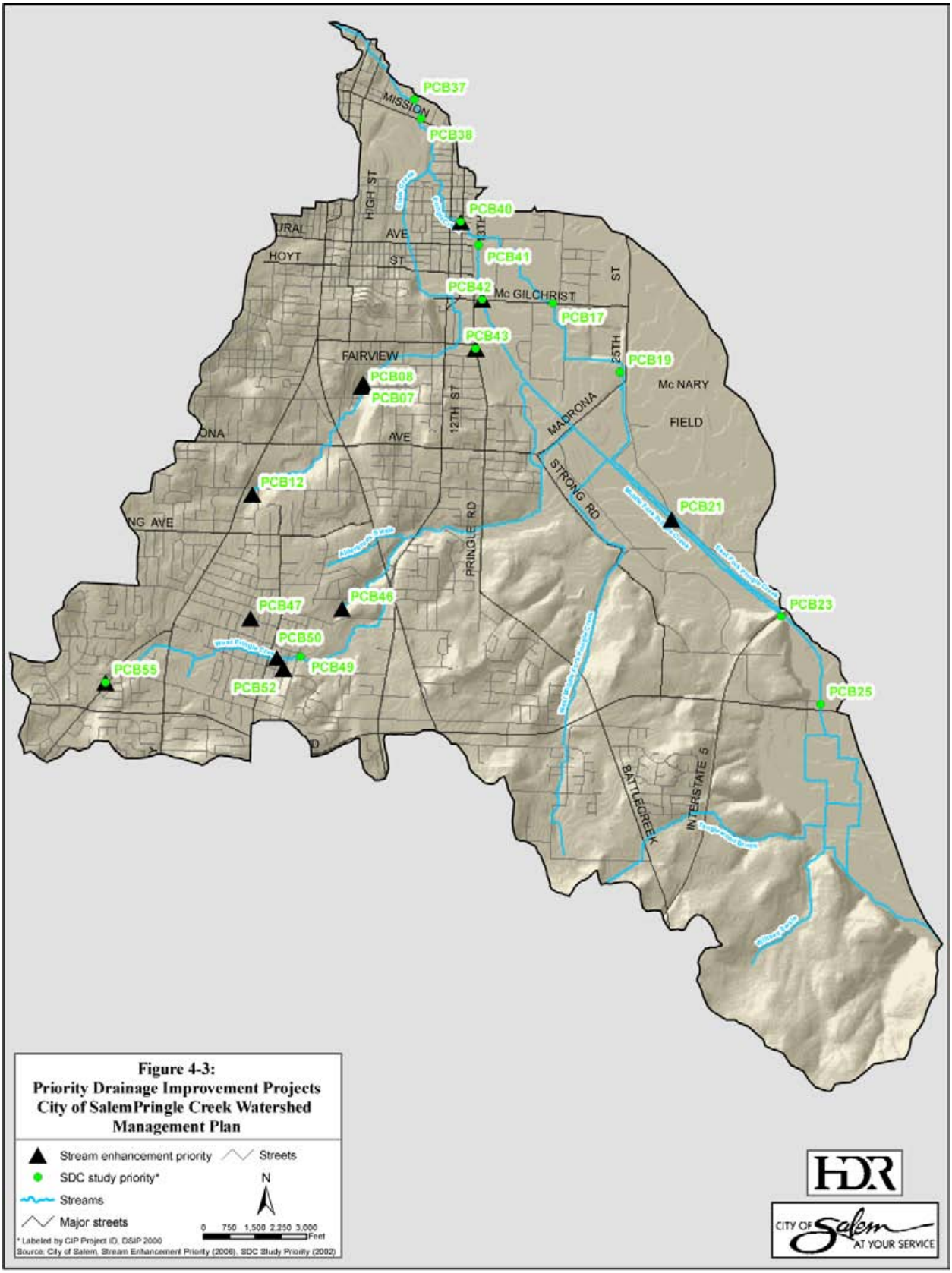


Figure 4-3:
Priority Drainage Improvement Projects
City of SalemPringle Creek Watershed Management Plan

Many of the proposed stream enhancement projects identified in the DSIP generally coincide with the areas where habitat conditions are noted as poor and where improvements are recommended based on the analysis in Chapter 5. These areas are located at the following locations:

- The East Fork of Pringle Creek along the railroad right-of-way and throughout Fairview Industrial Park on the Middle Fork.
- Several reaches of the West Fork of Pringle Creek as it stretches on the west side of Commercial from the Pringle Creek Nature Preserve to Woodmansee Park and the Carson Natural Area, and then upstream through residential backyards to the creek's headwaters above Kroger Park. East of Commercial, opportunities exist to evaluate the series of dams and weirs in residential subdivisions where some neighbors have already enhanced back gardens along the creek[1].
- Several reaches of Clark Creek, have proposed stream enhancement projects. East of Commercial, areas benefiting from projects include reaches from Willow Court through Clark Creek Park, between Winter and Summer Streets, around Gilmore Field, and along the east side of the ballfields at South Salem High School.

The priorities for stream or habitat enhancement projects listed in the DSIP are not defined in this Plan. Rather the approach is to identify areas in the watershed where specific habitat functions are impaired so that appropriate stream and habitat enhancement activities can be implemented or constructed as opportunities arise. This is discussed further in **Chapter 6**.

4.4.3 Detention Facility Projects

Stormwater detention facilities (e.g. dry or wet ponds, underground tank vaults or oversized pipes) are designed to capture, store and then slowly release stormwater runoff downstream. Three potential Pringle Creek watershed regional detention facility projects were specifically prioritized in the 2000 DSIP (PCB56, PCB57, and PCB58 in **Table 4-6).** In addition to helping prevent flooding and erosion, detention facilities help protect water quality by incorporating features that filter or remove sediments, excess nutrients and toxic chemicals.

As a result of the 2000 DSIP, the City performed a Regional Detention Facility Study in 2004 that evaluated the major components of constructing large detention facilities at three selected locations within the City (HHPR, 2004). The issues evaluated by the study included:

- Site analysis and conceptual design
- Flood impact significance, including peak flow reduction at critical downstream locations
- Stability and geotechnical soundness
- Water quality potential
- Fish and wildlife benefits, opportunities, and likelihood of being permitted
- Property acquisition, including ease of purchase
- Public involvement program

[1] Priorities for removal of fish passage barriers are discussed in Chapter 6.

- Cost estimate, including benefit analysis

One of the locations included in the study was West Pringle Creek at Leslie Middle School (DSIP PCB57). The study concluded that the detention facilities would have to be designed as off-line facilities to not affect fish passage (an on-line facility was deemed "unpermittable" by State and Federal fisheries resource agency staff). Off-line facilities rely on overflow devices to receive high-water flows and detain them. The West Pringle Creek location was not selected as an optimal location as the facility would not be cost effective. Even the site that was evaluated to be an off-line detention option was not recommended for construction because the amount of peak flow reduction did not justify the cost of the project (HHPR, 2004).

Based on this study, the City is no longer actively prioritizing regional detention facilities. Regional and sub-regional facility options will be further explored on case-by-case basis as potential sites are identified. However, the City is continuing to require on-site detention and continuing to inspect, inventory, and in some cases maintain stormwater detention facilities. The City is still open to the construction of smaller, local sub-regional detention ponds similar to the ones that already exist in the basin. Smaller basins will not be as effective individually at smoothing the peak of the hydrograph, but a few small detention facilities at optimal locations especially on West Fork Pringle Creek and Clark Creek would help control peak flows.

It was beyond the scope of this watershed plan to investigate the optimal locations for small detention facilities throughout the watershed. However, the City is currently updating the XP-SWMM hydraulic model originally developed in the 2000 Stormwater Master Plan. Updating the model is one of the best management practices included in the City's Stormwater Management Plan (SWMP) updated in 2005. Status of the model update is discussed further in **Section 4.6.**

4.5 Managing Imperviousness with Low Impact Development

As described in Chapter 3, impervious cover alters the hydrology of urban watersheds by generating increased stormwater runoff and reducing the amount of rainfall that infiltrates into the ground. The resulting changes in the hydrologic regime cause higher flows for longer periods, stream bank instability, and degraded water quality. Therefore, as development or redevelopment occurs in a basin it is important to limit increases in impervious area.

Table 4-7 presents the estimated amount of impervious area in each Pringle Creek subwatershed and the areas of each land use. This information is based on impervious area calculations by catchment calculated as part of the 2000 Stormwater Master Plan (Montgomery Watson, 2000)[2]. As **Table 4-7** indicates, the watershed is mostly residential with large tracts of public land. Public land in the watershed is not only pervious parks, but also includes hospitals and other government buildings. The large amount of public land in the East Fork area is the municipal airport (McNary Field). Estimates of impervious area are expected to increase from

[2] *The Impervious Study Report (City of Salem, 2002) included a comparison of the 2000 estimates, the values are considered comparable for the purposes of this Plan.*

approximately 25 percent to just over 50 percent in the Pringle Creek watershed under current building patterns to build-out (Hemesath and Nunez, 2002).

Table 4-7. Land use and impervious area for Pringle Creek Subwatersheds.

Pringle Creek Subwatershed	Residential (acres)	Commercial (acres)	Public (acres)	Industrial (acres)	Total Impervious Area (acres)	Total Area (acres)	% Impervious
West Fork	1,299	181	178	2	765	2,136	36%
Upper East Fork	1,025	37	18	268	164	2,289	7%
West Middle Fork	517	24	287	98	163	954	17%
East Fork	24	97	710	360	222	1,087	20%
Clark Creek	948	150	124	5	600	1,545	39%
Middle Pringle Creek	35	50	7	99	159	305	52%
Lower Pringle Creek	22	29	116	3	76	209	36%
Total	3,870	568	1,440	835	2,149	8,525	25%

New development projects can utilize low impact development (LID) techniques to limit the amount of new impervious surfaces. LID is described as “a stormwater management strategy that emphasizes conservation and use of existing natural features integrated with distributed, small-scale stormwater controls to more closely mimic natural (pre-development) hydrologic patterns in residential, commercial, and industrial settings” (Hinman, 2005). These practices are not new, but are gaining in popularity. Whereas conventional stormwater management emphasizes efficient collection and rapid conveyance of runoff from developments to central ponds, LID is primarily a source reduction approach. The greatest advantage with LID is that it better maintains the spatially distributed flows; whereas, the conventional approach results in point discharges that can cause excessive erosion and riparian and habitat impacts.

It is beyond the scope of this Plan’s development to prescribe specific LID options to different projects or areas within the watershed, but some LID options for reducing impervious surface include:

- Amending construction site soils to improve infiltration rates
- Use vegetated roofs
- Porous pavement for streets or parking areas with a low traffic volume
- Use of narrow roads in rural or less traveled areas
- Construct streets without curbs to allow drainage to flow into vegetation
- Use of common parking areas for multiple businesses or residents
- Road pattern designs to minimize impervious surface
- Use of BMPs such as vegetated swales in parking lots
- Separate sidewalk and housing from the street with vegetation strip
- Reduce the number and size of cul-de-sacs
- Use smaller parking stalls
- Establish a maximum number of parking spaces a developer is allowed to install

- Use alternative paving surfaces for spillover parking, e.g. porous pavement, gravel or mowed grass

Studies have indicated that a 65 percent mature forest cover is necessary to mimic pre-development hydrologic conditions and maintain a stable stream channel (Hinman, 2005). For medium- and high-density settings it is very difficult, if not impossible, to achieve this target using conventional methods. Therefore, in areas where less forest protection is possible, comprehensive application of LID practices is necessary. Although it may not be realistic to expect comprehensive application of LID practices throughout the City of Salem, the goal should be to identify opportunities to implement the practices listed above in the short-term (perhaps as demonstration or pilot projects), while developing incentives into the building permit process to use LID techniques.

For planning purposes, the following areas have been identified where opportunities may exist for low-impact development:

- Areas where development or redevelopment is planned or currently occurring.
- Areas where capital improvement projects are planned.
- Undeveloped or vacant land.

The City of Salem Community Development Department identified several areas where low impact development is occurring within the Pringle Creek watershed, as listed in **Table 4-8**. **Figure 4-4** shows the locations of these areas. Other areas designated as undeveloped or vacant land which provide opportunities for potential low impact development according to the Community Development Department include Partition 06-38, 06-34, 06-35 and Subdivisions 06-19 and 06-15.

Table 4-8. Areas with Low Impact Development Opportunities

Project/Development
Sustainable Fairview
Pringle Community
Cascadia Development (SUMCO South Campus)
McGilchrist Urban Renewal Area
Boise Cascade

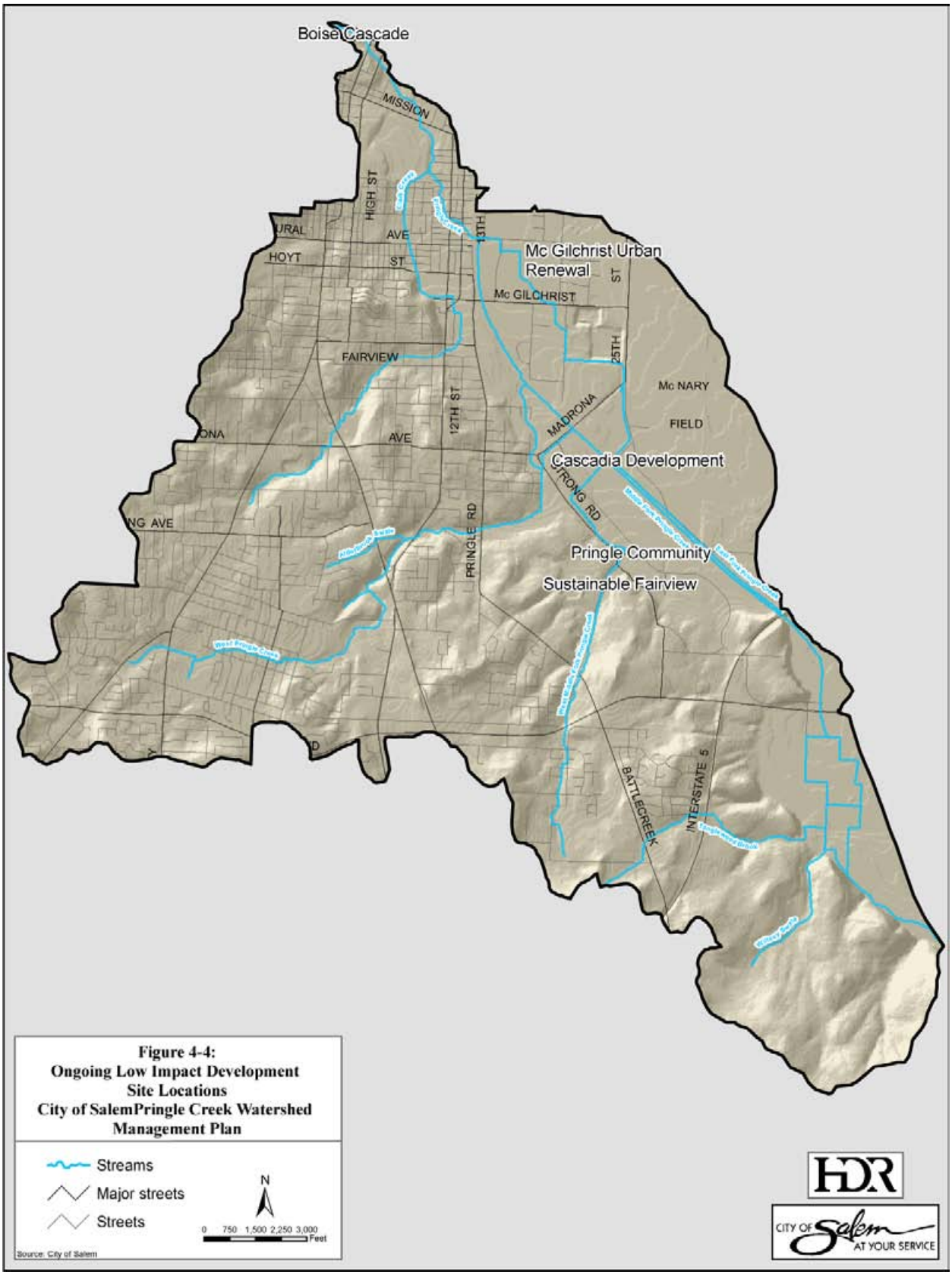


Figure 4-4:
Ongoing Low Impact Development Site Locations
City of SalemPringle Creek Watershed Management Plan

4.6 Wetlands Enhancement Priorities

Many floodplain and stream-associated wetlands absorb and store stormwater flows, which reduces flood velocities and stream bank erosion. Preserving these wetlands reduces flood damage and the need for expensive flood control devices. Many wetlands also augment summer stream flows when the water is needed by slowly releasing the stored water back to the stream system.

To identify wetlands out in the field, Oregon Department of State Lands (DSL) and U.S. Army Corps of Engineers (COE) use three criteria: hydrology, soils and vegetation. In general, an area is identified as a wetland if it can be proven to have surface water or saturated soil during some period of the growing season, contains hydric (moisture holding) soils, and has a predominance of vegetation typically adapted for life in saturated soil.

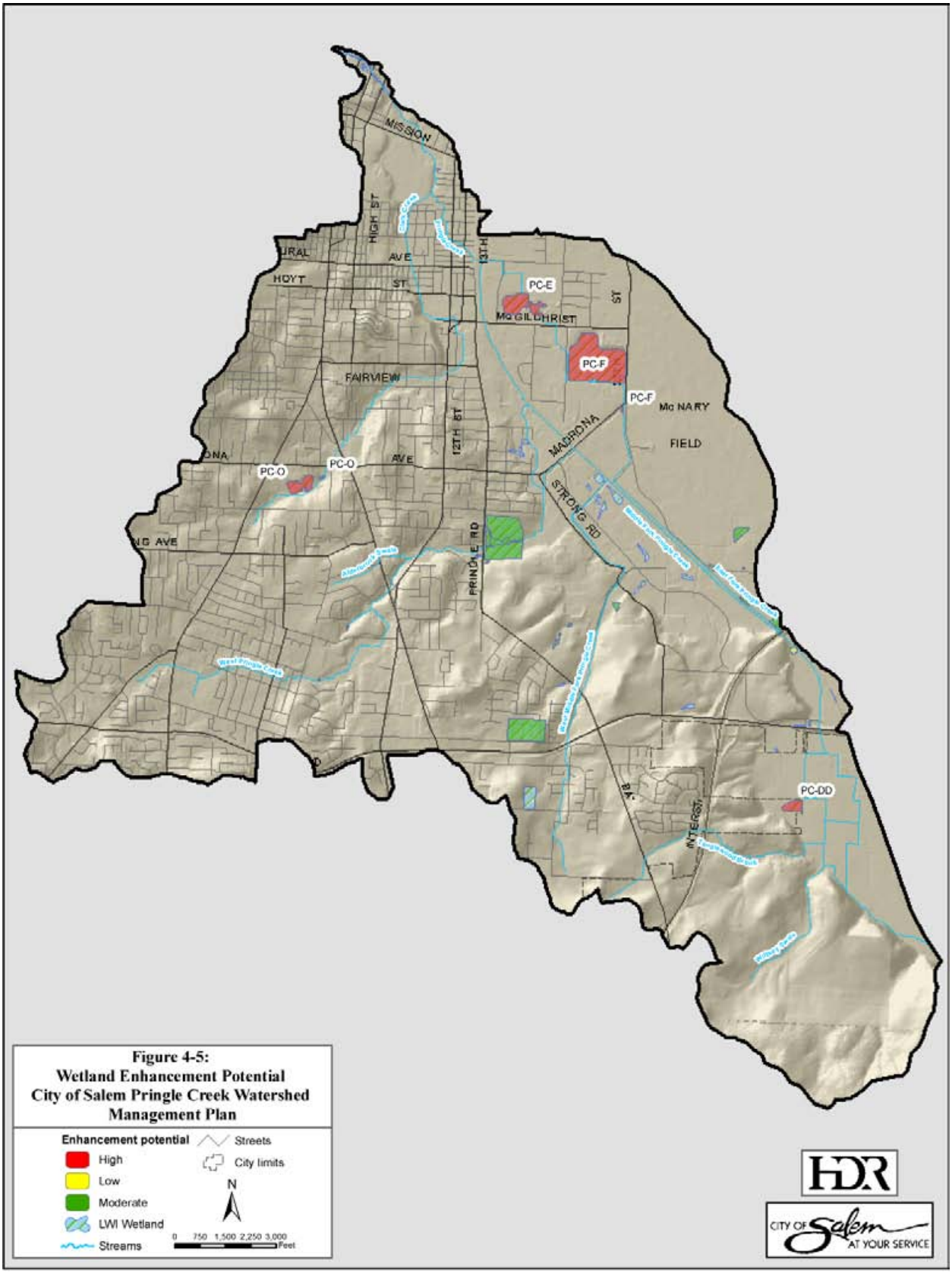
The City of Salem is in the process of completing the analysis for a list of "locally significant wetlands" as part of the City's effort to comply with the State's land use planning goals (Goal 5). The process for developing this list is outlined in the City's wetlands ordinance (SRC Chapter 126). Once the list is finalized, those wetlands within riparian corridors will have limited protection through SRC Chapter 68, Preservation of Trees and Vegetation. Further protection, such as for those wetlands outside riparian corridors, will be evaluated as the City's efforts progress.

Because wetlands provide many functions that are critical to good watershed health, enhancement and restoration of wetlands is a critical component in this Plan. Information obtained from the Salem LWI was used to compile a list of degraded wetland sites whose functions (i.e. water quality improvement, fish habitat, wildlife habitat and hydrologic control) could be enhanced through the efforts of the watershed councils or other interested parties. The local wetland inventories reviewed in this Plan are based on the information developed in the watershed assessment (Hemesath and Nunez, 2002) which used the Oregon Freshwater Assessment Methodology (OFWAM), along with professional judgment, to determine a wetland's potential for enhancement. The focus of the assessment was on opportunities for enhancement, rather than restoration or creation, because the inventories only identify existing wetlands.

Table 4-9 lists the wetlands with high enhancement potential in the Pringle Creek watershed according to the assessment in Hemesath and Nunez (2002). Three of the wetlands are abandoned gravel pits: Walling Sand and Gravel Pits (PC-E), Webb (Spinnaker) Lake (PC-F), and Berger (Hidden) Lake (PC-O). The fourth wetland is a cattail marsh (PC-DD) located west of 36th Avenue near the intersection of 36th and Kashmir Way SE. A forested wetland (PC-X) near the headwaters of the East Fork of Pringle Creek is the largest natural wetland still in existence in the watershed and may be a candidate for preservation. The wetland is dominated by Oregon ash and soft rush. The high priority wetlands are shown in **Figure 4-5**.

Table 4-9. Summary of Enhancement Potential of Wetlands			
Wetland ID	Location	Area (acres)	Enhancement Potential
PC-A		0.14	Low
PC-AA		0.36	-
PC-BB		0.61	-
PC-DD		3.32	**High**
PC-E		11.52	**High**
PC-F		43.69	**High**
PC-G		4.85	-
PC-I		0.62	-
PC-J		7.16	Moderate
PC-K		1.68	Moderate
PC-L		0.23	-
PC-M		0.58	Moderate
PC-O		5.96	**High**
PC-P		0.79	Moderate
PC-S		0.39	-
PC-T		28.16	-
PC-U		0.46	-
PC-V		0.79	Moderate
PC-W		0.12	-
PC-X		10.99	Low – Preserve
PC-Y		1.52	Low
Total		123.94	

Notes:
Taken from Hemesath and Nunez (2002)
"-" means not identified for enhancement opportunities.
Bold designates the wetlands ranked as "high" for potential enhancement.


MISSION
HIGH ST
AVE
HOYT
ST
13TH
PC-E
McGILCHRIST
ST
PC-F
PC-F
McNARY
FIELD
FAIRVIEW
12TH ST
MADRONA
AVE
PC-O
PC-O
STRONG RD
PRINGLE RD
PC-DD
INTERST
Figure 4-5:
Wetland Enhancement Potential
City of Salem Pringle Creek Watershed
Management Plan
Enhancement potential
High
Low
Moderate
LWI Wetland
Streams
Streets
City limits
N
0 750 1,500 2,250 3,000
Feet
HDR
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4.7 Drainage System Model Update

As stated in the 2000 DSIP, the current XP-SWMM computer hydraulic model created for each basin will need to be updated to contain more detail to design and evaluate the individual improvement projects. That upgrading and refinement is in process by City staff. The suggested model improvements include:

- Collect additional system inventory data and incorporate into GIS database
  - Survey cross sections, collect photographs, descriptions of vegetation, and roughness at each cross section
  - Collect culvert information including shape, invert elevations, size, top of embankment, material, and condition
  - Verify hydraulic structure data such as weir lengths, gate openings and dimensions, basin stage/volume curves, orifice diameters and configurations, and overflow elevations
  - Conduct closed system TV inspections to estimate roughness factors for pipes and their condition

- Develop Extran models in XP-SWMM to allow backwater affects to influence hydraulic modeling results. Since Pringle Creek has a history of flooding problems, updating the model is especially important.

4.8 Opportunities and Constraints for Drainage Management Actions

This chapter provided a summary of the hydrologic and hydraulic conditions in the Pringle Creek watershed, and presented management actions that can be taken to improve, mitigate or restore conditions to meet the drainage-related objectives of the plan. These objectives are to define opportunities and constraints to:

- Improve drainage and reduce the magnitude and frequency of flooding events.

- Reduce erosion and improve bank stability of urban streams.

- Restore stream and riparian habitat and function.

This last objective is directly tied to the habitat improvement objectives discussed in **Chapter 5**. Since many of the management actions have multiple benefits (for drainage, habitat and water quality), the stream repair/protection and riparian management actions are discussed in the next chapter.

The management actions to address drainage issues discussed in this chapter are summarized in **Table 4-10**, along with a summary of the opportunities and constraints for each of the management actions. Based on the opportunities and constraints listed in **Table 4-10**, the following is the recommended order by which the City should focus its efforts in implementing the drainage management actions:

1. Protect those existing watershed features that currently provide drainage benefits. Policies to protect these sensitive natural resources should be developed.

2. Continue to conduct public outreach and work with the community and other stakeholder organizations to educate and promote watershed health. This support base is necessary to continue to build a watershed-based program and implement the proposed actions, e.g. through volunteer efforts. This is also a relatively low cost option to implement.

3. Capital projects prioritized to address drainage should be funded, because flooding will continue to be the most important and visible "watershed health" issue to the public.

4. Because funding is consistently an issue, the capital improvement projects addressing flooding issues should be leveraged to identify opportunities for stream and habitat enhancement.

Although the management actions can be implemented or developed concurrently, some actions are more easily implemented because existing programs may already provide a framework or the action requires less financial resources or permitting. Other programmatic implementation consideration including plan promotion, staffing roles, and funding sources are discussed further in **Chapter 9**.

Table 4-10. Opportunities and Constraints for Drainage Management Actions

Management Action Category	Description	Opportunity	Constraint
Stormwater (Infrastructure) Management	▪ Address known flooding issues by implementing/constructing the priority drainage capital improvements (refer to Table 4-6). These projects generally involve adding or improving bridges, replacing undersized pipelines, and replacing or upgrading culverts.	▪ Project locations are defined in DSIP. ▪ City has a prioritized list of drainage projects (Table 4-6). ▪ Stormwater Management Plan includes BMPs (RC1, RC2, RC3) to prioritize and implement stormwater-related capital improvements, including detention and water quality facilities, as part of its NPDES MS4 permit requirement. ▪ City is currently updating the XP-SWMM hydrologic model which can be used to reassess impacts of drainage projects.	▪ With the exception of PCB42 (Bridge at McGilchrist) most DSIP projects are currently *unfunded* based on the 2006 CIP. ▪ May require a COE/DSL Section 404 Permit.
Stream Repair/Enhancement And Riparian Management	▪ Implement/construct stream and habitat enhancement projects in conjunction with drainage improvement projects wherever practicable. ▪ Incorporate restoration opportunities into all community development and planning programs and promote these opportunities for third-party involvement in implementing these enhancement projects.	▪ Watershed Plan has identified areas for conducting appropriate stream repair/ enhancement projects based on impaired watershed function analysis. ▪ Watershed Plan and database can be used to promote projects with other parties.	▪ Stream enhancement projects are currently *unfunded* based on 2006 CIP. ▪ Availability or access to streamside property is limited. Easements may need to be acquired. ▪ May require a COE/DSL Section 404 Permit.
Enhance Wetlands	▪ Implement wetlands enhancement where possible.	▪ City is considering a wetlands mitigation bank under its Wetlands Program. ▪ Priorities have been developed based on local wetlands inventory (LWI) and OFWAM methodology. ▪ The Marion Soil and Water Conservation District can be leveraged to recruit private landowners into the Wetland Reserve Program (WRP)	▪ Final list of locally significant wetlands has not been finalized to date, to include protection of SRC Chapter 68. ▪ Priorities developed under LWI have not been field verified. ▪ Wetland enhancement projects are currently *unfunded* based on 2006 CIP.
Promote/Implement Low Impact Development (LID)	▪ Reduce, prevent, or mitigate the creation of more impervious surfaces by promoting alternative planning strategies (low impact development) when developing new developments, including buildings, streets and parking lots.	▪ Several large urban developments in the watershed are already using some level of low impact development and can be used as demonstration projects. ▪ Industry experience has shown that LID can be cost effective.	▪ No design standards or incentives are in place to require or encourage the use of low impact development in the City. ▪ Perceived cost-to-benefit ratio is high for builders and developers.

Table 4-10. Opportunities and Constraints for Drainage Management Actions			
Management Action Category	Description	Opportunity	Constraint
Protect Natural/Sensitive Areas (including wetlands, riparian zones, floodplains)	▪ Protect existing private and public sensitive natural areas along all streams in the watershed.	▪ Stormwater Management Plan includes a BMP (RC6) to protect waterways as part of its NPDES MS4 permit requirement. ▪ City has Tree Preservation Ordinance (SRC Chapter 68). ▪ City currently has a Watershed Protection and Preservation Program.	▪ Highly urbanized watershed limits available natural resources for protection. ▪ Competition for the relatively limited developable or buildable land.
Develop and Build Upon Watershed Education and Stewardship Programs for the Community	▪ Build and expand community-wide education programs to enlist broad-based and long-term support and stewardship for watershed protection, enhancement and restoration.	▪ Stormwater Management Plan includes BMPs (RC23) to conduct education outreach as part of its NPDES MS4 permit requirement. ▪ City had Adopt-a-Street and Adopt-a-Stream programs. ▪ Leverage interest and active members of Pringle Creek Watershed Council.	▪

Chapter 5. Water Quality

Water quality in the Pringle Creek Watershed has been a topic of concern for many local residents and the other stakeholders of the Pringle Creek Watershed Council. Available data shows that water quality in the Pringle Creek watershed is likely being affected by commercial, industrial, residential, and agricultural activities, and by runoff from numerous roads. The documented water quality problems in the Pringle Creek watershed include elevated concentrations of bacteria, metals, and high water temperatures.

The following topics are covered in this chapter: (i) water quality assessment methods; (ii) water quality monitoring programs; (iii) existing water quality conditions; and (iv) water quality improvement plan. The City of Salem has been active in protecting and managing the water quality of its streams as part of other programs, specifically under its stormwater management program. Therefore, the water quality improvement plan described in this chapter relies on coordinating these efforts. Because the effectiveness of many of the management measures cannot be directly measured, the water quality improvement plan also involves continued monitoring of water quality. Monitoring is described in general in this chapter and discussed further in Chapter 7 – Monitoring.

5.1 Water Quality Assessment Methods

The water quality assessment in this chapter is based on data collected by the City of Salem, Geographic Information System (GIS) analysis, a review of DEQ's draft Mid-Willamette Total Maximum Daily Load (TMDL), information on land use and other watershed physical characteristics, and previous studies within the Pringle Creek watershed. Water quality constituents in stormwater and the TMDL requirements for the water-quality limited streams are emphasized. No new water quality sampling was conducted for this assessment, although a field reconnaissance of the Pringle Creek watershed was performed.

Water quality data in the Pringle Creek Watershed is currently too limited to determine specific locations (or reaches) that would isolate particular pollutant sources or pollutant hotspots. Therefore, water quality conditions in this chapter (and Plan) are described in terms of general stream characteristics as affected by the combination of point and nonpoint sources. Water quality data is limited in many Pringle Creek tributaries. However, based upon the types and the age of development in the watershed, it is likely that water quality conditions in the unmonitored tributaries are similar to the monitored tributaries in Pringle Creek.

5.2 Water Quality Monitoring Programs

The main source of *recent* water quality data in the Pringle Creek watershed is the urban stream monitoring program conducted by the City of Salem. In 1982, the City began a surface water quality monitoring program for selected streams within its jurisdiction. The monitoring program has been modified over the years. Up to 11 monitoring sites were located in the Pringle Creek watershed - four locations along the main stem of Pringle Creek, three along Clark Creek, and four locations were established along the West Fork of Pringle Creek. However, for the purposes of this plan, only data since 2001 was reviewed.

Since 2001, the City has collected monthly water quality samples at two sites on the mainstem Pringle Creek and two sites on Clark Creek (**Table 5-1 and Figure 5-1**). The City collects grab sample data for the following parameters: biochemical oxygen demand – 5 day (BOD5), conductivity, dissolved oxygen (DO), E. coli bacteria, nitrite plus nitrate-nitrogen (NO2+NO3-N), pH, temperature, and turbidity. The objective of the monitoring program is to establish baseline conditions, monitor the effects on urbanized areas within the City of Salem, and locate illicit discharges.

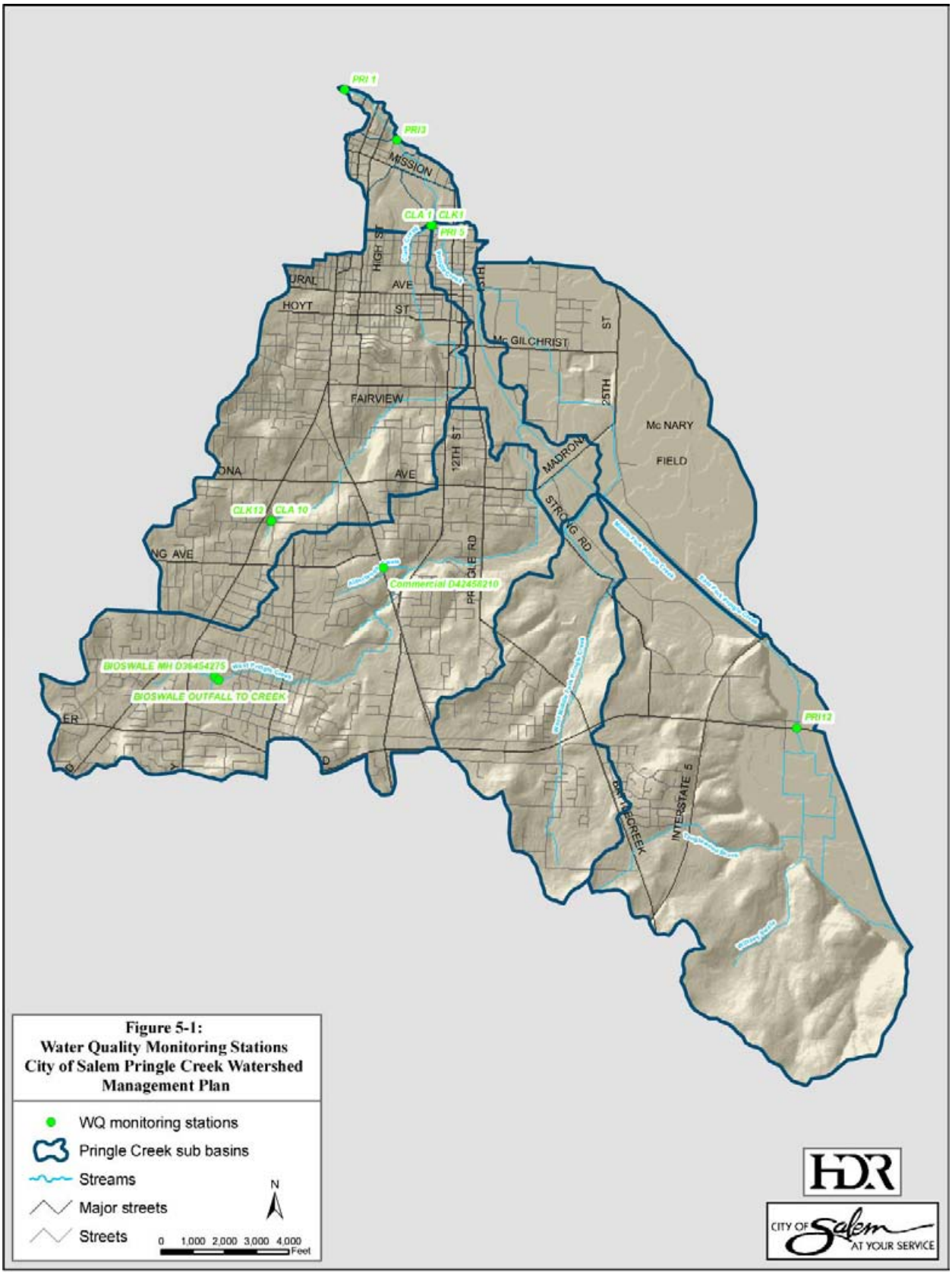
Table 5-1. Water Quality Grab Sample Monitoring Stations in the Pringle Creek Watershed

Station ID	Station Name	Location
CLA 1	Clark Cr. @ Bush Park	upstream of confluence with Pringle Creek
CLA 10	Clark Cr. @ Ewald	Between Liberty St SE and Commercial St SE on Ewald Ave SE
PRI 1	Pringle Cr. @ Commercial	in Riverfront Park
PRI 5	Pringle Cr. @ Bush Park	upstream of confluence with Clark Creek

In addition to the monthly grab samples, the City recently installed continuous flow and water quality monitoring stations (**Figure 5-1**) at PRI 1, PRI 5, CLK 10 and the upstream Pringle Creek station, PRI 12. The stations are to be installed under the City's Urban Stream Monitoring Program and currently monitor flow, temperature, dissolved oxygen, conductivity, turbidity and pH.

In addition to the Urban Streams Monitoring Program, the other sources of recent water quality data in the watershed include:

- **Continuous temperature monitoring** – The City conducted a temperature monitoring program throughout the city between April and October in 2002 (City of Salem, 2003). Continuous temperatures were recorded, using in-stream thermistors/data loggers, at the mouths of Pringle and Clark creeks as part of this study.
- **Bioassessment studies** – Water quality parameters were analyzed at several locations in the Pringle Creek watershed as part of the City's bioassessment studies conducted in 2000 and 2001 (City of Salem, 2002). The data collected as part of the bioassessments studies included dissolved oxygen, conductivity, temperature, pH, nutrients, metals and E. coli bacteria. Findings and interpretations of the bioassessment studies are discussed in **Chapter 6**.


PRI 1
PRI3
MISSION
CLA 1
CLK1
PRI 5
HIGH ST
URAL
AVE
HOYT
ST
Mc GILCHRIST
ST
25TH
FAIRVIEW
Mc NARY
FIELD
MADRONA
12TH ST
ONA
AVE
CLK12
CLA 10
STRONG RD
NG AVE
Commercial D42458210
BIOSWALE MH D36454275
BIOSWALE OUTFALL TO CREEK
PRI12
INTERSTATE 5
BRUSH CREEK
Figure 5-1:
Water Quality Monitoring Stations
City of Salem Pringle Creek Watershed
Management Plan
WQ monitoring stations
Pringle Creek sub basins
Streams
Major streets
Streets
N
0 1,000 2,000 3,000 4,000
Feet
HDR
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5.3 Water Quality Characteristics in Pringle Creek Watershed

5.3.1 303(d) listed Streams

The Oregon Department of Environmental Quality (DEQ) is the regulatory agency that establishes water quality standards for the state's surface waters. DEQ establishes water quality standards to protect State-designated beneficial uses of the state's waters. Beneficial uses are defined by law and include recreation, aquatic life, irrigation, fisheries and drinking water.

Section 303(d) of the Clean Water Act, outlines a process by which state regulatory agencies must identify those water bodies that do not meet adopted water quality standards based on designated beneficial uses. While there may be competing beneficial uses in a river or stream, federal law requires DEQ to protect the **most sensitive** of these beneficial uses. For Pringle Creek and its tributaries, aquatic life, particularly salmonid spawning and rearing, is considered one of the most sensitive beneficial uses.

Using monitoring data for receiving waters, DEQ develops a Section 303(d) list that names water bodies that do not meet standards, known as the "impaired waters list" or simply as the "303(d) list." The list is used to identify and prioritize water quality problems and serves as a guide for developing and implementing watershed pollution reduction plans or Total Maximum Daily Loads (TMDLs) to achieve water quality standards and protect beneficial uses.

DEQ completed the 2002 303(d) list of impaired waters and the U.S. Environmental Protection Agency (EPA) approved DEQ's 2002 303(d) list on March 24, 2003[1]. Clark Creek and Pringle Creek are both 303(d) listed streams (refer to **Table 5-2**).

Table 5-2 2002 Water Quality 303(d) Limited Water Bodies in the Pringle Creek Watershed

Waterbody	Parameter	Season	Criteria	Affected Beneficial Use
Clark Creek	E. coli	Year around	Log mean of 126 organisims/100 ml, no single sample > 406 organisms/100 ml	Contact Recreation
Pringle Creek	E. coli	Year around	Log mean of 126 organisims/100 ml, no single sample > 406 organisms/100 ml	Contact Recreation
	Temperature	Summer	17.8 ^{o}C	Salmonid Fish Rearing Anadromous Fish Passage
	Dieldrin	Year around	Listed in Table 20: Water Quality Criteria Summary (OAR 340-041)	Drinking Water Anadromous Fish Passage Resident Fish and Aquatic Life
	Copper, Lead, Zinc	Year round	Listed in Table 20: Water Quality Criteria Summary (OAR 340-041)	Anadromous Fish Passage Resident Fish and Aquatic Life

Source: DEQ 2006a.
Note: Mercury is a 2002 303(d) listed parameter for the Willamette River, based on fish tissue samples that exceeded health advisory target levels. The Pringle Creek watershed drains to the Willamette River and therefore will likely be included in the future TMDLs conducted for the Willamette River basin.

[1] *The 2002 303(d) list is the most recently approved 303(d) list. DEQ submitted an updated to 303(d) list to the U.S. Environmental Protection Agency in May 2006, but it has not been approved.* http://www.deq.state.or.us/wq/303dlist/303dpage.htm

5.3.2 Total Maximum Daily Load TMDL Allocations

For water bodies that exceed water quality standards a state or other regulatory authority is required to prepare a water cleanup plan – termed a TMDL – that specifies how the water body will meet the standards. A TMDL allocation is the maximum amount of a pollutant a water body can assimilate without violating a water quality standard. DEQ conducts TMDL studies to estimate the amount of pollutants reaching the receiving water from point sources and nonpoint sources and establish the allowable amounts of pollutants from these sources. DEQ assigns loading limits for point sources (wasteload allocations) and nonpoint sources (load allocations). Designated Management Agencies (DMA), which include the City of Salem, are then required to prepare "TMDL Implementation Plan" that document how the wasteload and/or load allocations will be met.

Currently there are no DEQ-adopted TMDL allocations for water bodies within the City's jurisdiction. TMDLs have been adopted for the Willamette Basin, which includes Pringle and Clark creeks, for mercury, bacteria, and temperature (DEQ 2004 and 2006). The TMDLs include load allocations for temperature and bacteria (pollutant reduction levels). Load allocations have not been established for other parameters within the City's jurisdiction, including mercury. DEQ determined that additional mercury sampling is required before it can develop TMDL allocations for the Willamette River (DEQ 2006b).

Bacteria

The draft load allocations for E. coli bacteria in the Pringle Creek watershed are listed in **Table 5-3**.

Table 5-3 DEQ TMDL E. coli Bacteria Load Allocations

Waterbody	Season	% reduction	Compliance Points	Land Use
Pringle Creek	Summer	90	West Pringle Creek at Madrona Road/Pringle Road RM 3.0	Urban
Pringle Creek	Fall/Winter/Spring	79	Pringle Creek at Pringle Park/Church Street RM 0.5	Urban
Clark Creek	Summer	94	Clark Creek at mouth in Bush Park RM 0.1	Urban
Clark Creek	Fall/Winter/Spring	89	Clark Creek at mouth in Bush Park RM 0.1	Urban

Source: Draft Willamette Basin TMDL (DEQ 2004)

** Compliance points refer to the locations where compliance with the TMDL allocations will be assessed by DEQ.*

Temperature

Load allocations for temperature are based on riparian shade and depend on criteria for specific stream reaches. The criteria include channel width, stream aspect, and system potential vegetation[2] estimates.

[2] System potential vegetation is vegetation that can grow and reproduce at a near stream site given climate, elevation, soil properties, plant community requirements and hydrologic processes. System potential vegetation is an estimate of the riparian condition where land use activities that cause stream warming are minimized (DEQ 2004)

5.3.3 Summary of Water Quality Conditions based on Measured Data

This section summarizes existing water quality conditions in Pringle Creek and its tributaries based on recent available data. Assessments of water quality conditions were recently conducted as part of the watershed assessment study (Hemesath and Nunez, 2002) and the SWMP (City of Salem, 2005). The following parameters were addressed:

- Temperature
- Dissolved oxygen
- Bacteria
- Conductivity
- Turbidity
- Nutrients

However, the discussion below focuses on the 303(d) listed parameters, comparisons with criteria, and the seasonal and spatial patterns of the monitored constituents, because those are the water quality parameters with a regulatory impetus. Nevertheless, the other parameters and water quality overall should be improved by the water quality improvement plan and other restoration activities discussed in **Chapter 6**.

Most water quality data were collected in lower Pringle Creek and Clark Creek. **Table 5-4** presents summary statistics for the parameters measured at the urban stream stations collected in Pringle and Clark Creeks.

Table 5-4. Summary statistics of water quality parameters collected in the Pringle Creek Watershed collected between 2001 and 2005

		CLK 1	CLK 10	PRI 1	PRI 5
Temperature (C)	Median	11.9	12.3	10.9	12.1
	Min	6.5	9.0	3.9	5.3
	Max	18.6	16.9	19.7	21.2
Dissolved oxygen (mg/L)	Median	10.2	9.1	10.5	10.1
	Min	7.2	7.3	7.2	6.7
	Max	12.3	11.0	13.7	13.3
Conductivity (uS/cm)	Median	80	57	62	71
	Min	28	42	42	41
	Max	93	69	91	95
Turbidity (NTU)	Median	6	4	7	6
	Min	3	3	3	3
	Max	30	15	40	30
E. coli (#/100 mL)	Median	649	167	192	231
	Min	75	3	29	6
	Max	2419	2419	2419	1986
NO2+NO3-N (mg/L)	Median	1.2	1.4	0.8	0.7
	Min	0.0	0.4	0.1	0.3
	Max	4.6	5.3	7.2	3.0

Source: City of Salem

Clark Creek showed the most consistent increase in E. coli counts, turbidity, and conductivity; however, this may be the result of the greater distances between the monitoring stations in Clark Creek. Pringle Creek differences were generally minor between upstream and downstream

locations with the exception of nitrate levels measured in the winter and spring. This may be a reflection that the two locations are in the lower end of the watershed. Refer to **Appendix E** for graphs of the water quality data collected between 2002 and 2005.

Temperature

The primary potential cause of elevated water temperatures in the Pringle Creek watershed is the low levels of streamside shade from areas that have minimal riparian vegetation. Other possible causes include the modifications to the channel that decrease water depth in the summer and the reductions in groundwater flow due to the increased impervious areas.

- **Pringle Creek -** Temperatures in the surface waters of Pringle Creek range from about 2 degrees Celsius (^{o}C) in late winter to about 20 ^{o}C in August (Refer to **Appendix E**). The lower Pringle Creek temperatures typically exceed the DEQ criterion of 17.8 ^{o}C (based on the salmonid fish rearing criteria) for a two-month period between mid-June and mid-August (**Figure E-1**). Temperatures are similar between the two Pringle Creek locations, likely due to the relatively short distances between the two monitored stations.

- **Clark Creek -** Temperatures in Clark Creek show the same pattern as Pringle Creek temperatures, with the following differences: Clark Creek temperatures generally do not exceed DEQ's temperature criterion, and the downstream station (CLK 1) is noticeably warmer than the upstream station (CLK 10) during the summer (**Figure E-2**). Increased water temperatures in downstream areas are common in streams, reflecting the influences of solar radiation as the stream moves downstream.

- **West Fork of Pringle Creek** – Based on temperature monitoring conducted between 1982 and 2000, temperatures in the West Fork of Pringle Creek are generally below the DEQ criterion of 17.8 ^{o}C (Hemesath and Nunez, 2002).

Dissolved Oxygen

Fish and other aquatic life depend on an adequate supply of dissolved oxygen. Potential causes of low dissolved oxygen concentrations in Pringle Creek and its tributaries include elevated temperatures and pollutants that indirectly lead to lower DO levels, such as nutrients that feed algae. Dissolved oxygen levels typically decrease after algae die and fall to the bottom of streams.

Dissolved oxygen concentrations are generally above DEQ's numeric criterion of 8.0 mg/L in both Pringle and Clark creeks and there are minimal differences between stations (**Figures E-3 and E-4**).

Bacteria

Potential sources of bacteria in urban areas include waste from pets, waterfowl, and other animals, sanitary sewer leaks, overflows or inadvertent cross-connections; and/or old on-site septic systems. Bacteria levels are often elevated in urban areas because bacteria adsorb onto sediment particles that are suspended in water. Urban areas typically have relatively higher suspended sediment concentrations.

Pringle Creek and Clark Creek have elevated levels of E. coli bacteria and typically exceed DEQ's numeric criteria of 126 log mean and 406 maximum count (City of Salem, 2005). Levels above the criteria occur throughout the year and are not restricted to the highest period of stormwater runoff (fall/winter) (**Figures E-5 and E-6**).

Conductivity

Conductivity is a measure of water's capacity to convey an electric current. (Conductivity indicates the total amount of dissolved charged substances in the water). There are no water quality standards for conductivity, but differences in conductivity reflect the combination of sources within a watershed and/or groundwater contributions. Therefore, conductivity can be used as a general indicator of the quality of the water and can also suggest the presence of unidentified material in the water. Pringle Creek's downstream station shows a reduction in conductivity, indicating dilution (**Figure E-7**). Clark Creek's conductivity levels typically increase at a steady rate indicating the consistent contribution from watershed sources (**Figure E-8**).

Turbidity

A primary pollutant of concern in urban runoff are fine particulates and pollutants which attach to them or are held in suspension. Dirt from bare soils, roadways, and areas under construction washes into waterways with rainfall runoff. Increased runoff from developments in upland areas promote accelerated erosion in the lower elevation areas.

Elevated turbidity levels and total suspended solids (TSS) concentrations have been measured periodically in water samples from Pringle and Clark Creeks; however, they do not appear to be a chronic problem. In general, turbidity and TSS concentrations in Pringle Creek are moderate throughout the watershed (**Figures E-9 and E-10**). The periodic high turbidity and TSS concentrations measured in the watershed occur during the high runoff period (fall/winter). Potential sources include land clearing and grading and removal of streamside vegetation in areas bordering Pringle Creek and its tributaries.

Nutrients

Elevated levels of nutrients (phosphorus and nitrogen) in streams can lead to the over abundant growth of algae and bacteria. Abundant algae can cause taste and odor problems and reduce dissolved oxygen concentrations. Nitrogen is typically abundant in natural fresh water bodies, while phosphorus concentrations are typically low and therefore act as the limiting nutrient. The EPA (1986) suggests that total phosphorus (TP) should not exceed 50 µg/L in any stream. Potential sources of nutrients in urban areas include fertilizers, pet wastes, leaves, grass clippings, and faulty sanitary sewer lines.

City of Salem data show that total phosphorus and nitrate+nitrite nitrogen concentrations are relatively low for developed areas. Nitrate levels are higher at the downstream Pringle Creek location during the high runoff periods, indicating a potential source between the locations (**Figure E-11**). Nitrate concentrations are similar between the upstream and downstream Clark Creek stations, indicating an absence of sources in this subwatershed (**Figure E-12**).

5.4 Water Quality Improvement Plan

This section discusses measures to improve water quality conditions in the streams within the Pringle Creek watershed. Existing water quality data do not indicate a specific source of pollution to Pringle Creek and tributaries. However, streams within the Pringle Creek basin are moderately degraded due to the cumulative effects of urban, residential, and agricultural land uses. In addition to the diffuse sources of pollution in the Pringle Creek watershed, the causes of water quality degradation include:

- **Hydrologic changes** as a result of increases in the basin's impervious areas and drainage modification (e.g. putting the streams in pipes and the installation of weirs).

- **Modification of riparian vegetation** – riparian vegetation shades streams and filters pollutants from stormwater.

Restoring the hydrologic and vegetation characteristics in the basin will indirectly benefit the water quality of the streams. These general physical improvements to the streams and site-specific habitat are described in Chapters 4 and 6. With this in mind, the general list of restoration or protection activities described in **Section 2.2** that address water quality issues is highlighted in **Table 5-5**. In this case, restoration alternatives are generally those practices where new structures or other physical features are constructed or where existing features that help to improve water quality conditions are altered. Protection alternatives are generally those practices that are administrative in nature and are used to maintain or improve areas in the watershed that are providing water quality benefits.

As mentioned previously, the water quality improvement plan is intended to coordinate the best management practices (BMP) developed under the City's Stormwater Management Plan (SWMP). **Appendix C** lists the SWMP best management practices (BMP) and **Table 5-5** identifies those BMPs that correspond with each of the management categories. In addition to these BMPs, other agencies, developers or the public can implement the management activities that compliment the City's programs.

Table 5-5. Restoration and Protection Activities for Managing Water Quality			
Management Activity	Primary Water Quality Objective(1)	Affected Water Quality Parameter	City of Salem Stormwater Management Plan BMP(2) (refer to App. B)
Stormwater Retrofit			
▪ Install water quality facilities ▪ Construct detention facilities	▪ Reduce source of pollutants of concern ▪ Reduce or eliminate the transport mechanism or other "carrier" of pollutants ▪ Provide treatment for pollutant of concern ▪ Reduce sediment contamination	Bacteria Dissolved Oxygen Metals Nutrients Sediment Toxins (Dieldrin)	RC1 – Capital improvements RC2 – Stormwater detention program RC3 – Water quality facilities RC21 – Inventory private stormwater facilities
Stream Repair			
▪ Stream cleanups ▪ Bank stabilization ▪ Flow deflection ▪ Grade controls	▪ Reduce source of pollutants of concern (debris) ▪ Reduce sediment contamination	Sediment	N/A RC1 – Capital Improvements
Riparian Management			
▪ Riparian wetland restoration ▪ Park/greenway plantings ▪ Riparian reforestation ▪ Vegetate streambanks	▪ Reduce or eliminate the transport mechanism or other "carrier" of pollutants ▪ Provide treatment for pollutant of concern ▪ Reduce sediment contamination	Bacteria Dissolved Oxygen Metals Nutrients Sediment Temperature	RC6 – Riparian protection
Pervious Area Preservation/Restoration and Impervious Area Minimization			
▪ Land reclamation ▪ Upland vegetation	▪ Reduce source of pollutants of concern ▪ Reduce or eliminate the transport mechanism or other "carrier" of pollutants	Bacteria Dissolved Oxygen Metals Nutrients Sediment Temperature	RC8 – Alternative gardening products RC9 – Modify land use and landscape requirements

Table 5-5. Restoration and Protection Activities for Managing Water Quality (cont'd)			
Pollution Source Control			
▪ Residential source controls ▪ Hotspot source control	▪ Reduce source of pollutants of concern ▪ Prevent illegal discharges/ spills	Bacteria Dissolved Oxygen Metals Nutrients Sediment	ILL1 – Spill prevention and response program ILL2 – Illicit discharge elimination program ILL4 – Illegal dumping control program ILL5 – "No Dump" Educational Program ILL6 – Storm drain stenciling and marking program IND1 – Industrial stormwater discharge program CON1 – Construction site control program
Municipal Practices and Programs			
▪ Street and storm drain cleaning ▪ Education and enforcement	▪ Reduce source pollutants of concern ▪ Prevent illegal discharges/ spills	Bacteria Dissolved Oxygen Metals Nutrients Sediment	RC4 – Street Sweeping Program RC5 – Deicing activities RC7 – Operations and maintenance program RC23 – School presentations and education outreach

(1) Some of the management activities have hydrology/drainage and habitat benefits in addition to meeting the water quality objectives.
(2) The best management practices are those developed by the City to meet their NPDES MS4 Stormwater Management Plan requirement (summarized in App. C).

The water quality management activities listed in **Table 5-5** are intended to improve the *overall* water quality conditions in the Pringle Creek watershed. The water quality improvement measures summarized in **Table 5-6** address the primary documented water quality concerns in the Pringle Creek watershed - bacteria and temperature (i.e. TMDL parameters)[3]. Water quality standards are designed to support the designated beneficial uses of the water (e.g., swimming, fisheries) therefore; compliance with water quality standards should support the designated uses and serve to support a healthier urban stream.

Table 5-6. Summary of Pringle Creek Water Quality Improvement Plan for TMDL Parameters

Pollutant	Control Measures	Monitoring	Reporting
Bacteria	Install and maintain construction and post-construction BMPs as specified in SWMP.	Conduct E. coli monitoring at the 3 TMDL compliance point stations to establish baseline conditions and track progress toward meeting the established load allocations	Document results in annual summary.
Temperature	Improve riparian shade conditions, particularly in those areas where there is greatest difference between current and system potential vegetation. Preserve those areas still having adequate effective shade	Continue temperature data collection in Pringle and Clark Creeks and measure shade estimates.	Document results in annual summary.

A further discussion of the water quality improvement plans for bacteria and temperature is provided in the following subsections.

5.4.1 Bacteria

Reducing bacteria levels in the watershed should include many of the activities listed in **Table 5-5**. Initial activities will be source characterization and identification followed by a combination of capital improvements and non-structural solutions, such as implementing land use revisions, eliminating any sanitary/storm cross-connections or illicit sanitary discharges to the storm system, low-impact development techniques, water quality treatment facilities within the watershed, and educating property owners and the public to reduce bacteria sources from developed areas. These techniques have been identified in the City's SWMP as summarized in **Appendix C** (City of Salem, 2005). Many of the BMPs identified in the SWMP would also improve other water quality parameters in addition to reducing E. coli concentrations in the Pringle Creek. In particular, the BMPs that reduce sediments would also reduce many pollutants that adsorb onto particulates, including E. coli and metals.

At this time, specific locations for implementing these management activities are not provided because water quality information does not allow identification of specific sources. However, implementing these activities watershed-wide as opportunities arise

[3] *More monitoring will be conducted by DEQ for those parameters that are on the state's 303(d) list, but do not have load allocations for the Pringle Creek watershed. These parameters include Dieldrin, metals, (copper, zinc, and lead), and mercury.*

should result in reduced concentration of bacteria. As such, monitoring is a key component of the water quality improvement plan for bacteria.

Monitoring E. coli at the three TMDL compliance points in Pringle and Clark Creeks should be conducted to establish baseline bacteria levels at these locations. The baseline levels should be used to assess the benefits from implementing BMPs within the watershed (reductions in E. coli levels) and whether TMDL E. coli load allocations are being met. Results from the monitoring program would be summarized in a brief annual report that would assess existing BMPs, bacteria levels at the compliance locations, and proposed follow-up measures.

5.4.2 Temperature

The key element in improving stream water temperature is to protect and improve the vegetated riparian corridor that shades the stream. Over 50 percent of Pringle Creek or its tributaries have low effective shade (less than 40 percent) (DEQ, 2004). The focus of riparian improvements could occur in the following areas:

- Priority areas identified as part of the habitat recommendations as described in **Chapter 5**. These areas include the portions of East Fork and Middle Fork Pringle Creek.

- Low shade (< 40 percent) areas identified in a 1999 study of riparian shade (Watershed Professionals Network 1999). Results of this shade survey are presented in the 2002 watershed assessment (Hemesath and Nunez, 2002).

- Achieving the TMDL effective shade load allocations specified in the draft Willamette Basin TMDL (DEQ 2004).

The draft Willamette Basin TMDL presents system potential effective shade for general areas in streams within the Pringle Creek watershed. Load allocations for riparian effective shade are based on meeting the estimated system potential effective shade along the creeks. For example, if the system potential shade for a section of Pringle Creek is estimated at 80 percent and the current riparian shade produces only 30 percent effective shade, the load allocation (needed improvement) is a 50 percent increase in effective shade. These target improvements are based on general site characteristics of stream reaches, including stream orientation, general soil types (geomorphic unit), and channel width.

It should be noted that riparian corridors are difficult to restore in many areas of the watershed, because much of the creek property in the Pringle Creek watershed is private, or riparian areas are limited for planting. However, for areas that have large lot sizes, participation from even just a few landowners could have a substantial benefit.

As discussed in Chapter 6, the following techniques may also be used to reduce stream temperatures and increase shade in the Pringle Creek watershed (DEQ 2004):

- Improving stream channel morphology

- Increasing stream channel complexity

- Increasing stream flow
- Decreasing tributary stream temperatures
- Decreasing channel width/increasing effective channel depth (but not further down cutting or incising the channel)

In addition to implementing BMPs and other measures to improve bacteria and temperature conditions in the watershed, it is recommended that the City assess the continuous data currently being collected. This will improve the City's understanding of water quality parameters that vary daily, such as temperature and dissolved oxygen, and how local streams respond to such varying conditions (including diurnal patterns).

5.4.3 TMDL Implementation Plan

Because Salem is located within the Willamette Basin, the City (as a DMA) will be required to prepare a TMDL Implementation Plan that describes how the City intends to achieve its TMDL wasteload and load allocations. Many of the best management practices (BMPs) the City currently conducts as part of its Stormwater Management Plan (SWMP) may satisfy the requirements of the Willamette Basin TMDL. The City's TMDL Implementation Plan will probably address temperature apart from its SWMP, because DEQ has rightly acknowledged that temperature is not a stormwater issue within the Willamette Basin.

It is important that this plan (Pringle Creek Watershed Plan) and Salem's TMDL Implementation Plan use consistent and integrated approaches for the management of water quality within the Pringle Creek watershed. It is beyond the scope of this Plan to develop the specific activities to satisfy the TMDL Implementation Plan, but both of these plans will be used to guide water quality improvements in this basin. Specific water quality improvement measures may have to be revised in the future as new TMDLs are completed for other 303(d) listed parameters, such as mercury, dissolved oxygen and select metals.

Because of the uncertainties involved in the development of a TMDL and in the effectiveness of management strategies to improve water quality, it is necessary to use an adaptive management approach for the implementation of the TMDL (DEQ 2004). The adaptive management approach involves tracking, assessment, and adjustment of management actions taken to reduce pollution. It is anticipated that it will require several years (if not decades) to adequately assess the effectiveness of management measures (in particular, improvements to riparian shade).

Chapter 6. Instream and Riparian Habitat

This chapter provides a description of the habitat conditions within the Pringle Creek watershed. The focus is on aquatic habitat because anadromous fish potentially present in the watershed are listed under the Endangered Species Act. Characterization of habitat conditions was based primarily on the bioassessment study data collected by the City in 2000 (Salem 2006), since reach-by-reach field surveys were beyond the scope of the plan development. The methodology to use the bioassessment data is summarized in this chapter.

This chapter presents management actions that can be taken to protect, restore and enhance habitat conditions to meet the habitat objectives of the plan. The habitat-related objectives are to define the opportunities and constraints to:

- Enhance or protect stream habitat for aquatic species (including fish passage).
- Restore riparian habitat and function.
- Improve aesthetics of the urban stream corridor and improve recreational facilities and features.

The chapter discusses the management actions for habitat in general terms and prioritizes these actions based on the opportunities and constraints to implement them. It was beyond the scope of this plan to develop site- or reach-specific projects or actions. The potential improvements and management activities for habitat are coordinated with the management activities for drainage and water quality improvements in Chapters 4 and 5, respectively.

6.1 Focal Species and Habitat

6.1.1 Pringle Creek Overview

The Pringle Creek Watershed is located within the Willamette Valley Ecoregion[1], including the Willamette River floodplain and surrounding areas **(Figure 6-1)**. It is characterized by fertile floodplain riparian forests, flat, fluvial terraces, and rolling foothills along the fringes of the valley floor. The ecoregion contains prairies, deciduous and coniferous forest, and wetlands. Vegetation dominating this region consists of cottonwoods, alder, Oregon ash, bigleaf maple and Douglas fir in the floodplain areas; Oregon white oak, Oregon ash and Douglas fir in the oak woodlands and savannah of the fluvial terraces; and Oregon white oak and Pacific madrone in the dryer, and Douglas-fir and western red cedar in the moister areas of the valley foothills (PNW-ERC 2002). Streams throughout the Willamette valley tend to be low gradient, meandering and naturally braided.

[1] Ecoregions are spatial classifications that distinguish areas with similar characteristics in order to provide a simplified view of the spatial variation across the landscape from environmental factors such as soils, precipitation, vegetative cover and land use. They provide a spatial map for research, management and monitoring of ecosystems and are a useful tool for excluding large-scale environmental factors from an analysis in order to narrow the variation in data to site specific factors.

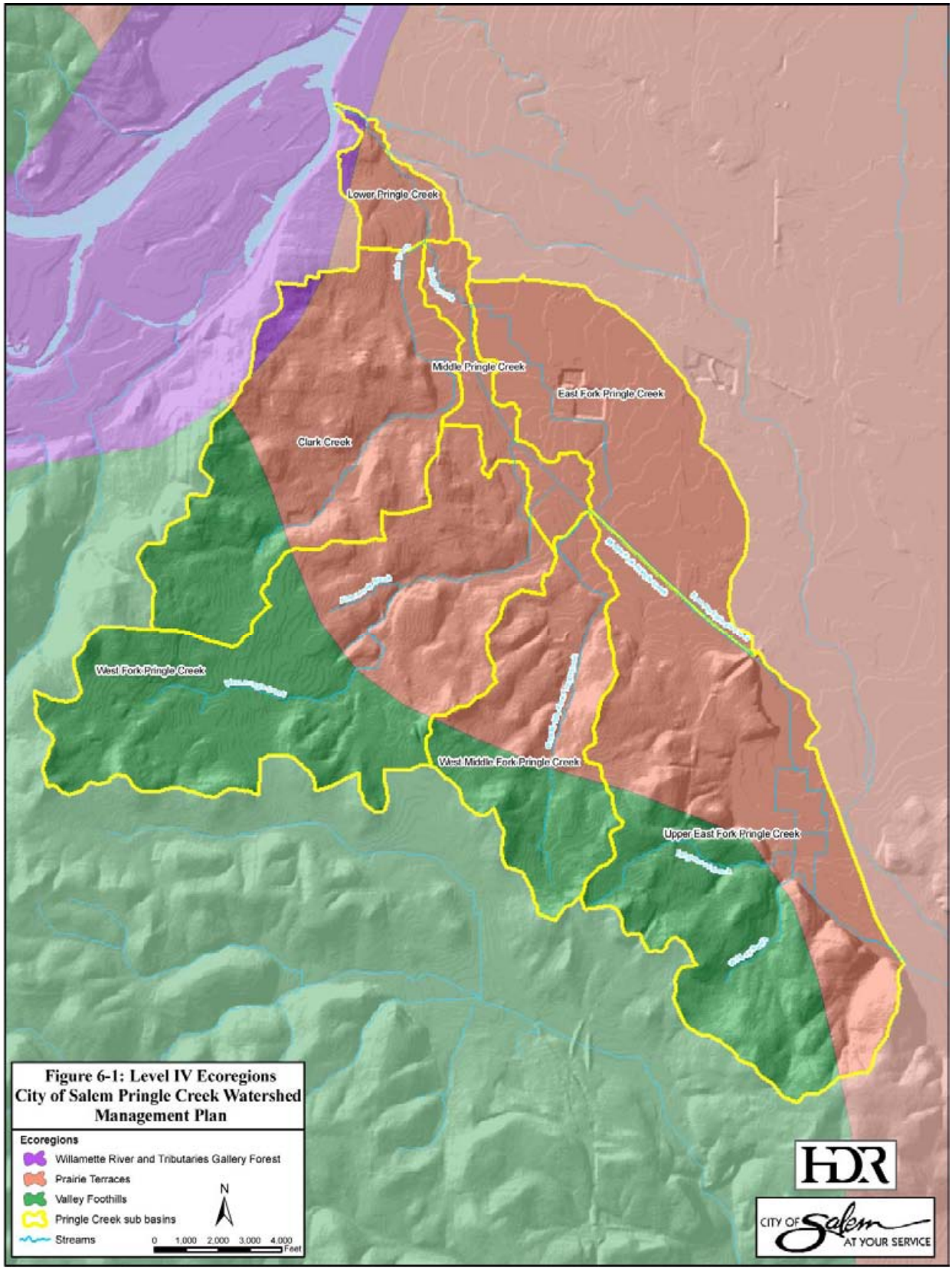


Figure 6-1: Level IV Ecoregions City of Salem Pringle Creek Watershed Management Plan

Rocks and soils in the watershed consist of Quaternary sedimentary deposits of alluvium, sand, gravel and silt along the mainstem, middle and east forks of Pringle Creek and Tertiary Columbia River Basalts in the foothill areas of the upper portions of Clark Creek and West Pringle Creek.

Pringle Creek is located almost entirely within the city limits of Salem. Within the northwest, the proportion of salmonid habitat that is located within urban areas is relatively small; however, much of the habitat located in urban areas contains critical, low-gradient areas that have historically functioned as overwintering habitat and migration corridors for salmonids. Unfortunately, aquatic habitats in urban areas are also very highly altered, which has resulted in a loss of many of the functions of these critical habitats that these species have depended on. Thus, minimizing negative effects and restoring habitats and access to them within urban areas can go a long way toward eliminating limiting factors to species recovery.

According to conversations with the local Oregon Department of Fish and Wildlife (ODFW) biologist (Hunt, personal communication, 2006), Pringle Creek is a relatively degraded basin; however, the healthiest areas appear to be the West Fork, which contain some resident cutthroat trout. There is relatively good habitat downstream of the culvert on Commercial Street, but few fish have been observed upstream of it. The East and Middle Forks are channelized and contain fewer fish; however they do contain lamprey. During the last few years, some isolated habitat restoration projects have been conducted in the watershed.

6.1.2 Aquatic Species

Two species of anadromous fish that are listed under the federal Endangered Species Act (ESA) are potentially present within Pringle Creek. These include the Upper Willamette River Spring Chinook Chinook_Salmon Evolutionarily Significant Unit (ESU), and the Upper Willamette River winter steelhead ESU, both listed in March 1999 (NMFS 2006). Despite their potential presence in the watershed, use of Pringle Creek by these species has only been observed from the mouth of Pringle Creek up into Shelton Ditch (river mile 0.44 of Pringle Creek) for rearing and migration (StreamNet 2006). The quality of the habitat is not ideal for spawning and these species likely migrate through to higher quality habitats within Mill Creek (NOAA Fisheries 2005).

Despite the existence of potential habitat, Pringle Creek (and all tributaries to Mill Creek and the Willamette River within the Mill Creek/Willamette River 5th field HUC) has been excluded from critical habitat designation because the economic benefits of exclusion outweigh the benefits of designation (Federal Register June 2005, 70 FR 52630). Despite its exclusion, Mill Creek (which is connected to Pringle Creek by Shelton Ditch) is considered an important connectivity corridor to the North Santiam River (NOAA Fisheries 2005), which contains a core population of UWR winter steelhead that may offer the most likely path to recovery, and contains one of the most intact representatives of the genetic character of the ESU.

Fall Chinook salmon, although not listed under the ESA, are documented to use the mainstem of Pringle Creek for spawning and rearing up to the confluence of Middle Fork Pringle Creek (StreamNet 2006). This run is not native to the Upper Willamette River and is present largely as a result of hatchery programs throughout the last 100 years, and the laddering of Willamette Falls (just upstream of the confluence of the Clackamas and Willamette Rivers), which allowed passage of fish above the falls at lower flows.

In addition to anadromous salmonids, a fish distribution study conducted by ODFW in 1999 (see appendix B, Salem 2003) found cutthroat trout are present throughout the Pringle Creek Watershed. Surveyors also observed lamprey, sculpin, speckled dace, redside shiners, roughskin newts and crayfish throughout the watershed.

6.1.3 Regulatory Background

Threatened salmonids could potentially be present within Pringle Creek. From a regulatory perspective, activities of concern within Pringle Creek include those that could affect these species or their critical habitats, or adversely affect any waters of the state through removal, fill or discharge of materials into or out of the stream channel. Any activities that will affect waters of the state require a US Army Corps of Engineers Section 404 permit, which includes an assessment of potential effects on listed species within the basin.

Although the basin has been excluded from Critical Habitat under the ESA, the Oregon Department of State Lands (DSL) and ODFW designated the mainstem of Pringle Creek as Essential Salmonid Habitat from its mouth to its confluence with East Fork Pringle Creek (DSL 2006). Essential Salmonid Habitat is defined by the DSL as "the habitat necessary to prevent the depletion of native salmon species (chum, sockeye, Chinook and Coho salmon, and steelhead and cutthroat trout) during their life history stages of spawning and rearing." From a regulatory perspective, this designation will affect whether or not a DSL permit is required for removal or fill activities. Removal or fill activities that occur within Essential Salmonid Habitat (with a few exceptions) require a Removal-Fill permit, even when the removal or fill is less than 50 cubic yards. This designation only applies to the mainstem of Pringle Creek; therefore, up to 50 cubic yards of removal or fill can be conducted in the upper reaches of the watershed without a permit.

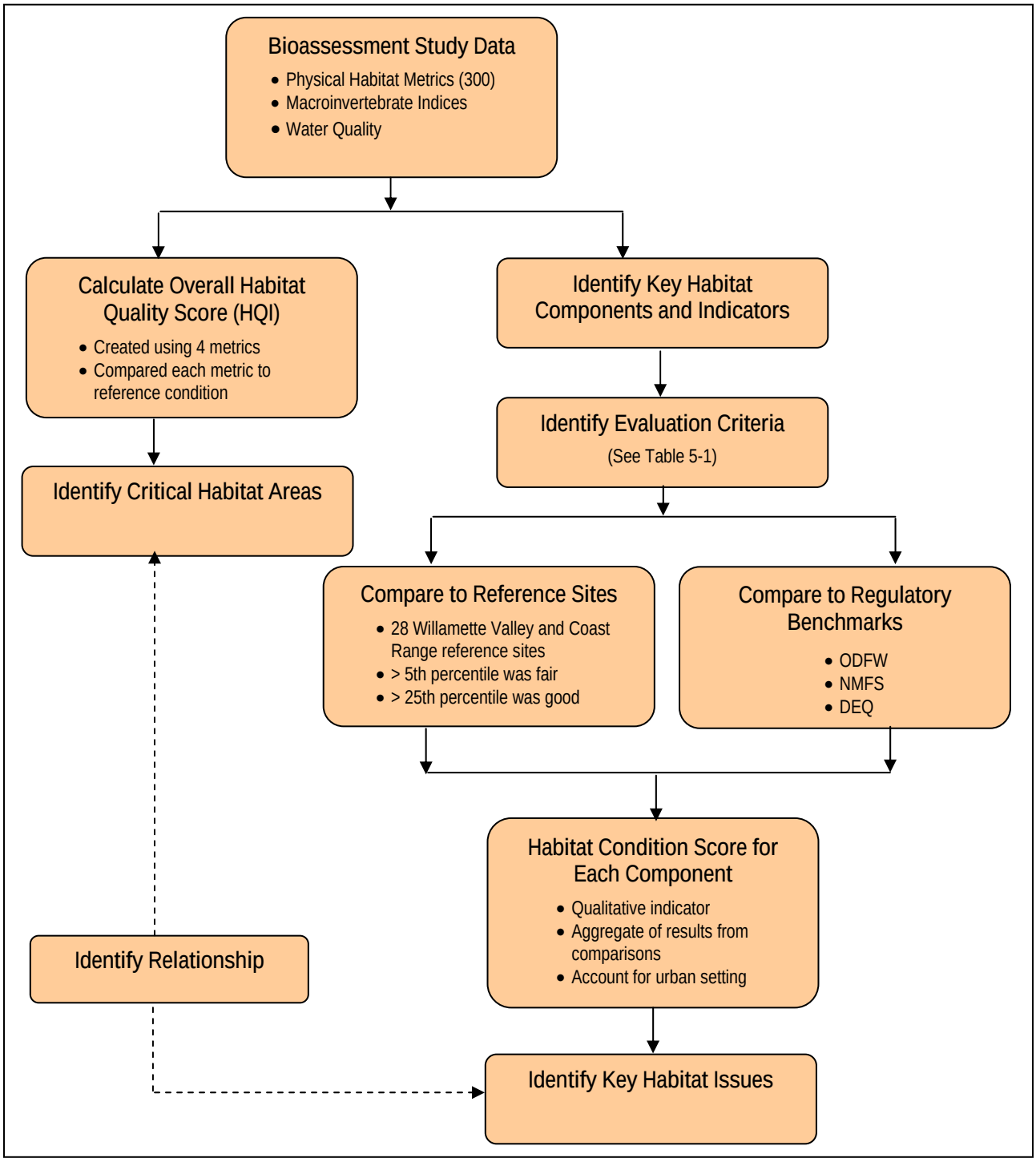
There are a number of exemptions from these permit requirements that apply to stream enhancement activities. These regulatory requirements should be kept in mind for construction that could affect the stream channel, as well as activities occurring within the stream channel that are intended to improve habitat within Pringle Creek.

6.2 Habitat Evaluation Methods

Characterization of habitat conditions within the Pringle Creek watershed are based primarily on information obtained from a Bioassessment Study conducted by the City of Salem in 2000 (City of Salem 2002). The purpose of the study was to collect data that could be used to quantitatively describe the current ecological condition of the streams in Pringle Creek. This data could also be used as a decision making tool for future stream management within the watershed. The bioassessment study was based on methodologies used by the Environmental Protection Agency's Environmental Monitoring and Assessment Program (EMAP) (Salem 2000). The study resulted in a set of approximately 400 quantitative physical habitat "metrics" that could be used to describe various aspects of aquatic habitat in Pringle Creek (Salem 2006). In addition to the physical metrics, the study also produced a Benthic Index of Biological Integrity (B-IBI), which quantifies the relative numbers and proportions of macroinvertebrate species, and a qualitative Rapid Habitat Assessment that provides a context for the Biological Index. B-IBI scores are often used as indicators of overall aquatic habitat condition. Because these scores were qualitative and there were no reference sites to compare them to, they were not used in the habitat evaluation for this watershed plan. **Appendix F** includes a summary of the bioassessment data evaluation using the methods described in this section.

For the habitat evaluation for this watershed plan, the physical habitat metrics were interpreted with the objective of characterizing the overall habitat quality of each surveyed site and identifying the limiting factors to healthy aquatic habitat. In order to characterize habitat in Pringle Creek, the overall habitat quality was summarized at each site using an overall habitat quality index (HQI) and by evaluating the condition of seven components of aquatic habitat. The general process is described below and outlined in **Figure 6-2**.

Figure 6-2. Evaluation of Habitat Quality and Key Habitat Issues



6.2.1 Habitat Components

In this watershed plan, a "habitat component" is defined as a feature of the environment that is essential for survival of aquatic species. Habitat components essential for fish and aquatic species have been described in detail in many studies. Components selected for evaluation of limiting factors to aquatic species in this study were adapted from components of fish habitat quality recommended by Kauffman (1999), Bauer and Ralph (1999), those used by the National Marine Fisheries Service (1996) in ESA consultations, and those used by ODFW (Foster et al. 2001) in aquatic inventories. These components create a mix of conditions known to constitute suitable habitat for fish and other aquatic species. If there are indications that a particular component is not properly functioning, the component could be limiting the suitability of the stream for migration, spawning or rearing of fish. Components that were included in this habitat assessment include channel morphology, channel complexity, pools, substrate, large wood, riparian vegetation, fish cover and water quality. These components are described further below.

- **Channel Morphology** includes features such as the width, depth, gradient, sinuosity and overall shape of the stream channel. The morphology of a channel is tied closely to the hydrology and sediment transport within the stream, and its connectivity to the surrounding floodplain. Channel morphology is the background condition under which other habitat features are created, or degraded, and it defines the amount of habitat space available for organisms to use by determining the depths and velocities of the flows that are present throughout the year and could become barriers to migration. Channel morphology also influences the quality of the water that flows through the channel through erosion and other sediment transport processes.
- **Channel Complexity** defines the variety of habitat types, and their distribution, that are available to support aquatic species of various life stages throughout the year. Channel complexity is created through variations in flow patterns that create recognizable habitat types called "units." These units can be defined based on the gradient, substrate type (see below), and flow patterns and are classified as pools, riffles, glides, rapids or cascades. Each habitat type is important to different species during different life stages; therefore, having a variety of unit types ensures that elements essential to an organism's survival are present.
- **Pools** provide deeper water, slower flows and a refuge to aquatic species. Slow-moving water provides resting places during upstream migrations, cover from predators and cooler temperatures during the summer months. Pools also contribute to habitat complexity and often contain other habitat elements that are essential to fish, such as course substrates at their tail-outs, large wood, and instream vegetation.
- **Substrate** is the composition of the material lining the stream bed, which ranges in size from silt and sand to large cobble and boulders, and could include concrete or organic matter. Substrate size and composition determine the types of organisms that can inhabit the stream and the habitat space available to them including macroinvertebrates which provide food for other aquatic species, and fish, which require coarse substrates for spawning. Along with channel complexity, substrate size in the channel influences the hydraulic roughness and the range of water velocities within the stream channel.
- **Wood** influences the morphology of the stream and provides complexity and structure within the channel. Wood provides structure in the channel that moderates flows, creates complex

habitat types such as scour pools and backwaters, aggrades coarse substrates, provides fish cover, and provides habitat for macroinvertebrates.

- **Riparian Vegetation** moderates stream temperatures through shading, and provides channel bank structure, cover, and nutrient inputs. Vegetation functions as a buffer from anthropogenic activities, stabilizes streambanks, and contributes organic materials and wood to the stream channel that provide instream structure, complexity, hydraulic roughness, and cover.
- **Fish Cover** conceals fish from predators and prey, and provides refuge from high flows and extreme temperatures. It includes undercut banks, boulders, wood and vegetation within and over the stream channel.
- **Water Quality** is the medium with which all aquatic organisms live. Changes in the condition of the water chemistry, temperature, turbidity, and oxygen content all influence the ability of aquatic organisms to breath, feed, reproduce and survive.
- **Habitat Access** determines the quantity and variability of habitat available for aquatic organisms. Aquatic species require different types of habitat during different life stages and seasons, and barriers can block both longitudinal access to upstream areas, as well as latitudinal access to floodplain and off-channel habitats. Barriers to access occur from both structural barriers such as culverts and dams, and ecological barriers from low or high stream flows, and channel incision.

These components are all essential for the survival of aquatic species, and most were included in the habitat assessment. Although water quality is one of the most important components of aquatic habitat, it was not included in the habitat assessment because it is addressed in detail in **Chapter 5**. Habitat access was not addressed in the Bioassessment Study, but is covered in **Section 6.4**.

6.2.2 Indicators of Habitat Condition

After defining the habitat components that are essential for aquatic organisms in Pringle Creek, a means of evaluating the health of these components was necessary. Evaluating habitat condition requires identifying indicators of the condition of habitat components, and then establishing standards from which to evaluate them. In a discussion of habitat indicators and their use in the Oregon Plan, Dent et al. (2005) suggest that “an indicator is a characteristic of the environment that, when measured, quantifies the magnitude of stress, habitat characteristics, degree of exposure to the stressor, or degree of ecological response to the exposure.”

Indicators (or metrics) selected to represent the habitat components were chosen based on the availability of data from the bioassessment study, the comparability to reference site data and regulatory benchmarks, and on professional judgment. These indicators are listed in **Table 6-1**.

Table 6-1 Indicators Used to Evaluate the Condition of Habitat Components	
Habitat Components	Indicators from the Bioassessment Study
Channel Morphology	Channel sinuosity Incision height (m) Bank angle (degrees)
Channel Complexity	Riffle percentage Glide percentage Pool percentage
Residual Pool Depth	Depth of deepest residual pool (m)
Substrate	Coarse gravel and larger (%) Embeddedness (%) Sand and fine sediments (%) Hardpan % Bed substrate stability index
Wood	Wood density (pieces/100 m, all sizes)
Fish cover	Natural fish cover (aerial proportion)
Riparian cover	Canopy shading mid-channel (% area) Riparian canopy cover (aerial proportion, large trees) Riparian canopy cover (aerial proportion, all trees > 5m tall) Proportion of reach with 3 layers of vegetation

6.2.3 Evaluation Criteria

To assess whether or not a specific metric indicates good or poor condition, a benchmark or standard is used for comparison. Habitat characterization generally requires a set of desired, expected or attainable conditions with which data from individual sites can be compared.

For some habitat indicators, federal and state fish and wildlife agencies have developed criteria for protection of aquatic species. Both ODFW (Foster et al. 2001) and NMFS (1996) have developed benchmarks specifically for evaluating the quality of habitat in stream channels for anadromous fish. These benchmarks were designed to provide an initial context for evaluating measures of habitat quality and do not account for the natural variability in streams relative to their location and natural flow regime. Consequently, these benchmarks may be difficult to attain in urban environments where streams may not have adequate riparian buffers and are not maintained by natural disturbance regimes. Despite these limitations, these values are useful for determining if the distribution of a habitat feature is “high” or “low” within the stream system and if this feature could be limiting to endangered species.

Another useful benchmark is to compare local conditions to “reference sites” which are generally located in areas absent of human disturbance – to the extent possible. Reference site conditions define and describe the natural variability present in streams in the absence of human disturbance. Habitat values from reference areas provide both a measure of what constitutes “good” conditions, as well as a measure of the variability of conditions present in undisturbed systems characteristic of that region. Habitat conditions from reference sites provide an expected, or potentially attainable, value from which to evaluate habitat condition.

6.2.4 Habitat Quality Index

Using data from reference sites within the Willamette Valley ecoregion, a Habitat Quality Index (HQI) was calculated. The HQI combines and quantifies the deviation of four habitat metrics from reference condition. This index was created by the Washington Department of Ecology (Merritt et al. 1999) and then later used by Clark County, WA (2003) for characterizing habitat in small streams. The index evaluates four indicators at each site (representing channel complexity, substrate, fish cover and riparian cover) and results in a value that is a proportion of the highest scoring site in the data set. For Pringle Creek, this highest score was obtained from the mean of eight Willamette Valley reference sites (Drake 2006), which represents the least disturbed condition for the Willamette Valley ecoregion.

6.2.5 Evaluation of Habitat Components to Determine Key Habitat Issues

In order to determine potential limiting factors to habitat quality, each habitat component was evaluated by comparing its indicators to both reference condition and regulatory benchmarks.

To evaluate the sites relative to reference condition, indicators of each habitat component were evaluated relative to the distribution of the same indicators sampled from 28 Willamette Valley and Coastal reference sites. These reference sites were selected based on gradient and stream size. The 5th and 25th percentiles of each metric were calculated and used as benchmarks for "fair" and "good" condition, respectively.

Using both reference condition benchmarks and regulatory benchmarks, each indicator was evaluated, and then combined with the results of other indicators for each habitat component. The habitat components were then given a condition score ranging from zero to three, with zero representing "very poor" and three representing "good". Due to the urban nature of Pringle Creek, and the fact that reference condition, by definition should be more representative of expected conditions in a low-gradient valley, the evaluation was weighted more strongly toward reference benchmarks than regulatory benchmarks.

Summaries of all of the sites that were surveyed are included in **Appendix G**. Each summary includes a general reach description, the habitat quality index, the condition score of each habitat component, and outlines the key habitat issues at each site.

6.2.6 Limitations of the Bioassessment Study

While evaluating the data from the bioassessment study for this evaluation, some limitations of using the EMAP methods for identifying limiting factors became evident. EMAP methods were initially developed for use in detecting trends in conditions at large spatial scales or for monitoring habitat conditions over time (Lazorchak et al., 1998). Therefore, data collected using EMAP methods is quantitative and precise, well-suited to distill large amounts of information into simple statistics, and provide a benchmark with which to compare future data. However, it does this at the expense of accuracy and detail about the processes occurring within the stream reach, and locations of specific features are lost. Most of the information collected using these methods to date has been used to quantify habitat at the regional scale. Currently, there are efforts to apply the information from these methods at smaller scales; however a standardized model for how to apply this type of data to an individual watershed does not currently exist.

Habitat criteria currently used in regulatory programs designed to protect fish often use descriptive (contextual) criteria, at the habitat unit scale, that describe the interaction between habitat components. Habitat indices created from EMAP data is averaged over an entire reach.

Therefore, details about the quality and locations of specific features are lost when summed throughout the reach.

In meeting the City's goals of identifying causes of impaired functions (stressors) and potential improvement opportunities throughout the basin, the EMAP sample site selection process presented a number of limitations. The sample design involves averaging information collected from reaches of stream that are defined around a systematically or randomly chosen point, with data gaps in-between. Identification of specific features such as barriers or other problem areas are not possible because conditions in the areas that are not surveyed are unknown.

The sample design is based on the assumption that the sites surveyed are representative of the whole stream. The survey sites were not chosen based on geomorphic characteristics or changes in land use. In urban areas, land use and stream characteristics vary on an extremely small scale, and extrapolating the data would not be representative of the whole stream reach. In addition, areas that were not suitable for survey (such as inside of culverts) were not characterized or quantified in the study. This methodology over-represented portions of the stream that were survey-able, and under-represented those areas not suitable for survey, which may also be locations that are unsuitable for aquatic organisms. For these reasons, the method is not well suited to accurate representation of an urban watershed, or for identifying specific problem areas.

There are a number of attributes that are important to identify in urban streams in order to understand the processes that are contributing to habitat conditions and to identify specific urban problems. Some of the attributes that are not collected using the EMAP methodologies include:

- Bank erosion
- Channel stability
- Off-channel habitat
- Floodplain quality
- Riparian width
- Stream connectivity and barriers
- Type, location and extent of stream and floodplain modifications
- Piped or channelized stream

Despite their limitations, the EMAP methods provide a quantitative and precise snapshot of current conditions within Pringle Creek, which can be used to assess changes over time. Furthermore, the data and the approach used to compare the habitat indicators to reference site conditions and benchmarks do provide a useful tool for characterizing the general habitat conditions in the watershed. Once key reaches are identified, further evaluation, including stream surveys and specific land use analysis can be undertaken to determine the most likely stressors and the potential restoration or enhancement project to address the impairment. Options for future stream characterization are discussed in the following section.

6.2.7 Options for Future Stream Characterization

EMAP methods are not the only widely used quantitative stream habitat methodologies in Oregon. ODFW has developed stream survey methods (Moore et. al. 2002) that are widely used within the state at multiple spatial scales. Because of its use in the Oregon Plan and recommended use by the Oregon Watershed Enhancement Board in Watershed Assessments (WPN 1999), it is well supported and large amounts of information and data are available. Assessments are linear and cover the whole basin, and thus lend well to reach definitions based

on changes in the stream corridor such as confinement or land use, and incorporating barriers into the assessments. Habitat is measured at the unit scale (the places where aquatic organisms eat, rest, spawn, etc.) and can be evaluated at that scale or combined into reach-scale summaries. In addition, with the use of GPS, the resulting assessments can be spatially explicit for use in linking stressors to habitat conditions. These methods have been used for monitoring trends in habitat conditions over time and a monitoring program could be developed from information collected in this way.

In order to incorporate identification of specific stream enhancement opportunities, Schuler et al. (2002) outlines a Unified Stream Assessment (USA) which could be used independently to identify specific problem areas, or in combination with another whole-basin methodology such as the ODFW Aquatic Inventory methods mentioned above. The survey methodology was specifically designed to identify urban stream processes and impairments for the purposes of determining stream enhancement opportunities. The USA is qualitative, and therefore training and quality control are a very important component of the assessment process.

In addition to these two programs, there are many different options for assessing stream habitat and identifying enhancement opportunities. The main thing to keep in mind is that assessments must be tailored to address the specific topics of interest and the objectives of those conducting the analysis. In an urban environment, these topics and objectives will be different than in rural environments. As was discussed in Chapter 3, scale is also an important consideration. Watershed level assessments will focus more on overall processes and patterns within the watershed, where site level assessments will be more project-specific.

6.3 Key Habitat Issues

Based on the methods described in the previous section, key habitat issues are discussed in this section. The habitat issues are characterized in terms of overall habitat conditions and each of the habitat components. Finally, critical areas of good habitat quality are identified to focus management activities.

6.3.1 Overall Habitat Condition

The overall habitat condition is based on comparing the percentage of the HQI for each of the reach sites in Pringle Creek watershed to the mean of the Willamette Valley reference sites. Results of the analysis show that the overall habitat quality within the Pringle Creek watershed ranges from 12 to 87 percent of least disturbed condition (the mean of the Willamette Valley reference sites), with a mean score of 55 percent. These results show that habitat quality is variable within the Pringle Creek watershed, and deviates a large amount from the Willamette Valley reference sites. The lowest habitat quality areas are primarily located along the railroad tracks of Middle Fork Pringle Creek and the upper reaches of West Pringle Creek (**Figure 6-3**). As is shown on **Figure 6-4**, many of the areas of extremely low habitat quality were not part of the original Pringle Creek stream channel, and most likely show poor habitat quality because they are man-made channels that do not follow the natural topography of the watershed.

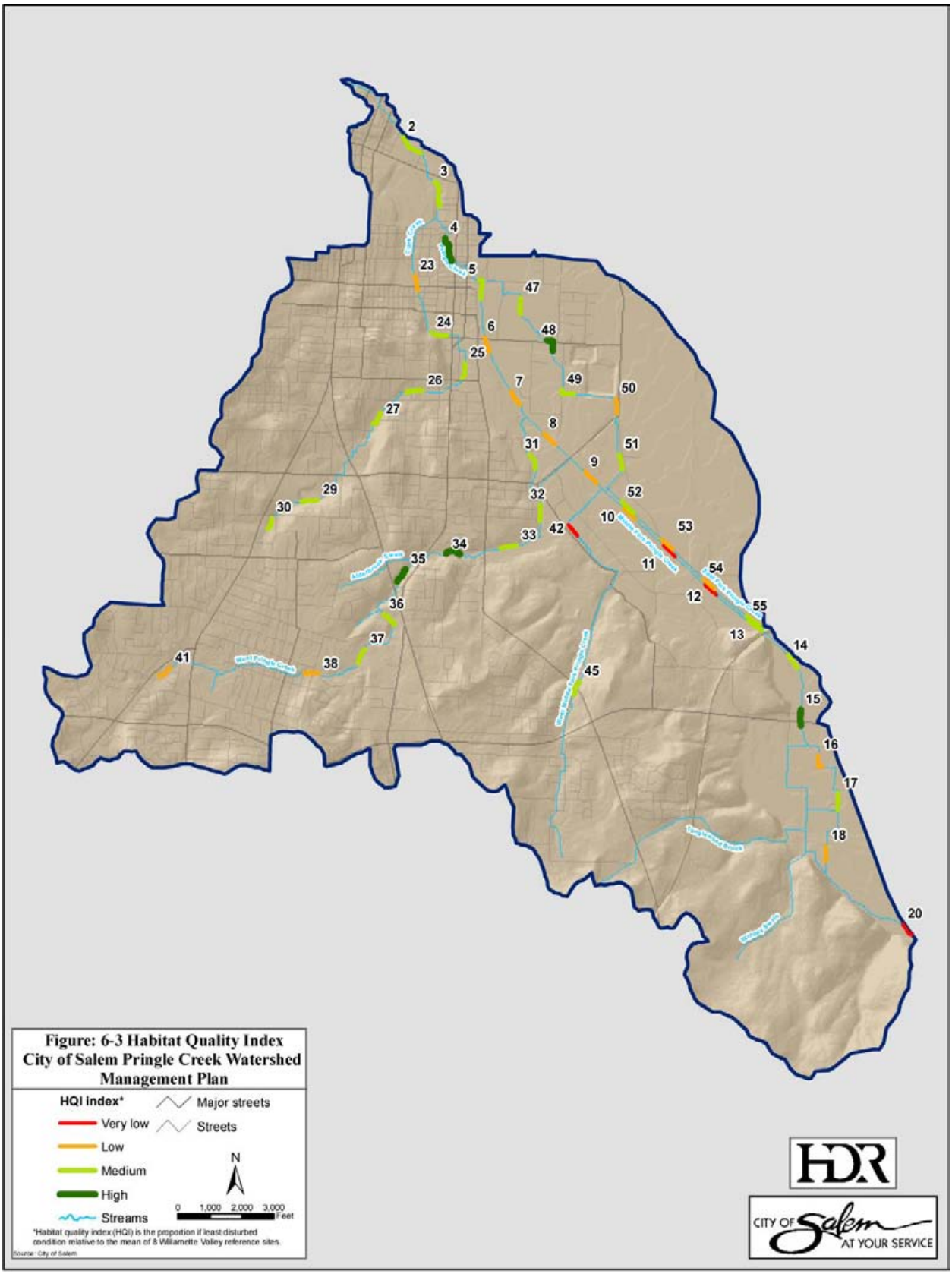


Figure: 6-3 Habitat Quality Index
City of Salem Pringle Creek Watershed
Management Plan
HQI Index*
Very low
Low
Medium
High
Streams
Major streams
Streets
N
0 1,000 2,000 3,000 Feet
*Habitat quality index (HQI) is the proportion if least disturbed condition relative to the mean of 8 Willamette Valley reference sites.
Source: City of Salem
HDR
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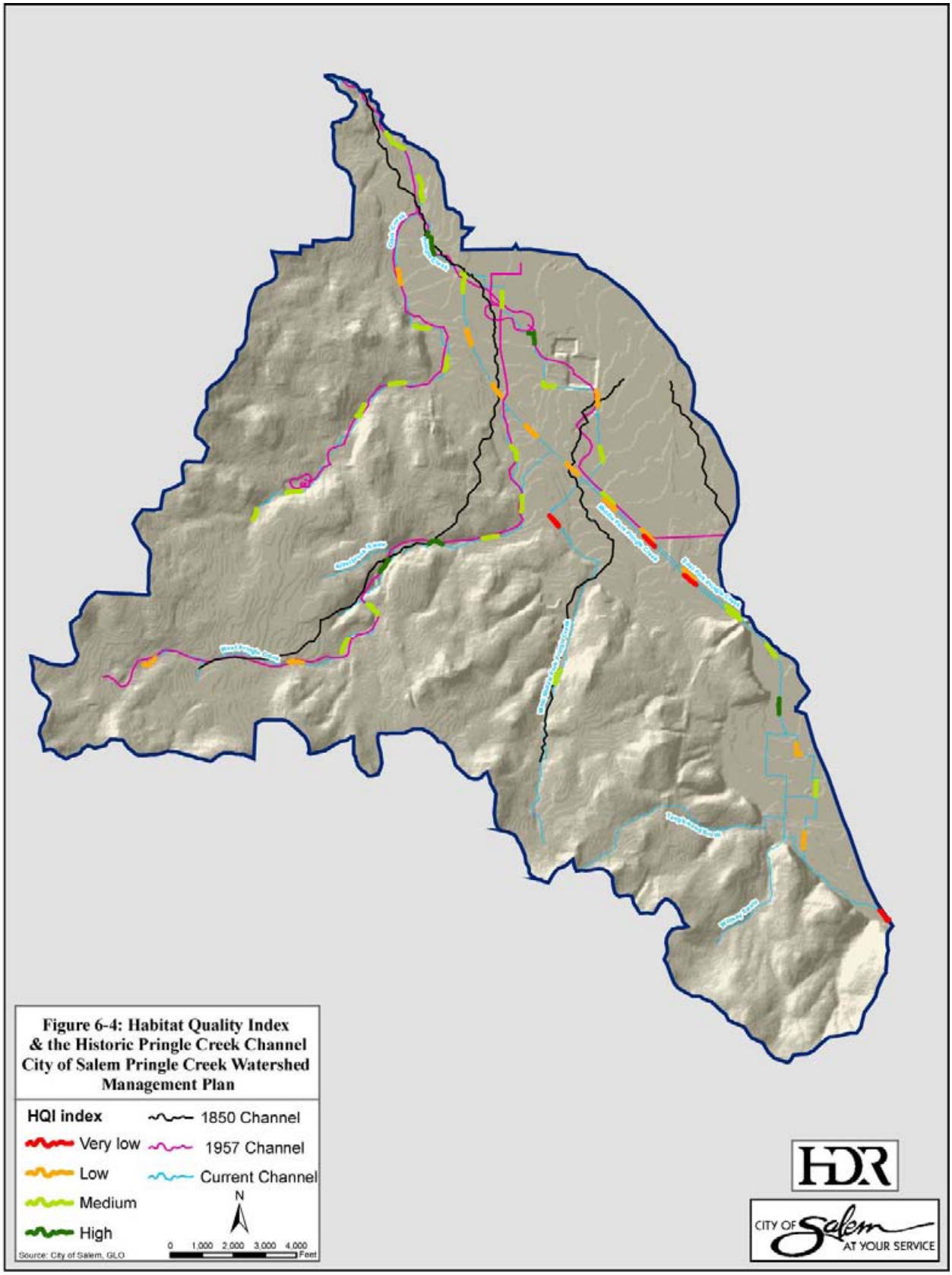


Figure 6-4: Habitat Quality Index & the Historic Pringle Creek Channel City of Salem Pringle Creek Watershed Management Plan

The benthic index of biological integrity is a multi-metric index that characterizes the condition of aquatic habitat based on the numbers and proportion of macroinvertebrate species sampled from stream substrates. The distribution of B-IBI scores in Pringle Creek is very narrow with index scores averaging 19 with a standard deviation of 4. Benchmarks obtained from B-IBI scores from 28 Willamette Valley and Coast Range reference sites were 31 for fair condition, and 40 for good condition. Comparison of the Pringle Creek B-IBI scores to reference condition indicates that all of the sites are in poor condition. The narrow distribution of these scores indicates that watershed-wide factors are likely limiting the biota in the stream; therefore, these scores are not very useful for identifying limiting factors and prioritizing restoration opportunities within the watershed on a site by site basis.

6.3.2 Habitat Issues and Patterns

Based on the analysis of habitat components throughout the Pringle Creek Watershed (**Figure 6-5a-f**), there were no locations within the watershed that were properly functioning for all of the habitat components. Within the watershed, even the reaches with the highest number of functioning components (sites 5, 24, 30, 34 and 35) were highly impaired for at least a couple of habitat indicators. The key habitat issues throughout the watershed include:

- Wood (100%)[2]
- Channel complexity (83%)
- Riparian cover (69%)
- Deep pool habitat (58%)
- Channel morphology (58%)

More specifically, most sites that were surveyed in Pringle creek had straight, incised channels with steep bank angles that were disconnected from their floodplains. Channels were simple, consisting primarily of glide habitat, especially throughout Upper East Fork and West Middle Fork. There were few or no pools and approximately half of the sites lacked deeper pool habitat. Sites had very little or no wood and lacked canopy cover and complex riparian cover. All sites were highly disturbed within their riparian zones (defined as 10 meters from the streambanks), with disturbances consisting primarily of trash, roads, pavement, buildings, rip-rap/walls and park/lawns. For a description of issues at each individual site, see **Appendix G**.

Most sites had excessively high wetted width to depth ratios (by NMFS standards), indicating that channels have widened and baseflows have become shallower. The exception to this was throughout Middle and East Forks of Pringle Creek. Wide, shallow flows can be a barrier to fish passage as they reduce the habitat space available to fish during the summer; can result in high stream temperatures and even result in a dry stream.

[2] Percentage refers to the fraction of total number of sites that were in poor or very poor condition for this component.

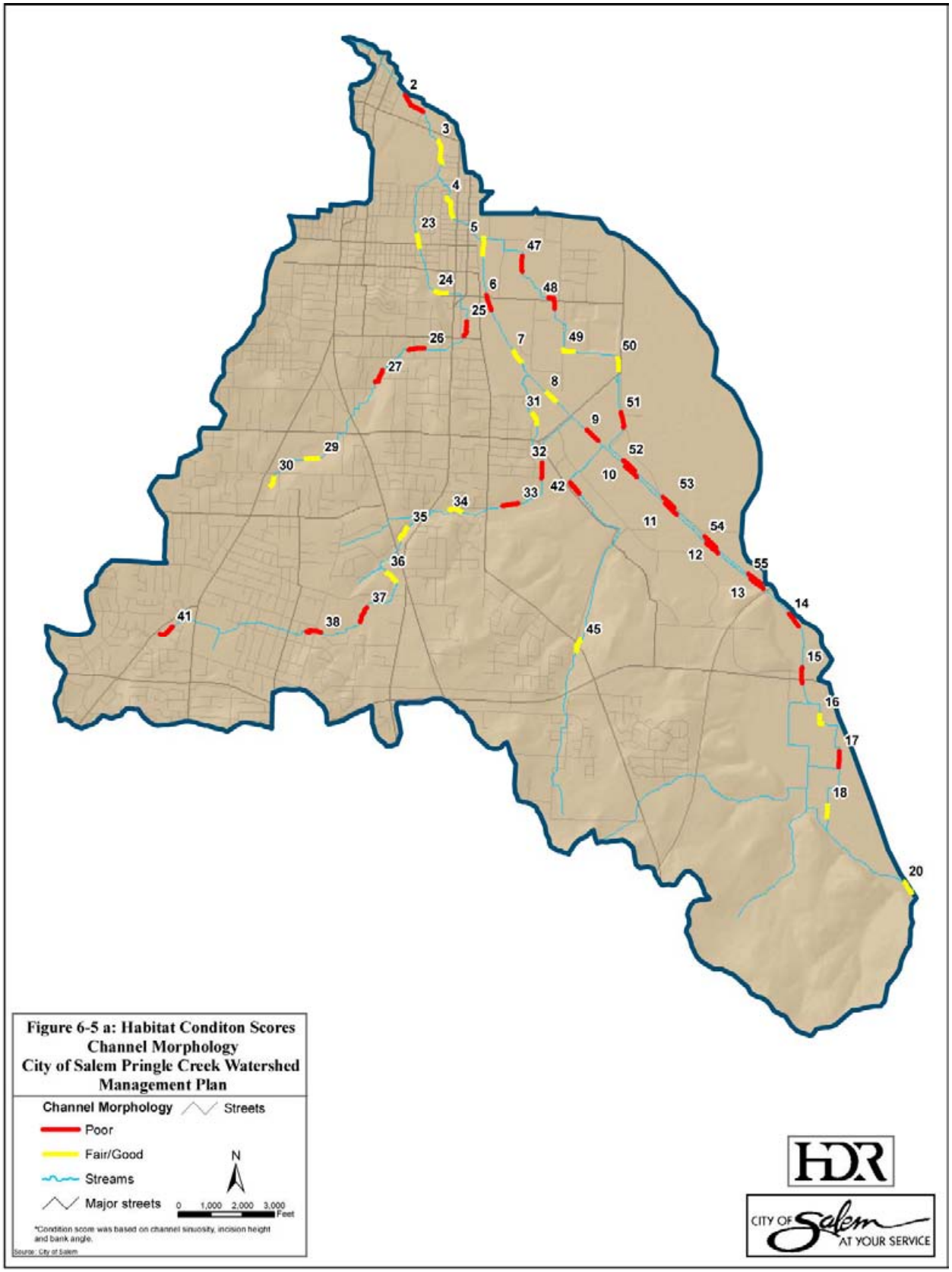
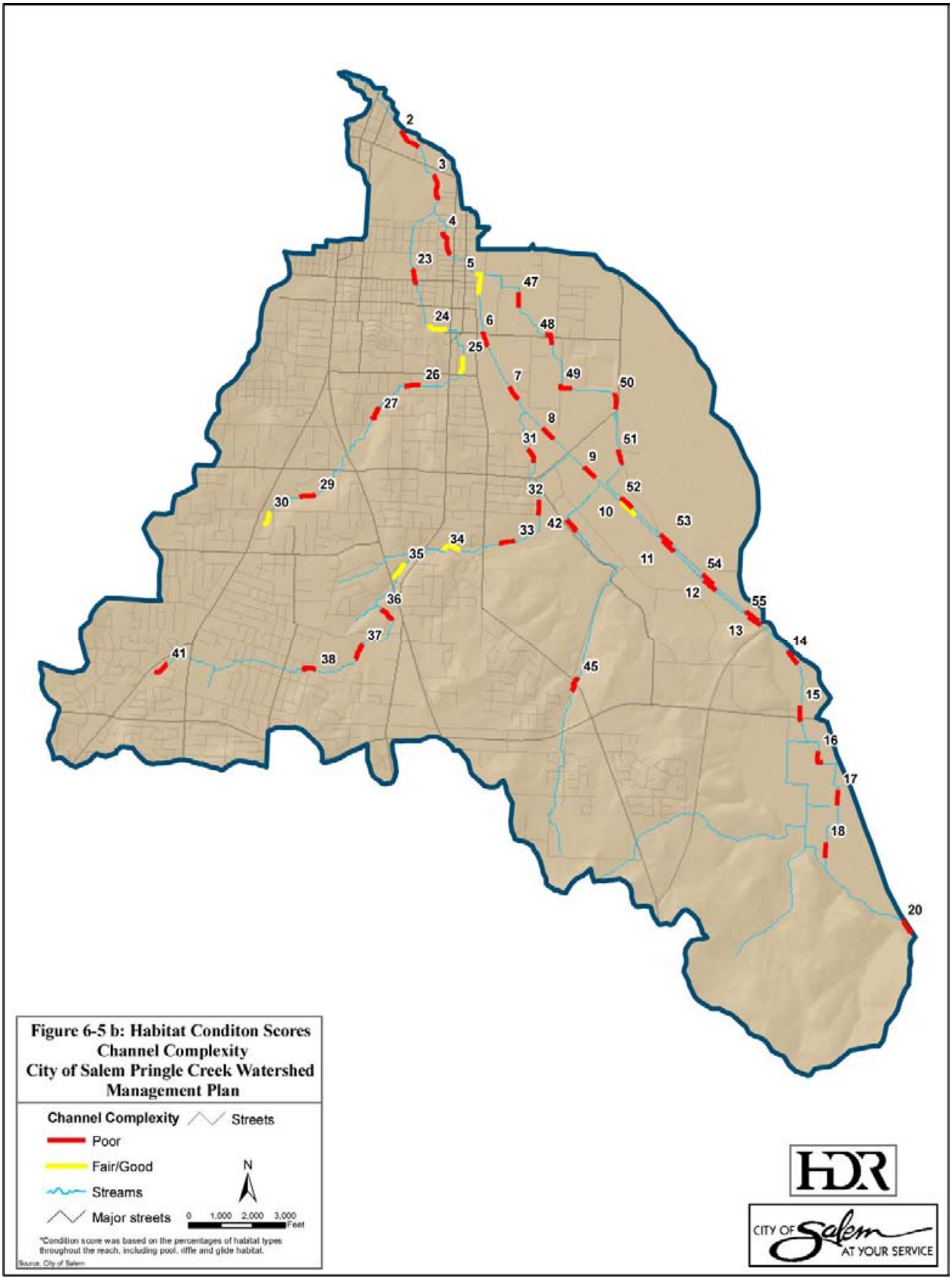


Figure 6-5 a: Habitat Conditon Scores Channel Morphology City of Salem Pringle Creek Watershed Management Plan


2
3
4
23
5
47
24
6
48
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26
7
49
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31
51
9
29
32
52
30
10
42
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33
34
35
11
54
12
36
55
13
37
14
41
38
45
15
16
17
18
20
Figure 6-5 b: Habitat Conditon Scores
Channel Complexity
City of Salem Pringle Creek Watershed
Management Plan
Channel Complexity
Streams
Poor
Fair/Good
Streams
Major streets
N
0 1,000 2,000 3,000 Feet
*Condition score was based on the percentages of habitat types throughout the reach, including pool, riffle and glide habitat.
Source: City of Salem
HDR
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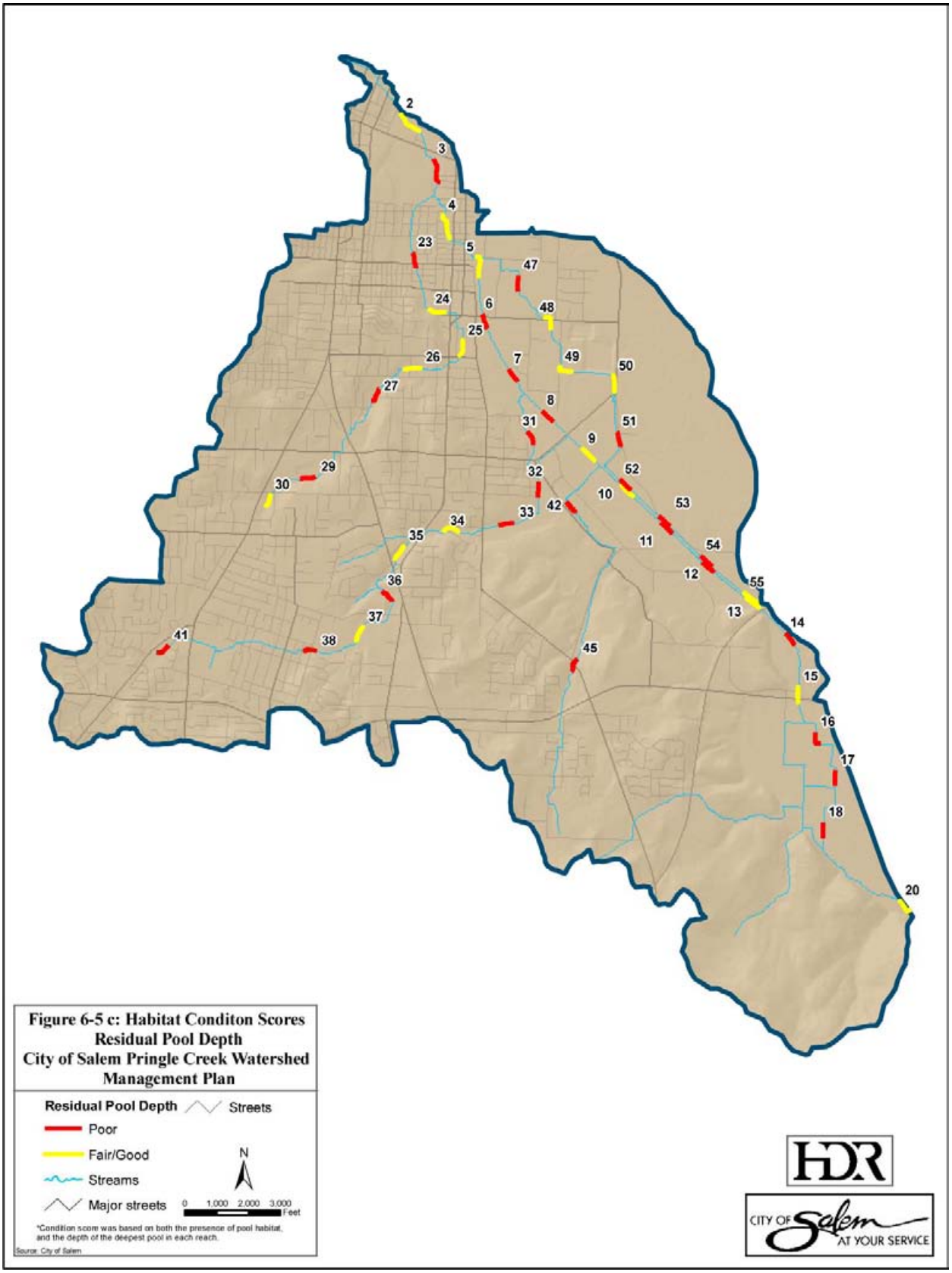

Figure 6-5 c: Habitat Conditon Scores Residual Pool Depth City of Salem Pringle Creek Watershed Management Plan

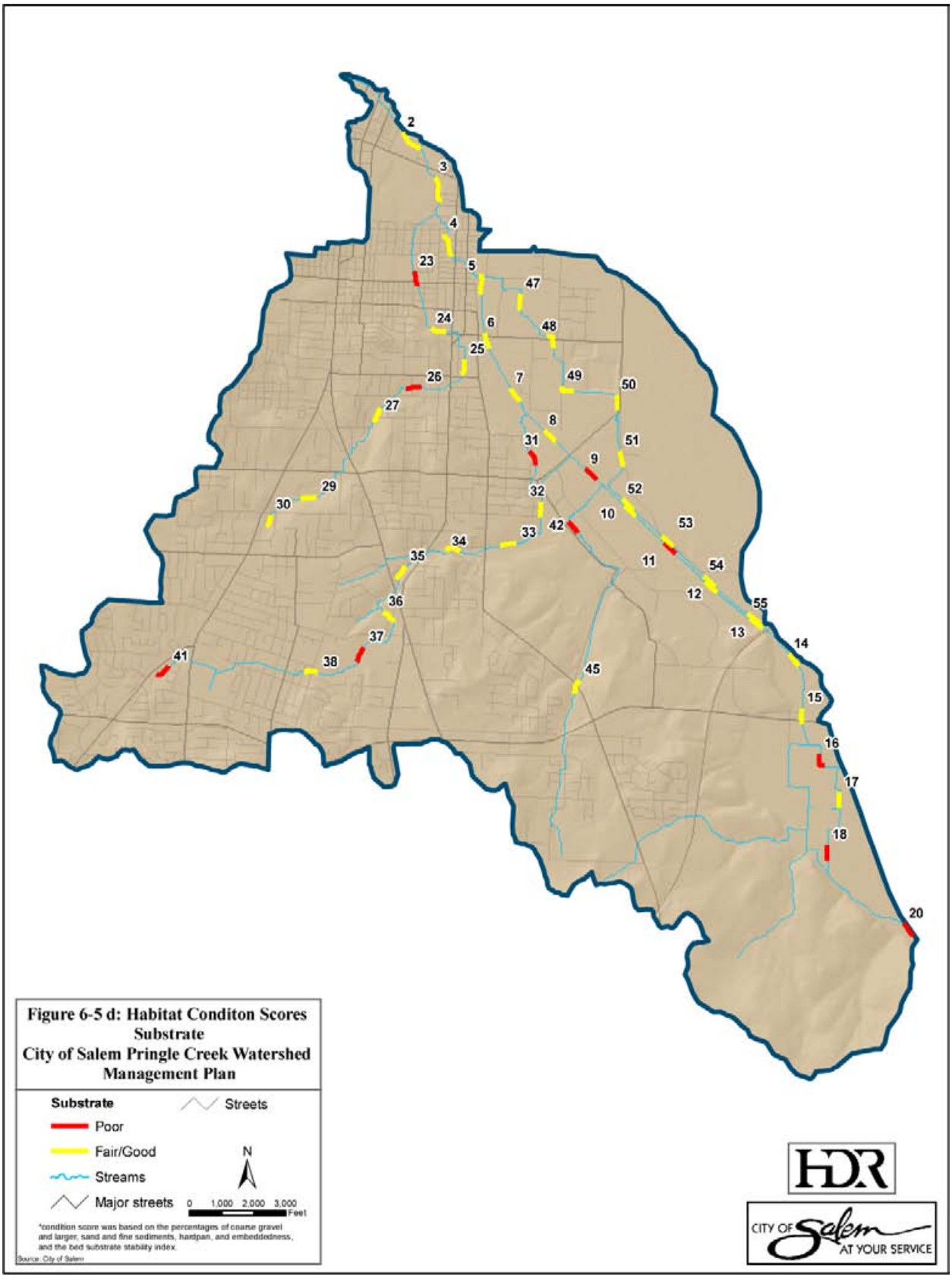

Figure 6-5 d: Habitat Conditon Scores Substrate City of Salem Pringle Creek Watershed Management Plan

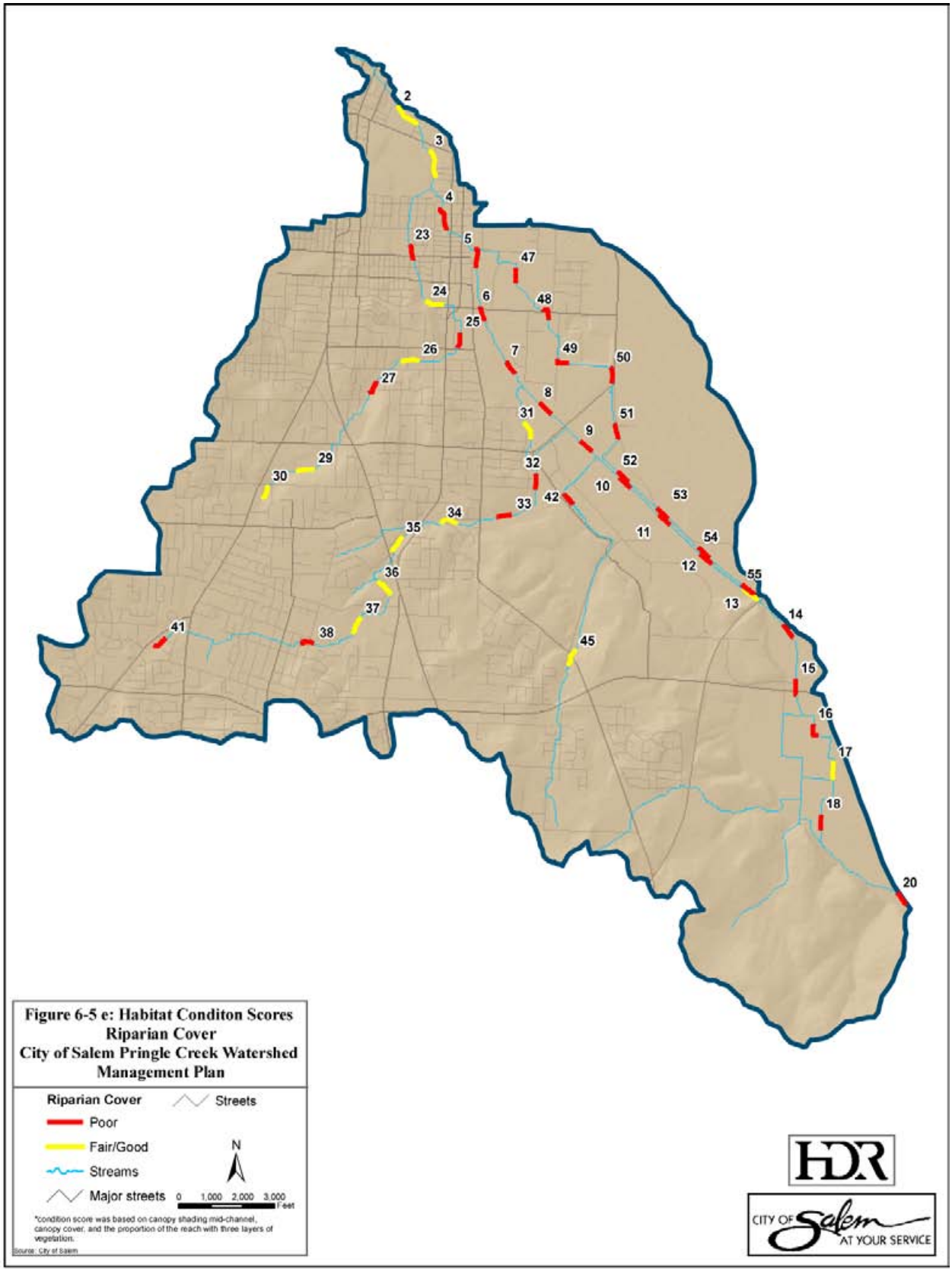

Figure 6-5 e: Habitat Conditon Scores Riparian Cover City of Salem Pringle Creek Watershed Management Plan

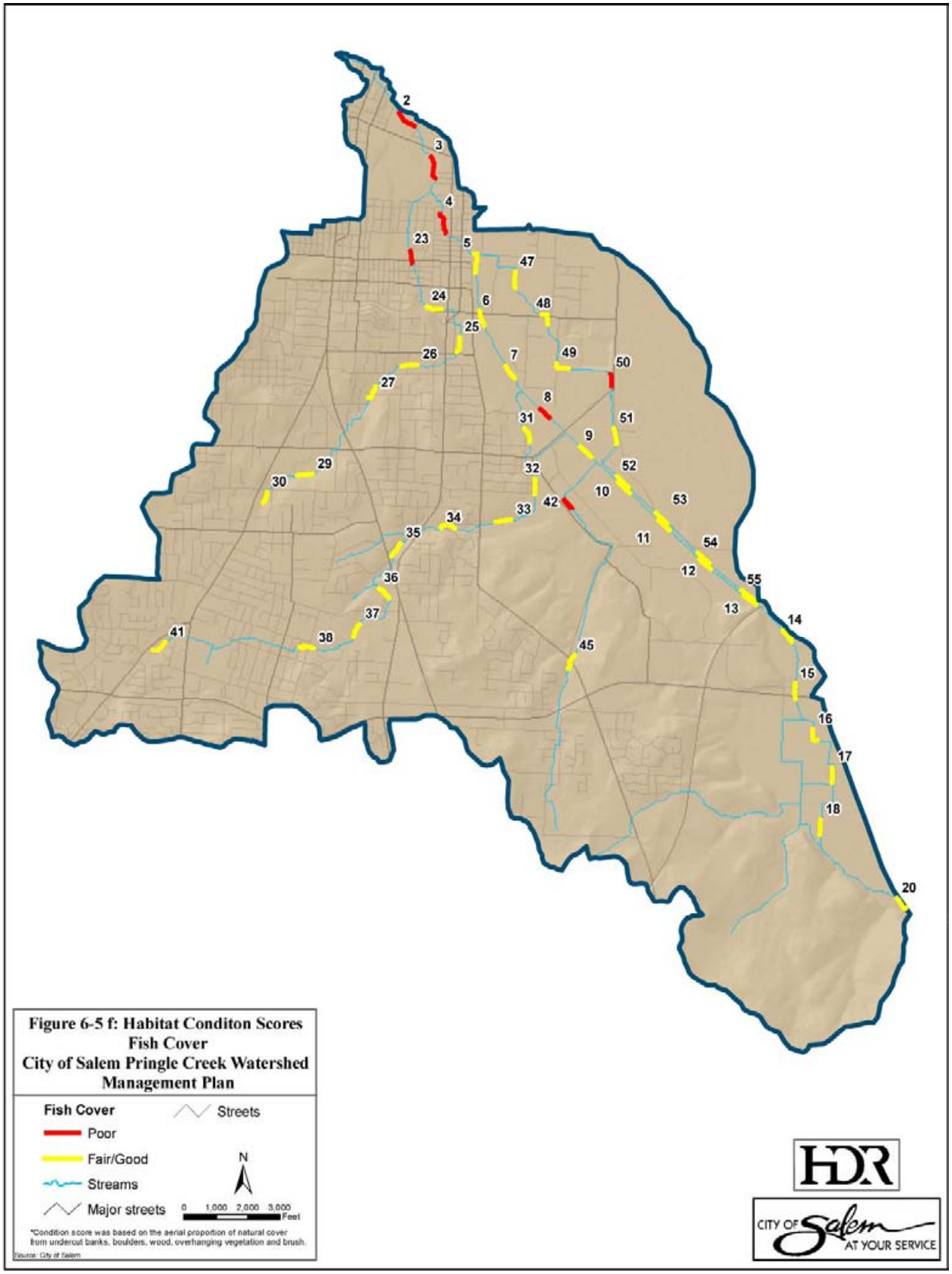

Figure 6-5 f: Habitat Conditon Scores Fish Cover City of Salem Pringle Creek Watershed Management Plan

Lack of mid-channel shade was a limiting factor throughout the entire watershed, with the exception of scattered areas of West Pringle and Clark Creeks (**Figure 6-5e**). Riparian cover was highest and most complex throughout the residential areas and mainstem parks. These results were consistent with a 1999 shade study (Watershed Professionals Network 1999) that was presented in the 2002 watershed assessment (Hemesath and Nunez, 2002) for Pringle Creek. This study classified stream shade levels based on the amount of the stream surface that was visible from aerial photographs taken from 1994-1998. The results of this study showed that over 50 percent of the streams in Pringle Creek had low, or less than 40 percent shade cover. These results are shown in **Figure 6-6**.

Two components that appeared to be less impaired overall include substrate (76 percent of the sites were in fair or good condition) and fish cover (84 percent). The evaluation for substrate (**Figure 6-5d**) was based on a number of metrics including percentage of large substrates, percentage of fine substrates, substrate embeddedness, relative bed stability and percentage of hardpan. Relative to NMFS and ODFW benchmarks, these sites had excessive fine substrates and substrate embeddedness, especially throughout East, Middle and West Middle Fork Pringle Creek. However, compared to reference condition, which also had high embeddedness and a larger percentage of fine substrates, these sites were in fair/good condition. Reference condition was assumed to be more representative of the natural range of conditions in these sites. Fourteen of the sites had excessive hardpan (greater than 4.8 percent) relative to reference condition. These were located primarily in Clark, West Pringle and middle mainstem Pringle.

Fish cover (**Figure 6-5f**) was poor in two general areas: the lower mainstem of Pringle Creek, and the industrial area of Salem. The lack of natural fish cover appears to be primarily due to the presence of walls, roads and buildings within the riparian area, with the exception of Site 3 in Bush Pasture Park, which had none of these riparian disturbances.

6.3.3 Causes of Impairment

Root causes of these limiting factors include changes to hydrology, alterations of the sediment balance in the system, changes in the amount of channel complexity and roughness, and removal of riparian vegetation, which provides many of the functions listed above as well as providing organic inputs to the stream, nutrient cycling, improving water quality and providing a buffer from human activities.

Human factors in Pringle Creek that may have contributed to the impairment of these habitat components may include:

- Large amounts of impervious surface in the watershed, including not only pavement, but also compaction of soils from landscaping and manicuring parks and lawns. This affects the hydrology within the watershed and contributes to increased erosion, incision, widening and simplification of stream channels.
- Vegetation removal, which increases impervious cover and decreases infiltration of water into the soil, removes the structure that stabilizes streambanks, removes shade and cover from the stream channel, and also removes a significant source of wood and organic inputs into the stream.
- Removal of wood and other structural elements within the stream channels.
- Channel alteration, including ditching, revetments and culverts which simplify stream channels and disconnect them from their floodplain.

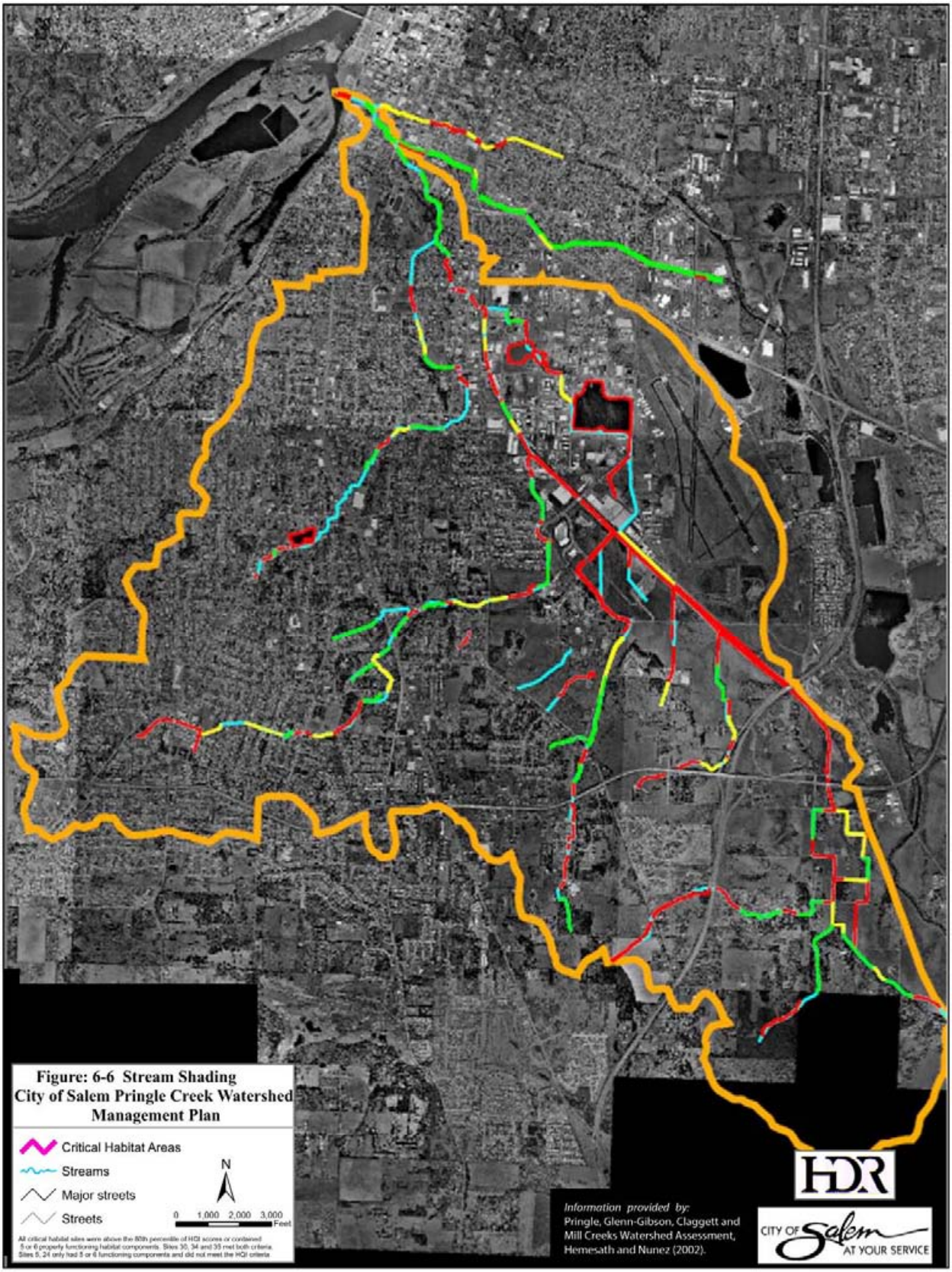
Figure: 6-6 Stream Shading
City of Salem Pringle Creek Watershed
Management Plan
Critical Habitat Areas
Streams
Major streets
Streets
N
0 1,000 2,000 3,000
Feet
All critical habitat sites were above the 80th percentile of HQI scores or contained 5 or 6 properly functioning habitat components. Sites 30, 34 and 35 met both criteria. Sites 5, 24 only had 3 or 4 functioning components and did not meet the HQI criteria.
Information provided by:
Pringle, Glenn-Gibson, Claggett and Mill Creeks Watershed Assessment, Hemesath and Nunez (2002).
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These human causes are often difficult to isolate and habitat effects occur cumulatively over long periods of time. Often the effects of human activities occur miles upstream or upslope of the resulting habitat effects.

6.3.4 Critical Areas

As was mentioned previously, habitat conditions vary throughout Pringle Creek, and overall are fairly poor. Areas where enhancement practices are likely to be most successful, are those that have some properly functioning components that can be improved upon. Critical areas with these functioning components within the Pringle Creek Watershed are shown in **Figure 6-7**. The lower reaches of the Pringle Creek mainstem, the middle reaches of West Pringle Creek and the lower reaches of East Fork Pringle Creek all contain the reaches with the highest quality habitat (the 80th percentile of HQI scores) or the greatest number (at least 5 or 6) of properly functioning components. In addition to ranking among the best-functioning sites within the basin, most of these sites were ranked among the highest-scoring Rapid Habitat Assessment Scores that were collected during the Bioassessment Study.

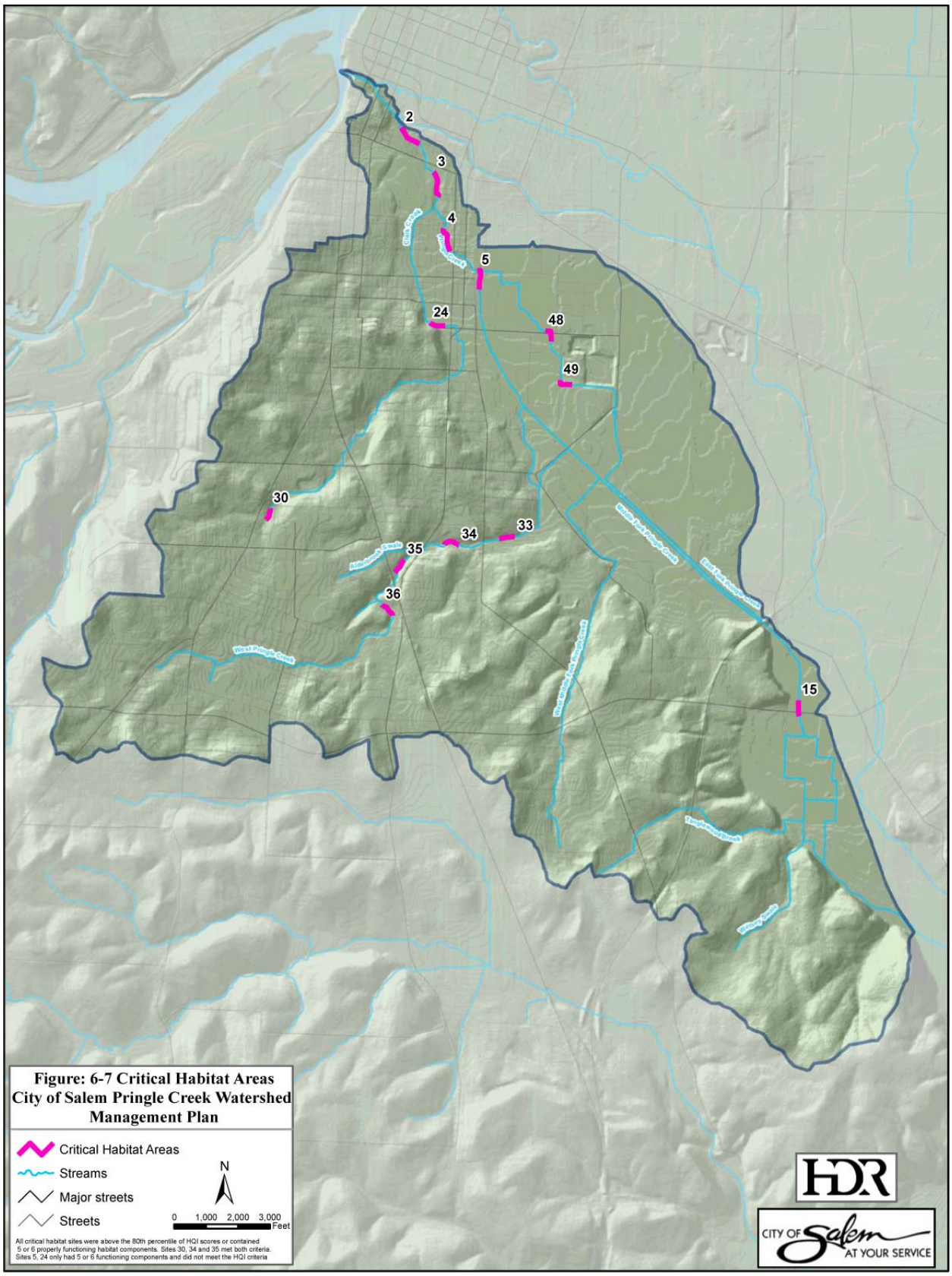

Figure: 6-7 Critical Habitat Areas City of Salem Pringle Creek Watershed Management Plan

6.4 Fish Passage

Habitat quality is influenced not only by the physical habitat available in a given reach of stream, but also the accessibility of that habitat to the aquatic species that use it. One activity that has had large effects on habitat within the Pringle Creek watershed are channel alterations such as enclosing channels into culverts and obstructing the natural flow of the stream using weirs.

A fish passage study (Salem 2001) was conducted in the Pringle Creek Watershed during June 2000 in order to identify and inventory structures that impede the passage of fish. Culverts, weirs and bridges throughout the watershed were classified using ODFW fish passage criteria. The evaluation of potential impediments to fish passage was based on features of culverts such as length, water velocity, slope, depth, jump height and pool depth, and features of dams and weirs such as downstream pool depth and waterfall length.

Within the watershed, 73 culverts were surveyed, of which 48 percent were classified as barriers. Out of 31 dams/weirs within the watershed, 77 percent were found to be barriers. Fourteen bridges were identified, of which none were classified as barriers. As shown on the map (**Figure 6-8**), these barriers are distributed throughout the Pringle Creek Watershed, with a large number located at the lower reaches of Pringle Creek Tributaries. The number of barriers identified in each subwatershed is summarized in **Table 6-2**.

Table 6-2. Fish passage barriers in the Pringle Creek Watershed

Subwatershed	Number of barriers	Culverts			Dams		
		Number surveyed	Juvenile barriers	Adult and Juvenile barriers	Number surveyed	Juvenile barriers	Adult and Juvenile barriers
Clark Creek	14	22	2	8	4	0	4
Pringle Creek	19	21	2	8	14	2	7
West Middle Fork Pringle Creek	14	4	1	3	10	0	10
Middle Fork Pringle Creek	4	3	0	3	1	0	1
East Fork Pringle Creek	9	18	2	5	2	0	2
Entire Pringle Creek Watershed	61	73	7	28	31	2	24

Data taken from Salem Public Works (2001)

Of these identified barriers, five are listed as priorities for replacement based on a fish passage prioritization study conducted for all watersheds within the City of Salem (2003). Three of these were located at the downstream end of Clark Creek (downstream of Site 24), one was located near the downstream end of West Pringle Creek (downstream of Site 31), and one was located in East Fork Pringle Creek (upstream of Site 50). All of these barriers except for the barrier on West Pringle Creek are scheduled for replacement.

The prioritization model was based on basin priority (based on the viability of the stream to sustain fish populations), number of downstream barriers, habitat rating (based on a habitat evaluation included in the barrier study), and replacement schedule. Habitat was considered in both the basin prioritization and habitat rating portion of the model; however, because Pringle was rated low on the basin priority scale, habitat influenced very little of the barrier prioritization.

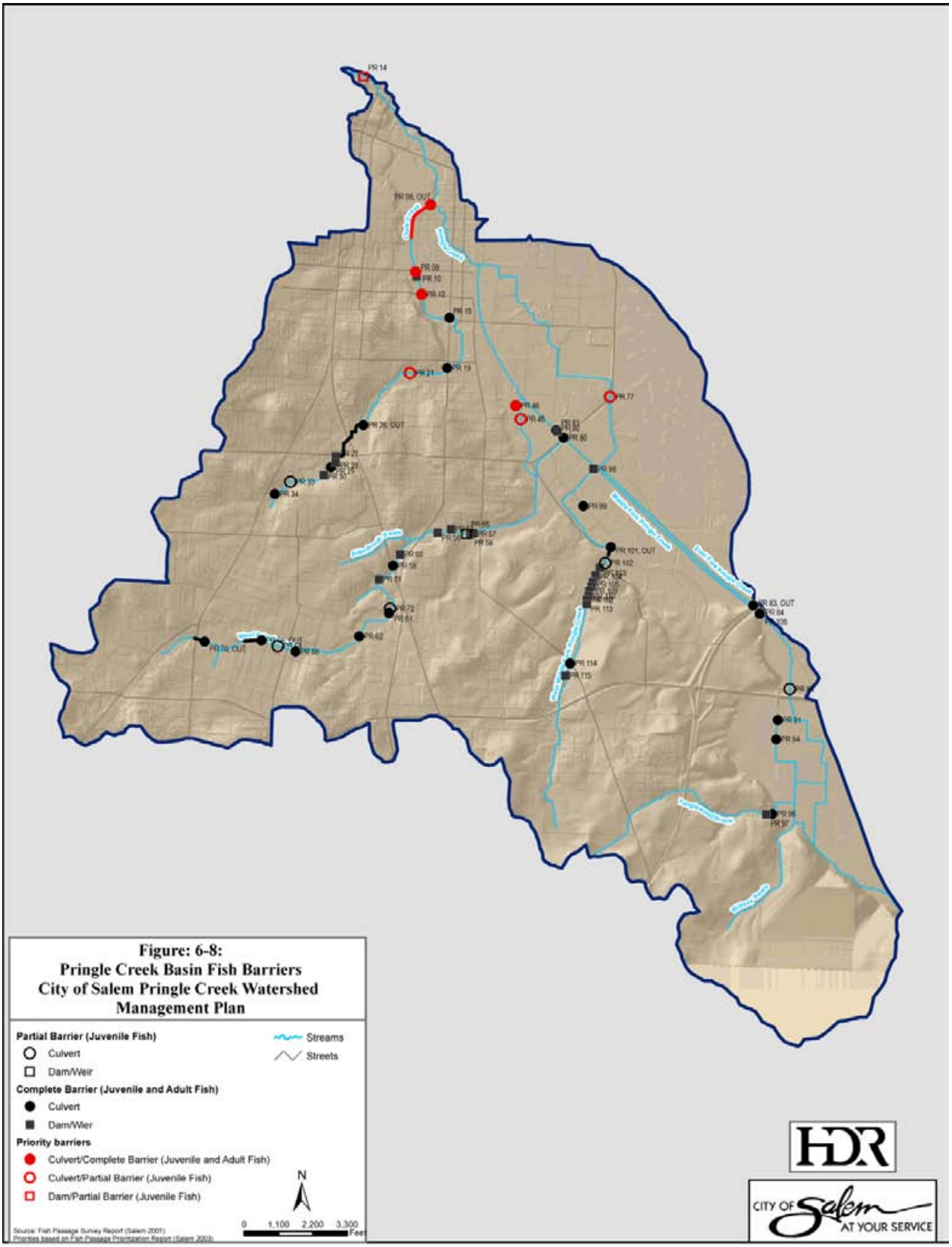

Figure: 6-8:
Pringle Creek Basin Fish Barriers
City of Salem Pringle Creek Watershed Management Plan

One factor that was not considered in this prioritization study was the quantity, as well as quality of habitat upstream of the barrier that would be gained by removal of a barrier. Based on the bioassessment habitat evaluation, the highest quality habitats are in Clark Creek, West Pringle Creek and East Fork Pringle Creek. Removal of the barriers on Clark Creek would only begin to open the subwatershed for fish use. One higher quality site (Site 24) would become accessible to adult and juvenile fish, but many barriers upstream would continue to block passage to a majority of Clark Creek. In West Pringle Creek, the highest priority barrier is a barrier only to juvenile fish, and is upstream of one that was classified as a barrier to both juveniles and adults. Removal of both would open a large section of West Pringle Creek, but seven weirs upstream would continue to block passage to the highest quality habitat along the creek (Sites 34 and 35). In East Fork Pringle Creek, removal of the high priority barrier that would open up a long reach of stream to fish passage; however, the habitat quality upstream of this barrier to the next barrier is of poor quality.

6.5 Management Actions to Improve Habitat

Management actions that are intended to meet the watershed objectives were presented in Section 2.2. The actions that are applicable to addressing habitat issues include:

- Stream and Habitat Repair / Protection
- Riparian Management
- Stormwater Management
- Wetlands Enhancement
- Protection and Policy
- Education, Involvement, Stewardship

Some of these actions are described in the hydrology and water quality chapters of this report. Actions related specifically to improving habitat, their primary habitat-related objectives, and specific repair practices that could be implemented to accomplish these objectives are outlined in **Table 6-3**. Application of these management actions will be specific to the habitat issues that are to be addressed and the goals of habitat enhancement. The discussion in this section will address management options with respect to the habitat issues presented in **Section 6.3** above, and several common objectives of habitat enhancement.

Table 6-3 Stream Management Activities and Associated Repair Practices			
	Management Activities	Habitat Objectives	Stream Repair Practices
Stormwater/ Wetlands	Hydrologic alteration	Encourage a more natural hydrograph by detaining peak flows in the upper parts of the watershed, and increasing baseflows during dryer months.	• Wetland restoration • Upstream detention/infiltration
Stream and Habitat Repair / Protection	Fish passage improvements	Improve connectivity of existing habitats to allow free passage of fish, other organisms, matter and energy through the system.	• Barrier removal/modification • Fish passage devices
	Channel and floodplain redesign / construction	Recreate a more natural channel form and shape in order to develop a stable, self-sustaining stream channel in balance with the existing hydrologic-sediment regime.	• Streambank shaping, meander creation, hydrologic connections, dechannelization, stream daylighting
	Streambank stabilization	Prevents additional streambank erosion to stabilize the channel and allow riparian vegetation to re-establish	• Soft bank stabilization - erosion control fabrics, brush mattresses, coir fiber logs, revegetation • Hard bank stabilization - live cribwalls, rootwad/boulder revetments, rip-rap
	Instream flow controls	Directs and manipulates flows or reduces stream velocities to prevent streambank erosion and bed scour, to concentrate the baseflow channel, and to encourage creation of complex channel features such as pools and riffles	• Grade controls – rock/log weirs and cross-vanes • Flow deflectors - wing deflectors, rock/log vanes
	Instream habitat structures	Replaces lost habitat structures that provide channel complexity and cover for fish and other aquatic organisms.	• Large wood, boulder clusters, lunkers
Riparian Management	Riparian management	Provides streambank stability and roughness, fish cover and stream shade, increases perviousness of soils, reduces surface erosion, alters the flow regime and provides a buffer from human activities.	• Create riparian buffer • Increase quantity of riparian canopy and vegetative cover • Improve quality and composition of riparian vegetation • Remove invasive plant species • Vegetate streambanks
Protection and Policy	Protect existing high quality habitats and features (such as large wood)	Protect habitats and features that are presently functioning in the watershed and discourage or stop activities that lead to additional degradation.	• Discontinue removal of wood from the stream channel • Protect riparian zones from vegetation removal • Zoning to require buffers
Education, Involvement, Stewardship	Provide education, involvement and stewardship on watershed function to organizations and the public	Increase interest and participation for indirectly (support for funding) or directly implementing on-the-ground measures to improve habitat conditions, e.g. riparian plantings, streamside landowner participation.	• Stream cleanups • Encourage involvement to remove barriers to fish

6.5.1 Addressing Limiting Factors

The limiting factors described in **Section 6.3** affecting the Pringle Creek watershed are not specific to any particular reach. These problems appear to be systemic throughout the entire watershed. Since the watershed has been highly manipulated, the most beneficial activities are those which will restore some of the self-sustaining processes that have been disrupted, such as connectivity of the stream longitudinally and laterally with its floodplain so that organisms, organic matter and substrate can pass into and through the system, a natural channel location and pattern, elements that provide habitat structure, and riparian vegetation.

In a highly altered system like Pringle Creek, the ability to restore all habitat-forming processes is limited, and it is unrealistic to assume that the creek can be restored to its pre-disturbance condition. A more realistic goal is to restore as many processes as possible within the given land-use constraints to create a self-sustaining potential biological community and ecosystem. Habitat improvements, like habitat impairments, are cumulative. Incremental improvements resulting from multiple small-scale projects over time can collectively achieve many restoration goals.

Table 6-4 lists repair and enhancement activities that can be implemented to address the limiting factors described in **Section 6.3**. When beginning any stream enhancement project, it is important to consider the effects of the project on the whole watershed, because any modification in hydrology or sediment transport could have both upstream and downstream effects on watershed processes. Further study will need to be conducted in areas that are identified for habitat improvement to determine the potential effects of the projects on the functioning of the rest of the stream.

Urbanization of the Pringle Creek Watershed has resulted in fragmented habitats with little connectivity to their floodplains, simplified, unstable channels, reduced complexity, loss of habitat structure and riparian cover. The first step toward improving habitat within Pringle Creek is to reduce and/or reverse the activities that caused the impairments in the first place. Ideally, this includes reducing impervious surface areas in the watershed, removing barriers to passage of fish and other habitat elements, removing revetments and other channel simplification devices to allow connectivity of the stream to its floodplain, stop removing wood and other natural materials from the stream channel and riparian zone, and re-establishing riparian vegetation. However, these actions cannot be taken without consideration of other objectives, specifically the need to manage for flood control and drainage. Other constraints are discussed in **Section 6.6**.

Table 6-3 Activities to Repair Impaired Habitat Components			
Habitat Component	Indices[1]	Objective	Management Activities[2]
Channel Morphology	Channel sinuosity, incision height and bank angle	Reverse or prevent channel incision and simplification by altering stream hydrology to reduce peak flows, add roughness and complexity to dispel flow energy and increase sinuosity, and protect the streambanks and streambed from further erosion.	Channel and floodplain redesign Streambank stabilization/revegetation Instream flow controls (grade controls, flow deflectors) Instream habitat structures (large wood/boulders) Upstream detention/infiltration Wetland restoration Riparian management
Channel Complexity	Percentage of habitat unit types (riffles, glides, pools)	Create diversity in habitat types and in-stream structure, including creation of riffle and pool habitats, backwater areas, and creation of a stable (narrow and deep) baseflow channel. To be successful, prevention of erosion and other factors that simplified the channel need to be addressed first (see morphology).	Instream flow controls (grade controls, flow deflectors) Instream habitat structures (large wood/boulders) Streambank stabilization/revegetation
Residual Pool Depth	Depth of deepest residual pool (m)	Create channel complexity and reduce siltation of pools	Instream flow controls (grade controls, flow deflectors) Instream habitat structures (large wood/boulders) Streambank stabilization/revegetation
Substrate	Percentages of coarse gravel and larger, sand and fine sediments, hardpan, and substrate embeddedness. Bed substrate stability.	Increase proportion of coarse sediments, reduce substrate embeddedness and hardpan by preventing erosion of fine sediments from streambanks and altering flow velocities to reduce scour and cause aggradation of larger substrates.	Instream flow controls (grade controls, flow deflectors) Instream habitat structures (large wood/boulders) Streambank stabilization/revegetation
Wood	Wood density	Increase wood and wood recruitment sources.	Large wood Instream habitat structures Riparian management
Fish cover	Natural fish cover (aerial proportion)	Increase elements that provide refuge and cover for fish, including wood and boulders, undercut banks and overhanging vegetation.	Instream habitat structures (large wood/boulders, lunkers) Streambank stabilization/revegetation Riparian management
Riparian cover	Mid-channel shading, aerial proportion of riparian canopy cover and proportion of reach with three layers of vegetation.	Create a riparian buffer that provides shade, complex riparian habitat, and organic inputs to the stream. Streambanks may need to be addressed first in order to support vegetation.	Vegetate streambanks (multilayered) Riparian revegetation Remove invasive species
Human Disturbance	Trash Walls / revetments Pipes / culverts Parks / lawns Agriculture	Minimize and improve human factors that have negative effects on aquatic habitat and fish passage.	Stream cleanup and adoption Channel and floodplain redesign (dechannelization, daylighting) Streambank stabilization/revegetation Instream flow controls (flow deflection) Barrier modification/removal Riparian management

1 Obtained from the Bioassessment Study (Salem 2001)
2 For additional information on implementation of these management activities, see Schueler and Brown 2004.

6.5.2 Goals and Priorities for Habitat Enhancement

From a prioritization perspective, the goal of habitat enhancement for a given tributary, or reach, is dependent on the existing and potential habitat quality and whether fish and other aquatic species are likely to use the tributary or reach, even under improved conditions. For example, although barriers may limit the quality of habitat for migratory fish use, stream enhancement and repair practices may help meet other objectives such as improving water quality, addressing drainage problems, providing aesthetic benefits and recovering biological diversity within the stream channel for other aquatic species. In the case of Pringle Creek, cutthroat trout were found throughout the entire watershed and could benefit from improvements in habitat despite existing barriers. In addition, improving water quality within the watershed by improving the riparian area, reducing streambank and streambed erosion, and reducing pollution may also benefit fish in the downstream portions of the watershed.

The range of management actions discussed in the previous section does not consider the specific habitat objective for a given tributary or reach. These objectives may include:

- Improving passage and spawning potential for anadromous species such as the Upper Willamette River Chinook salmon and Steelhead.
- Improving habitat for fish (resident and anadromous) and overall biological diversity.
- Improving hydrology and flow condition and preventing additional channel degradation.
- Improving the aesthetic value of the stream through stream cleanup and naturalization.

The critical areas (good habitat quality) discussed in **Section 6.3.4** are used to identify those areas in the Pringle Creek watershed where these four objectives are most applicable.

6.5.3 Anadromous Fish

Habitat value to fish and other aquatic species is dependant not only on the physical habitat components in a given reach of stream, but also on the availability of that habitat through free upstream and downstream passage. Although Pringle Creek is not listed as designated critical habitat for UWR Chinook salmon and UWR steelhead, habitat quality and access to upstream habitats are limiting factors to these species. Maintaining conditions within the stream that provide hydrological and structural barriers to fish habitat are limiting their recovery. Enhancing habitat will not benefit these species without free access.

There are many structural barriers within the Pringle Creek watershed that block juvenile and adult passage **(Section 6.4)**. Priorities for removal or modification should be those that will provide access to suitable habitats upstream (see **Figure 6-9**). Based on the habitat evaluation from the bioassessment study and the Fish Barrier Study (Salem 2001), *the following barriers are recommended priorities for removal to benefit anadromous fish:*

- Barriers identified in the lower half of West Pringle Creek downstream of Woodmansee Park (including a number of weirs with unknown functions), if removed, would provide access to some of the more suitable habitat in the basin.
- Several barriers on East Fork Pringle Creek (PR 77, PR 83 and PR 108), if removed would expose a large amount of habitat in the upper portions of East Fork Pringle Creek.

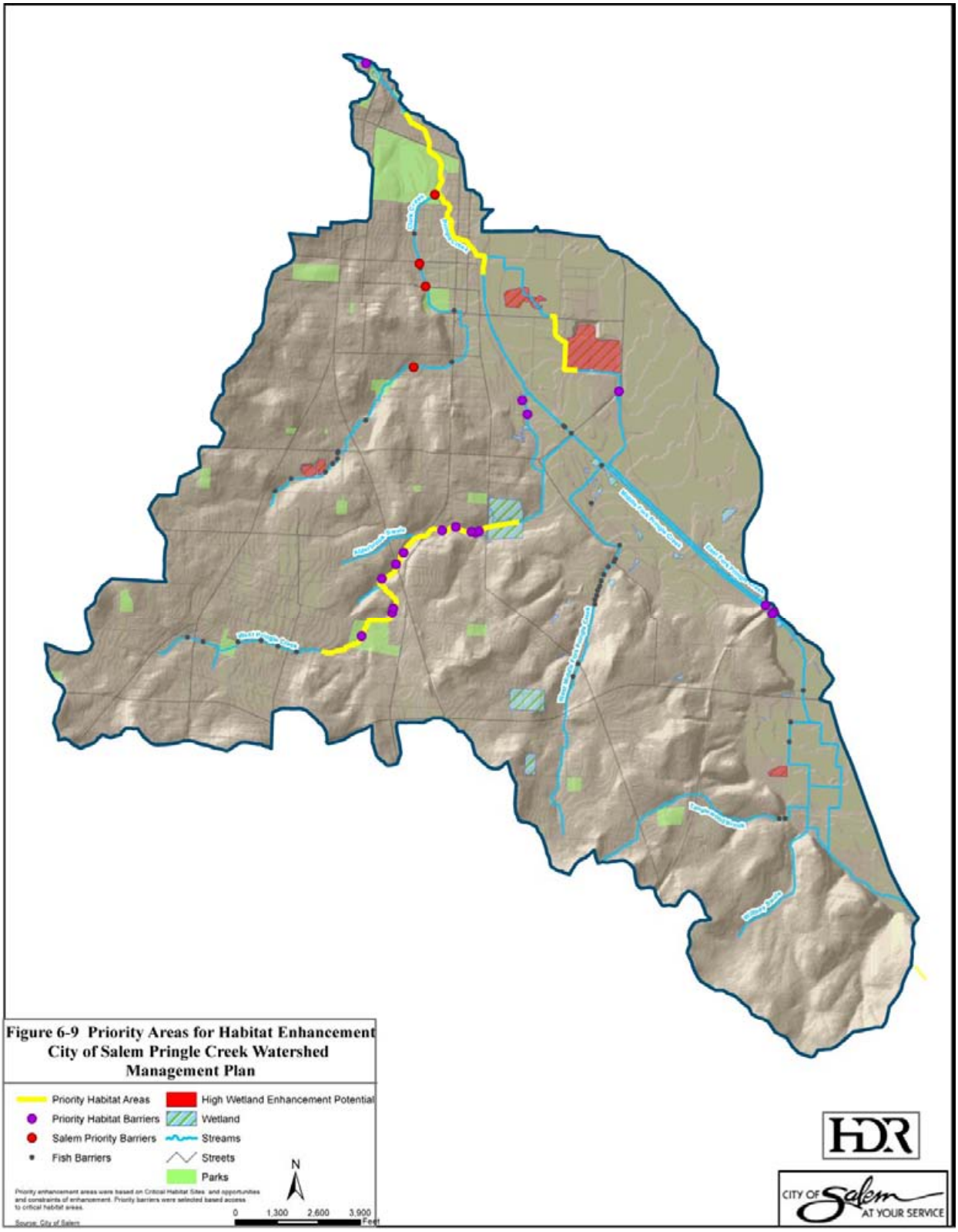

Figure 6-9 Priority Areas for Habitat Enhancement City of Salem Pringle Creek Watershed Management Plan

6.5.4 Improving Resident Fish Habitat and Biological Diversity

For those areas where the goal is improvement of resident fish habitat and biological diversity, the primary objective of habitat enhancement is to create a diversity of habitat types and habitat elements that are suitable to support various life stages and species of aquatic life. These changes can be accomplished by increasing channel complexity and residual pools, improving substrate conditions to include more gravel and less hardpan or fine substrates, stabilizing streambanks to reduce erosion and sedimentation, and managing the riparian zone to increase stream shade, reduce input of fine sediments and provide organic inputs and cover for aquatic species.

Priorities for habitat enhancement are those areas where there is adequate space, access and some currently intact functions. Many of these areas are shown in **Figure 6-7**. *The recommended priorities to improve habitat for resident fish include:*

- Lower portions of the main stem of Pringle Creek
- Middle reaches of Clark Creek
- Lower portions of West Pringle Creek
- Lower portions of East Fork Pringle Creek

In addition, factors such as fish passage and water quality should be considered in order to maximize the benefits of habitat enhancement. These additional factors are considered in **Figure 6-9**. Factors that will influence the choice of methods include access, available space, riparian vegetation and planting conditions and floodplain capacity and connectedness.

6.5.5 Prevention of Additional Channel Degradation

Often the goal of habitat enhancement is to bring the hydrology and sediment transport into balance in order to prevent additional erosion and incision, and to create a stabilized channel. Primary causes of incision often include straightening, confining or shortening the channel, increases in peak flows due to runoff from impervious surfaces, dams and weirs can halt the natural transport of sediment and culverts can cause localized incision (Saldi-Caromile et al. 2004).

Activities that are often used to address incision or streambank erosion are to control the hydrology, or control the sediment input. Hydrologic control is obtained by reducing the magnitude and frequency of peak flows by altering the hydrology through upstream detention and infiltration, or restoring wetland habitats to provide additional storage. If space permits, a new channel and floodplain can be reconstructed to lengthen the stream channel, connect it to its floodplain and create a more natural channel design that is in balance with the current hydrologic regime. These types of activities are most effective in the upper reaches of the watershed where decreases in channel complexity have resulted in problems farther downstream.

Instream flow controls such as grade controls or flow deflectors can prevent bed erosion and reduce the sediment load in the stream in areas that appear to be actively eroding. Stabilizing the streambanks with vegetation or other soft bank stabilization practices prevents additional sediments from entering the stream and provides roughness to help control flows.

The recommended priority for improving channel stability and preventing channel degradation is:

- West Fork Pringle Creek in Woodmansee park; this area could benefit from channel lengthening, connection to the floodplain, grade controls and riparian plantings to halt degradation of the channel and alleviate downstream flows.

6.5.6 Aesthetics

If the goal of habitat enhancement is to improve the aesthetics of the stream corridor, the primary objective should be to clean up the stream, stabilize stream banks and manage the riparian zone to create a more natural stream environment. *Generally, improving aesthetics can be implemented throughout the watershed wherever opportunities exist.*

6.5.7 Addressing Multiple Objectives

Many of the stream habitat enhancement activities described in the preceding sections can be applied to address multiple objectives or habitat components (see **Table 6-5**). The overall objectives for each individual reach should be outlined prior to implementing any habitat enhancement program in order to maximize the benefits achieved and prevent conflicts between competing goals. Chapters 4 and 5 describe strategies for addressing hydrology and drainage and water quality problems. Many of these practices can be integrated into a program to address multiple objectives.

Table 6-5 Habitat Components Addressed by Each Management Activity

Management Activities	Channel Morphology	Channel Complexity	Residual Pool Depth	Substrate	Wood	Fish cover	Riparian cover	Human Disturbance	Fish Passage
Channel and floodplain construction	x							x	x
Hydrologic alteration	x								x
Streambank stabilization	x	x	x	x		x	x		
Instream flow controls	x	x	x	x					
Instream habitat structures	x	x	x	x	x	x			
Riparian management	x				x	x	x		
Barrier removal / modification								x	x
Fish passage devices								x	x
Stream cleanup and adoption								x	
Pollution control								x	

6.6 Opportunities and Constraints for Stream Enhancement

This chapter provided a summary of the habitat conditions in the Pringle Creek watershed, and presented management actions that can be taken to protect, restore or enhance conditions to meet the habitat-related objectives of the plan. The objectives are to define the opportunities and constraints to:

- Enhance or protect stream habitat for aquatic species (including fish passage), focusing on benefits for anadromous fish and secondarily on resident fish and other aquatic species.

- Restore riparian habitat and function.
- Improve aesthetics of the urban stream corridor and improve recreational facilities and features.

The management actions to address (aquatic) habitat issues discussed in this chapter are summarized in **Table 6-6**, along with a summary of the opportunities and constraints for each of the management action categories. The opportunities and constraints for the other management action categories are generally the same as those in **Chapter 4, Table 4-10**.

As discussed in **Section 6.5**, most habitat problems appear to be systemic throughout the entire watershed, and in a highly urbanized system like Pringle Creek, the ability to restore *all* habitat-forming processes is limited. Therefore, the appropriate goal is to improve habitat conditions in the watershed within the given land-use constraints and the opportunities that arise, but within the context of priorities described in the watershed plan. Incremental improvements resulting from multiple small-scale projects over time can collectively achieve many restoration goals.

With this in mind, target reaches should be prioritized by focusing first on those with the greatest potential for recovery (good quality) at the least amount of risk and cost, and then secondarily focusing on those systems or areas requiring greater intervention for recovery. Based on the "critical areas" (good quality habitat) as determined from the bioassessment study analysis and the understanding that the lower portions of the watershed are the most likely key habitat areas for fish, the following areas are recommended as priority habitat enhancement areas **(refer to Figure 6-9)**:

- Lower reaches of Pringle Creek mainstem
- Middle reaches of West Fork Pringle Creek
- Lower reaches of East Fork Pringle Creek

When developing specific stream enhancement projects for these areas, it is important to consider the effects on the whole watershed as the project can have effects both upstream and downstream. A detailed, project-specific study will need to be conducted in areas identified for habitat improvement projects to determine the potential effects of enhancement projects on other stream functions. In addition, these streams are all limited by fish passage barriers. Removal of these barriers is a key management action to improving the overall habitat conditions in these reaches.

The following is the recommended priority by which the City should focus its efforts in implementing the habitat management actions:

1. Protect those existing watershed features, or areas, that currently provide high quality habitat (natural stream channels, riparian areas, wetlands). Policies to protect these sensitive natural resources should be developed.
2. Continue to conduct public outreach and work with community and other stakeholder organizations to educate and promote watershed health. As part of this effort, work with and educate streamside landowners to identify opportunities for stream enhancement projects.
3. Continue to promote riparian vegetation/plantings and stream cleanup through stewardship programs or in conjunction with other capital improvement projects.

4. Leverage capital improvement projects for drainage to identify opportunities for stream and habitat enhancement.
5. Removal of fish passage barriers. Although Pringle Creek is not considered critical habitat, existing barriers prevent access to existing quality habitat and limit the benefits of efforts to improve habitat further up in the watershed. Those areas identified to gain access to the higher quality habitat should be addressed first.
6. Connect and provide access to existing isolated habitat. There are existing good quality habitat areas in the Pringle Creek watershed.
7. Modify or create stream habitat. Restore processes that create, maintain, and connect habitats, including restoration of sediment dynamics, large wood dynamics, flow regimes, and floodplain connectivity.

The first three actions (1-3) are generally lower cost and easier to implement but can be just as visible as the last four (4-7), which are more capital intensive actions. Although the management actions can be implemented or developed concurrently, some actions are more easily implemented because existing programs may already provide a framework or the action requires less financial resources. Other programmatic implementation considerations including plan promotion, staffing roles, and funding sources are discussed further in **Chapter 9**.

Table 6-6. Opportunities and Constraints for Habitat Management Actions			
Management Action Category	Description	Opportunity	Constraint
Stormwater Management (detention/infiltration)	▪ Implement/construct the priority drainage capital improvements (refer to Table 4-6). These projects generally involve adding or improving bridges, replacing undersized pipelines, and replacing or upgrading culverts.	▪ Project locations are defined in DSIP. ▪ City has a prioritized list of drainage projects (Table 4-6). ▪ Stormwater Management Plan includes BMPs (RC1, RC2, RC3) to prioritize and implement stormwater-related capital improvements, including detention and water quality facilities, as part of its NPDES permit requirement. ▪ City is currently updating the XP-SWMM hydrologic model which can be used to reassess impacts of drainage projects.	▪ With the exception of PCB42 (Bridge at McGilchrist) most DSIP projects are currently *unfunded* based on 2006 CIP. ▪ May require COE/DSL Section 404 permit
Enhance Wetlands	▪ Implement wetlands enhancement where possible.	▪ City is currently working on a wetlands bank under its Wetlands Program. ▪ Priorities have been developed based on local wetlands inventory (LWI) and OFWAM methodology. ▪ The Marion Soil and Water Conservation District can be leveraged to recruit private landowners into the Wetland Reserve Program (WRP)	▪ Final list of significant wetlands has not been finalized to date, to include protection of SRC Chapter 68. ▪ Priorities developed under LWI have not been field verified. ▪ Wetland enhancement projects are currently *unfunded* based on 2006 CIP.
Fish Passage Improvements	▪ Removal of instream culverts, dams and weirs.	▪ Fish passage barrier removal priorities have been defined.	▪ Barriers are “layered” in many streams and require removal of a series of barriers to gain access to the entire stream length. ▪ Ownership of some of the barriers (especially weirs) is unknown. ▪ Barrier removal projects are currently *unfunded* based on 2006 CIP.

Stream Repair/Enhancement and Riparian Management *Including:* ▪ *Channel and floodplain redesign / construction* ▪ *Streambank stabilization* ▪ *Instream flow controls* ▪ *Instream habitat structures* ▪ *Riparian management*	▪ Implement/construct stream and habitat enhancement projects in conjunction with drainage improvement projects wherever practicable. ▪ Incorporate restoration opportunities into all community development and planning programs and promote these opportunities for third-party involvement in implementing these enhancement projects.	▪ Watershed Plan has identified areas for conducting appropriate stream repair/ enhancement projects based on impaired watershed function analysis. ▪ Watershed Plan and database can be used to promote projects with other parties.	▪ Stream enhancement projects are currently *unfunded* based on 2006 CIP. ▪ Availability or access to streamside property is limited. Easements may need to be acquired. ▪ May require COE/DSL Section 404 permit
Promote/Implement Low Impact Development	▪ Reduce, prevent, or mitigate the creation of more impervious surfaces by promoting alternative planning strategies (low impact development) when developing new developments, including buildings, streets and parking lots.	▪ Several large urban developments in the watershed are already using some level of low impact development and can be used as demonstration projects. ▪ Industry experience has shown that LID can be cost effective	▪ No design standards or incentives are in place to require or encourage the use of low impact development in the City. ▪ Perceived cost-to-benefit ratio is high for builders and developers.
Protect Natural/ sensitive Areas	▪ Protect existing private and public sensitive natural areas along all streams in the watershed.	▪ Stormwater Management Plan includes a BMP (RC6) to protect waterways as part of its NPDES MS4 permit requirement. ▪ City has Tree Preservation Ordinance (SRC Chapter 68). ▪ City currently has a Watershed Protection and Preservation Program.	▪ Highly urbanized watershed limits available natural resources for protection. ▪ Competition for the relatively limited developable or buildable land.
Develop and Build Upon Watershed Education and Stewardship Programs for the Community	▪ Build and expand community-wide education programs to enlist broad-based and long-term support and stewardship for watershed protection, enhancement and restoration.	▪ Stormwater Management Plan includes BMPs (RC23) to conduct education outreach as part of its NPDES MS4 permit requirement. ▪ City had Adopt-a-Street and Adopt-a-Stream programs. ▪ Leverage interest and active members of Pringle Creek Watershed Council.	

Chapter 7. Monitoring Programs

This chapter provides a summary of recommendations to conduct future monitoring for stream flow, water quality and habitat quality in the Pringle Creek watershed.

7.1 Flow Monitoring

As discussed briefly in Chapter 4, the Pringle Creek watershed does not have much historical stream flow data. However, the City installed four continuous stream flow (and water quality) monitoring stations as part of recommendations that came out of the Drainage System Improvement Plan (Montgomery Watson, 2000). The DSIP recommended many more monitoring locations in Pringle Creek and other watersheds with a cost of approximately $3 million, as estimated at the time. Due to the budget limitations constraining the installation of the monitoring stations, the City prioritized four locations for the upstream and downstream reaches of Pringle Creek and Clark Creek as listed in **Table 7-1**. There are also three rain gauges that can be used in conjunction with the stream flow gauges to monitor the relationship between rainfall-runoff. These gauges have been collecting data since January 2006.

Table 7-1. Existing Flow Monitoring and Rain Gauging Stations in Pringle Creek Watershed

Flow Monitoring Station	Location	Rain Gauge	Location
PRI 3	Lower Pringle Creek mainstem above confluence of Shelton Ditch	Rain Gauge No. 7	Salem City Hall; 555 Liberty St. SE
PRI 12	East Fork Pringle Creek at I-5	Rain Gauge No. 19	3850 Turner Rd. SE
CLK 1	Clark Creek at mouth to Pringle Creek	Rain Gauge No. 7	Salem City Hall; 555 Liberty St. SE
CLK 12	Clark Creek near Liberty Rd. and Ewald Ave.	Rain Gauge No. 10	Fire Station #7; 4730 Libert y Rd. S

The DSIP recommended a total of 12 stream flow monitoring locations for the Pringle Creek watershed. Realizing the budget limitations, additional monitoring locations are recommended to be prioritized near the mouths of three additional Pringle Creek tributaries, which include West Fork, West Middle Fork, East Fork, or Upper East Fork. These locations are coordinated with the recommendations for water quality monitoring discussed in **Section 7.2.3**. For the size of the Pringle Creek watershed, the existing rain gauges are sufficient.

7.2 Water Quality Monitoring

This section describes a water quality monitoring program for Pringle Creek and its tributaries. The monitoring program summarized in **Table 7-2** is designed to meet the following objectives:

- Support NDPES MS4 permit monitoring requirements
- Collect baseline data for TMDL parameters
- Assess tributary subwatershed water quality

Each of these objectives is discussed further in the following sub-sections. The monitoring program would require slight changes to the City's current urban streams monitoring program

(as summarized in **Chapter 5**). The program requires yearly assessment of the collected data to maximize usefulness of the monitoring program and evaluate changes to the monitoring program based on the new information. Additionally, the program should be flexible to reflect the assessment of data as it is collected or to meet other objectives.

Table 7-2. Summary of Pringle Creek Water Quality Monitoring Program

Monitoring Element	Objective	Monitoring	Reporting
MS4 permit	Support the requirements and objectives of the City's MS4 permit.	Specified in the MS4 Second Annual Report and SWMP Evaluation (City of Salem, 2005).	Annually, as required in the MS4 permit
TMDL baseline monitoring	Develop baseline data for TMDL parameters	Bacteria - Develop baseline E. coli database at 3 TMDL compliance points (two stations on Pringle Creek and one station on Clark creek). Effectiveness of future BMP measures will be assessed by improved E. coli concentrations. Temperature – Collect shade measurements during EMAP surveys or every 3 to 5 years. Collect continuous temperature data in Pringle Creek and its major tributaries. Assess continuous data collected in summer 2006. **Mercury**- Monitor as necessary compliant with and DEQ issued MAO and/or the City's TMDL Implementation Plan.	Document results in an annual report that summarizes the data and analysis results.
Tributary water quality	Asses water quality for the major tributaries to Pringle Creek	Locate permanent monitoring stations at the mouth of Pringle Creek (already in place) and select tributaries.	Document results in an annual summary that documents data and analysis results.

7.2.1 Support NDPES MS4 Permit Monitoring Requirements

The City of Salem is required to conduct water quality monitoring to meet the requirements and objectives of the City's stormwater NPDES MS4 permit. The stormwater monitoring program includes four major types of monitoring throughout the City's permit area (boundaries beyond the Pringle Creek watershed):

- Willamette River (not within the Pringle Creek watershed)
- Urban streams (locations on Pringle Creek, Clark Creek, and other urban streams.)
- Outfalls (Commercial Street SE. on West Fork Pringle Creek and elsewhere within the City)
- BMP percent removal efficiency (Kroger Park bioswale discharging waters to West Pringle Creek)

The *NPDES MS4 Permit Second Annual Report and SWMP Evaluation* (City of Salem, 2005) includes an evaluation of the City's current monitoring program and recommended modifications to the monitoring program in order to better support the requirements and objectives of the City's MS4 permit. The proposed modifications to the monitoring program based on the evaluations in the 2005 2nd Annual Report and relevant to the Pringle Creek watershed include:

- The monitoring program will focus on the 303(d) listed streams, which include Pringle Creek and Clark Creek. Monitoring will be conducted at select outfall and urban stream locations upstream and downstream of the outfall to account for the contributions of select stormwater discharges to receiving water quality. Sampling from the outfalls and the urban stream locations will be coordinated. It is recommended that the monitoring occur near the mouths of each of the major tributaries (at a minimum).
- Parameters monitored at the priority outfalls and urban streams will focus on identified 303(d) listed parameters and other associated parameters. Flow will be monitored or estimated for select 303(d) listed urban streams during the sampling collection periods.
- Options for source monitoring for bacteria will be evaluated by the City[1]. A final monitoring plan for bacteria will be based on the adopted TMDLs and the subsequent TMDL Implementation Plan.
- BMP effectiveness monitoring will include monitoring other representative stormwater treatment proprietary devices (e.g. vortex-type units and the Stormceptor unit). Opportunities to retrofit these facilities will be explored to facilitate influent and effluent monitoring. The Kroger Park bioswale project will continue to be monitored.

The City will be in a better position to make specific modifications during its MS4 permit renewal process when the Stormwater Management Plan is reviewed and updated again in early 2008. This will allow coordination with the TMDL Implementation Plan development that will occur during year 2007. In the meantime, the City is committed to continuing to meet the requirements of the MS4 permit monitoring requirements. The monitoring program and data collected will be evaluated regularly as part of the permit process and associated annual reports.

7.2.2 Collect Baseline Data for TMDL Parameters

The current TMDL parameters in the Pringle Creek watershed include E. coli and water temperature.

E. Coli Bacteria

The City of Salem will likely be required to determine the baseline (current) conditions for E. coli levels at the three compliance locations (refer to **Table 5.3**) in the Pringle Creek watershed for implementation of the Willamette Basin TMDL. The baseline monitoring would be conducted to:

[1] See discussion in Section 7.2.2.

- Develop the necessary information from which to assess the effectiveness of watershed BMPs.
- Evaluate whether the E. coli allocations in the Willamette Basin TMDL can be met.

The baseline monitoring would consist of E. coli sampling at the Clark Creek station (year round) and the two Pringle Creek stations depending on the season. Assessment of this data should occur yearly, with summaries of the data and discussion of results. The City should continue evaluating bacteria source tracking (BST) methods to determine the most cost effective way of isolating the source(s) of bacteria. This information may be very useful in developing an effective TMDL Implementation Plan for bacteria.

Temperature

There are not specific compliance locations for temperature. Instead, TMDL allocations for temperature are based on the amount of shade (percent effective shade) along stream reaches. The temperature monitoring program in the Pringle Creek Watershed should include the following elements:

- Recording shade measurements during the EMAP surveys, or every 5 years to assess the progress being made to meet the TMDL allocations.
- Placing temperature loggers every three to five years at the mouths of the main tributaries to Pringle Creek – West Middle Fork, West Fork, East Fork and Upper East Fork. The City is already monitoring Pringle Creek main stem and Clark Creek. The temperature monitors would be used to evaluate temperature conditions and track the results of shade improvements within the sub-basins.

Additionally, assessing the continuous temperature data collected during the summer months each year at the permanent stations will help provide information about temperature during the critical period of the year.

Other Parameters

Increased baseline monitoring efforts may be required in the near future as TMDL allocations are developed for other parameters on the 2004 303(d) list in the Pringle Creek watershed, such as dieldren, mercury, and select metals. Also, additional monitoring stations may be required for other tributary streams included on the 2004 303(d) list. For example, the 2004 303(d) list includes E. coli and heptachlor for an unnamed Pringle Creek tributary.

7.2.3 Assess Tributary Water Quality

Currently, there are five permanent monitoring water quality stations in the Pringle Creek watershed. Through the paired (upstream/downstream) arrangement of stations, the permanent monitoring stations are useful for assessing the cumulative land use influences on the water quality of Clark Creek. The upstream Pringle Creek station (PRI 12) and the downstream Pringle Creek station in Bush Park will also likely provide similar information.

However, for the management of water quality and planning purposes, it is important to determine water quality conditions and isolate the influences of land uses at the subwatershed level. A data gap identified through the assessment of water quality data (Chapter 5) is the lack of water quality data for the main tributaries to Pringle Creek. To help fill this data gap, the five permanent stations could be located at the following sites:

- Pringle 1 – The downstream Pringle Creek Station should be used to identify water quality conditions of the creek as it enters Willamette River. This station should be located upstream of the confluence of Mill Race, otherwise it would largely reflect Mill Race conditions.

- Clark Creek at Bush Park – This is the current location of the permanent station.

- Near the mouths of three additional Pringle Creek tributaries, which include West Fork, West Middle Fork, East Fork, or Upper East Fork.

7.3 Habitat Quality Monitoring

This section describes an approach for habitat quality monitoring in Pringle Creek. Monitoring is a crucial part of any habitat management program in that it answers key questions that measure the success of enhancement efforts, or directs attention to problems that arise before they become irreversible. Several habitat monitoring activities that should be implemented in Pringle Creek are outlined in **Table 7-3**. These activities are described below:

- *Status and trend monitoring* to identify whether overall habitat conditions in the Pringle Creek watershed are improving, maintained or degrading.

- *Implementation monitoring* of specific habitat management and enhancement projects to determine if projects were implemented as planned.

- *Effectiveness monitoring* of specific habitat management and enhancement projects to evaluate which projects worked and which did not.

7.3.1 Monitoring Status and Trends in Habitat Quality

The purpose of status and trend monitoring is to determine if current (or implemented) management actions are improving, maintaining or degrading overall habitat conditions within the watershed, and to identify potential problem areas so that management activities can address them. This requires the ability to detect long-term environmental change with enough detail to provide insight into the magnitude and consequences of that change. Status and trend monitoring is not intended to identify the specific activities that are contributing to the change (see effectiveness monitoring below), but it can provide insight into what factors are changing over time.

Monitoring Approach

As discussed in Chapter 6, the City conducted a bioassessment study in the Pringle Creek watershed in 2000. A similar study was conducted in 2001 throughout the entire City of Salem. The field approach initiated by the City has been used by the EPA's Environmental Monitoring and Assessment Program (EMAP) and numerous other federal, state, and local groups for monitoring streams over time. These methods are standardized, create a rigorous data set, have strict quality control, and are quantitative. These are important features that provide the precision necessary to detect real environmental change over time. Although EMAP methods have limitations for characterizing stream habitat, they are specifically designed for status and trend monitoring.

Information on habitat condition that can be used as baseline data for trend monitoring was collected during the 2001 Bioassessment Study, when 44 sites were surveyed throughout the City of Salem. Eight of these sites were located throughout the Pringle Creek Watershed. Other monitoring programs throughout the Pacific Northwest, such as the Aquatic and Riparian Effectiveness Monitoring Program (which monitors watersheds within the Northwest Forest Plan Region), evaluate habitat condition using data collected from six to eight sites per 6th field HUC (REO 2006). Therefore, a sample size of eight sites from the Pringle Creek Watershed is considered adequate to represent its overall habitat condition and detect changes in condition over time. However, the 2001 sample from Pringle Creek omitted three subwatersheds from Pringle Ceek: East Fork, Upper East Fork and West Middle Fork. In order to more completely represent the entire Pringle Creek watershed, three additional monitoring sites should be included in the sample. A 2000 Bioassessment Study site could be randomly selected from each of these subwatersheds to provide baseline condition and function as additional monitoring locations.

In order to detect change in environmental conditions over time, these monitoring sites should be re-surveyed every five years using the EMAP methods outlined in the City of Salem's 2001 Bioassessment Study Field and Laboratory Methods Manual (Salem 2001). Five years is an adequate length of time for environmental changes to occur, and is also frequent enough to be useful from a management perspective.

Parameters

Parameters that will be used to determine the status and trends in habitat condition in the Pringle Creek Watershed include:

- *Benthic Index of Biological Integrity (B-IBI) scores.* This metric measures the ability of the stream to support a biologically diverse assemblage of organisms. These values can be compared to previous B-IBI values in order to detect change in the stream's ability to support aquatic biota.
- *Habitat Quality Index (HQI).* In order to detect overall habitat quality based on the interactions of four key metrics, comparison of the HQI from each monitoring site will show changes in the overall habitat condition of individual sites within the watershed.

- *Key Metrics.* The key metrics outlined in Chapter 6 were selected to represent components of habitat quality that are essential for aquatic species. These metrics will be compared to previous metric values in order to detect change. They will also be compared to reference condition and regulatory benchmarks in order to evaluate the magnitude of change. Comparison of key metrics to these benchmarks provides threshold values from which to evaluate the magnitude of the response of the ecosystem to management activities.

Reporting

For information on status and trends to be useful, it must be documented in a timely manner. Data that is collected and evaluated from the monitoring locations will be integrated into the Pringle Creek GeoDatabase and summarized in status reports on habitat quality. These reports can be used to assess whether the quality of habitat in the Pringle Creek Watershed is improving, and give direction on factors that may require management action.

7.3.2 Monitoring Habitat Enhancement Projects

Monitoring is an important tool during and after implementation of any management or enhancement activity that is designed to improve habitat conditions. Monitoring answers the question of whether or not the activity was implemented as designed (implementation monitoring), and if it was successful in meeting the objectives of the project (effectiveness monitoring). These two types of monitoring, taken together, can lead to mid-course corrections that can save projects from failure and guide future decisions regarding management of aquatic habitat.

Implementation Monitoring

Implementation monitoring involves monitoring projects during and shortly after completion in order to determine if they were implemented as planned, and to summarize what activities were actually carried out. Monitoring a project during implementation can identify potential problems in coordination or design, and guide adaptations that can help ensure project success. Specific recommendations for implementation monitoring are not provided here, because activities are project specific. However, typically the monitoring activities involve visual inspections, photographs, and field notes confirming that the project was completed as intended.

Effectiveness Monitoring

Effectiveness monitoring answers the question of whether or not the management activities were effective in meeting their goals. It is an important tool in guiding management of a resource and should be conducted as part of any enhancement program. Methods and parameters collected as part of an effectiveness monitoring program are project-specific. They can range from simply walking through a project area documenting changes in pools, erosion or improved hydrology, to intensive surveys of fish and habitat responses.

The results of project implementation and effectiveness monitoring activities are documented in a report that can be used to assist the City in implementing future projects and prioritizing

allocation of funding and resources to management activities. Enhancement projects should also be reported to the Oregon Watershed Restoration Inventory (OWRI), which is a database that was established and is maintained by the Oregon Watershed Enhancement Board (OWEB) to track completed restoration work around the state. Reporting to the OWRI is required for projects receiving funding from OWEB, but is voluntary for other projects. In addition to assisting with local decision making, reporting the successes and failures of enhancement projects can benefit management decisions throughout Oregon, and enhance understanding of the relationship between aquatic habitat and restoration and enhancement management activities.

Table 7-3 Summary of Pringle Creek Habitat Quality Monitoring Activities			
Monitoring Activity	Habitat Condition Status / Trend Monitoring	Effectiveness Monitoring	Implementation Monitoring
Objective	Detect long-term changes in habitat conditions, provide insight into the consequences of these changes, and guide future management of the Pringle Creek Watershed	Determine whether the specific action/project is successful in meeting the habitat improvement objective. Findings help to guide future management decisions.	Establish whether success or failure of management activities is due to implementation.
Monitoring Question	Are overall habitat conditions in the Pringle Creek Watershed maintained, degrading or improving over time?	Has the enhancement/management action accomplished its objectives?	Has the enhancement / management action been implemented as planned?
Parameters	• Habitat Quality Index (HQI) • Key metrics • Macroinvertebrate metrics	Based on the objectives of the management activity – could include flow and water quality monitoring, or survival of plantings.	Project specific – could include project area measurements, number of plantings.
Methods	• EMAP Field Sampling Protocol and calculated PHab Metrics. • Compare metrics to baseline data from 2000 to detect changes in the values of the indicators. • Use reference condition and regulatory benchmarks to determine threshold values to determine the degree of change.	Based on the objectives of the management activity - could range from establishing photo points to intensive habitat surveys.	Project specific – could include visual assessments or field measurements comparing plans to as-built project
Study Design & Location	• Same as 2000 Bioassessment Study • Add three sites in the Pringle Creek Watershed to represent East Fork, Upper East Fork, and West Middle Fork subwatersheds, randomly selected from the 2000 Bioassessment Study Survey sites.	Based on locations of potential management effects.	Project specific
Frequency	Every 5 years	Project specific – could be monitored seasonally or annually, or longer term incorporated into trend monitoring	During implementation of project
Reporting	• Document results in a status report for each sample period. • Integrate information into the GeoDatabase.	• Document results in a project report which will aid in future management activities. • Report to Oregon Watershed Restoration Inventory .	• Document results in a project report. • Report to Oregon Watershed Restoration Inventory.

Chapter 8. Early Action Projects

One of the primary goals of the watershed plan is to identify early action projects that are highly visible and can show early successes for improving watershed health. The challenge is to identify early action projects that fit into the "programmatic" or "big picture" plan of improving overall watershed health, while taking advantage of implementation opportunities. Ideally, early action projects are not isolated in their benefits, but rather benefit areas beyond the immediate vicinity of the project or can be used as the first of a series of projects to address multiple watershed restoration/enhancement objectives. Thus, the identification of early action projects cannot be selected in a vacuum, but rather in conjunction with the long-term strategy which relies on the larger watershed characterization and habitat assessments described in the previous chapters. The other consideration is to identify potential early action projects that have potential for developing partnerships with other stakeholders, such as neighborhood organizations, private landowners, industrial land owners, and environmental organizations.

This chapter presents a framework for selecting early action projects and identifies a few example projects for potential development by the City of Salem or other interested stakeholders.

8.1 Identifying Early Action Projects

The early action projects are identified through a combination of: (1) reviewing the capital improvement plans from the Stormwater Master Plan and identifying the CIP projects that have habitat or other multi-objective benefits; (2) conducting discussions with City staff for high visibility projects; and (3) interviewing members of the Pringle Creek Watershed Council.

Candidate early action projects will generally fall into the following projects types:

- *Riparian enhancement projects.* Planting trees, shrubs, and other vegetation in riparian areas and removal of invasive species such as blackberries. This will help stabilize the banks, increase channel complexity, re-establish floodplain and reduce incision of the creek. Sites may be identified based on the shading index and tree canopy survey.
- *Instream habitat improvements.* Physical habitat improvements including placement of large woody debris (LWD), and removal of bank armoring/walls to improve channelization. Sites may be identified based on habitat quality indices from the bioassessment study.
- *Parks Management.* Change management practices in the parks to create a stream buffer. Plant native riparian plants along the banks. Sites may be identified based on water quality impacted reaches and opportunities along park property.
- *Removal of fish barriers.* This could include removal of culverts, weirs, and other structures. Specific locations of fish barriers are identified in the watershed assessment report (Hemesath and Nunez, 2002) and fish passage prioritization study (Salem, 2003).
- *Stormwater Capital Improvements.* Design and construct CIP projects in the Stormwater Master Plan – Drainage System Improvement Plan (Montgomery Watson, 2000) prioritized by opportunities identified in this planning process. For the most part, priority projects identified in **Table 4-6** that involve culvert or bridge improvements are considered for early

action projects. These are considered more "highly visible" than projects related to replacing undersized stormwater conveyance pipelines.

- *Pilot Studies for innovative stormwater treatment techniques*.. Implementation and monitoring of innovative BMPs for both private and public pre- and post-construction projects. For example, these projects may be proposed by developers of proprietary stormwater treatment technologies. Sites may be identified based on water quality (e.g. sediment, turbidity, or other pollutants) impacted stream reaches.
- *Low Impact Development (LID) Pilot Study*. Implement and monitor LID design and construction for new and re-development projects to reduce impervious areas. Sites may be identified based on flooding data and water quality impacted stream reaches.

Table 8-1 lists locations of candidate early action projects that generally fall into one of the categories listed above.

8.2 Screening and Prioritization

The potential projects identified in Section 8.1 can be prioritized using evaluation criteria discussed in this section. The criteria focus on opportunities for early implementation and "visibility" rather than the level of functional improvement that would be achieved. The main purpose of the early action projects, at this stage, is to help promote the watershed planning program and educate the public on improving watershed health. In the end, the City's Public Works Department needs to decide whether a project can be implemented within their budget or whether adequate funding is available from other stakeholders to pursue the project.

The following evaluation criteria can be applied to projects identified, including those listed in **Table 8-1** or any projects identified through the public input process:

- Timely Benefits – How quickly will the City/public see benefits from the project?
- Ownership/Availability – This refers to the ease of site acquisition for the project. Are there multiple owners, public or private ownership, is the site for sale, would condemnation be required? Sites with many owners and/or if the site would be difficult to acquire would score lower than sites with fewer owners and/or if the site is readily available.
- Threat of Losing Opportunity – Is the project (e.g. mitigation or restoration opportunity) at risk of being otherwise developed?
- Project Support – How much support currently exists for this project or site? A project with high project/community support is likely to be easier to develop than other sites that lack this level of interest.
- Maintenance & Long-Term Protection – This refers to the need for maintenance and mechanisms for long term project function or operation. Projects that require little to no maintenance are preferable to opportunities that require human intervention. Does the site have potential to be turned over to another agency or conservation group for long-term protection and maintenance?

- Site Constraints/Constructability – This refers to project site issues that may present constraints or constructability issues associated with the site (e.g., clearing, grading, fill removal, filling, hydraulic structures, etc). These characteristics will be helpful in estimating the rough costs, and the cost benefit ratio. Constraints to consider include: Site contamination; Utility locations; Presence of cultural, historical, or archaeological features.
- Consistency with Local Land Use Plans and Local, State, and Federal Regulations – Is the project consistent with land use plans and regulations such as comprehensive plans, master plans, critical areas ordinances, and other regulations?
- T&E Species Support –Does the project or site provide ecological support for Threatened, Endangered, or sensitive species? How does the site provide ecological support for species present at the site?

After the level of "screening" from the criteria above, the following two criteria can be evaluated in greater detail to aid in determining project priorities.

- Cost Effectiveness – This refers to the overall planning level costs to implement the project relative to the area (ecological/functional) benefits that can be realized. The benefits would also consider the "values" developed by the City and the public. If applicable, this would also consider the amount of mitigation credits the site would generate relative to the expected impacts and project cost.
- Partnership Opportunities – Are there partnership opportunities available that would assist in leveraging project funds or enhancing the long-term manageability of the site. For example, if City Parks owns property that needs restoration, a private developer may get mitigation credit for completing the restoration work, but does not need to acquire the site or provide for long-term site protection and maintenance. This would involve providing a list of cost efficiencies that would be available through a partnership opportunity.

Once the plan has been accepted by the City and public input is received through the public promotion and outreach efforts, specific projects under the categories listed in **Table 8-1** can be developed further and evaluated against these criteria.

Table 8-1. Potential Early Action Projects			
Location	**Description**	**Opportunities**	**Constraints**
Riparian Enhancement (refer to Figure 6-5E)			
▪ Lower Pringle Creek mainstem (between confluence of East Fork and Clark Creek – Sites 4 and 5) ▪ Lower Pringle Creek mainstem (between confluence of West Fork and East Fork – Sites 6 and 7) ▪ West Fork Pringle Creek (downstream of Pringle Rd. - Sites 32 and 33)	Planting trees, shrubs, and other vegetation in riparian areas and removal of invasive species such as blackberries.	▪ Generally, low cost/high visibility actions. ▪ Private landowners in industrial areas may be willing to participate to gain public relations benefits. ▪ Areas around schools provide opportunities to integrate with educational programs/classes.	▪ Primarily residential properties; site access may be limited. ▪ Need private landowner participation/ approval for many areas. ▪ Funding not identified in CIP program.
Instream Habitat Improvement (refer to Figure 6-5A and 6-5B)			
▪ Woodmansee Park (Sites 37 and 38) ▪ Middle Clark Creek (Sites 26 and 27)	Physical habitat improvements including placement of large woody debris (LWD), and removal of bank armoring/walls to improve channelization.	▪ High visibility projects (with signage for education purposes). ▪ Public lands allow easy access. ▪ Permitting requirements may be reduced if habitat benefits are demonstrated.	▪ Depending on the specific improvements defined, actions can be relatively expensive. ▪ Funding not identified in CIP program. ▪ May need private landowner participation/ approval in some areas.
Parks Management			
Woodmansee Park, Bush Park, Pringle Park	Change management practices in the parks to create a stream buffer. Plant native riparian plants along the banks.	▪ Public lands allow easy access. ▪ Relatively low cost/high visibility actions (with signage for education purposes)	▪ Support would have to be obtained from Parks Operations.
Wetlands Enhancement (refer to Table 4-9 and Figure 4-5)			
Wetlands PC-E, PC-F, PC-O (abandoned gravel pits)	Enhancement of wetlands and abandoned gravel pit sites	▪ Provides multi-benefits for habitat/ drainage/ water quality in a highly visible area and areas identified to be "critical areas" for habitat protection/improvement (refer to Chapter 6) ▪ High visibility projects (with signage for education purposes) ▪ Permitting requirements may be reduced if habitat benefits are demonstrated.	▪ Funding not identified in CIP program. ▪ Projects are generally costly to implement. ▪ Significant study would have to be conducted and timeliness of benefits would be longer-term than other early action-type projects.
Wetland PC-DD	Enhancement of cattail marsh		
Wetland PC-X	Preservation of forested wetland near the headwaters of East Fork Pringle Creek		

Table 8-1. Potential Early Action Projects (cont'd)			
Location	Description	Opportunities	Constraints
Removal of Fish Passage Barriers			
▪ Dam/partial barrier at mouth of Pringle Creek mainstem ▪ Culverts/complete barriers on lower Clark Creek and lower West Fork Pringle Creek ▪ Culvert/partial barriers on Middle Clark Creek, lower West Fork Pringle Creek, and middle East Fork Pringle	Includes removal of culverts, weirs, and other structures.	▪ Habitat improvements can be integrated with these projects under a single funding proposal. ▪ High visibility projects (with signage for education purposes).	▪ Funding not identified in CIP program. ▪ Projects are generally costly to implement.
Stormwater Capital Improvements (refer to Table 4-6 and Figure 4-3)			
For locations of CIP project sites, refer to Table 4-6 and Figure 4-3 PCB07, PCB12, PCB21 – replace undersized culverts	Replacement of undersized culvert or bridge improvement with optional channel and habitat improvements.	▪ Addresses erosion and localized flooding due to undersized culverts at key drainage problem areas. ▪ Habitat improvements can be integrated with these projects under a single funding proposal. ▪ Permitting requirements may be reduced if habitat improvements are included in the project.	▪ Funding not identified in CIP program. ▪ Projects are generally costly to implement.
PCB08, PCB23, PCB25, PCB50 – replace undersized culverts with habitat improvements			
PCB17, PCB19, PCB37, PCB38, PCB40, PCB49 – replace bridge			
PCB41 – replace bridge including habitat improvements			
Low Impact Development Study			
Pringle Community; Sustainable Fairview; Cascadia Development; McGilchrist Urban Renewal Area; Boise Cascade	Develop promotion program (signage, education materials) for these on-going developments that may be using LID.	▪ High visibility projects (with publicity for education purposes) that are already underway. ▪ Minimal funding required to implement the action.	• May need revision to or variance in current land use development standards.

8.3 Project Descriptions

Project descriptions were developed for select candidate early action projects identified by Public Works Department staff. The projects were selected primarily because they are on public park lands and easily accessible. They are also highly visible in terms of being at widely used park locations.

The early action projects are documented in the "summary characterization report" in Appendix H. The purpose of the characterization report is to provide enough background to justify the project and allow stakeholders (e.g. developers and resource and funding agencies) to understand how the project benefits watershed health, and also provide enough technical and cost information for stakeholders to understand how the project can be implemented, i.e. how it might be integrated with their program, project, or development. The characterization reports can be maintained as part of the project database and can be integrated in the City's overall capital improvement program. **Table 8-2** lists the four projects that have characterization reports included in **Appendix H**. The projects range in cost from approximately $35,000 to stabilize a bank at Pringle Creek in Bush Park to over $850,000 to create a more natural channel in Pringle Creek within Pringle Park. The higher cost projects may be cost-prohibitive to implement, but the intent was to demonstrate the range of costs to develop similar projects.

Table 8-2. Candidate Early Action Projects

Location	Problem	Project	Benefits
Pringle Creek Bush Park Near Mission St. and Capitol St. SE	▪ Erosion along left bank along bend in stream. ▪ Gravel deposition upstream of the bridge.	▪ Lay back and stabilize eroding left bank; ▪ Remove gravel bar upstream and under bridge; ▪ Create a pool using weir; ▪ Place large wood in stream	▪ Stabilizes eroding bank ▪ Reduces risk of overtopping Mission St. Bridge during high flow events ▪ Disperse energy of flow and cause targeted deposition of sediments ▪ Provides fish habitat and complexity; may cause a pool or side channel to form. ▪ Provides opportunity to increase public awareness of urban watershed issues.
Pringle Creek Pringle Park Near confluence of Pringle Creek and Shelton Ditch	▪ No riparian area along the right bank. ▪ Stream is channelized with little complexity due to the retaining wall. ▪ Deposition of gravel under the Church Street bridge.	▪ Remove the retaining walls and pull back the banks, ▪ Stabilize and revegetate the bank ▪ Remove gravel bar under the bridge. ▪ Plant native riparian trees and shrubs. ▪ Place a boulder weir upstream.	▪ Stream may re-establish some of its meander. ▪ Riparian vegetation would provide cover and shading. ▪ May cause a pool or side channel to form. ▪ Provides opportunity to increase public awareness of urban watershed issues.

Table 8-2. Candidate Early Action Projects			
Location	Problem	Project	Benefits
Clark Creek Bush Park Confluence of Clark Creek at Pringle Creek	▪ Left bank eroding.	▪ Remove previous bank stabilization materials ▪ Lay back Clark Creek banks and restabilize ▪ Plant more native riparian plants (alders, vine maple, willow, and ground cover) along the bank to stabilize the bank and provide complexity.	▪ Stabilizes eroding bank ▪ Provides fish habitat and complexity; may cause a pool or side channel to form. ▪ Provides opportunity to increase public awareness of urban watershed issues.
West Fork Pringle Creek at Woodmansee Park	▪ Stream is channelized ▪ Banks have little riparian vegetation ▪ Substrate is hardpan ▪ Little channel complexity or cover.	▪ Change park management practice of mowing up to the bank (although this has kept blackberries in check). ▪ Pull back banks. ▪ Plant native riparian trees and shrubs along the banks ▪ Place wood in the stream to increase complexity and help the stream re-establish its meander. ▪ Remove culvert under the footpath and replace with a bridge.	▪ Stabilizes eroding bank ▪ Provides fish habitat and complexity; may cause a pool or side channel to form. ▪ Provides opportunity to increase public awareness of urban watershed issues.
West Middle Fork Pringle Creek Industrial Area (near Strong Rd)	▪ Stream channelized with little cover or complexity	▪ Encourage industrial / commercial landowners to maintain a riparian area as part of the landscaping instead of mowing up to the banks. ▪ Plant native riparian trees and shrubs.	▪ Stream may re-establish a riparian area, shade the stream and provide more cover for fish.

8.4 Relevant Permit and Regulatory Compliance Requirements

This section summarizes permits and regulatory clearances that may be required for some of the early action projects identified in the previous sections. The permit listing can assist stakeholders by identifying a preliminary list of permit requirements that need to be considered when developing watershed enhancement projects. **Table 8-3** presents a summary of the potential environmental permits and regulatory clearances that will need to be obtained during design and prior to implementation of the project. Some of the permit requirements could be a prohibitive constraint to implementing an early action project. In some cases, the project may have to be redefined (e.g. reduce areal extent) to minimize or eliminate some of the permit constraints.

In addition to the list in Table 8-3, the Oregon Watershed Enhancement Board (OWEB) has published a permitting reference guide for implementing watershed restoration projects, entitled *"A Guide to Oregon Permits"* (OWEB, 2000).

Table 8-3. Summary of Potential Environmental Permits and Procedures for Projects

Permit/Consultation	Responsible Agency	Notes	Approximate Timeframe
Clean Water Act (CWA) Section 401	Oregon Department of Environmental Quality (DEQ)	▪ Will review Section 404/Removal Fill permit to determine if the project would affect beneficial uses of wetlands/waters. ▪ Stormwater and erosion and sediment control plans will be required.	▪ Concurrent with CWA 404 permit process
CWA Section 402 NPDES Construction Permit (1200-C and 1200-CA)	DEQ	▪ Required for construction (clearing, grading and excavating) affecting 1 or more acres. ▪ Erosion and Sedimentation Control Plan (ESCP) to be developed during final design	▪ Prepare ESCP during final design ▪ Typically a 90-day review process
CWA Section 404 / Oregon Removal/Fill	U.S. Army Corps of Engineers (COE); Oregon Department of State Lands (DSL)	▪ Impacts to regulated waters (including wetlands) will likely require an Individual Permit. ▪ Mitigation plan will need to be developed prior to completion of the permit application.	▪ Submit complete application to COE/DSL at least six months prior to bid letting. ▪ 120 day review of permit application after permit application is deemed complete.
City of Salem Land Use/ Building Permits	City of Salem	▪ Development review approval will be required. ▪ Building permits will be required and potentially Removal/ Fill Permit and Floodplain Development Permit	▪ Development review is typically a 180-day review process. ▪ Building permits are obtained following development/ land use review and approval.

Chapter 9. Plan Implementation Considerations

The previous chapters developed general and specific management recommendations with respect to drainage, water quality and habitat to help improve the overall health of the Pringle Creek watershed. The management plan also included recommendations for monitoring the implementation and effectiveness of management actions, as well as developing a framework for implementing early action projects. However, the utility of any plan is whether the recommended actions can be implemented. This chapter includes a summary of the management recommendations and presents implementation considerations for scheduling, funding and updating the plan in the future.

9.1 Summary of Recommendations

This section summarizes the general management recommendations and presents a summary of implementation considerations and scheduling of activities.

9.1.1 Summary of General Management Recommendations

Using the "Values and Guiding Principles" listed in **Table 2-1** and the "Watershed Management Guidelines" listed in **Table 2-2**, several key recommendations have been developed as part of this watershed plan for Pringle Creek. The recommendations are grouped into three categories: programmatic/policy, on-the-ground projects, and monitoring and operations/maintenance. The key recommendations are listed in Table 9-1.

Table 9-1. Summary of General Management Recommendations
Programmatic/Policy (Institutional)
• Continue to implement the strategies and best management practices as described in the current *Stormwater Management Plan*. The SWMP has many effective BMPs in place to improve watershed health. Updates to the SWMP should be integrated with the watershed plan. • Protect existing watershed features that provide drainage and habitat benefits (riparian zones, wetlands, stream reaches). As part of this effort, prioritize continued development of the existing Wetlands Program, Watershed Protection and Preservation Program, and development of Riparian Buffer Program; also consider land acquisition program for critical areas. • Augment current public outreach and involvement activities being conducted under the stormwater management program to promote overall watershed health concepts to develop a stewardship mentality and help implement the management actions in this Plan. • Work with and educate landowners adjacent to waterways to identify opportunities for stream enhancement projects; as part of this process, identify ownership of weirs and barriers to facilitate opportunities for fish passage improvements. • Develop incentives (and ultimately standards) for low impact development for long-term watershed health. Leverage current low impact developments occurring in the City as opportunities to promote the benefits of minimizing imperviousness with new development and redevelopment. • Require water quality facilities/BMPs for new developments (post-construction controls). Continue on-going efforts under the stormwater management program to develop formal requirements and design criteria for water quality facilities. • Review environmental elements of Comprehensive Plan with the goals and objectives of the integrated watershed approach.

Table 9-1. Summary of General Management Recommendations (cont'd)
On-the-ground Projects
• Leverage funding identified for capital improvement projects to the extent possible to include habitat enhancement components. Coordinate efforts among the Utilities Planning, Water Resources, Community Development, Urban Development, Engineering Division, and others to identify opportunities for multi-benefit projects. • Continue to implement low-risk, high visibility projects such as riparian plantings/revegetation and stream cleaning to promote watershed health benefits. • Identify sources of grants and other funding sources that can be leveraged with City resources.
Monitoring and O&M
• Bioassessment (EMAP) methods are most useful for long-term watershed health monitoring. Stream surveys are needed to develop reach-specific stream enhancement projects. • Review operation and maintenance protocols focusing on improving operations and maintenance standards to use fewer resources and less damaging processes, especially with respect to street, stormwater facilities and parks maintenance. • Continue monitoring for TMDL parameters as key components of the water quality improvement and TMDL implementation plans. • Updating drainage system model (XP-SWMM) is critical to evaluate planned and proposed improvements. • Maintain geodatabase for effective data management and data sharing/transfer with developers, agencies, decision makers, and other stakeholders.

9.1.2 Management Actions and Implementation Schedule

The previous chapters included management actions to address drainage, water quality and habitat issues based on the categories of management actions presented in **Table 2-5**. **Table 9-2** provides additional detail on these activities for the following topics:

- *Priority:* refers to the priority of the action relative to other management actions identified in the watershed plan; ranking considers the ease of implementing the project and cost/benefit factors.

- *Priority action areas:* areas where the actions should be implemented first; do not imply that other areas would not also benefit from these actions.

- *Champion:* identifies key City departments and other stakeholders, or agencies to implement the action. "Lead" implementer would take responsibility for organizing efforts under this action, including pursuing funding sources.

- *Financial/economic costs:* preliminary, generalized estimates of financial or economic costs to the community or project owner. High: greater than $500,000; Medium: $50,000 to $500,000; Low: less than $50,000; total cost per project or annual cost.

- *Funding sources:* general funding source (county, City and/or stormwater funds, state or federal grants, legislative appropriations, permitting fees); key potential funding sources are discussed in **Section 9.5** and listed in **Appendix I**.

It should be noted that many of these activities will require staff resources. At the same time, many of these activities can be integrated with existing programs and should not be necessarily viewed as new, additional responsibilities.

In addition to the considerations listed in **Table 9-2**, other steps need to be taken to implement the management actions. A general schedule of activities over the next 2-years, 5-years, 10-years and beyond is provided in **Table 9-3**.

Table 9-2. Implementation Considerations for Management Actions

Management Action	Priority[1]	Priority Action Areas	Champion[2]	Financial/ Economic Costs[3]	Funding Sources
Category: Stormwater Management					
Modify storm drain system to increase infiltration. (Can be used to decrease the amount of detention required)	High	*Priority Areas:* See Figure 4-3 for priority drainage improvement projects *Other Areas: Watershed-wide*	Lead: Public Works Department (Stormwater) Others: none	High (per project)	Main: City CIP/sewer funds Additional: City permitting fees; Development, SDC's
Modify storm drain system to treat stormwater (water quality treatment)	High	*Priority Areas:* Discharges to Clark Creek and Pringle Creek mainstem *Other Areas:* Watershed-wide	Lead: Public Works Department (Stormwater) Others: none	Medium – High (per project)	Main: City CIP/sewer funds Additional: City permitting fees; Development, SDC's
Increase stormwater conveyance capacity (culverts/pipelines/bridges)	High	*Priority Areas:* See Figure 4-3 for priority drainage improvement projects *Other Areas:*	Lead: Public Works Department (Stormwater) Others: none	Medium – High (per project)	Main: City CIP/sewer funds Additional: City permitting fees; developer
Category: Stream Repair/ Protection					
Fish Passage Improvements	High	*Priority Areas:* See Figure 6-7 for priority fish passage barriers *Other Areas:* Barriers on Clark Creek; West Fork Pringle Creek; Lower East Fork Pringle Creek	Lead: Public Works Department Others: Private landowner; Developer	Medium (per project)	Main: City CIP/sewer funds Additional: Grants; Private landowner
Channel and floodplain redesign / construction	Moderate	*Priority Areas:* West Fork Pringle Creek in Woodmansee Park and lower reach; middle reach of Clark Creek; lower reach of East Fork Pringle Creek *Other Areas:* East Fork and Middle Fork Pringle Creek along railroad tracks and West Fork Pringle Creek	Lead: Public Works Department Others: Private landowner; Developer; industrial landowner	Medium – High (per project)	Main: City l CIP/sewer funds Additional: Grants; Private landowner; Development
Streambank stabilization	Moderate	*Priority Areas:* Lower Pringle Creek mainstem; Lower East Fork Pringle Creek; Lower West Fork Pringle Creek *Other Areas:* East Fork Pringle Creek; West Middle Fork Pringle Creek	Lead: Public Works Department Others: Private landowner; Developer	Medium (per project)	Main: City CIP/sewer l funds Additional: Grants; Private landowner; Development
Instream flow controls	Low	*Priority Areas: same as row above* *Other Areas:*	Lead: Public Works Department Others: Private landowner; Developer	Medium (per project)	Main: City CIP/sewer funds Additional: Grants; Private landowner; Development

Table 9-2. Implementation Considerations for Management Actions

Management Action	Priority(1)	Priority Action Areas	Champion(2)	Financial/ Economic Costs(3)	Funding Sources
Instream habitat structures	Moderate	*Priority Areas: same as row above*	Lead: Public Works Department Others: Private landowner; Developer	Medium (per project)	Main: City CIP/sewer funds Additional: Grants
Category: Wetlands					
Wetland enhancement	Moderate	*Priority Areas: See Figure 4-5 for priority wetland enhancement potential.*	Lead: Public Works Department (Water Resources) Others: Private landowner; Developer	Medium – High (per project)	Main: City CIP/sewer funds Additional: Grants; Private landowner; Developer
Category: Riparian Management					
Increase quantity and quality of canopy and other vegetative cover (includes removing invasive species)	High	*Priority Areas:* Lower Pringle Creek mainstem; Lower East Fork Pringle Creek; Lower West Fork Pringle Creek *Other Areas:* East Fork Pringle Creek; West Middle Fork Pringle Creek	Lead: Public Works Department (Water Resources) Others: Private landowner; Developer	Low – Medium (per project)	Main: Grants Additional: City CIP/sewer funds; Private landowner; Developer
Create riparian buffer	Moderate	*Priority Areas:* same as row above *Other Areas:*	Lead: Public Works Department (Water Resources) Others: Parks and Recreation; Private landowner; Developer	Low – High (per project; depends on area)	Main: City CIP/sewer funds Additional: Grants; private landowner; Developer
Category: Protection and Policy					
Promote low impact development practices in development and redevelopment projects	High	*Priority Areas:* East Fork Pringle Creek subwatershed; West Fork Pringle Creek subwatershed *Other Areas:* All redevelopment areas	Lead: Public Works Department Others: Community Development/ Planning Division, Urban Renewal	Low – Medium (annual)	Main: City CIP/sewer funds Additional: Grants, Development, Incentives
Protect sites/features with high watershed value	High	*Priority Areas:* See Figure 4-5 for priority wetland areas. *Other Areas:* All other Wetlands, floodplains, riparian areas	Lead: Community Development/ Planning Division Others: Public Works Department	Low – Medium (annual)	Main: City CIP/sewer funds Additional: Grants
Revise or update zoning ordinances to provide incentive-, performance- or watershed-based zoning	Moderate	*Priority Areas:* East Fork Pringle subwatershed; Upper East Fork Pringle subwatershed *Other Areas:* Clark Creek subwatershed; West Fork Pringle subwatershed;	Lead: Community Development/ Planning Division Others: Public Works Department	Low – Medium (annual)	Main: City CIP/sewer funds Additional: Grants

Table 9-2. Implementation Considerations for Management Actions					
Management Action	Priority(1)	Priority Action Areas	Champion(2)	Financial/ Economic Costs(3)	Funding Sources
Category: Education, Involvement, Stewardship					
Provide education, involvement and stewardship on watershed function to organizations and public	High	*Priority Areas:* Watershed-wide	Lead: Public Works Department Others: Community Services Department	Low – Medium (annual)	Main: City CIP/sewer funds Additional: Grants
Category: Monitoring					
Water quality (stormwater-based)	High	*Priority Areas:* Pringle Creek and Clark Creek *Other Areas:* Mouths of all tributaries	Lead: Public Works Department Others: none	Medium (annual)	Main: City CIP/sewer funds Additional: City CIP/sewer funds; Grants
Habitat	Moderate	*Priority Areas:* Lower Pringle Creek mainstem; Lower East Fork Pringle Creek; Lower West Fork Pringle Creek *Other Areas:* All locations where habitat enhancement projects are implemented.	Lead: Public Works Department Others: Parks Department	Medium (annual)	Main: City CIP/sewer funds Additional: Grants
Category: Implementation					
Assign Lead Implementation Coordinator	High	*NA*	Lead: Public Works Department	Low (annual)	Main: City CIP/sewer funds Additional: Grants
Form "Watershed Planning Committee"	High	*NA*	Lead: Public Works Department Others: Other City departments, resource agencies, potentially the public	Low (annual)	Main: City CIP/sewer funds Additional: Grants

(1) Priority in context of all actions in the Watershed Management Plan.
(2) "Lead" implementer would take responsibility for organizing efforts under this action, including pursuing funding sources.
(3) Preliminary, generalized estimates of financial or economic costs to the community or project owner. High: greater than $500,000; Medium: $50,000 to $500,000; Low: less than $50,000. Total cost, whether up-front or over a period of time up to 10 years.

Table 9-3. Proposed Schedule of Activities to Implement Management Actions				
Activity	Within 2 Years	Within 2 - 5 Years	Within 5 - 10 Years	Beyond 10 Years
City Council reviews, revises (as necessary) and approves the watershed plan and integrated watershed approach*	●			
Conduct Plan promotion and public input*	●			
Incorporate public input into the Plan priorities and implementation strategies/opportunities*	●			
Present Plan to resource agencies for review and input	●			
Develop "watershed planning committee"*	●			
Further develop early action projects and identify potential funding sources; submit funding source applications, as necessary.	●			
Continue riparian plantings and streambank improvement projects (early action and on-going)	●	●	●	●
Initiate process for land use protection policies and ordinances	●			
Integrate TMDL Implementation Plan activities into watershed plan, as necessary	●			
Complete update and maintenance of hydraulic model (SWMM) for stormwater system.	●		●	
Continue flow and water quality monitoring; make necessary changes to program	●	●	●	●
Continue updating watershed geodatabase	●	●	●	●
Identify key drainage and habitat enhancement projects for inclusion in CIP program	●		●	
Complete design and construction of "high profile" habitat improvement projects		●		●
Complete design and construction of a major drainage improvement projects		●		●
Complete financing study and adopt stormwater utility program		●		
Initiate low impact development incentive program and design guidance for developers		●		
Adopt additional land use protection policies and ordinances (including incentive-based zoning)		●		
Finalize wetlands prioritization studies and identify banking opportunities		●		
Evaluate additional opportunities for habitat enhancement projects		●		●
Develop watershed plans for the City's other urban watersheds			●	
Integrate SWMP update recommendations into watershed plan, as necessary			●	
Conduct habitat status and trend monitoring (e.g. EMAP/bioassessment study)		●		●
Review/update Pringle Creek Watershed Plan, if necessary		●		

** - Recommended to implement within the first year of finalizing the watershed plan.*

9.2 Implementation Roles and Responsibilities

Table 9-2 lists the recommended lead implementers for each of the general management actions. With an implementation period spanning many years and the need to coordinate several City departments, it will be important to establish some mechanism for coordination and oversight for implementing the Pringle Creek Watershed Management Plan (and other subsequent plans). Successful implementation of the plan recommendations requires some near-term and short-term actions and participants to move the process forward.

The most important implementation action is to assign the principal lead within the City to track and coordinate the actions in the watershed plan. Because many of the actions already have an established framework within the Department of Public Works, it is recommended that a division manager from this department be designated as the principal lead.

Once the principal lead is established, the following participants and activities are needed to *initiate* the implementation of the plan in the near term:

- *City Council members* and top managers should be involved at the plan review and approval stage.
- *Resource agencies (ODFW, DSL, and DEQ)* should be given an opportunity to review the Watershed Plan for input and to allow the agencies to plan for any coordination on proposed projects or actions. An interlocal agreement may be useful in defining coordination and oversight responsibilities with ODFW, DEQ, and Marion County.
- *City departments and other coordinating entities* will need to budget for plan actions and identify funding sources. This should be incorporated in the budget process each year.
- Identify staff that will be responsible for carrying out proposed actions/commitments in the Plan, and for reporting back to management.

Similarly, many activities are needed to coordinate the long-term implementation of this plan:

- Tracking implementation of Plan actions by the many organizations involved (City and other parties, e.g. non-governmental organizations, watershed groups, resource agencies), to ensure that actions are being carried out in a timely fashion and that the priorities identified in the Plan are being addressed.
- Coordinating efforts to seek funding for Plan actions and ensure that funding agencies see an organized and unified support for funding requests.
- Providing information to the public on Plan implementation and improvements in watershed conditions.
- Monitoring of watershed conditions, data management and providing data access.
- Periodic review of the Plan, and updating when appropriate.

It is recommended that the City form an internal “watershed planning committee” to conduct the activities listed above. Representatives from other City departments should be selected to

participate in the watershed planning committee. At a minimum, members from the following divisions/sections should be involved in the watershed planning committee:

- Community Development: Planning Division, GIS mapping
- Community Services: Community Involvement, Parks Operations
- Urban Development: Urban Renewal
- Public Works: Utilities Planning, Engineering Administration, Water Resources, Stormwater Services, Transportation, Wastewater Collection, Facilities Engineering.

The City should consider adding members from the public and representatives from the resource agencies to participate in some form in the watershed planning committee.

9.3 Funding Sources

Table 9-2 presents a qualitative summary of the implementation considerations for the management actions proposed in this Plan, including a preliminary planning level estimate of the costs and identification of potential funding sources. **Appendix I** provides a summary of key potential funding sources in the form of grants or financial partnering available for watershed improvements including in-stream, wetlands, fisheries, upland, and wetland related projects. Most grants are obtained through an application process. Applications are competitively scored and ranked unless otherwise indicated. As a general rule, most grants and funding pay for "on-the-ground" projects, public education, or inventory and monitoring. Few grants provide funding for planning studies and/or stakeholder consensus building activities. Grants have been identified from the following agencies and organizations:

- U.S. Fish and Wildlife
- U.S. Environmental Protection Agency
- National Fish and Wildlife Foundation
- National Resources Conservation Service
- National Oceanic and Atmospheric Administration
- U.S. Army Corps of Engineers
- Federal Highway Administration
- National Park Service
- Oregon Watershed Enhancement Board
- Oregon Department of Environment Quality

In addition to the grants and funding sources presented in **Appendix I**, other funding sources include:

- Rates collected from City customers for sewer services and system development charges.
- City/County permitting fees or general fund revenues.
- Assessments on property for projects that benefit those properties.

- Private industry funds for voluntary projects at selected industrial facilities (supplemented by public funds where possible).

- Private/ Non-profit organizations such as Ducks Unlimited and the Public Land Trust.

- Landowners for voluntary projects at selected sites (supplemented by public funds where possible).

9.4 Plan Promotion and Partnerships

One of the key guiding principles for this management plan (refer to **Table 2-1**) is to promote public awareness and education on stormwater management and urban watershed issues. Furthermore, one of the key management policies (refer to **Table 2-2**) is to consider the priorities and needs identified by watershed planning groups and other public interests in developing the restoration priorities. Therefore, promoting this Plan and developing partnerships with the community is a key implementation step. A public outreach plan was developed as part of the development of this Watershed Plan and is included in **Appendix B.**

Once the Plan is approved by the City Council, the public outreach plan will be implemented to gather input on the recommendations of the Plan. The public values and priorities will be integrated into the implementation strategy.

9.5 Adaptive Management and Future Plan Updates

This watershed plan relied on data collected and studies conducted over the past 6 years. The actions recommended in this plan were developed based on current understanding of conditions at the time the Plan was developed. New priorities will likely be developed over the next several years as a result of changes in regulatory and funding programs and as new information is collected. In addition, modifications of the recommended actions may result as new information becomes available.

To accommodate these ongoing changes, an adaptive management approach is needed. However, implementing a true adaptive management program for watershed planning is a very intensive exercise involving the development of conceptual models of the various systems and their interactions in the watershed. It is beyond the scope of this plan to develop a full program; however, monitoring needs for adaptive management are discussed in **Chapter 7**. At a minimum, the following recommendations are considered necessary for adaptive management to be effective and successful for this watershed plan:

- Establish a permanent “watershed planning committee” to provide oversight and act as a central coordinating body for data collected by different parties.
- Establish a consistent funding source within the City’s annual budget to provide resources for maintaining the watershed program.

- Adopt monitoring protocols to provide consistent means for comparing information, and conduct the implementation and effectiveness monitoring for specific projects as described in Chapter 7.
- Establish a "data portal" through the Public Works Planning Division or other City departments to share data with resource agencies and the public.

It is recommended that the Watershed Plan be reviewed on a regular basis to determine whether a formal update is needed. The first review should occur within 5 years of the date of the "approval" of this plan by the City Council.

Appendix A
Geodatabase Contents and Metadata

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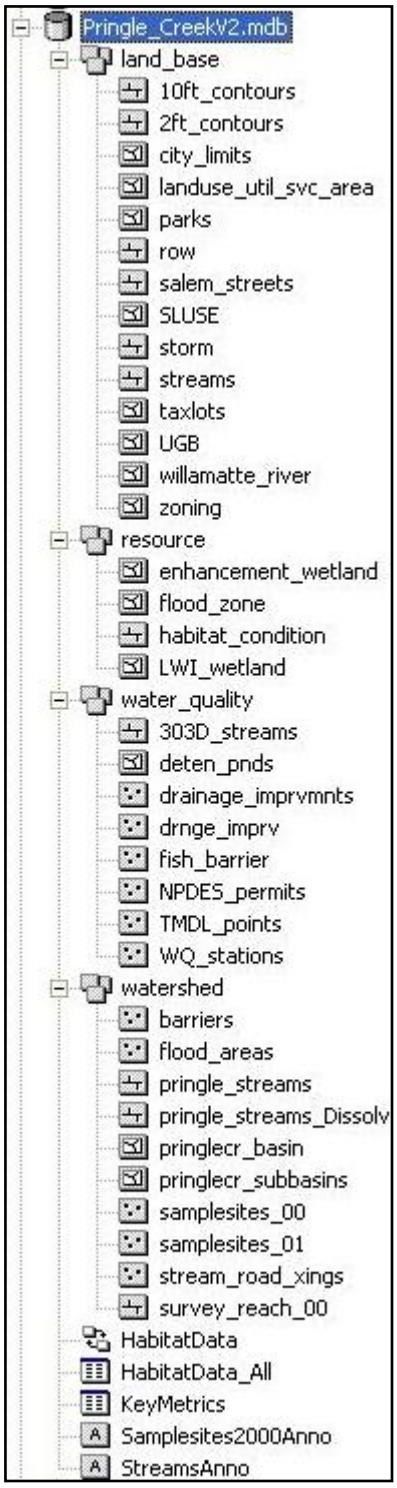
Pringle Creek Geodatabase data table		
Theme	Data type	Source/ Comments
Base data		
10 foot contours	Feature class/ line	City of Salem
2 foot contours	Feature class/ line	City of Salem
Streets	Feature class/ line	City of Salem
Streams	Feature class/ line	City of Salem
Tax lots	Feature class/ polygon	City of Salem
City Limit	Feature class/ polygon	City of Salem
UGB	Feature class/ polygon	City of Salem
Parks	Feature class/ polygon	City of Salem/ Was not included in the initial data delivery
Land use	Feature class/ polygon	City of Salem
Zoning	Feature class/ polygon	City of Salem
Willamette river	Feature class/ polygon	City of Salem
Watershed		
Pringle Creek Basin	Feature class/ polygon	City of Salem
Pringle Creek Sub Basins	Feature class/ polygon	City of Salem
Pringle Creek Catchments	Feature class/ polygon	City of Salem
Streams	Feature class/ line	City of Salem/ Clipped by basin
Flood Areas	Feature class/ polygon	City of Salem
Barriers	Feature class/ point	City of Salem/ Clipped by basin
Stream Road Crossings	Feature class/ line	HDR (created during study)
Sample Site 2000	Feature class/ point	EMAP/ Clipped by basin
Survey Reach 2000	Feature class/ point	EMAP/ Clipped by basin
Sample Sites 2001	Feature class/ line	EMAP/ Clipped by basin
Water Quality		
Water quality monitoring stations	Feature class/ point	From SWM plan
303D streams	Feature class/ lines	DEQ
Detention ponds	Feature class/ polygon	City of Salem
Drainage improvements	Feature class/ point	City of Salem
NPDES permits	Feature class/ point	DEQ
TMDL compliance points	Feature class/ point	DEQ/ Created from Water quality monitoring stations
NPDES permits	Feature class? Table?	DEQ
Resource		
Floodplains	Feature class/ polygon	FEMA
Wetlands	Feature class/ polygon	NWI,LWI
Enhancement wetlands	Feature class/ polygon	City of Salem
Habitat condition	Feature class/ point	HDR created from study
Tables		
2000 Physical habitat (EPA)	Table	City of Salem/ linked by relationship class to survey reaches
2000 Macroinvertebrate indices	Table	City of Salem/ linked by relationship class to survey reaches
2000 Rapid Habitat Assessment	Table	City of Salem/ linked by relationship class to survey reaches
2000 Habitat indices (HQI)	Table	HDR/ linked by relationship class to survey reaches



The Pringle Creek Geodatabase

In order to assist with the analysis and mapping related to the Pringle Creek Watershed Management Plan an ESRI personal Geodatabase was developed. Data was compiled from numerous sources including the City of Salem and previous assessment studies in the watershed. The data itself consists of feature classes and tables. It has been organized into feature data sets based on spatial locations and topological relationships.

The following is a brief description of the databases schema: (see the geodatabase data table for information pertaining to the individual feature classes)

- The land base feature data set contains general base data that was obtained from City of Salem and clipped by the Pringle Creek watershed boundary.
- The resource feature data set contains wetland and flood data and the habitat feature class, which was created by HDR and maps the overall habitat quality of the watershed.
- The water quality feature dataset is a collection of layers obtained from DEQ and City of Salem that were used for analysis during the project.
- The watershed feature dataset contains all the standard components and was modeled using parts of the Arc Hydro data model. Topologies were set up and the data was cleaned and imported into the master database.

Other components of the geodatabase include tables, relationship classes, and annotations, which are all listed in the comprehensive data table.

Appendix B
Public Outreach

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Pringle Creek Watershed Management Plan
Public Outreach Plan – Rev. 3/17/06

Goals

- Design and implement an effective public outreach program to inform, educate, and involve citizens in watershed planning, preparing them to accept stewardship responsibilities in their watershed.
- Through lasting community partnerships, enlist an informed and ever-growing cadre of "watershed stewards" – residents, property owners, business owners, students and other volunteers in the Pringle Creek area who are ready and willing to initiate and continue watershed protection activities well beyond the current Pringle Creek planning effort.
- Develop and conduct public outreach for Pringle Creek watershed planning as a prototype for other watersheds. Use the Pringle Creek Watershed Management Plan (PCWMP) to promote city-wide awareness of Pringle Creek watershed issues and activities – as examples for Salem's other urban watersheds.
- Conduct the public education in phases: first raising awareness regarding stream health and the effects of urbanization; then promoting cost effective watershed restoration and best management practices.

Objectives – Phase I

- Use the Pringle Creek watershed analysis and planning to educate area residents, agencies and other key stakeholders, raising awareness about stream health, watershed issues, and priorities for protection.
- Coordinate the public education / outreach for watershed planning with outreach activities undertaken in conjunction with source water protection for the City's ASR (Aquifer Storage & Recovery) drinking water wells – which are also located within the Pringle Creek watershed.
- Document public involvement in watershed planning, and how public comments and public values are ultimately incorporated in the design of the Pringle Creek Watershed Management Plan.

Objectives – Phase II

- Pursue an outreach program that promotes cost effective watershed protection and best management practices that will minimize future public expenditures for watershed protection, to handle both water quantity and quality.
- Maximize program effectiveness by partnering with interested organizations and key stakeholders, getting their buy-in and enlisting their full participation.

- Tap existing channels of communication in the community to raise awareness of "common sense" steps area residents and businesses can take to promote watershed stewardship and best management practices.

- Inform Pringle Creek residents and interested stakeholders about Salem's watershed improvements planned and underway. Involve stakeholders in additional early priorities and action projects for watershed protection, and deciding the project hierarchy.

- Assist the Pringle Creek Watershed Council to identify and pursue citizen-driven projects that improve the health of the watershed and stream.

Target Audiences

Pringle Creek Watershed Council
Streambank property owners
Area neighborhood associations
Area schools
Other community organizations in Pringle Creek watershed
Pringle Creek watershed residents and businesses
Watershed Enhancement Team (WET)
Salem Area Chamber of Commerce
Other Salem watershed councils
City policymakers: Water / Wastewater Task Force and Salem City Council
State and federal agencies
Salem area news media
City of Salem residents / businesses / ratepayers

Public Outreach Activities

1. ***Public Outreach Plan***

   The Salem Public Works Department will adopt a work plan that guides public outreach for the City's Pringle Creek Watershed Management Plan. The Public Outreach Plan will identify goals and objectives for public outreach, and outline specific methods to inform and involve citizens in the plan.

2. ***Vision and Public Values***

   The Pringle Creek Watershed Management Plan will be guided by a vision statement and public values rooted in underlying beliefs and principles drawn from citizens and interested stakeholders. Initially, the Pringle Creek planning will utilize the ***Values and Guiding Principles*** recommended by Salem's Stormwater Advisory Committee and adopted for the 2000 Stormwater Master Plan and 2005 SWMP Update (attached). Later, working with the Watershed Council and interested stakeholders, a Vision and Public Values specific to the Pringle Creek Watershed will be developed to reflect new priorities identified through surveys and other public outreach.

3. ***Public Information Materials***

Basic information materials will be prepared early in the watershed planning, then updated as needed. Materials will include:

- Project fact sheet / updates: providing an overview of the PCWMP objectives and planning process, schedule, key issues, and information on how to get involved
- Utility bill insert
- Watershed map
- PowerPoint presentation and other materials to accompany community briefings (see Task 7)
- Watershed protection video

4. ***Outreach Partnerships***

The City of Salem will enlist community partners to assist in education and outreach to area residents and other interested parties. Potential partners include: Pringle Creek Watershed Council (and other watershed councils), area neighborhood associations, streambank property owners, Salem-Keizer School District, Chamber of Commerce, Watershed Enhancement Team (WET), and others.

5. ***Watershed Surveys***

A series of public surveys will be conducted to learn more about the current awareness of watershed issues, and interest in participation in stewardship activities. Watershed surveys will include:

- Survey mailed to random sample of 12,400 homes in Pringle Creek watershed area
- Survey mailed to streambank property owners along Pringle Creek
- Feedback forms distributed / collected at community briefings (see Task 7)

6. ***Targeted Outreach to Affected Parties***

Reaching these potentially affected parties will be a special focus for public outreach. Targeted outreach will include:

- Pringle Creek Watershed Council: through a partnership with the Council, informational mailings will be sent to Council members and others on their existing lists.

- Streambank property owners: the City of Salem will develop a mailing list of streambank property owners along Pringle Creek, who will receive targeted mailings.

- Interested persons mailing list: the City of Salem has another existing public contact list that was developed and updated recently for the Stormwater Management Plan. This city-wide list includes some of Salem's citizens who are most interested in stormwater issues.

- Targeted mailings will be sent to these and other interested / affected parties at appropriate intervals.

7. ***Community Briefings***

   The City of Salem will schedule presentations with interested community organizations within the Pringle Creek watershed and beyond its boundaries, to review watershed management issues, seek public input on priorities, and enlist active participation in stewardship programs. Materials supporting the community briefings will include:

   - Fact sheet (see above)

   - PowerPoint presentation

   - Display(s)

   - Feedback form(s)

8. ***Media Outreach***

   The Salem news media – the ***Statesman Journal*** and neighborhood papers, as well as the radio station and KATU Salem bureau – will receive information on the PCWMP, emphasizing the messages keyed to potentially affected / interested Pringle Creek and Salem residents and businesses. However, it is unlikely the media will have a deep interest in watershed management – unless or until there is a flood, spill, or other natural or manmade event that threatens Salem homes or businesses. Media outreach will include:

   - Media briefings (to groom in-depth newspaper coverage)

   - Media releases

   - Other supportive materials

9. ***Open House / Public Workshop***

   One public workshop will be convened during the public review period for the Pringle Creek Watershed Management Plan. An open house will be held right before the workshop, giving citizens an opportunity to get information and offer advice in an informal setting.

10. ***Website***

Timely information about Salem's Pringle Creek Watershed Management Plan will be displayed on the Public Works website.

11. ***Policymaker Consultation***

The effort to develop the Pringle Creek Management Plan will be coordinated with two policy bodies: the Water / Wastewater Task Force, and City Council.

- Water / Wastewater Task Force: Task Force members will be briefed twice – early in the planning, and again when the draft PCWMP is ready for public review.

- City Council: The Council will be briefed during an information-only agenda item prior to the second public workshop date. (The PCWMP does not require formal City Council adoption.)

12. ***Documentation***

The public involvement process and its results will be documented for later review by Public Works management, City policymakers, regulators, and interested parties. A summary will be prepared to highlight material public comment and how it has been incorporated in the PCWMP.

Schedule

January-February 2006	Public Outreach Plan Fact sheet (draft) – to be revised based on staff and public input Interested parties mailing list Organize/schedule community briefings Outreach partnerships (ongoing) Website (ongoing)
March	Community briefings begin (ongoing) Targeted outreach (ongoing) Water / Wastewater Task Force (initial workshop)
April	Surveys Vision & Public Values (revised)
May	Update fact sheet Public notice / workshop announcement
June	Media outreach Water / Wastewater Task Force City Council Open house / public workshop
July	Documentation

Pringle Creek Watershed Management Plan
Public Outreach

Outreach Methods / Tools	Assignment
1. Public Outreach Plan	Consultant (staff input)
2. Values & Guiding Principles	Consultant
3. Public Information Materials	Consultant
4. Outreach Partnerships	Staff
5. Watershed Surveys	Consultant
6. Targeted Outreach	Consultant
7. Community Briefings	Staff (consultant provide materials)
8. Media Outreach	Staff (consultant provide materials)
9. Open House / Public Workshop	Consultant team, staff
10. Website	Staff (consultant provide content)
11. Policymaker Consultation	Staff (consultant team provide materials)
12. Documentation	Consultant

Attachment A

Salem Stormwater Management Plan
Values & Guiding Principles – June 2005*

- ✓ Promote proactive environmental stewardship.
- ✓ Preserve and enhance stream corridors.
- ✓ Balance water quantity and water quality considerations.
- ✓ Seek cost-effective solutions.
- ✓ Educate and involve the public.
- ✓ Meet / exceed regulatory requirements.

Salem Stormwater Management Plan
Values & Guiding Principles – June 2005*

- Manage the City's stormwater infrastructure to minimize flood damage, and protect life and property. Assign highest priority to the safety and security of persons and property potentially affected by flooding, but apply a balanced perspective between water quantity and quality issues.

- Implement prudent planning to meet the community's existing and long-range needs for cost-effective stormwater management.

- Continue sound environmental stewardship, acting as proactive stewards for Salem's urban watersheds as natural amenities in the urban environment.

- Improve water quality in, and the beneficial uses of, Salem's urban streams. Sustain and enhance these streams as naturally occurring watercourses. Preserve stream riparian corridors to protect native plant and animal life.

- Promote public awareness and education on stormwater management and urban watershed issues. Disseminate timely and accurate information.

- Provide responsive customer service in the area of stormwater management.

- Provide a long-term vision and feasible implementation strategy for system improvements and expansion, and ongoing operation and maintenance coordinated with land-use plans.

- Anchor stormwater planning and management in sound principles of environmental science, economics, engineering and public works management.

- Identify cost-effective solutions for flood control, water quality, improvements and stormwater management services.

- Assure compliance with current and anticipated regulations, meeting at least the minimum Federal and State regulatory requirements for Salem's stormwater program.

* Updated from values and guiding principles adopted by Salem's Stormwater Advisory Committee in October-November 1996

City of Salem Public Knowledge Survey

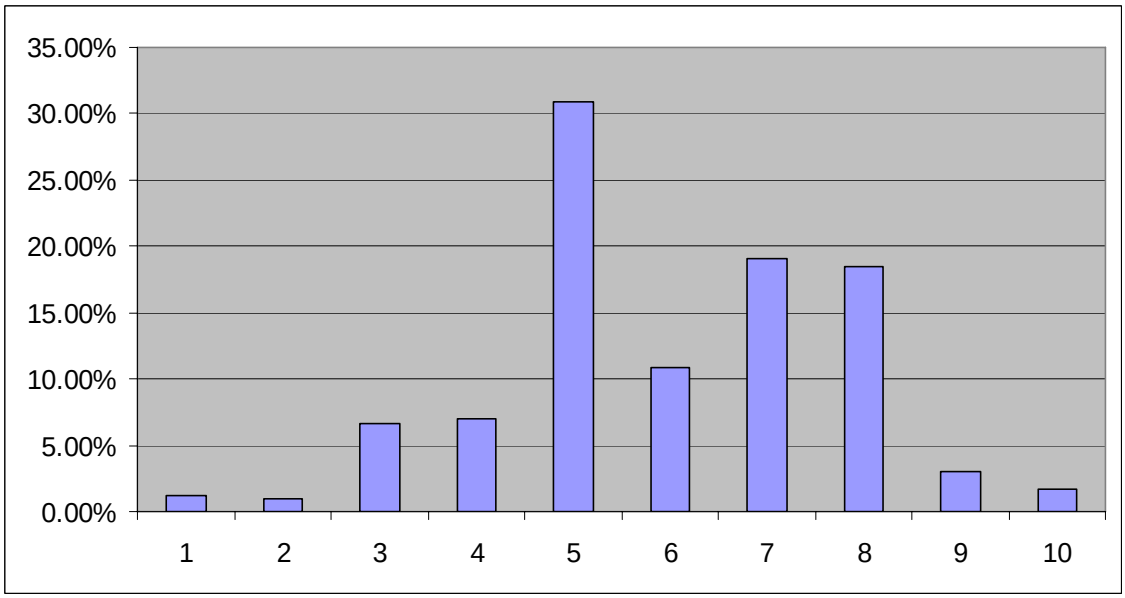
Hello my name is _____ with the City of Salem. Your name was selected at random from a list of residents for a City survey. I have been asked to listen to your thoughts regarding water quality issues in our local watersheds. (IF NECESSARY) Are you 18 or older? (IF UNDER 18) Is there an adult available? The survey will take 10 - 15 minutes over the phone. (IF NO TIME) When would be a good time to call you back?

Before we start, Id like you to know that all of the information you provide will be held in strict confidence, and you will not be identified with any of your responses. There are no right or wrong answers, as I am here to simply record your viewpoints.

Our map show a stream within 25 feet of your property. Do you know the name of that stream?
Answer:___**Yes- 48 (8.29%) No- 531 (91.71%)**

Pringle Creek- 16 (33.3%)
Croisan Creek- 1 (2.1%)
Clark Creek- 1 (2.1%)
Carter Creek- 1 (2.1%)
Glenn Creek- 5 (10.42%)
Don't know name- 24 (50%)

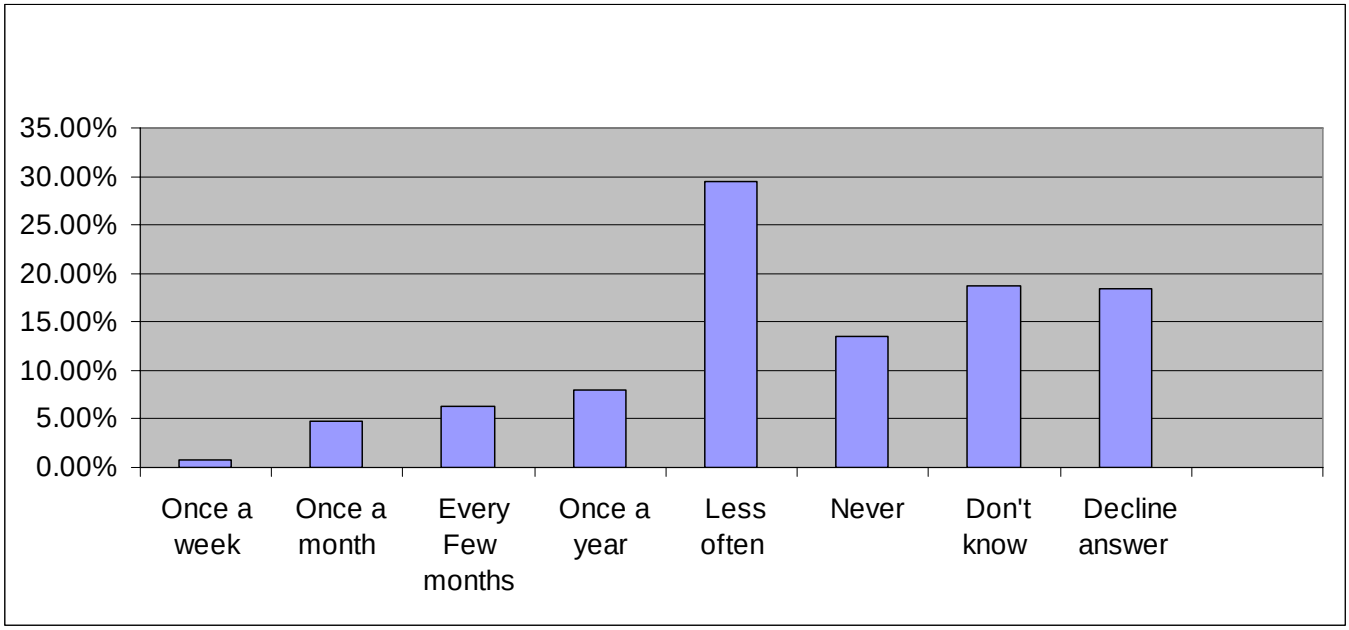
1. On a scale 1 – 10 with one being completely polluted and 10 being completely clean, how would you rate the water quality of streams and rivers in Salem? (Total responses = 524)



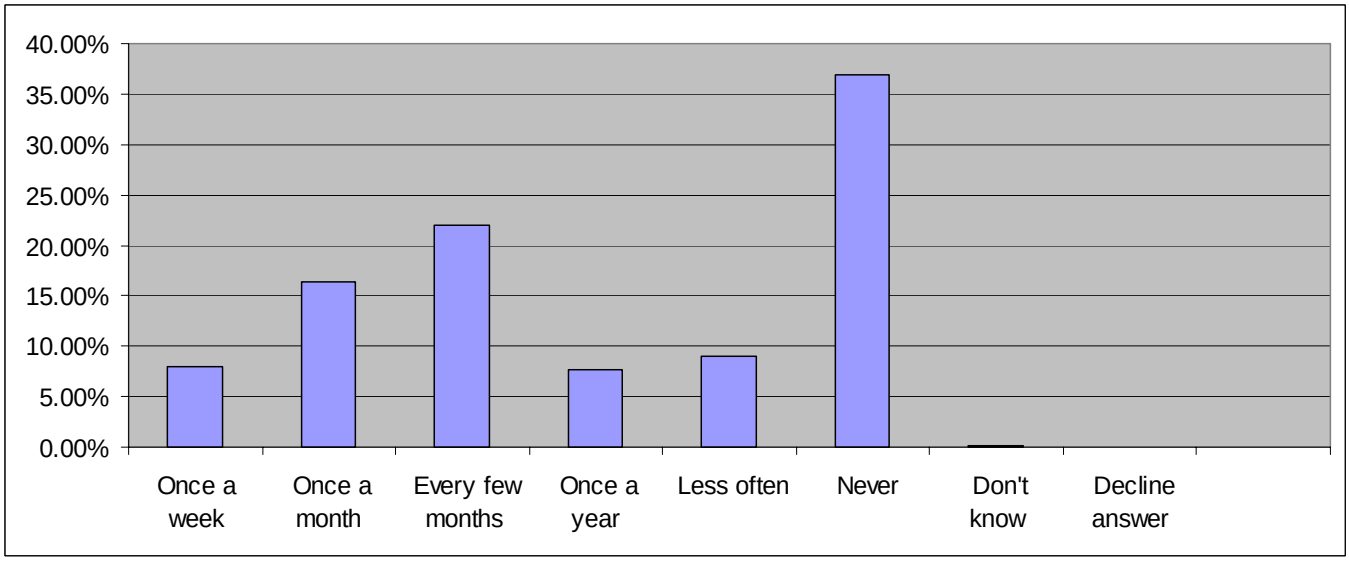
Completely Polluted → **Completely Clean**

I'm going to read to you the following list of activities that people commonly perform around their home. We would like to ask you how often you participate in these activities.

2. Wash the car in the street or driveway? (Total responses= 509)



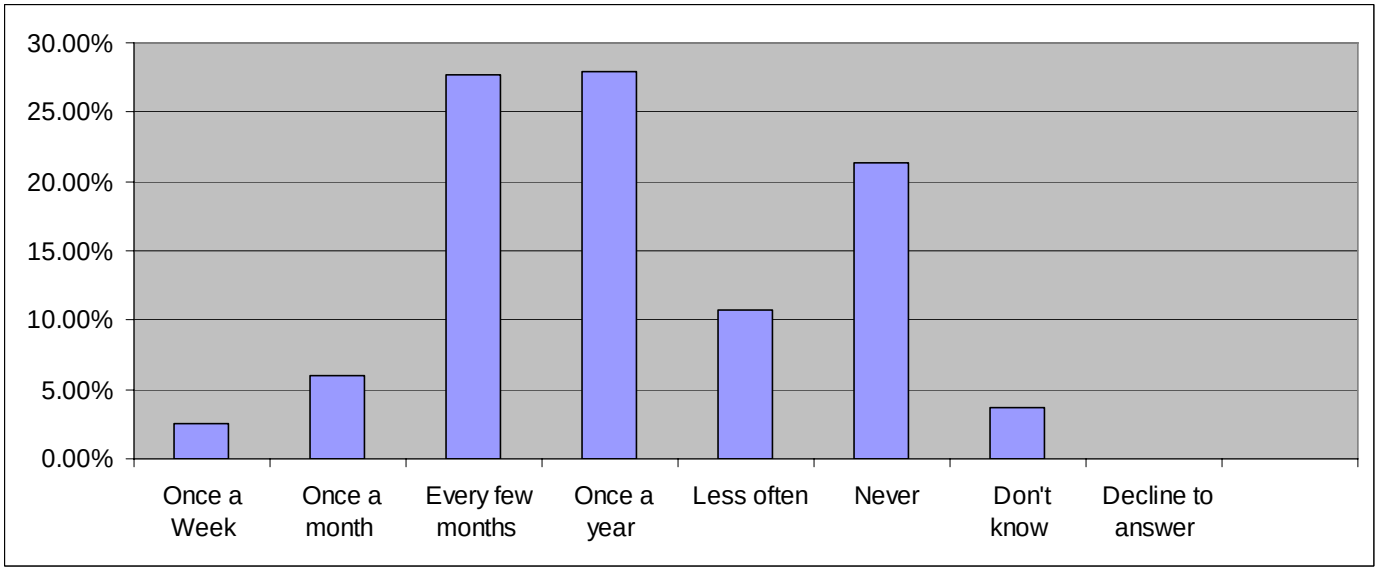
3. Wash the car at a drive-thru carwash? (Total responses = 556)



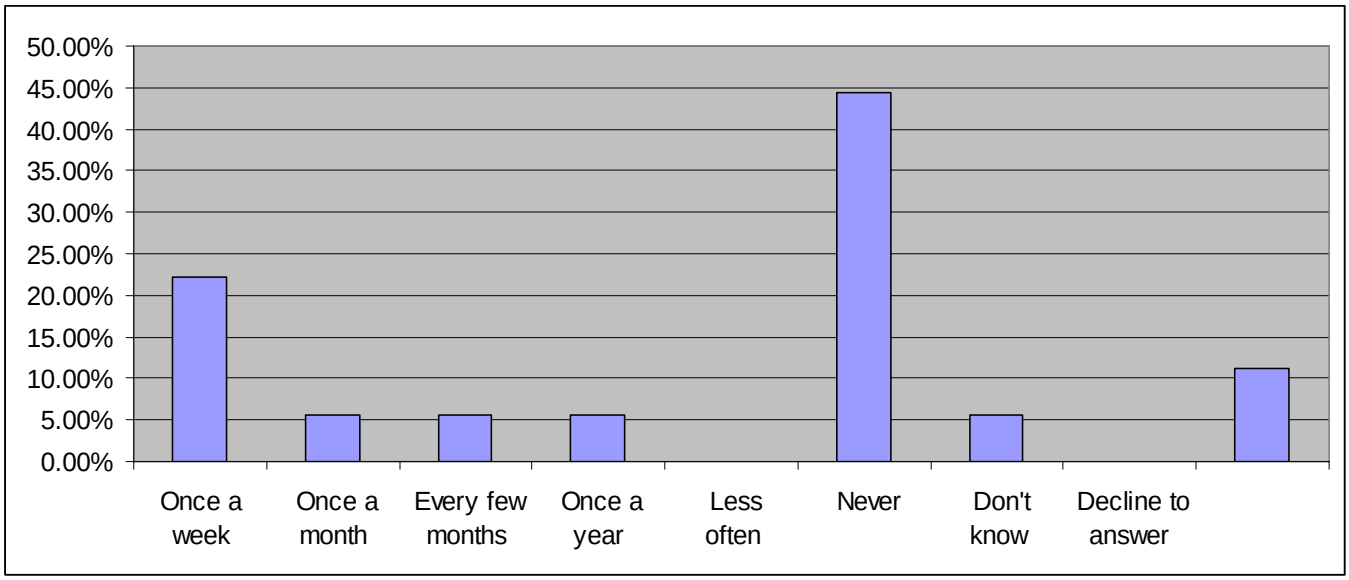
4. Do you use a landscaping service to maintain your yard? (Total responses = 579)

	Responses	Percentage
YES	120	20.70%
NO	459	79.30%

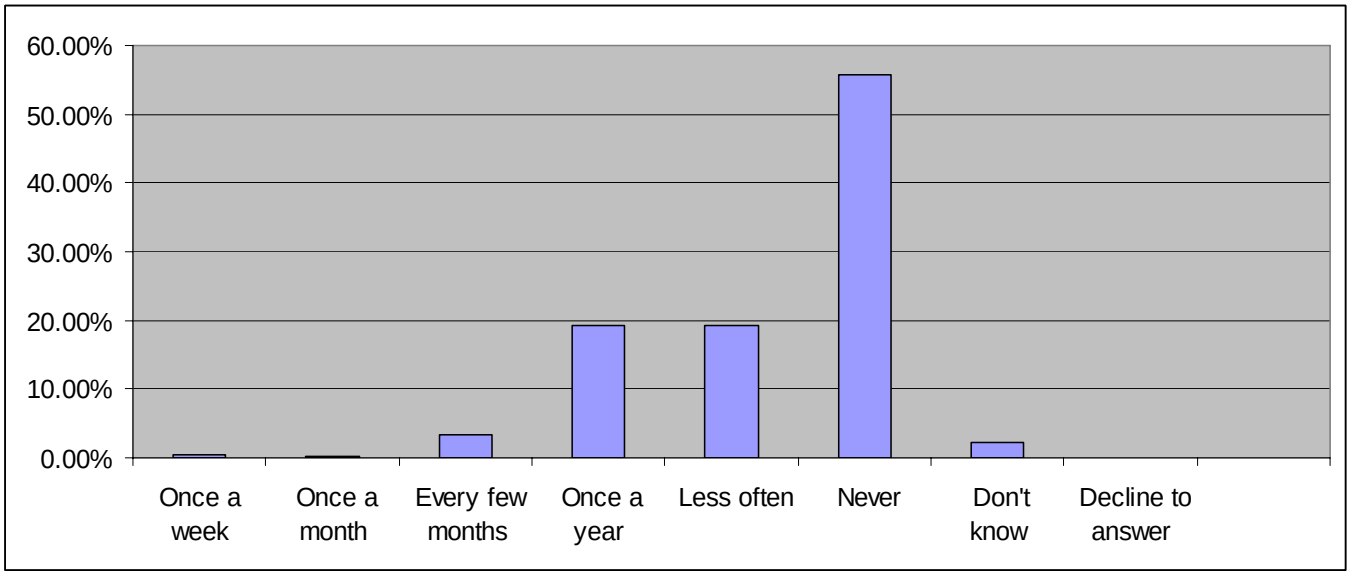
5. How often do you use weed killer or insect-control products, such as Round Up, Weed 'N' Feed, and insecticides? (Total responses = 549)



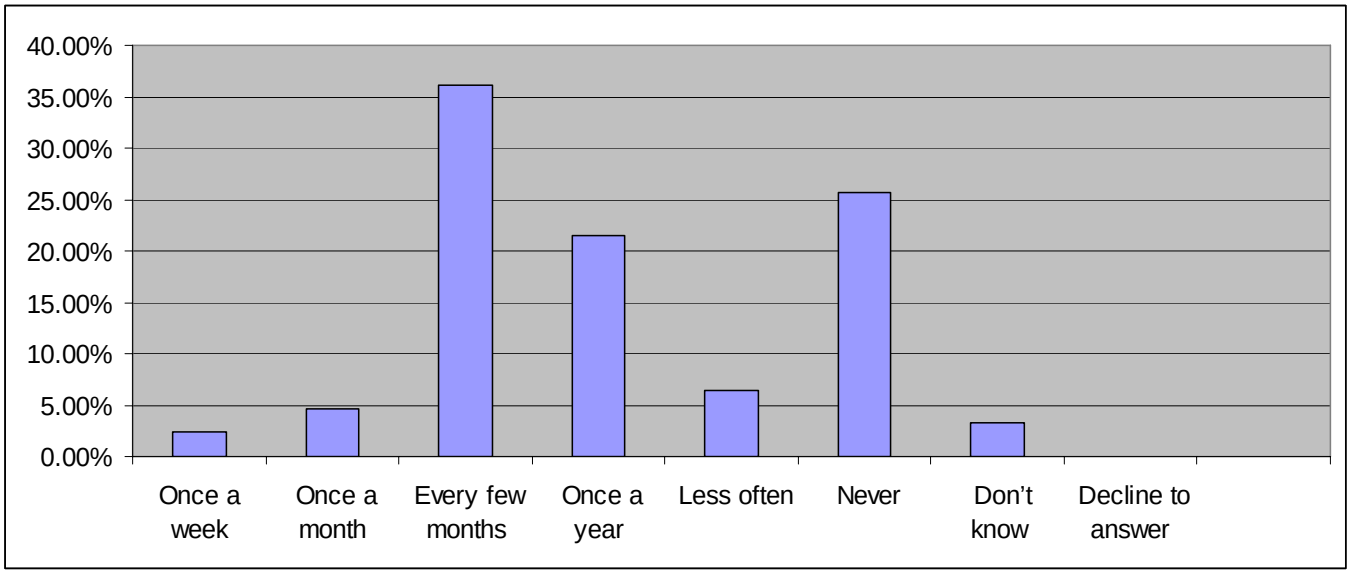
6. How often do you mow or maintain the lawn within 10 feet of the stream? (Total responses = 18)



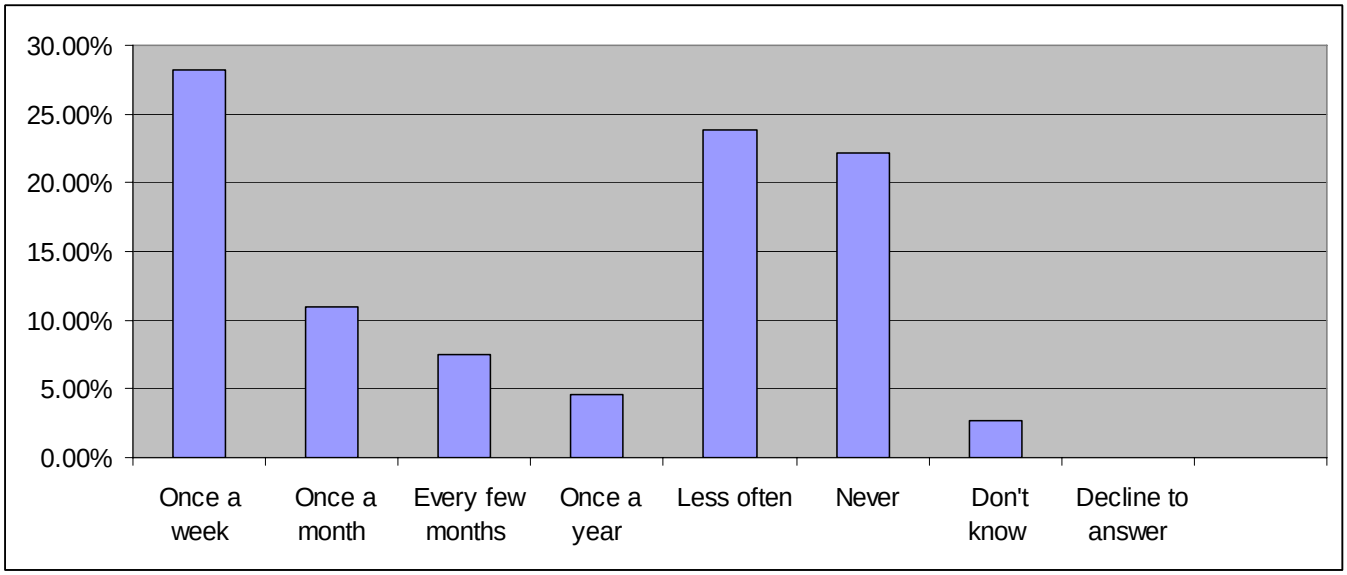
7. How often do you treat your roof for moss growth? (Total responses = 564)



8. How often do you use lawn fertilizer? (Total responses = 543)



9. How often do you notice evidence of animal droppings around your neighborhood and in public areas? (Total responses = 482)



I would now like to hear your thoughts on a few other common practices. For each of the following practices, I'll read a question followed by a series of potential answers. For each, I'll ask you to tell me which is the best answer, or the most fitting. The first question is...

10. Why do you think that people don't pick up their dog's droppings in public places? It is because: (Total responses = 570)

	Responses	**Percentage**
Its inconvenient to dispose of the waste	201	35.26%
Its unpleasant to pick up	136	23.86%
Other people leave the waste	20	3.51%
It's a natural area	14	2.46%
It will decompose quickly	11	1.93%
All of the above	9	1.58%
Other (see following list)	179	31.40%

(Responses for Question #10 cont.) Representative other responses included:

Laziness (77 responses)		Lack of courtesy
Don't know (10 responses)		Unprepared/forgetful
They don't care (6 responses)		It's not a problem there
Hoping someone else will do it		Careless and thoughtless
Inconsiderate (3 responses)		Not prepared
Irresponsible (3 responses)		Careless
Disrespectful (2 responses)		They are inconsiderate and/or unprepared
Unpleasant and they are rude and selfish		Not a problem there
Some don't have a clue about picking it up		negligence
They think they can get away with it – inconsiderate		Don't know how unpleasant it is for the neighbors
They're jerks		Not prepared to do so
Habit		People are never educated to do so
They don't like doing it		Inappropriate comment
Collapse of society		Could be from stray animals
Lack of respect for people and it is unpleasant		

11. Which of the following would **most** likely encourage people to clean up after their dogs more often? (Total responses = 565)

	Responses	**Percentage**
Free scooper or bags at site	195	34.51%
More disposal locations throughout the park and on trails	97	17.17%
Complaints from neighbors	51	9.03%
Knowing it would protect public health	29	5.13%
Knowing it would protect the family's health	29	5.13%
Knowing it would protect water quality	24	4.25%
Knowing it would protect wildlife habitat	7	1.24%
Other (see following list)	133	23.54%

Representative other responses included:

Fines (27 responses)		People who won't, don't
All of the Above (22 responses)		Understanding the consequences of not doing so
Combination of the Above (12 responses)		Education, why it's bad
Knowing it would protect family's health (2 responses)		Complaints from those seeing them not pick it up after their dogs
Don't Know / Not Sure (6 responses)		Better parents
Lazy (4 responses)		Ads, education
None of the Above (2 responses)		Nothing will help
Pass / Decline to Answer (2 responses)		Fees
Give them Tickets (3 responses)		Just deciding to become responsible
More disposal locations (3 responses)		Pay public to do so
Need penalty		More public service notices

(Responses to Question #11 cont.)

Inappropriate comment		Educate the masses better for the kids
They need to step in it		Enforce rules about errant pets
No way		Add places outside of parks
Nothing is likely to work		If they don't know, they aren't likely to
Picked up placed for fertilizer		

12. Why do people use chemicals to kill weeds and bugs in their yards and gardens? (Total responses = 573)

	Responses	**Percentage**
They are easy to use	227	39.62%
They are the only thing that is effective	143	24.96%
They are convenient to purchase	97	16.93%
They are safe	8	1.40%
They are inexpensive	7	1.22%
Other (See following list)	91	15.88%

Representative other responses included:

Lack of education (19 responses)		They want pretty yards
All of the above (11 responses)		Perceived as safe and harmless
Lazy (4 responses)		Don't know natural methods
Combination (5 responses)		Because of better product
Pass / Decline to Answer (2 responses)		Don't know
Its convenient to use (7 responses)		They are convenient and believed safe
Effective (4 responses)		Good Advertising
Lack of understanding		To protect home from insects
Most consumers are uninformed on eco-friendly products		Convenient to purchase – we don't have readily available natural alternatives
Peer pressure from neighbors		It's a habit, reinforced by media
Most efficient		Peer pressure and expected
They are stupid		Don't know any better
Easiest, most effective		Easy to do
People use chemicals to speed yard work		Last resort
They are the only thing effective and they are		Because neighbors won't use it
They are the only thing that is effective/convenient to purchase		They believe they will have a nice green lawn if they use the chemicals
They are convenient and cheaper than bio-friendly		

13. Which of the following would **most** encourage people to use less toxic weed and bug control methods? (Total responses = 521)

	Responses	Percentage
A list of natural or non-toxic products	134	25.72%
A better understanding of the benefits	107	20.54%
A reduction in price of less toxic alternatives	75	14.40%
Convenient access to less toxic products	77	14.78%
Knowing it would protect water quality	14	2.69%
Knowing it would protect the family's health	19	3.65%
Knowing it would protect public health	11	2.11%
Knowing it would protect wildlife	7	1.34%
Other (see following list)	77	14.78%

Representative other responses included:

All of the above (51 responses)		Better products
Combination (13 responses)		Knowing how toxic and wise alternatives
Don't know / Not Sure (3 responses)		Knowing what alternatives there are
Pass / Decline to Answer (2 responses)		Educate public and readily available
Offer a safe and effective alternative (4 responses)		Plus knowing of effective alternatives
Better education (6 responses)		Knowing an alternative exists
Understanding the consequences of their personal actions		People are uninterested, will know other do not do so
A better understanding of the risks of not changing		All works with education
Better understanding of benefits		Better education and warning of consequences
We haven't been there and need to be		Be less lazy
Convenient access to less toxic products		Knowing it would protect wildlife
Knowledge of the products		Some available that work
Better education about pesticides and fertilizers		Need more toxic chemicals
For people who are more interested in sharing knowledge these methods can be safe and inexpensive		If they cost less and were just as effective

14. Why do people wash their vehicles at home rather than at a carwash? (Total responses = 562)

	Responses	Percentage
It's less expensive	257	45.73%
Hand washing is better for the vehicle	45	8.01%
It's more convenient	70	12.46%
A person cleans the car better	41	7.30%
People like to wash their own cars	71	12.63%
It saves time	6	1.07%
Other (see following list)	72	12.81%

(Responses for Question #14 cont.) Representative other responses included:

All of the above (34 responses)		Car wash companies do a bad job
Combination (10 responses)		A chore for a young driver
Good exercise (2 responses)		Less damage to vehicle
Don't know (4 responses)		Most of the above
Modified vehicles won't go through the car wash		They're idiots
It's therapeutic		A person cleans the car better
Fun to do		Safer for cars
Peer pressure		Kids like to wash cars on hot days
Kids earn money		Less damage
Car washers often do not work well		Pass
Hand washing is better and people like to wash their cars themselves		Too lazy and cheap to go to the drive through
People like to wash their cars themselves		Hand washing is better, more convenient and they are told in literature not to use
They have a false belief that it is better		

15. Which of the following would **most** encourage people to use a carwash? (Total responses = 563)

	Responses	**Percentage**
Provide discounts or coupons for car washes	272	48.31%
Knowing they use recycled water	61	10.83%
Knowing it would protect water quality	35	6.22%
Adding more car wash locations	49	8.70%
Knowing it would protect public health	17	3.02%
Knowing it would protect wildlife habitat	17	3.02%
Other (see following list)	112	19.89%

Representative other responses included:

All of the above (31 responses)		Location for larger vehicles
Combination (6 responses)		Consumer service they provide
Don't know (9 responses)		Time and convenience
Less expensive 11 responses)		Amount of time car washes take and cost issues
Pass / Decline to Answer (2 responses)		But that's not enough
Time and Convenience (6 responses)		Give better service
Educate the people (2 responses)		Education, public health, wildlife, money
Better car washes, damages vehicles, lifted trucks won't fit, more versatile		Unlikely to influence those who like to wash their own
Protect their car		Media influence
A place where people can do it themselves		Better service, lower price
Awareness level raised		Install brushless car washes
Standardize and reduce car washes		Adding more car wash location
Educate the public		Convenient

(Responses for Question #15 cont.)

Make washing more affordable, non-tax solution		Adding more car wash location
Safer car wash and better understanding of long term effects		High dollar cars not going through automatic car washes
Uses 1/3 of the water than washed at home		Better quality and doesn't cause damage
Something that cleans both inside and outside		More soft brush car washes available
All except more car washes		A free car wash

16. Why do people like a maintained and manicured grass lawn? (Total responses = 522)

	Responses	**Percentage**
They look nice, they enhance property values	408	78.16%
They look like their neighbors	47	9.00%
They provide a place for kids to play	33	6.32%
They are easy to care for	16	3.07%
They are less costly to maintain than shrubs, trees and other groundcover	9	1.72%
Other (see following list)	9	1.72%

Representative other responses included:

All of the above (13 responses)		Don't believe they should
Combination (6 responses)		Also very relaxing
Pride of ownership (2 responses)		It is more pride and conscientious
Look like the neighbors, place for kids to play (5 responses)		Tradition, pastoral scene, not much without the pasture
Image thing		Mix of the above
Neighbors and landlord insist on it		Habit
I have no idea		Looks nice, property values, looks like neighbors, place for kids to play
First 3 answers		Beauty
Status symbol and neighborhood expectation		Don't care about environment
Personal satisfaction		Path of least resistance, that is what's there
All others		Pressure from neighborhood association

17. Which of the following would **most** encourage people to reduce the size of their grass lawns by using native plants, trees, and landscaping? (Total responses = 549)

	Responses	Percentage
Discounts or coupons for native plants	161	29.33%
Technical support (online expert advice)	121	22.04%
Time to work on it	48	8.74%
If the neighbors did it	35	6.38%
A list of native plants	23	4.19%
Knowing it would protect water quality	22	4.01%
Knowing it would protect public health	9	1.64%
Knowing it would protect wildlife habitat	9	1.64%
Other (see following list)	121	22.04%

Representative other responses included:

All of the above (19 responses)		People choosing to do so
Combination (6 responses)		Grass is safer than bushes
Don't know / Unsure (10 responses)		Knowing cost and education
Educating the public of the benefits (2 responses)		None of the above
If it was easy to maintain (2 responses)		A list of attractive native plants
Pass (9 responses)		Learning more about it
Educate public better (3 responses)		Will not influence those to change
Knowing it would reduce water consumption (2 responses)		They won't do it because they like the look of grass
None of the Above (2 responses)		Education – what is best suited
Discount on the water bill		Understanding environmental benefits
Mix of the above		Make that action more prestigious
Having someone to actually help do it right		Personal preference
Addressing neighborhood association limitation, they often regulate what plants are allowed		None of the above, communicate benefits to community
People not apt to change, if the prefer lawns		Don't agree with this
If they understood property values (return on investment)		Knowing how easy it could be, and someone to help learn
For the value of the house		No opinion
Technical support and a list of native plants		Knowing it would reduce water consumption
Educate people on native plant option		Tax break
Limit use of non-native plants and availability at nurseries		Don't want small grass lawns, want bigger lawns
More knowledge of natural plants		Change lawns
Does not like the looks of it, she would not do so		Trees and shrubs are too labor intensive
Knowing what native plants are good for Oregon		The law to make them
It's easy to do this		A list of native plants
Educate public better		Knowing of alternatives
Educate residents on ways that native plants may reduce their water bills		

18. Why do stream side residents mow or maintain their lawns or gardens to the stream's edge? (Total responses = 541)

	Responses	Percentage
It looks nice	259	47.87%
It's their property so they can do what they want	60	11.09%
They want to see the water	64	11.83%
It's a fire hazard not to do so	21	3.88%
They want easy access to the water	51	9.43%
Other (see following list)	86	15.90%

Representative other responses included:

All of the above (21 responses)		Good for the stream
Combination (6 responses)		Depends on location
Don't know (8 responses)		More resistant to erosion
Pass on question (10 responses)		Personal preference
Lack of education (8 responses)		Case by case
Don't know how to change others		To look more presentable
They want to see and have easy access to the water		Reduce vermin
Don't want groundcover to encourage critter on property		Easiest way to do it
It's always been done		It's on their property
It's done that way in the public park		It's a riparian
People just like it		They can afford it

19. Which of the following would most encourage people to leave at least a 10-foot buffer to remain as a natural area between their manicured yard and the stream? (Total responses = 552)

	Responses	Percentage
A tax benefit	260	47.10%
Information on the benefits of doing so	112	20.29%
Knowing it would protect water quality	49	8.88%
Knowing it would protect public health	10	1.81%
Knowing it would protect wildlife habitat	27	4.89%
Knowing it would protect fish	14	2.54%
Other (see following list)	80	14.49%

(Responses for Question #19 cont.) Representative other responses included:

All of the above (23 responses)		Change the laws
Combination (8 responses)		Not involved with this
Don't know (6 responses)		Something else
Pass (2 responses)		Should be mandatory
Knowing it would protect public health and wildlife habitat (2 responses)		Depends on location
Knowing "Why" and "How"		A bit of everything
Education, positive information, what benefits		Not sure
Not likely to be done by such owners		Impose fines
Have the are maintained by someone else		Educate public on the need
Not clear enough for a good answer		Education on necessity
All except tax exempt		Rock or gravel, make this mandatory
Regulation		None, would create fire hazard
A good 100 year flood would convince people		Protect fish
Not likely		

20. What would be the **most** effective way to encourage people to not dispose of their yard waste or litter in storm drains or the creek? (Total responses = 516)

	Responses	**Percentage**
Educate them on why not to dump item in the stormdrain and creeks	210	40.70%
A reduction in yard waste fees	119	23.06%
Complaints from neighbors	38	7.36%
Knowing it would protect public health	20	3.88%
Knowing it would protect wildlife habitat	21	4.07%
Other (see following list)	108	20.93%

Representative other responses included:

All of the above (17 responses)		Mandatory not to dump
Impose fines or fees (24 responses)		Yard debris to use
Combination (6 responses)		Makes sense not to do so
Bins for dumping		Free disposal
Pass (4 responses)		Don't know
Knowing it would protect public health and wildlife habitat (2 responses)		Reward system, fighting laziness, recognition of "job well done" or incentive
A law requiring no dumping		Eliminate yard waste fees
Make it easier to dispose		Threat of raising fees if they pollute
Curbside dumping		Sever harsh punishment
Use big green		Education by example
Education to those who pollute		We already have free recycling
Produce alternative		City ordinance
A public alternative, conveniently placed		Not sure
An easier way to dispose of it		No excuse

(Responses for Question #20 cont.)

Educate first, then enforce the existing laws		Encourage yard waste cans or compost piles
Post signs telling not to dump in the creek		Know it is illegal
All of the above – show how clogged drains cause damage		Increase availability and lower cost of removal means

21. In the past few years, would you say that you have personally made significant changes, some changes, or no changes in any of your activities, specifically to protect the water quality in Salem's streams?

	Responses	**Percentage**
No changes	274	49.37%
Some changes	209	37.66%
Significant changes	63	11.35%
Do not know	8	1.44%
Declined to answer	1	0.18%

22. What has prompted you to do so? (See following list)

N/A (13 responses)		A sense of responsibility and stewardship
Educational Awareness (31 responses)		Access to recycling service
Concern for the Environment (15 responses)		Allergic to chlorine
Concern for Water Quality (17 responses)		Age
Hearing about pollution (18 responses)		Always have been environmentally friendly
Wanting to help the environment (13 responses)		Wanting to be different
Attending classes		Already environmentally conscious
A regard for what goes into drainage systems, more environmentally conscious		All natural lawn chemicals, wash car on lawn not on street or driveway
Already doing it, trying to convince neighbors to change		Already garden organically to help reduce pollution
Awareness of water issues and sidewalk markers noted		Awareness for Mother Earth, giving up the idea that personal action counts for little
Awareness from wife		Bad for the environment
Be environmentally sound and conscious		Because it is good for the environment
Because of their knowledge of the Willamette		Being able to preserve this creek
Being more careful with nature		Better conditions
Better health, better tasting water		Better understanding of water quality problems
Bulletin about watershed area and at all the parks		By reading bill inserts and newsletters
Because he cares		Children
Change in profession, now have more awareness		Coincidence, luck of the move
City of Salem speaking at neighborhood meetings		Concern about water and pesticides
We have continued to have an environmentally friendly attitude		Try to do things that are environmentally friendly

(Responses for Question #22 cont.)

Concern for the food chain		Concerned for wildlife and water quality
Concerns about water quality and the environment		Conservation mentality
Continued to be environmentally friendly		Convenience
Cost of water		Didn't think it was the right thing to do
Do not use City of Salem streams		Doesn't use any pesticides in the yard
Don't put things in the street to go down the stormdrain since she found out that it goes in the streams and rivers		Desire to be "Green" and less worried about appearance
Doing more of the same		Don't want to harm the habitat
Easier and less expensive to do so		Easier, don't like pulling weeds
Easier to maintain		Educated on her impact on water quality
Educated on water run-off		An environmentalist
Environmental concerns and concern for next generation		Have a dog and have to be careful of what is put on the yard
Environmental teaching from college		Environmentalist family
Environmentally friendly		Family health, public health
Fisherman/outdoorsman		For wildlife reasons
Fish dying, more pollution, more aware		Future generations
Grass and weeds getting to high		Guilt
Had a lot of grass in backyard, is left as a natural wooded area instead of manicured yard. Don't waste water and use of chemicals		Greater sense that others are making changes also
Haven't needed to		Health concerns for family and pets
Hearing that water needs protection		Her animals and kids
His college degree and career all point to those changes		Husband was a scientist, hired gardener to promote healthy eco-friendly habits
Higher consciousness of health problems		His wife's (family) criticism
Illness in family forced changes		It was the right thing to do
Info that had heard about and recycling things		It's better for the environment
Just trying to protect wildlife		Knowing (She works for Public Works)
Knowing her unchanged actions were harmful to the environment		Interest in nature plants and concerns for the watershed
Knowing how it effects the streams		Knowing it was bad
Knowing reduced chemicals, reduced run-off		Knowing that it all runs into the river
Knowing the damage it can do		Knowledge of friends
Lack of water		Like clean water
Knowing what pollution does to the environment		Likes natural area and wildlife
Less washing in water use, handling compost better		Local environmental concerns
Living by a creek – want to pollute less		Long-time resident – replacing dead shrubs
Long-term concern for water quality/environment		Made him feel better
Love for nature		More aware of toxic materials
Make it better for his elderly mother		Moved, smaller yard
More convenient due to access to recycle and composting		More environmentally conscious – parent / homeowner
Moved to Oregon and realizing how it is pristine		Need healthy water supply
Need to respect those who are conserving water		Needed one
Never polluted, no change to make		New home in "green" development

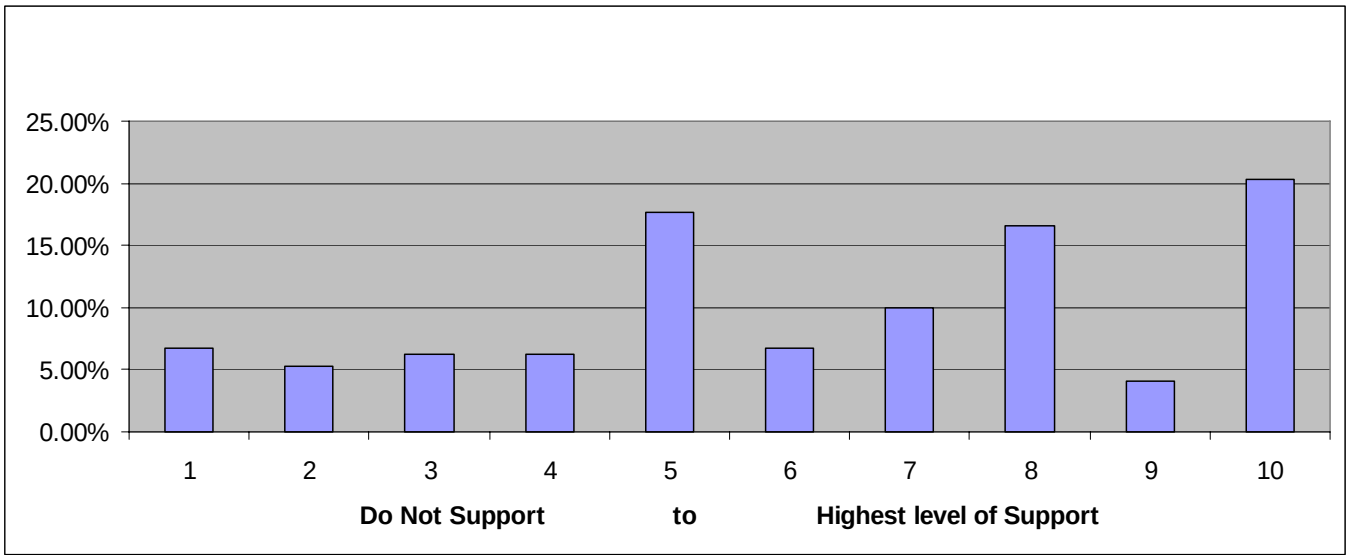
(Responses to Question #22 cont.)

None needed, has been doing so for years		Not close to a stream, not thinking
Not dumping chemicals in the gutter		Nothing
Our water is very important		Part of an environmental class (Student)
Paying for own water		Personal health for family
Pesticides are bad for the environment		Physical health and the environment
Not close to a stream and have no interactions with them		Partly for age and convenience and water is expensive
Protect fish		Protect fishing habitat
Public awareness		Public Information
Quality of water and water shortage		Realizing what goes down the drain
Population increase – they are not aware		Reality of the situation
Reading info received – Environmental Quality have educated the public well		Recognition that we all have to protect the environment above all
Replaced appliances with friendlier ones		Re-landscaped for a better lawn
Researching and studying water issues and water quality issues over all		Respect the environment and have become a fisherman
Retired: more time and wife gives reminders		Right thing to do, has to do with business
Right thing to do and enjoy this more, as they are and as role models to the kids and neighbors		See haz-mat picking up things and have become more aware
River looks bad when you don't		Save money
Saving water, reducing usage		School advertisements to be more careful
Seeing how bad and dirty the creek looked		Social consciousness
Stickers on storm drains		The benefits of life quality
Son-in-law who works for the water department told them about pollution		The car wash down the street advertises that they use recycled water
The 1996 flood and septic line problems		The nasty taste of city water
The news, water quality		The river is filthy
They live in close proximity to streams, groundwater and wildlife – they care		The taste of water has declined, plus higher water usage
To be more environmentally friendly, better soap with laundry, more aware		Tired of seeing environment destroyed significantly
To better the local habitat		To change for the better
To help the environment – works at a golf course and understands the repercussions of chemical use		To reduce water consumption and promote erosion control
To help with water issues		To keep the environment healthy
To make a better environment, more healthy		To save the environment
To pollute less and better the environment		Too much garbage already
Trying to be easy on the land		Want pure, clean water and loves wildlife
Want Salem to look a lot nicer		Want to avoid toxic chemicals
Want to conserve water		Wanted less lawn to mow
Wanted native planted yard		Wanted to be more environmentally helpful
Wanted to help the wildlife – bio-degradable		Wanting Salem's water to be better
Wanting to be an example for the children		Was easy to do – makes own compost
Watched Al Gore movie		Water bill and eco-friendly
Water price and water concerns		Water quality and public health
When they heard about a local polluted, river they wanted to make a difference		Watching information on global warming and pollution

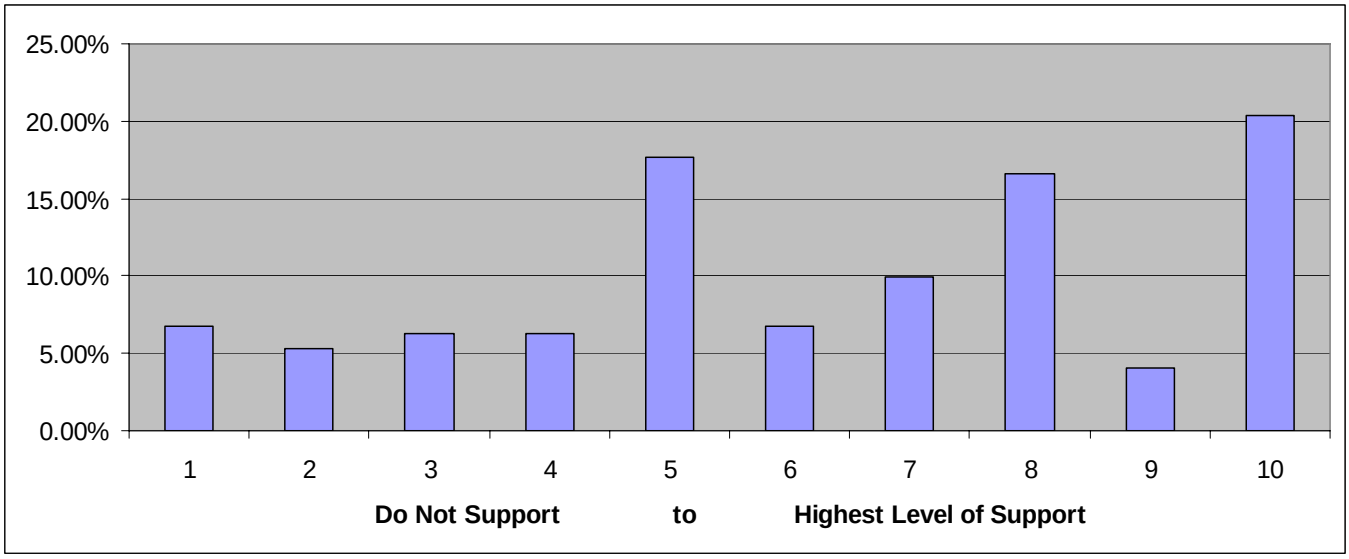
23. From what sources have you received information about local stream and river quality issues? (Probe) And how else have you received the information? (Check all answers)
(Total responses = 558)

	Responses	Percentage
Newspaper	11	1.97%
Brochure	53	9.50%
Radio	36	6.45%
Public Events	0	0%
TV	1	0.18%
Word of Mouth	28	5.02%
Kids/School materials	215	38.53%
Signs	0	0%
Billing inserts	10	1.79%
Nowhere	69	12.37%
Newsletters	10	1.79%
Meetings	125	22.40%
Unsure	0	0%
Declined to answer	0	0%
Other	0	0%

24. General pollution prevention information in the newspaper, TV, and radio.
(Total responses = 561)



25. Mailing information to individuals. (Total responses = 561)



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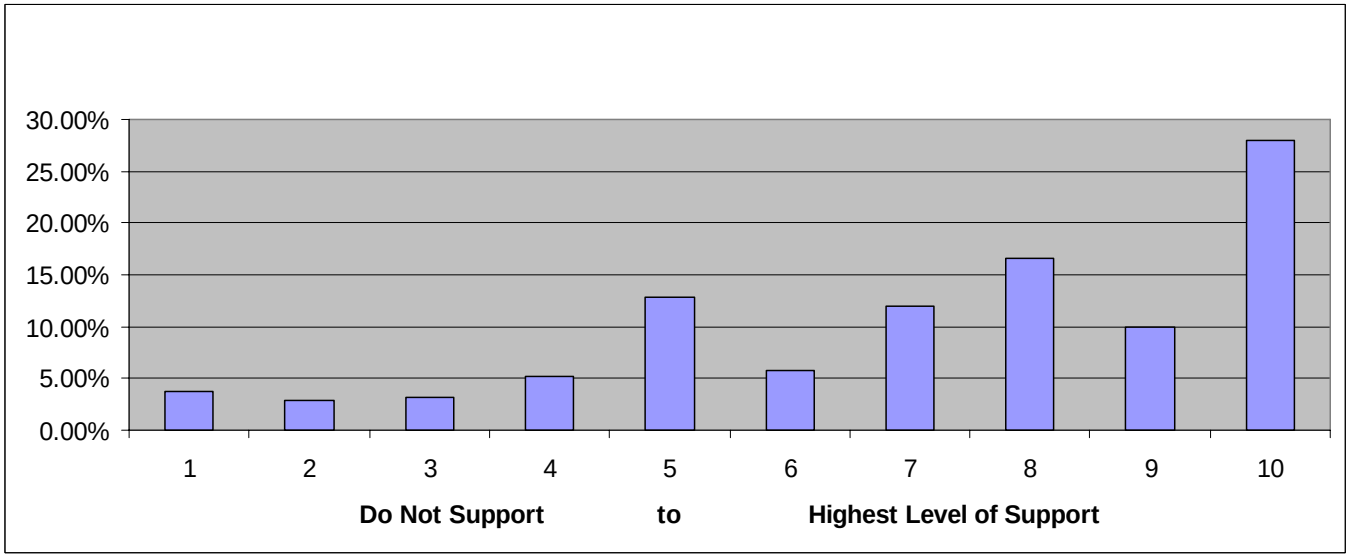
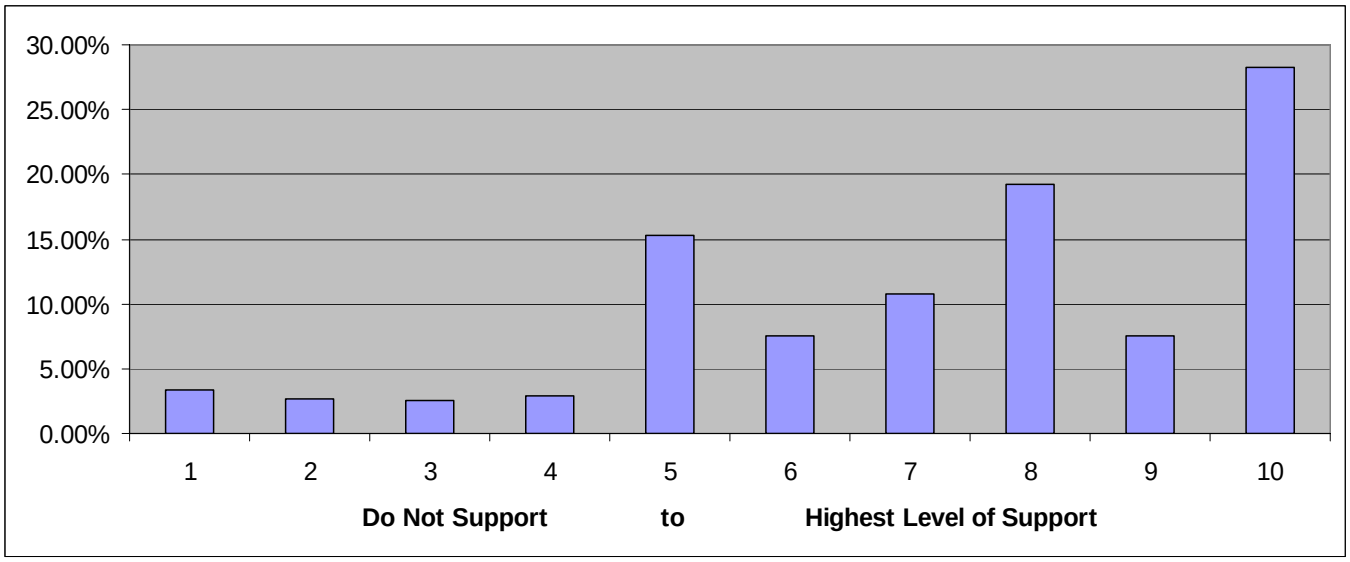
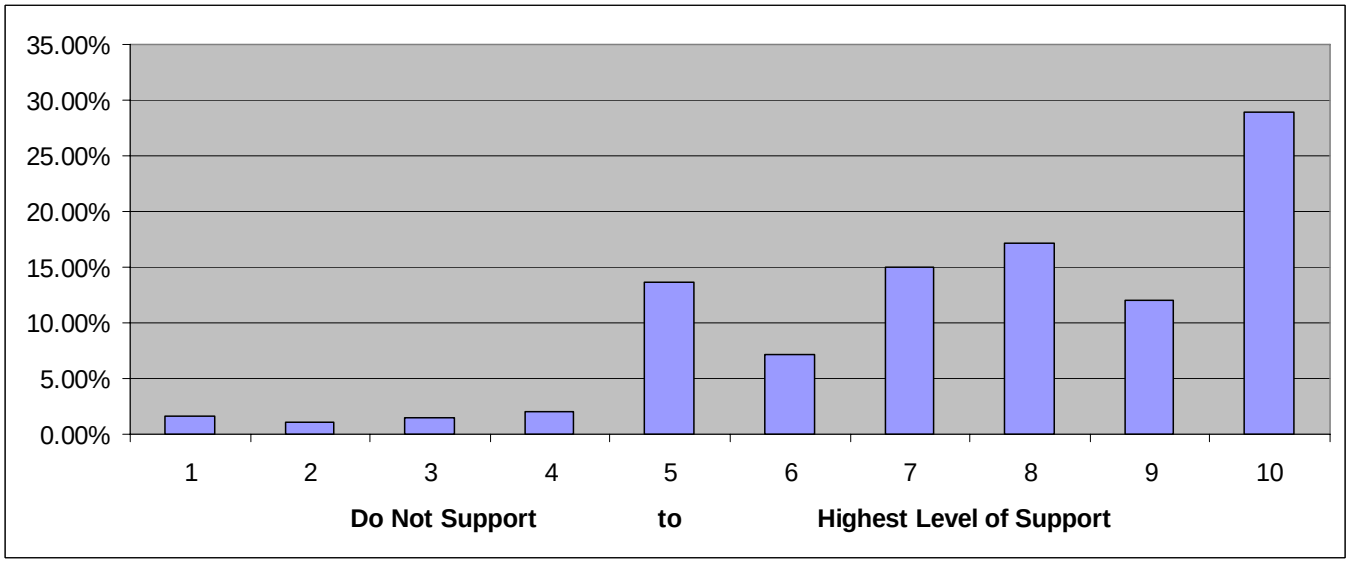
26. Providing information on an insert in your water and sewer bill. (Total responses = 561)



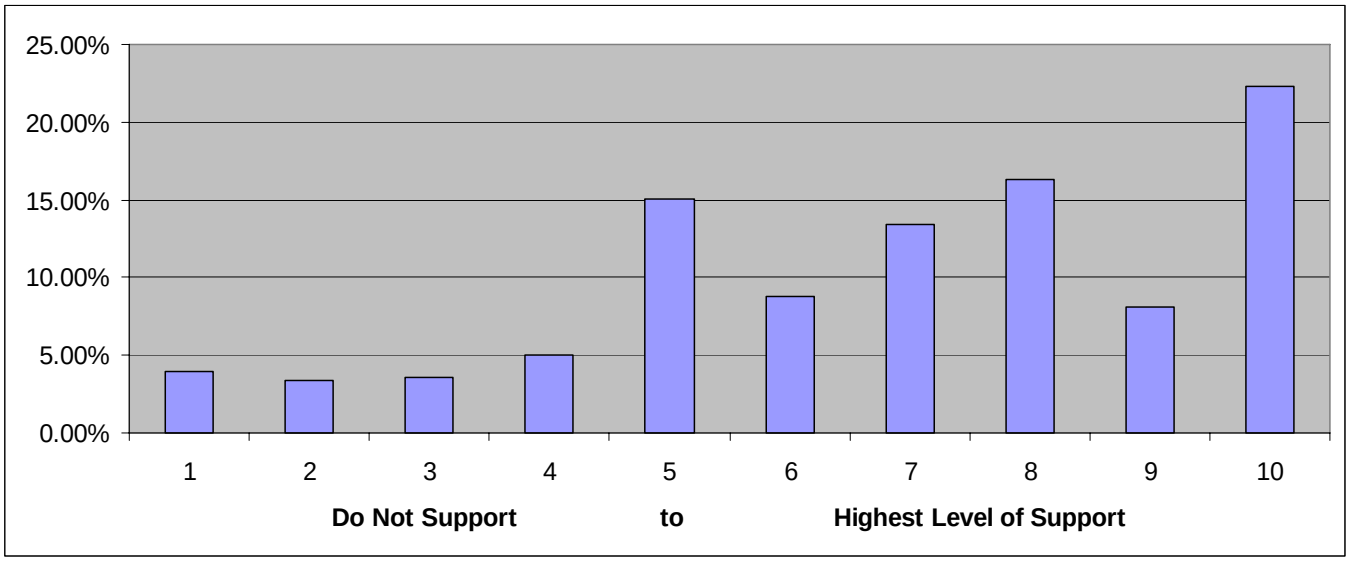
27. Strengthen regulations and enforcement. (Total responses = 558)



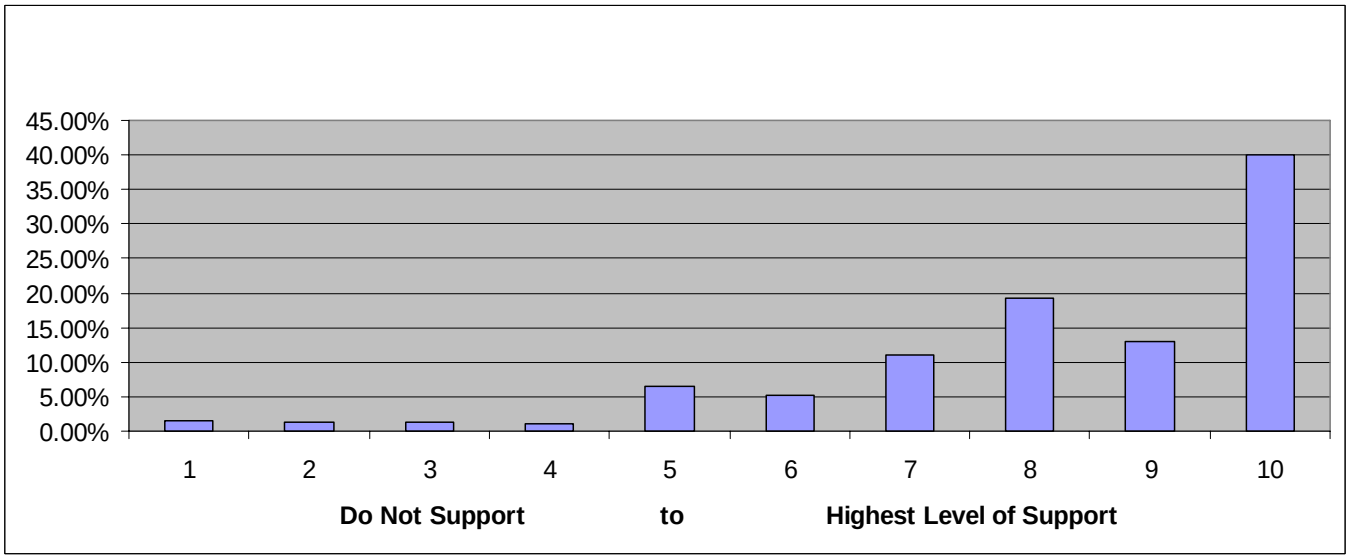
28. Sponsoring community involvement and cleanups. (Total responses = 558)



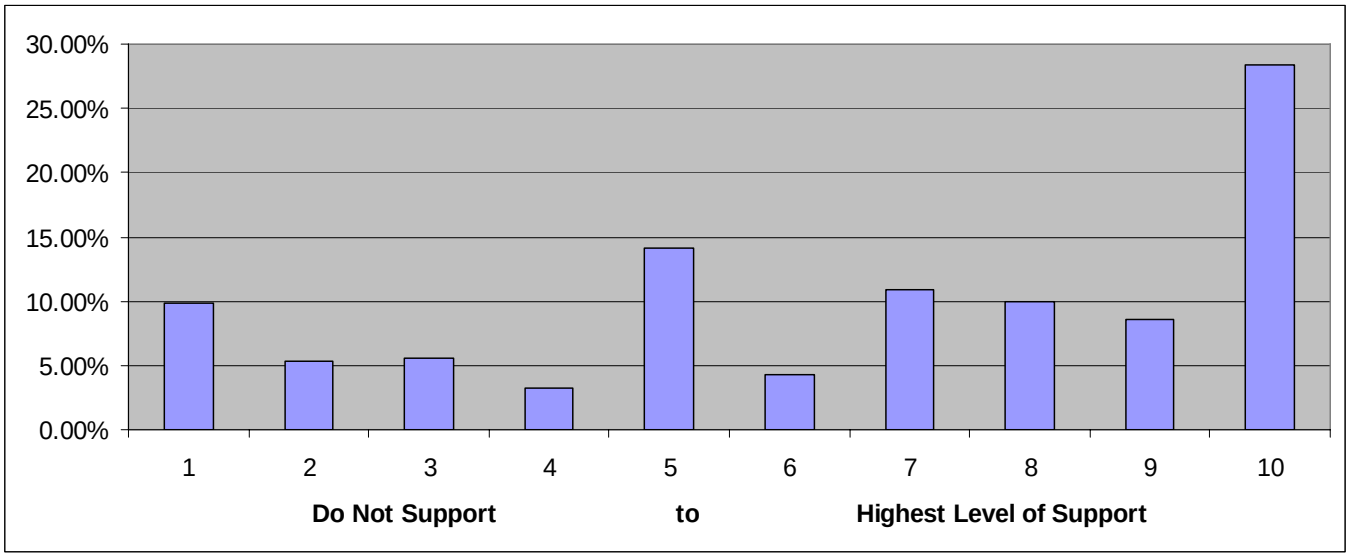
29. Providing technical assistance and workshop training. (Total responses = 557)



30. Providing money-saving deals for the purchase of environmentally friendly products. (Total responses = 557)



31. Volunteers coming to your home to help with planting and clean up. (Total responses = 561)



32. Are there any other ideas you would support? (See following list)

NO (171 responses)		Enforcement of the laws
Education (49 responses)		Give free native plants and sample products
School programs like DARE (18 responses)		Attention to farmers using chemicals
Very important what numbers to call for pollution in streams – put numbers in insets to be readily available on signs, etc.		Educate the yard maintenance companies of using chemicals/environmental products. Get a license in Salem
Coupons in flyers or bills for the environmentally friendly products		Information kiosk around parks
Workshops on native plants that use less water		Tax breaks for those who follow the rules and fine for those who don't
General awareness day		Develop ways to water landscaping not using the drinking water
More contact to people to be more environmentally friendly		Get info in fall not to dump leaves in the street
Not getting information out to people		Community volunteer projects
Volunteer supporter		A new TV special that goes through the issues
Reduce population pressure – too many people make issue moot		Need to pave roads with non-oil products

(Responses to Question #32 cont.)

People going door-to-door in stream areas, more personal hands-on approach		Signs near streams – even plant identification
CCTV local access spots , Oregon State Fair and ODFW Exhibit, and Marion County Fair		Stream habitat restoration
Make public aware of dumping toxins into watershed		2 prong – save money/educate
City ought to not dump raw sewage into waterways		Rebate program for non-toxic – treat Willamette and tributaries
By not using the average amount of water used people can get a tax break		Just let people know where their money is going and what it is being used for. (How does it help?)
Volunteers to help the elderly		Helping the elderly
Having a mobile chipper come around now and then – like a mulching/chipping day		Increase public signage, especially in Minto Brown Park, an other major areas
Encourage not to waste water and not to dump stuff into water ways		Mailings with bills
Don't be lazy and don't pollute		Painting messages on or near storm drains
Pay minimum wage for disabled people to do some of the work / signs posted that read "Do not pollute" and "Throw away plastic bags"		Stronger enforcement of stronger regulations
Use electronic media, like cross channel promotions		Public demonstration area where there is access to a stream
Educate		Change law: what can we do for streams?
Make developers account for their ecological activities: increase # of parks and common areas in neighborhoods		A place to dispose of toxic medications
Internet as some do not take the newspaper		Establish fines per this survey and properly advertise this program
More random calls like this survey		Fines for violators
None come to mind		Incentive program
Heard more in this survey than in the last 10 years		Take care of cars so as not to drip fluids on the streets
More rules for companies that might have waste		No, but support pollution enforcement
An economic incentive		No, accept legislation against more toxic chemicals, educate in the interim
Inform the public through the media		Don't send as many advertisements in the mail
Any eco-friendly volunteer betterment		Yes, where does all the money come from for all these suggested projects?
Trash cans in more places in recreational areas		Get the word out via television, water bill insert attractively made, free workshops
Pop ups on the internet (tag water quality, Oregon, etc.) for tech support or info on tax benefit		Use neighborhood groups to have a "Fair" and show environmental issues using examples of effective practices (Like Show of Homes)
General neighborhood adherence to races		Some people might misunderstand chemicals like Round-up, may think it is harmless
Upgrade sewer system; better drainage; clean up industrial areas		Cut down on plastic grocery bags
Too much time spent on small creeks		The ones in the survey are good

(Responses to Question #32 cont.)

Just local media and newspapers, perhaps a place on website to address pollution and landscaping issues		More presence at parks and streambeds, community involvement.
Open booth at Farmers Market in Salem		Provide info to new people in the area
Get neighborhood associations involved; perhaps contribute to the newsletter for specific concerns and city contact.		Advocate for the better quality of water and more knowledge spread to the public about issues
Look into power washing sidewalks and driveways; location of animal droppings, often on concrete; fund clean up by clean water act; need to look into corporate cooperation		Stenciled letters on storm sewers; continuing that effort; careful evaluation of pollution by individuals, commercial, agriculture, industrial polluters, and proportion the efforts accordingly
More knowledge		Regulate pesticides more
Discounts and incentives for upgrading pipes to improve water for home owner		Bicycle registry mandatory, the fees would go to help litter; tax beer and wine
Don't let the farms dump sewage in the ponds		"cats should have to be registered just like dogs. The immigrants should be regulated, not the Americans, when it comes to surveys and laws"
Public service announcements		A mandatory overlay zone – 10ft buffer along rivers and streams
Fine violators; strict laws on dog waste in parks		Regulated information and accountable for accuracy of information
Send those in the community more information about planting and pollution		Good public information
Electronic spread of information		Cheaper information dispersal as opposed to radio /TV; fines for non-compliance
Private property rights		Promote community pride in yards – peer pressure
Have the City quit dumping pollution and garbage into the Willamette		City discontinue surcharge for Jan Rae
More information on organic fertilizer		Planting things that don't need a lot of water
Better PR to explain what the problem is		Edible landscapes; encourage permeable driveways
Do away with "0 Lot Lines" and apartments; reinforce lot or roof areas to drainage and pollution issues and decisions		More information for the public
Clean up the river more, especially the Willamette River		Higher fines or fees for dumping or whatever near streams; educate, environmentally friendly products
People need to learn to care; they do not; they only notice through their pocketbooks		Any park cleaning, volunteering, teach children and grandchildren
Expand recycling to more things and reach to more untapped regions, not just the City		Dairy farms should be required to help keep the water clean as well as not dumping sewage in the river
Would be nice to have regulation on noxious weeds		More informative signs like "No Dumping Near Drains" etc.
Profusion of written data; use of neighborhood associations		Get help with ideas about flooding and regulating of industries pollution

(Responses to Question #32 cont.)

Storm drain improvement	10 ft setback from streams, low cost gravel/stones for that 10 ft strip
Recommends the master gardener class and community volunteer projects	Don't dump water from treatment plant into river
Emergency response needs to be more prompt and enforced more when it comes to businesses	Nicer environmental enforcement
Increase public awareness	Ban medical things flushed down toilets, outlaw clear cutting, stiffen fines for developers along watersheds
Easy or central location for technical advice, central Phone #	Someone to interpret for non-english speaking residents
More people picking up garbage on the streets	How to clean up the Willamette River
Recycle everything	Encourage draught-tolerant plants, auto sprinkling systems to save water and shade trees for new homes
Neighborhood parks and recreation	How to get rid of creek-side blackberries without chemicals
Make non-toxic fertilizers less expensive and get more info out to people letting them know it's a better choice than the toxic stuff they have been using.	Focus on more developers who appear to be unmindful of the environment; encourage wildlife and fish restoration and publicize.

33. How many years have you lived in your current residence?

	Responses	**Percentage**
3 years or less	155	27.58%
4-9 years	172	30.60%
10-19 years	116	20.64%
20 or more years	119	21.17%

34. Do you rent or own your home?

	Responses	**Percentage**
Rent	52	9.27%
Own	509	90.73%
Decline to answer	0	0.0%

35. What is the highest level of education you have had the opportunity to complete?

	Responses	Percentage
High School or less	93	16.64%
Some college or trade school	176	31.48%
4-year college degree	157	28.09%
Graduate school or more	133	23.79%

36. Which category best describes your age?

	Responses	Percentage
18-24	13	2.31%
25-34	60	10.66%
35-44	79	14.03%
45-54	134	23.80%
55-64	106	18.83%
Over 64	171	30.37%

37. Do you have children under 18 living in your household?

	Responses	Percentage
YES	197	34.02%
NO	382	65.98%

38. Gender:

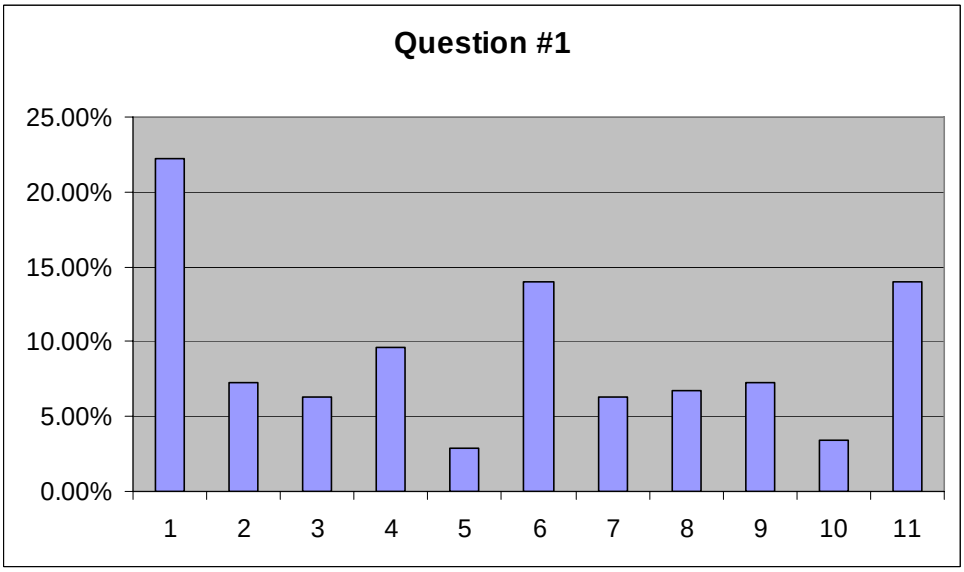
	Responses	Percentage
MALE	248	44.13%
FEMALE	314	55.87%

City of Salem Public Values Assessment
Pringle Creek Watershed
2006

Hello my name is _____ with the City of Salem. Your phone number was selected at random from a list of residents that live in the Pringle Creek Watershed. The City is completing a management plan for the Pringle Creek Watershed and we value your input. I have been asked to listen to your thoughts regarding water quality issues. (IF NECESSARY) Are you 18 or older? (IF UNDER 18) Is there an adult available? The survey will take 10 - 15 minutes to complete over the phone. (IF NO TIME) When would be a good time to call you back?

Before we start, I'd like you to know that all of the information you provide will be held in strict confidence, and you will not be identified with any of your responses. There are no right or wrong answers, as I am here to simply record your viewpoints.

1. I would like to start by asking you about the Pringle Creek Watershed. Using a scale where 0 means not at all and 10 mean a lot, how personally connected do you feel to Pringle Creek and its tributaries? (Number of responses = 207)



Not at all connected **A lot connected**

2. What do you value about Pringle Creek Watershed and your local stream? (PROBE AND CLARIFY ALL RESPONSES) (Number of responses = 200)

Category	Number of Responses
Water Quality	70
Habitat for Fish and Wildlife	20
Livability	20
Miscellaneous	90

Habitat for Fish & Wildlife:

Wildlife support (9 responses)		Environmentally it is good
Wildlife, view of watershed, and how it has been altered – issues due to flooding		It supports wildlife, unique value, peaceful and tranquil
Source for fish and wildlife		Good environment
Pretty, shelter to animals		Important to environment
Represents habitat for wildlife		Value the ecosystem
Fisherman, so I like the fish		The environment in our parks

Water Quality:

Water Quality / Clean water (43 responses)		Beautiful look that H2O provides
Provides water (2 responses)		Good water (2 responses)
It is very important for receiving water and getting rid of wastewater		Really good water
Preserve the natural stream		Quality of it and our environment
Drinking water, fruit trees and gardens		Pretty water to look at
Valuable water source		Keep water pure
I like the water and natural scene		Concerned about the water in the creek
All the water we have		

Livability:

Maintained, not polluted (4 responses)		It is well maintained, important to citizens
Nice that we have a stream through the City and habitat for family to enjoy, aesthetic		Still a watershed, still existing creek – hasn't been diverted
Necessary to get home		Enhances the community
Natural environment project		Community effort to maintain
Life blood		Recreational attributes and important resources
Runs through neighborhood and provides beauty		Value unpolluted natural resource
Maintaining a valuable resource		It helps the area
Preserved in its natural state		Management of system and benefits

Miscellaneous:

N/A (22 responses)		Can't put a value on it
Don't Know / Not Sure (37 responses)		Think it's cool
The view (4 responses)		Beauty, natural scents, shade
Lucky to have stream, view, fish, beauty		No idea
Presence and accessibility, the view		Don't like how it is maintained, too many blackberry bushes and cottonwoods by Judson School, W. Fork
Salmon run, until it quit		Public access by Leslie School
Nothing (2 responses)		Don't value
Easy access to creek		Don't think much about it
Like them, especially in the park		Beautiful, fun and interesting
Like that they are there		Keep it healthy
Nice to look at, good for animals, beauty		Beauty of Creek

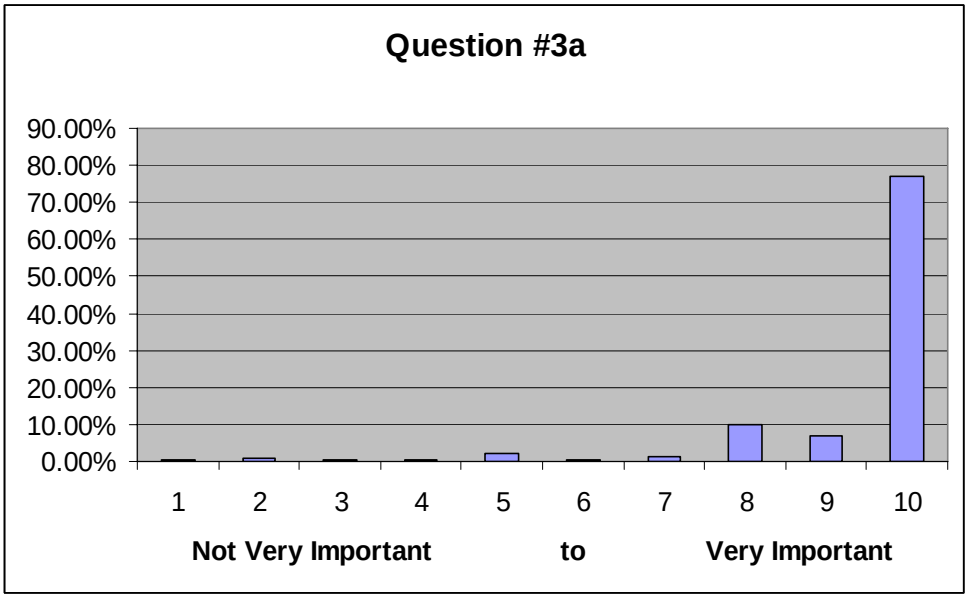
(Responses to Question #2 cont.)

Glad it's there		Access to be next to streams at parks
Mainly for chance to use recreation and education		I don't
The natural beauty		Great; one in my yard

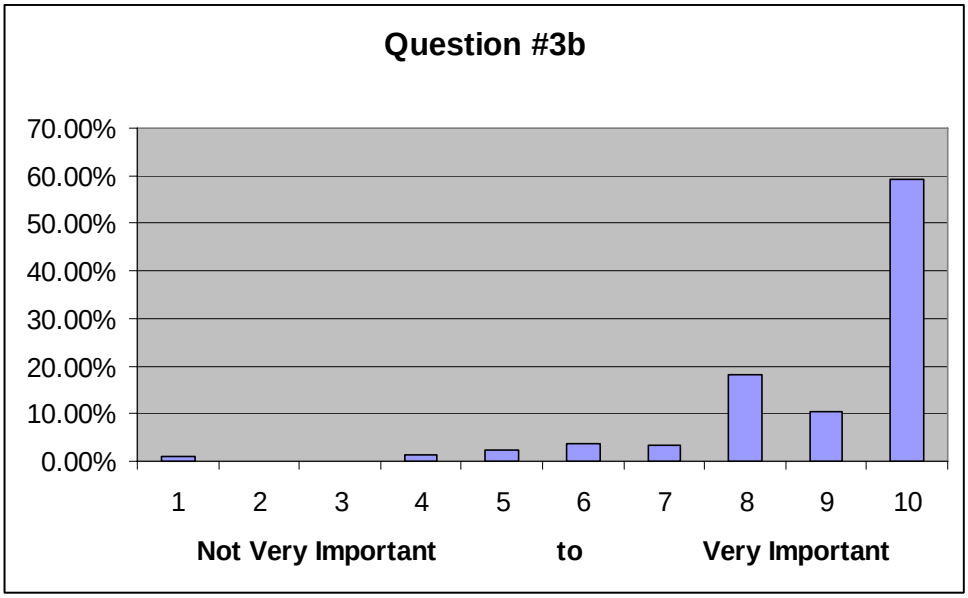
3. I'd like to read you a list of values for Pringle Creek and its tributaries. Using a scale of 0 to 10 with 0 being not very important and 10 being very important, please tell me how important each value is to you personally for Pringle Creek and its tributaries:

(RECORD # FROM 0 - 10, VARY STARTING POINT FOR EACH INTERVIEW)

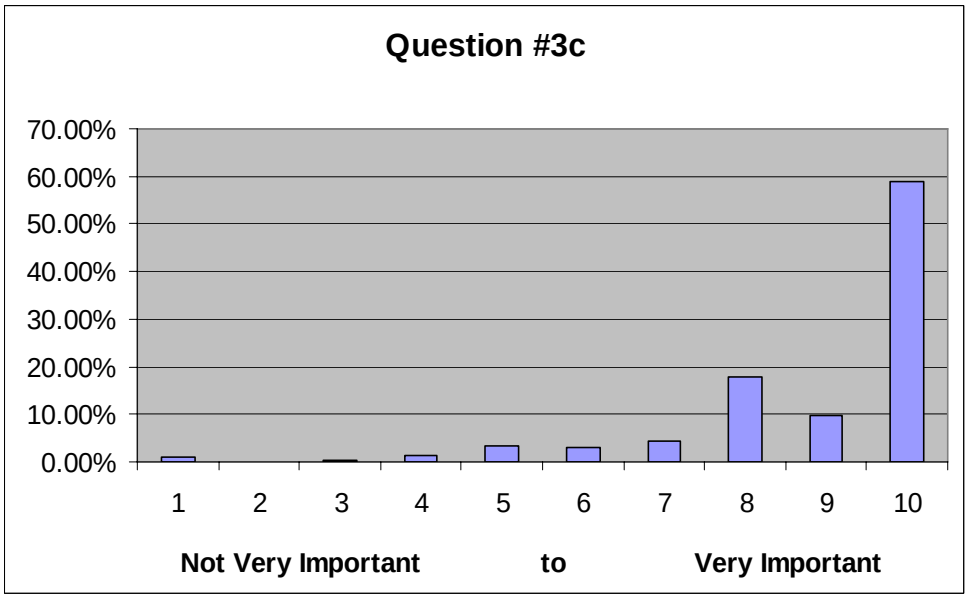
a. Clean Water (Number of responses = 203)



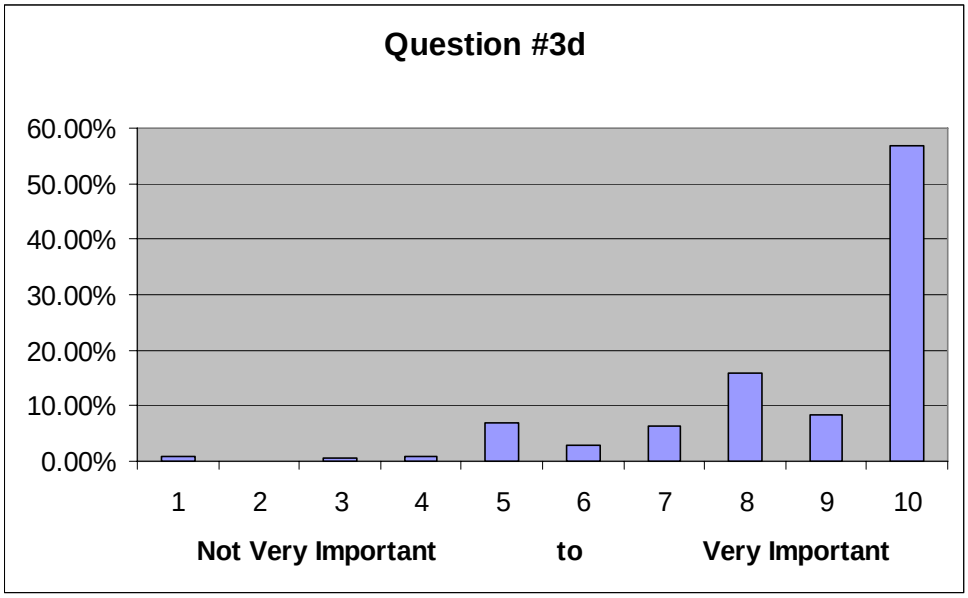
b. Healthy streams that support fish (Number of responses = 208)



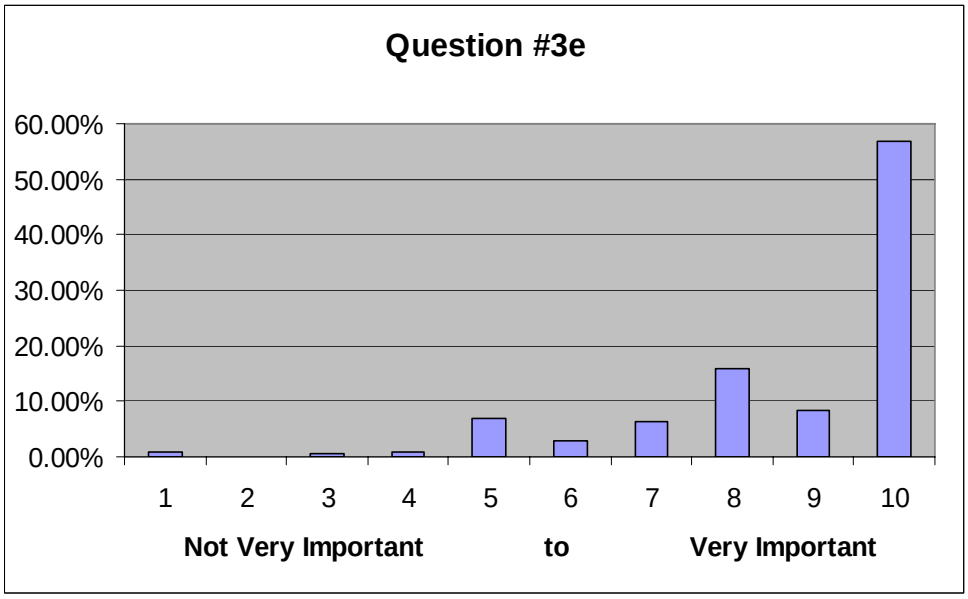
c. Adequate water in streams for fish and wildlife (Number of responses = 207)



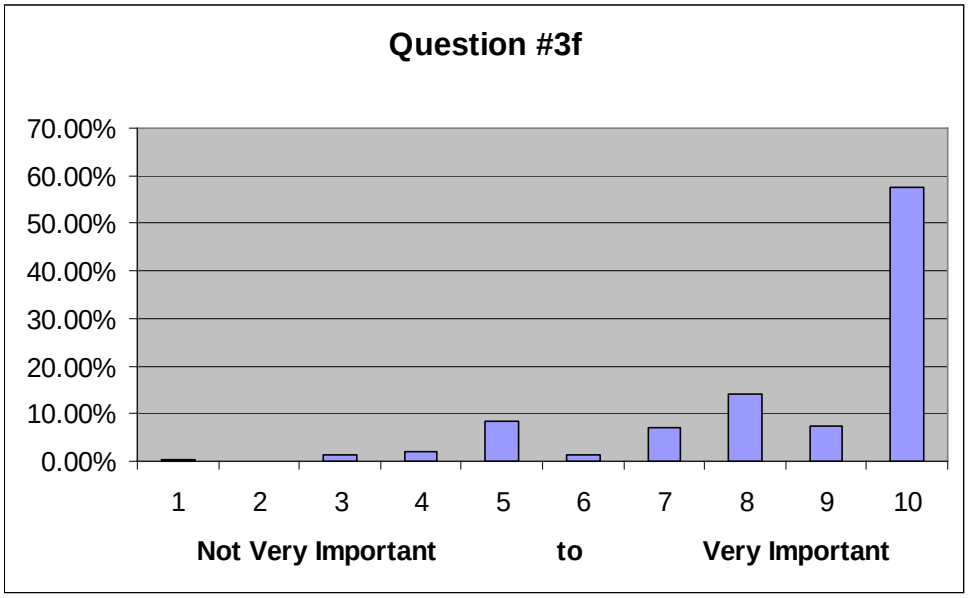
d. Healthy fish populations in local streams (Number of responses = 202)



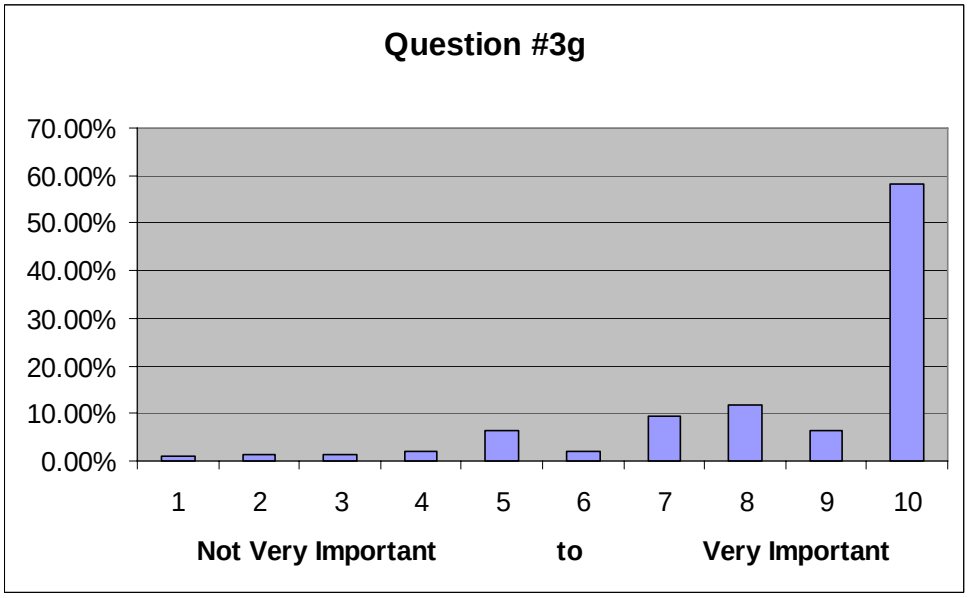
e. Open space for natural areas for fish and wildlife habitat
(Number of responses = 208)



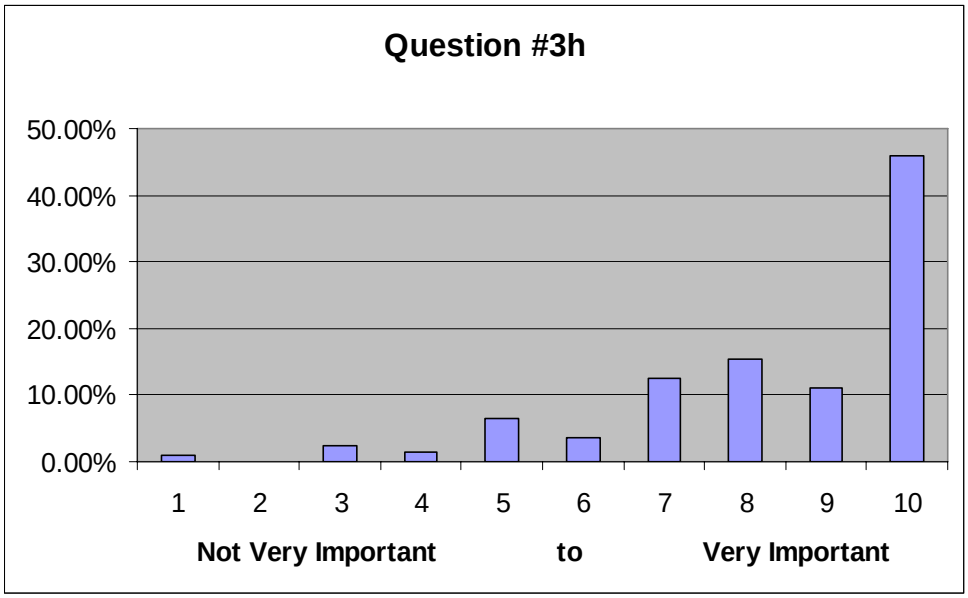
f. Existing wetlands protected (Number of responses = 200)



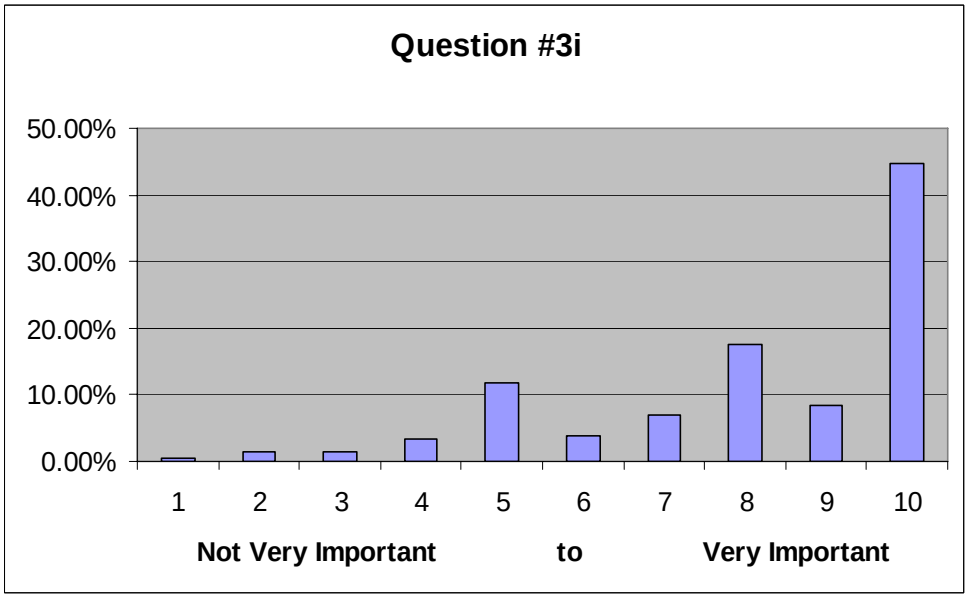
g. Stream side areas protected from development (Number of responses = 203)



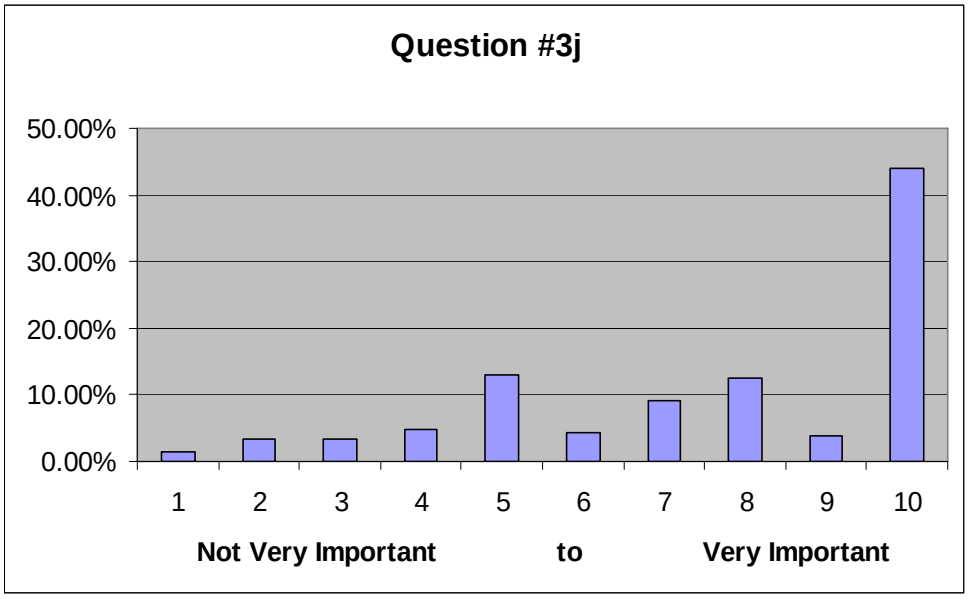
h. Open Space and natural areas for recreation (Number of responses = 200)



i. Property protected from flooding (Number of responses = 204)



j. Private property rights fully protected (Number of responses = 207)



4. I'll read the list again and please tell me which value is the most important? (Number of responses = 207) Second most important? (Number of responses = 203)

Value	Most Important	2nd Most Important
Clean water	52.66%	6.90%
Healthy streams that support fish	8.70%	15.76%
Adequate water in streams for fish and wildlife	4.35%	7.88%
Healthy fish populations in local streams	1.93%	7.88%
Open space and natural areas for fish and wildlife habitat	5.80%	8.87%
Existing wetlands protected	4.35%	8.87%
Stream side areas protected from development	5.80%	14.29%
Open space and natural areas for recreation	3.38%	5.42%
Property protected from flooding	4.35%	8.87%
Private property rights fully protected	8.70%	15.27%

5. What do you see as the biggest potential problem facing Pringle Creek and its tributaries? (CLARIFY ON RESPONSE) (Number of responses = 191)

Category	Number of Responses
Affects of Urbanization	53
Water Quality	9
Development / Land Use Issues	97
Miscellaneous	40

Affects of Urbanization:

Population (10 responses)		People, Industry
People throwing or dumping trash into it (3 responses)		Sewer System Overflow
Pollution (31 responses)		Drainage of pollution
Encroachment of people		Growth
City of Salem not allowing Resident…		Human Impact
People dumping pollutants (Like oil, etc.) on the ground by the creeks		In the middle of an urban area

Water Quality:

Preservation of clean water (3 responses)		Protecting water quality from industrial run-off
No water		Water quality connected to chemicals from lawns
Loss of fish		Enough clean water
Water rats		

Development / Land Use Issues:

Development (81 responses)		Building near streams and creeks
Run-off from surrounding area (7 responses)		People not knowing that run-off goes into the creeks
Over building near creeks (4 responses)		Numerous buildings
Land use issues that restrict land owners, government shouldn't put restrictions		Building next to them, not enough space, they are crowding the creek

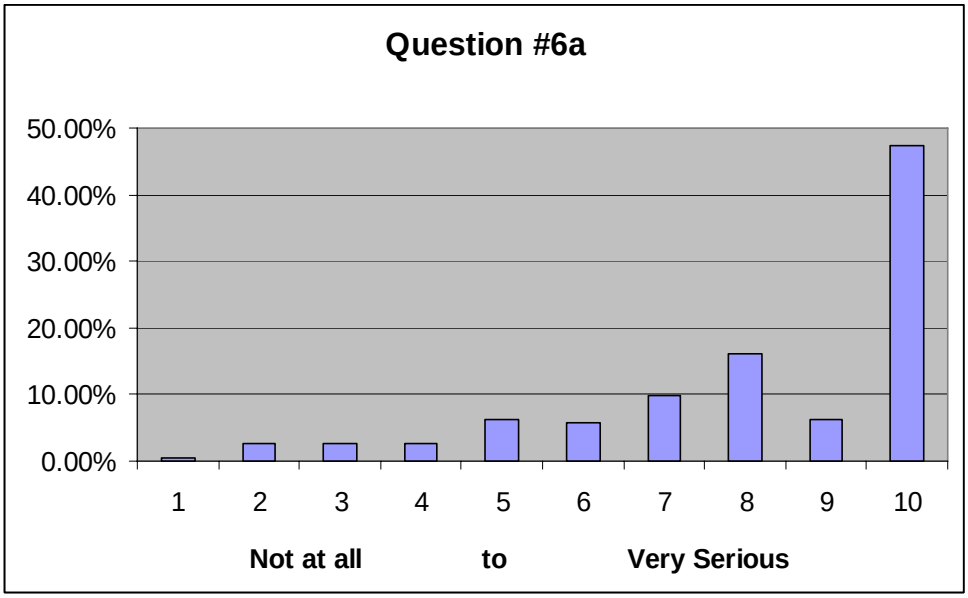
Miscellaneous:

N/A (8 responses)		Not monitored very well
Don' Know / Not Sure (21 responses)		Lack of commitment to project (City Officials)
No longer provide services for stream		Political Squabbles on issue
City Council orientation towards businesses, letting them do what they want to		City of Salem trying to annex due to wanting more money
No problem		The state of the city, they don't care
Measure 49		Polluted and sewage – Why is there sewage in it??
Causing people to pay for unwanted procedures such as watershed changes and mistakes		

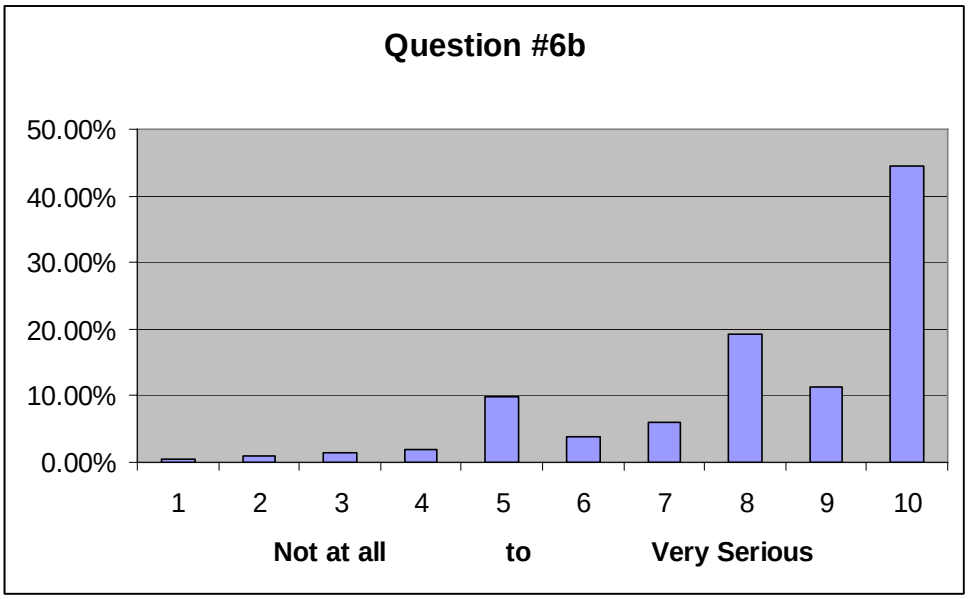
6. Now I'd like to read you a list of things that some people say could create problems for the Pringle Creek Watershed. On a scale of 0 to 10 with 0 being not at all and 10 being very serious, please tell me how serious a threat you believe each one is to Pringle Creek and its tributaries.

(RECORD # FROM 0 - 10, VARY STARTING POINT FOR EACH INTERVIEW)

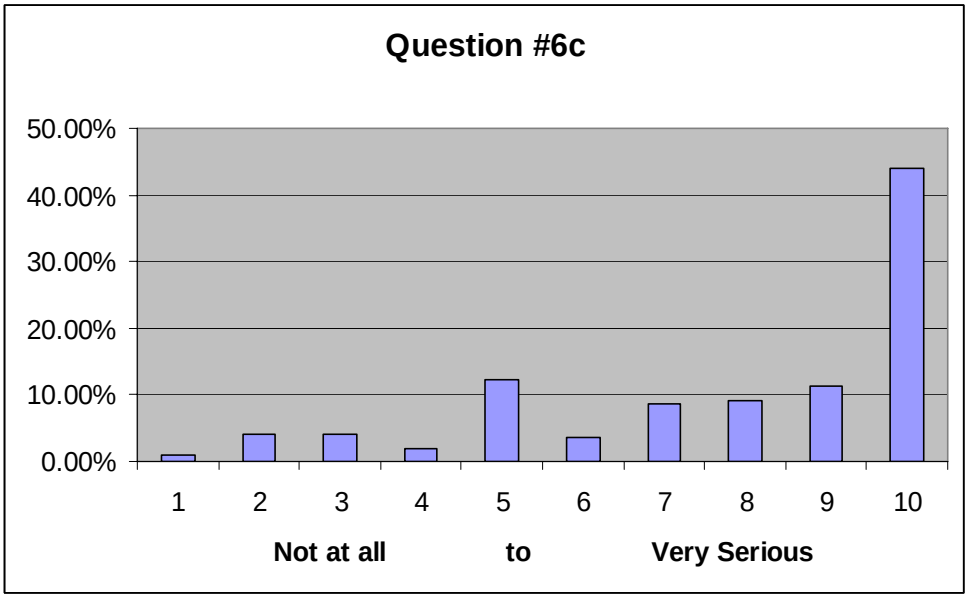
a. Industrial pollution (Number of responses = 192)



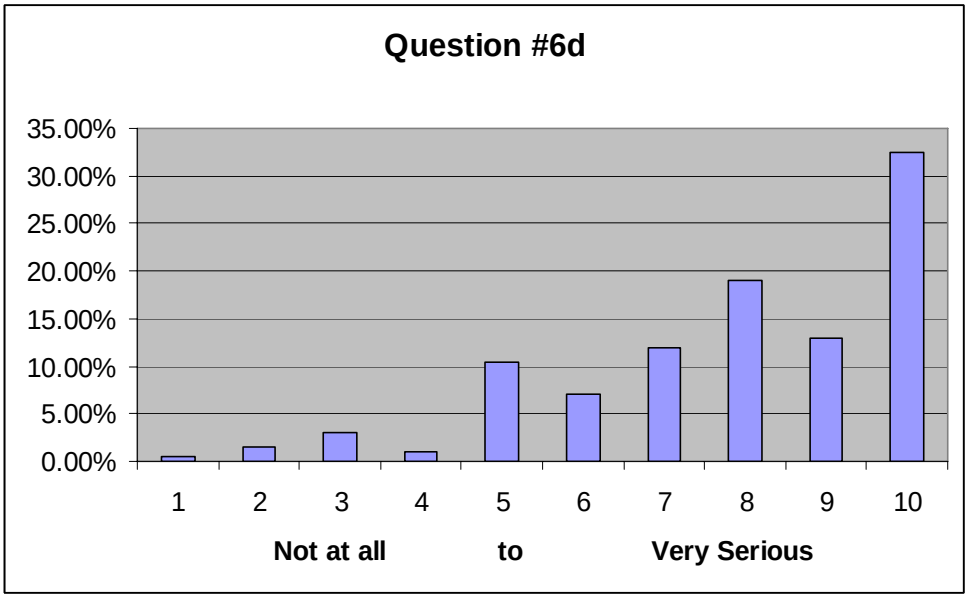
b. Development and buildings too close to creeks and streams
(Number of responses = 202)



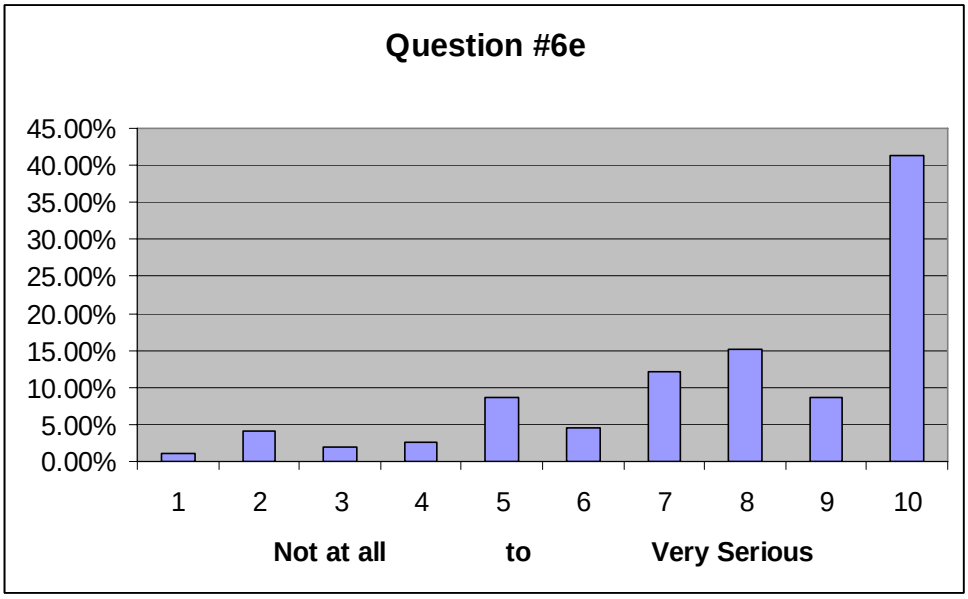
c. Poor or inadequate sewer and septic systems (Number of responses = 196)



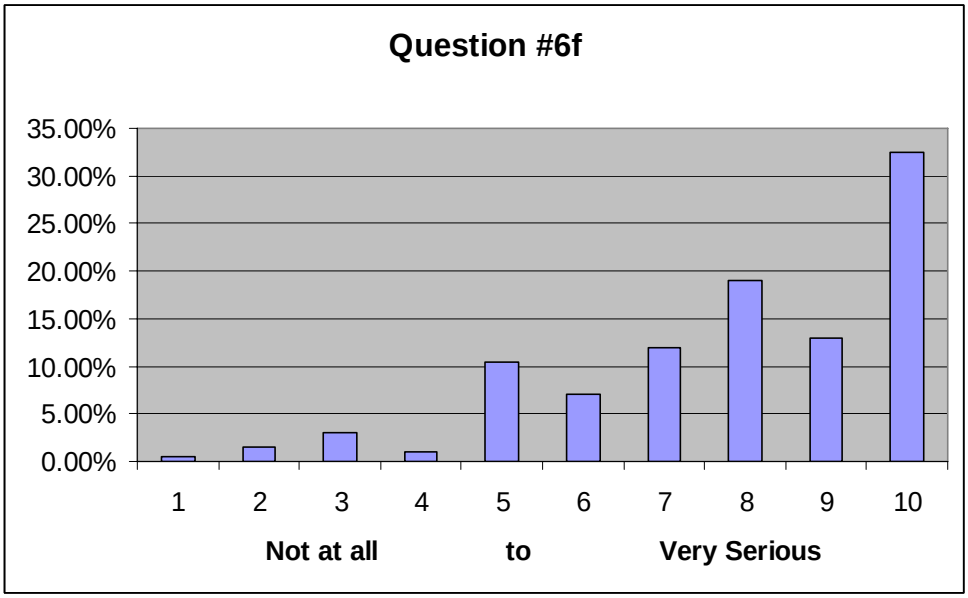
d. Loss of wetlands (Number of responses = 200)



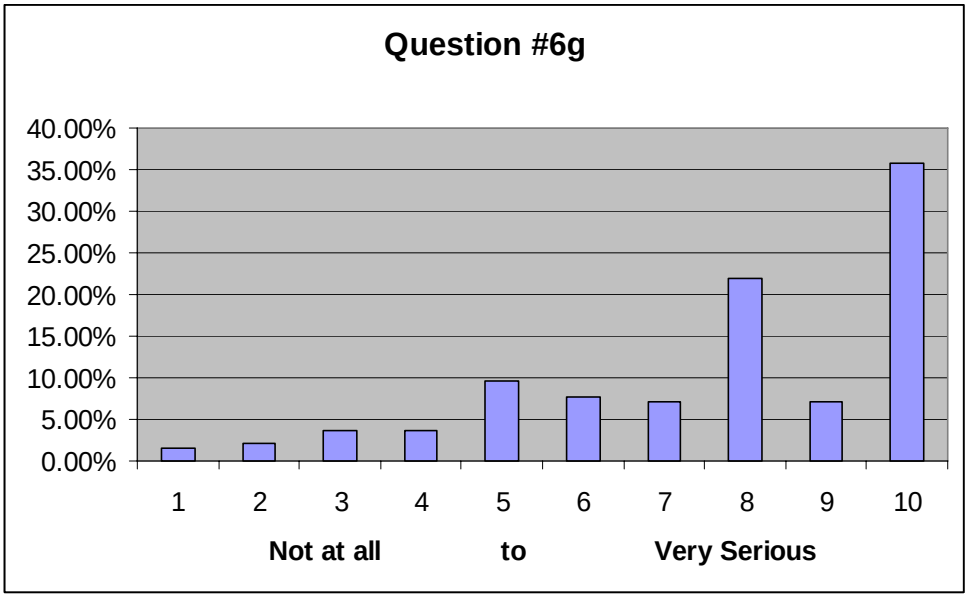
e. Pollution from oil, antifreeze, etc from car repair/ maintenance
(Number of responses = 198)



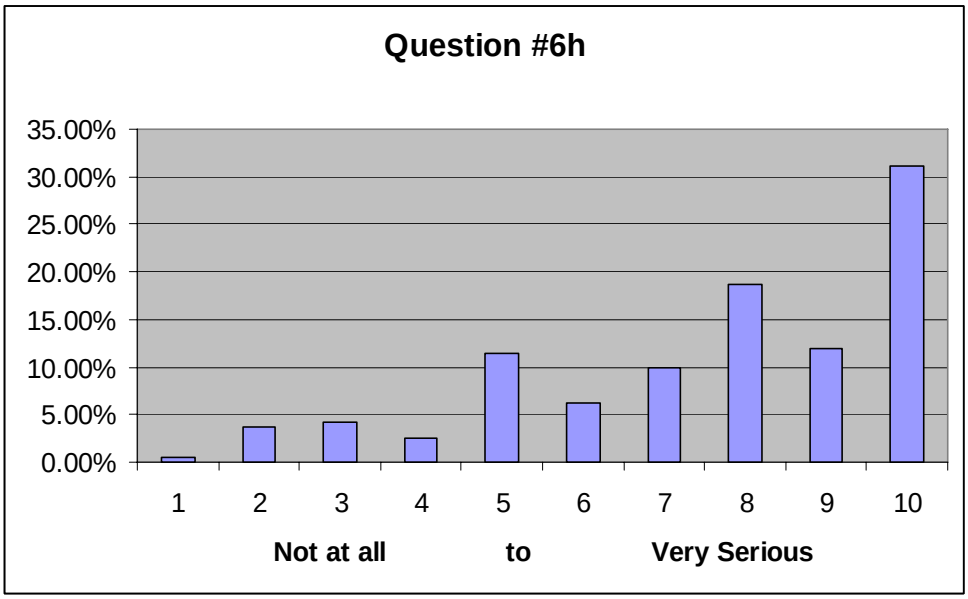
f. Run-off from lawn and garden chemicals (Number of responses = 200)



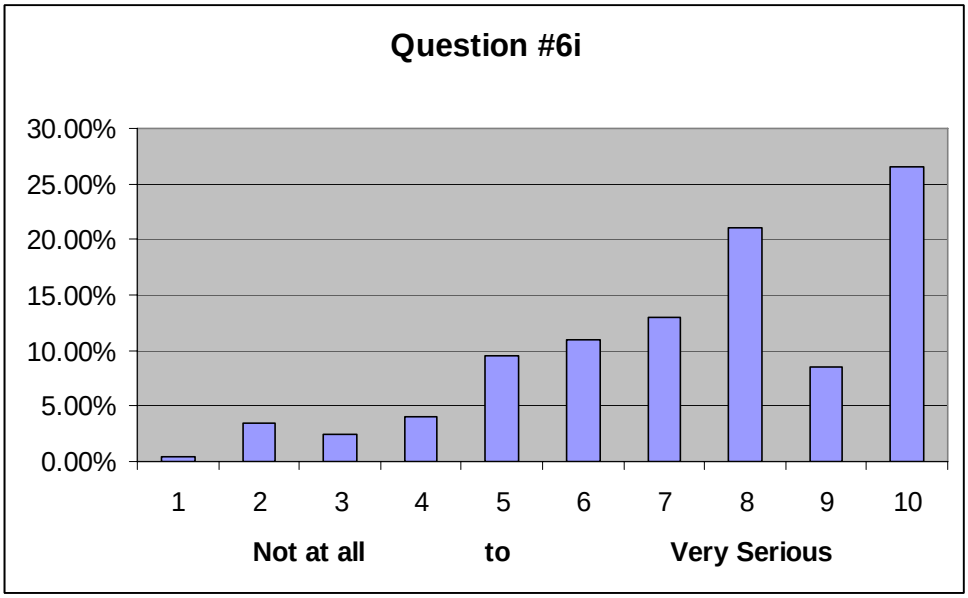
g. Not enough water in streams for fish and wildlife (Number of responses = 196)



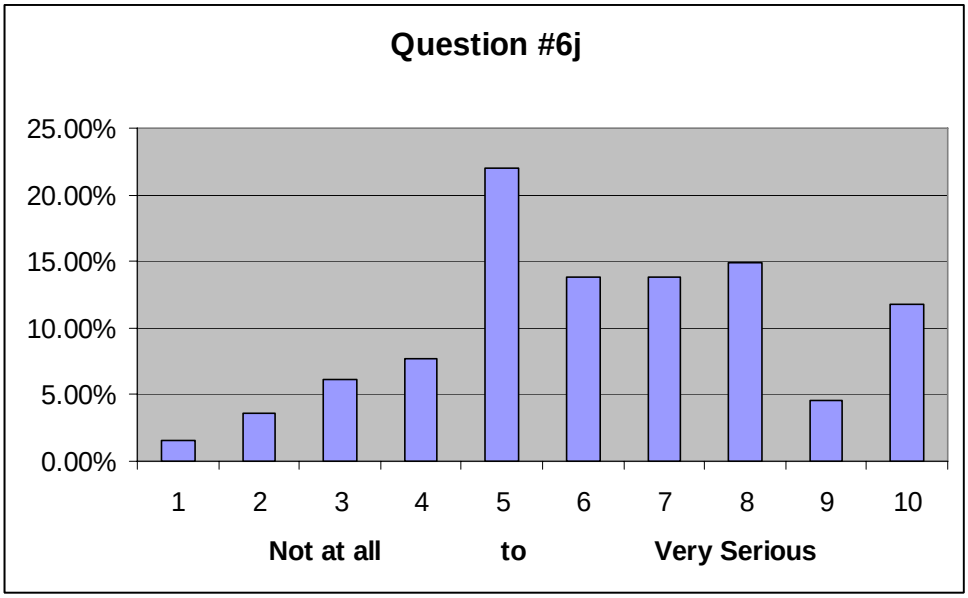
h. Not enough trees shading streams to keep the water cool for fish and plants (Number of responses = 193)



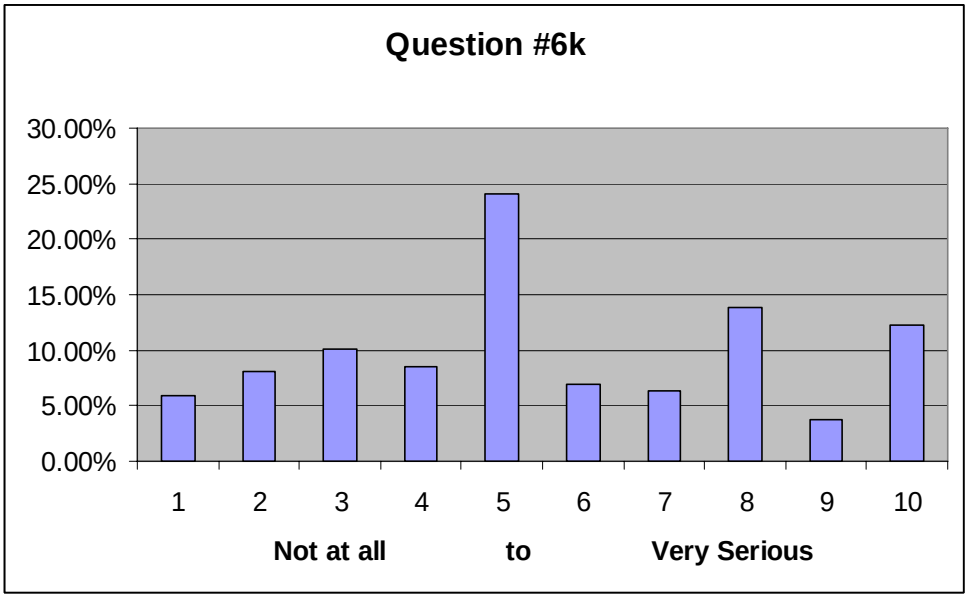
i. Storm water run-off from roads and parking lots (Number of responses = 200)



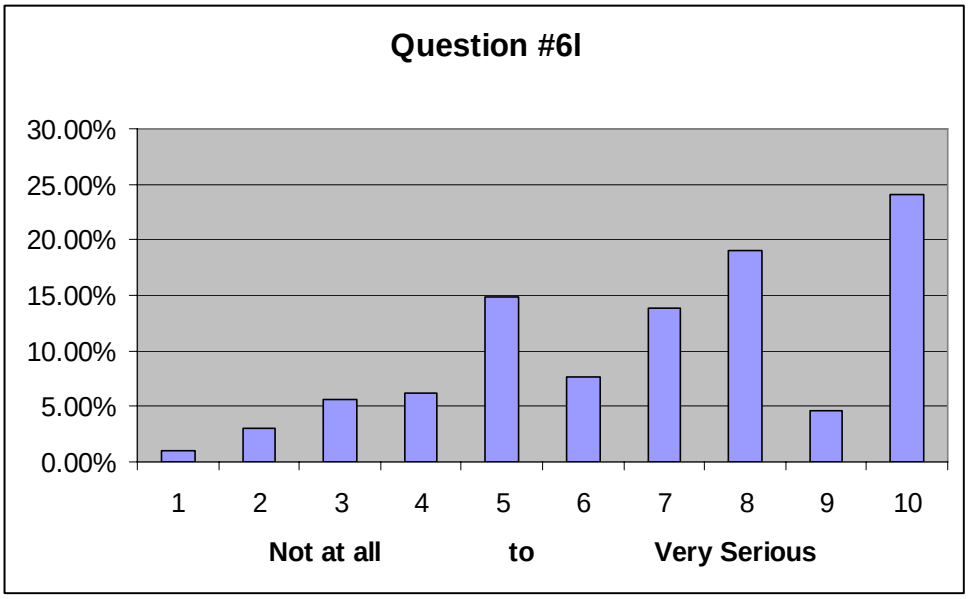
j. Runoff from cars being washed at home (Number of responses =195)



k. Runoff from pet waste (Number of responses = 187)



l. Muddy runoff from construction sites. (Number of responses = 195)



7. In reference to the previous question, which one of these is the biggest problem? (Number of responses = 200) The second biggest problem? (Number of responses = 198)

Problems/ Issues	Biggest Problem	2nd Biggest Problem
Industrial Pollution	32.50%	9.60%
Development/ buildings too close to creeks and streams	23%	19.19%
Poor or inadequate sewer and septic systems	8.50%	13.64%
Loss of wetlands	7%	9.09%
Pollution from oil, antifreeze, etc from car repair/ maintenance	8.50%	6.06%
Run-off from lawn and garden chemicals	9%	9.60%
Not enough water in streams for fish and wildlife	3%	7.58%
Not enough trees shading streams to keep the water cool for fish and plants	2%	6.06%
Storm water run-off from roads and parking lots	4%	7.07%
Runoff from cars being washed at home	0%	1.01%
Runoff from pet waste	.005%	2.02%
Muddy runoff from construction sites.	2%	9.09%

8. The City of Salem, the Pringle Creek Watershed Council, and other organizations are working together to protect the quality of our streams, reduce flood damage, and protect endangered fish. I'm going to read you a list of items. For each one please tell me how much you favor the approach: a lot, somewhat, only a little, or not at all.

Item	A lot	Some what	Only a little	Not at all	Don't Know/ NR
Improve water quality in creeks and streams by planting more trees alongside streams to filter and keep water cool.	144	51	7	5	0
Improve and increase fish and wildlife habitat near streams and creeks.	118	69	14	3	1
Improve the flow of water in streams to make sure there is adequate water supply.	133	61	10	2	0
Increase natural areas and open spaces near streams and wetlands for recreation.	83	85	32	7	2
Make creeks and streams more fish friendly by repairing and removing bridges, culverts, and pipes.	74	83	33	17	4
Improve flood management by re-locating homes and businesses outside of flood zones.	67	63	26	34	8

9. Out of the ideas presented, which one do you favor the most? Which is your 2nd most favorite?

Item	Favor Most	Favor 2nd Most
Improve water quality in creeks and streams by planting more trees alongside streams to filter and keep water cool.	95	19
Improve and increase fish and wildlife habitat near streams and creeks.	32	39
Improve the flow of water in streams to make sure there is adequate water supply.	25	51
Increase natural areas and open spaces near streams and wetlands for recreation.	17	36
Make creeks and streams more fish friendly by repairing and removing bridges, culverts, and pipes.	11	8
Improve flood management by re-locating homes and businesses outside of flood zones.	12	33

10. The average water and sewer bill for most Salem residents is about $90 every two months. About $14 of that bill goes to operating and maintaining the City's storm drainage system, creeks, and waterways. If new things need to be done to protect creeks and streams it may cost more money. Would you be willing to pay and additional $2 every two months to support such activities? $5 every two months? $10 every two months?

	Response – YES	**Response – NO**	**Percentage – YES**	**Percentage - NO**
2$ every 2 months	175	32	84.54%	15.46%
5$ every 2 months	139	68	67.15%	32.85%
$10 every 2 months	69	138	33.33%	66.67%

(Number of responses = 207)

11. How many years have you lived at your current residence? (Number of responses = 175)

	Responses	**Percentage**
3 years or less	0	0.00%
4-9 years	42	24.00%
10-19 years	65	37.14%
20 or more years	68	38.86%

12. Do you rent or own your home? (Number of responses = 204)

	Responses	Percentage
Rent	14	6.86%
Own	190	93.14%
Declined to answer	0	0.00%

13. What is your highest level of education you have had the opportunity to complete? (Number of responses = 186)

	Responses	Percentage
High school or less	55	29.57%
Some college or trade school	17	9.14%
4-year college degree	55	29.57%
Graduate school or more	59	31.72%

14. Which category best describes your age? (Number of responses = 201)

Age	Responses	Percentage
18-24	4	1.99%
25-34	14	6.97%
35-44	38	18.91%
45-54	35	17.41%
55-64	48	23.88%
Over 64	62	30.85%

15. Do you have children under 18 living in your household? (Number of responses = 201)

	Responses	Percentage
YES	71	34.30%
NO	136	65.70%

16. Which of the following categories best describes your total household income before taxes? (Number of responses = 205)

	Responses	Percentage
Less the $30k	19	9.27%
$30k up to $50k	45	21.95%
$50k up to $75k	49	23.90%
$75k up to $100k	32	15.61%
$100k and over	29	14.15%
(don't read) NR	31	15.12%

17. How long have you lived in the City of Salem? (Number of responses = 205)

	Responses	Percentage
0-5 yrs	34	16.59%
6-10 yrs	43	20.98%
11-20 yrs	29	14.15%
More than 20 yrs	98	47.80%
NR	1	0.49%

18. Gender: (Number of responses = 197)

	Responses	Percentage
Male	102	51.78%
Female	95	48.22%

We appreciate your time and participation in our survey. Thank you and have a good day.

Pringle Creek Watershed Management Plan
Website

Pringle Creek Watershed Management Plan

- Overview
    - Salem's urban watershed
    - Pringle Creek pilot
- Goals / objectives
- Watershed map / reaches
- Map of Salem's watersheds

Tour of Pringle Creek

- Watershed map linked with photos

Projects

- Restoration projects, planned or underway

Fish-Finder Trouble Spots

- Fish distribution map

Library (downloadable documents)

- Map of impervious surface
- Impervious area study
- Pringle-Claggett Watershed Assessment
- Monitoring station locations

Find Out More

- Educational materials / "best practices"
- Resources for streambank property owners
- For more information, contact …

Get Involved

- Volunteer programs / sign-ups
- Web survey(s)

Links

- Other City of Salem webpages
- Watershed councils
- Center for Watershed Protection
- Other

Appendix C
2005 Stormwater Management Plan –
Best Management Practices

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The water quality improvement plan for the Pringle Creek watershed relies on the BMP activities set forth by the Stormwater Management Plan (SWMP), which was recently updated in 2005 to satisfy the City of Salem's NPDES MS4 permit requirements. The best management practices (BMPs) included in the SWMP are designed to reduce locally-defined water quality problems and pollutants that may degrade the quality of receiving waters in the permit area. The BMPs are intended to reduce pollutants discharged from the storm drainage system to the "maximum extent practicable" as required by the regulations.

The BMPs are summarized in the following series of tables. The SWMP has 25 BMPs. A separate summary table is provided below for each BMP and presents the BMP objective and general description of the strategy. The strategy is generally a summary of the specific tasks that make up the BMP.

RC1 - Capital Improvements	
BMP Objective:	Identify, prioritize, and implement stormwater-related capital improvements to protect life and property, minimize flood damages, and reflect a balanced perspective between water quantity and quality issues.
Strategy:	With the initial stormwater system improvement projects from the Stormwater Master Plan (2000) identified (focusing on stormwater quantity and conveyance; water quality facilities; stream and habitat enhancements; and stream inventory, monitoring and modeling activities), the City intends to review and update the prioritization of the projects based on information from monitoring, new standards, and additional studies. The prioritization will also occur in conjunction with development of the TMDL (Total Maximum Daily Load) Implementation Plan and watershed assessments planned by the City. The prioritized projects will be implemented based on availability of funding and the urgency of the need, and reviewed annually as part of the CIP process.

RC2 - Stormwater Detention Program	
BMP Objectives:	Ensure that stormwater detention facilities are managed for optimum effectiveness in order to continue to reduce flooding and provide water quality benefits where technically, environmentally and financially feasible and practical.
Strategy:	The Stormwater Master Plan (2000) identified regional detention as a high priority. The City of Salem requires new developments to provide on-site (local) stormwater detention facilities to reduce flooding impacts. Currently, all public and private stormwater detention facilities have been inventoried and are inspected annually. Deficiencies in facilities are corrected, while owners of privately-owned facilities are also provided information outlining responsibilities for proper maintenance. Based on the findings of the regional detention study (2004), the City will not prioritize construction of regional detention facilities, but will continue to explore their feasibility on a case-by-case basis as opportunities arise. With limited opportunities for regional facilities, the City will seek to maximize the water quantity and quality benefits of local detention facilities. The City will also ensure that all local detention facilities (City- and privately-maintained) continue to operate properly.

RC3 - Water Quality Facilities	
BMP Objective:	Commensurate with funding levels, develop and implement a surface water quality facility program to meet the requirements of the NPDES Municipal Stormwater Permit, while integrating the needs of DEQ's TMDL Program, Endangered Species Act, and the water quality needs of the community's urban streams.
Strategy:	Except for high risk or problematic developments, the City does not currently require stormwater water quality facilities to treat stormwater from developed sites and has not adopted standards for water quality facilities. However, the City fully expects to require water quality facilities in the near future under a water quality program that integrates the requirements of NPDES MS4, TMDL, and ESA regulatory programs. To manage the transition and financial implications of these new requirements, the City will focus on first prioritizing those urban watersheds where water quality facilities will be required. The City will also seek opportunities to construct new or retrofit existing facilities where available.

RC4 - Street Sweeping Program	
BMP Description:	Maintain and monitor the current street sweeping program with the goal of cost-effectively improving water quality.
Strategy:	The City has successfully implemented and improved upon its street sweeping program during the course of the permit period. The City will continue the program while conducting regular reviews of its effectiveness and opportunities for improvement.

RC5 – De-icing Activities	
BMP Objective:	Minimize impacts of de-icing activities on stream water quality from stormwater runoff.
Strategy:	A City Master Plan for reconstruction and reorganization of Operational Facilities has been adopted (March 2005), and will be used to ensure proper operation and maintenance activities related to the de-icing program. The City plans to continue the efficient use of sand and Anti-Icer for road and street de-icing activities with respect to application, collection and storage of sanding material, and will continue to seek opportunities to improve its operation through recycling and other storage and application practices. The City will also continue monitoring its facilities for any discharges to the drainage system at its storage facilities.

RC6 – Waterways Protection Program	
BMP Objective:	Develop a uniform and integrated program that works with existing regulations and the results of current and prior scientific studies to increase the level of protection on Salem's natural waterways.
Strategy:	The City will develop a waterway protection program that will include, continue, and expand incentives to private land-owners (residents and businesses) to maintain, enhance, and restore riparian areas. The City has been offering grants to volunteer groups and riparian zone land owners for several years to promote restoration projects. The City will rely on urban waterway assessment projects to prioritize future waterway areas to be included in the program.

RC7 - Operations and Maintenance (O&M) Program	
BMP Objective:	Sustain an adequate level of system operation and maintenance (O&M) to provide effective stormwater management service to City customers and protection of water quality in a cost-effective manner.
Strategy:	The City conducts numerous O&M functions and activities. The City will continue tracking its stormwater-related O&M activities by recording them and updating their databases. With the databases established and regularly being updated, City staff will regularly review their activities to identify opportunities to assess and optimize effectiveness. The City will also work with the owners of privately-maintained stormwater facilities to ensure their proper function and maintenance. O&M practices will also be improved through a review and update of design standards.

RC8 - Alternative Gardening Products	
BMP Objective:	Promote the use of non-polluting alternative gardening products by low volume users of pesticides, herbicides and fertilizers (e.g., household use) through educational programs.
Strategy:	The City's use of brochures focusing on pesticide/herbicide reduction through alternative products and other materials for distribution has been successfully implemented. The City will continue using distribution of such materials and working with nonprofit and nongovernmental organizations to educate the public about alternative gardening products. The City will also continue using the Straub Environmental Learning Center (SELC) as a primary education "hub" to disseminate the information.

RC9 - Modify Land Use Development and Landscape Requirements	
BMP Objective:	Decrease the amount of nutrients, pesticides and herbicides that enter streams, rivers and lakes through modified land use and landscape requirements.
Strategy:	The City has successfully implemented some changes in land use and land development requirements to reduce nutrient, pesticide and herbicide loadings. The focus of these efforts has been on riparian areas, trees, and vegetation. The City plans to review additional land development approaches that address impervious areas, excavation and fill provisions, and other construction practices that may reduce nutrient, pesticide, and herbicide loadings. Furthermore, the City will evaluate how to most successfully implement the program: as standards, through incentives, or as rules (Salem Revised Code, SRC).

RC10 - Public Education and Participation Program	
BMP Objective:	Sustain and enhance community stewardship through stormwater/watershed educational and outreach activities.
Strategy:	The principal objective of the Public Education and Participation Program continues to be to heighten the community's knowledge and awareness of stormwater quantity and quality issues, focusing on the community amenity values of our urban watersheds and streams, and encouraging citizens to assume an active ownership in the quality of our urban surface water environment.

RC11 - Stormwater Management Program Financing	
BMP Objective:	Implement a feasible financing strategy for the timely construction of improvements and satisfactory management of the entire stormwater management program, including adequate operations and maintenance of the stormwater infrastructure system.
Strategy:	The City's recent Stormwater System Development Charge (SDC) Methodology Study will continue to be reviewed and updated as needed to ensure that adequate funding is available to manage stormwater from new developments. The City is planning to pursue the formation of a stormwater utility to allow for a sustainable funding source for capital projects, stormwater operations and maintenance, and program management.

RC13 - Update GIS System	
BMP Objective:	Maintain an up-to-date inventory and mapping of the stormwater drainage system and maintenance activities in an accessible database form to monitor level of service, effectiveness, and to support budgetary requests.
Strategy:	The City will continue updating the GIS and Hansen IMS database and use this information to monitor level of service, effectiveness, and to support budgetary requests.

RC16 - Resource Agency Coordination	
BMP Objective:	Improve coordination and communication among City departments and resource agencies regarding stormwater management activities and activities related to other regulatory programs and requirements including FEMA, COE/DSL, NEPA, TMDL and ESA.
Strategy:	This BMP originally focused only on coordinating water quality improvement measures in areas subject to FEMA and/or COE/DSL Section 404 permits. The City has updated this BMP and has integrated the former BMP *CON3 –NEPA Coordination.* The City continues to experience increased responsibilities with respect to the Clean Water Act (CWA), Endangered Species Act (ESA), and National Environmental Policy Act (NEPA). This BMP now addresses coordination issues associated with these programs including TMDL, NPDES, ESA, and other water quality-related regulatory requirements with the City's MS4 permit requirements. The City has developed programs to address the various environmentally-related requirements under the Clean Water Act and Endangered Species Act. The City will continue to coordinate with resource agencies to review and identify potential water quality oriented measures. Using this information, the City will continue to use the Water Resources Program Manager position to coordinate the integration of the water quality-related requirements for the City's projects.

RC17 - Stormwater Grant Program	
BMP Objective:	Maintain a grant program to assist property owners, businesses and industries in their specific efforts undertaken to clean up stormwater.
Strategy:	The City will continue to maintain the grant program, which was initially intended to create small matching grants for volunteer and educational organizations to create innovative watershed preservation (restoration and/or enhancement) projects, with the intention of expanding the program in relation to available funding. The City will continue to review and update its criteria for selecting projects to optimize the benefits of the program for overall water quality of its MS4 and receiving streams.

RC18 - Program Revisions for Easements	
BMP Objective:	Review and revise as appropriate existing policies, procedures, and easement/right-of way acquisition documents to facilitate the City's physical access to the storm drainage system.
Strategy:	The City will continue to identify facilities for which easements are needed to gain access for maintenance. The City will also review and update a plan, including a priority schedule, for the acquisition of easements.

RC21 - Inventory Private Stormwater Facilities	
BMP Objective:	Inventory private stormwater control facilities (primarily on-site detention facilities, but also water quality facilities) and evaluate their effectiveness to control water quantity and quality.
Strategy:	The City will continue to inventory the private detention facilities and water quality facilities, and update the GIS database. The City will continue conducting inspections of these facilities and provide owners with information on proper maintenance and their responsibilities.

RC23 - School Presentations and Education Outreach	
BMP Objective:	Utilize a variety of educational methods and materials to promote knowledge and understanding of Salem's water supply, stormwater system, water pollution concerns, wastewater system, and water conservation efforts through the elementary and secondary school system.
Strategy:	The City has successfully implemented and coordinated with schools to provide educational opportunities, support, and materials directly to students and for teachers to relate information on to their students. The City will continue to utilize existing educational resources and future opportunities as they develop.

ILLI - Spill Prevention and Response Program	
BMP Objective:	Continue the Spill Prevention and Response Program to reduce the frequency and volume of spills to the stormwater system.
Strategy:	The City's spill response program has been established and is considered effective in minimizing impacts to surface waters resulting from spills and clean-up activities. The City will continue this program and continue to review and improve the program. The City will also continue its City vehicle inspection and maintenance program to minimize leaks from these sources.

ILL2 – Illicit Discharge Elimination Program	
BMP Goal:	Develop and implement an Illicit Discharge Elimination Program (IDEP) to prevent, detect, and control illicit discharges to the stormwater system, including potential infiltration from the sanitary sewer system.
Strategy:	The City will continue its existing illicit discharge elimination program, which involves monitoring, public and permitted facility inspections, and relying on observations/ complaints from staff and the public to identify illicit discharges. The City will continue its response by tracking reports of discharges and the action/response taken by the City. The City will continue to review and update its monitoring information to refine and prioritize locations for its monitoring and inspection program. Finally, the City will continue working with the Watershed Enhancement Team (WET) to provide assistance in reducing illicit discharges from businesses.

ILL4 - Illegal Dumping Control Program	
BMP Goal:	Facilitate efforts to report illegal dumping, illicit connections, and other such incidents, and foster efforts to clean up illegally dumped materials.
Strategy:	The City's illegal dumping program is focused on educational programs and public participation in the Adopt-a-Street and Adopt-a-Stream programs. The City will continue supporting cleanup efforts and providing a hotline for reporting illegal dumping.

ILL5 - No Dump Educational Program	
BMP Objective:	▪ Educate the public about the harmful effects of dumping waste and other potentially harmful chemicals into the storm sewers or drainage ditches /channels. ▪ Support programs that provide convenient means for people to properly dispose of or recycle garbage and other potentially harmful chemicals and waste materials.
Strategy:	The City's illegal dumping program has been effectively providing information and educational materials to the public on the harmful effects of dumping wastes into storm drains, and has also provided means to properly dispose of some wastes. The City will continue with these programs.

ILL6 - Storm Drain Stenciling and Marking Program	
BMP Objective:	Increase public awareness of the direct connection between storm drains and open water.
Strategy:	Continue the storm drain marking program until all storm drains are marked.

ILL7 - Review Enforcement Regulations	
BMP Objective:	Review the language and enforcement of existing regulations that give the City legal authority to prevent and eliminate the improper disposal and discharge of pollutants into storm sewers and drainage ditches/channels.
Strategy:	The City will continue to review and revise City codes and ordinances to address new regulatory requirements, specifically related to TMDL and ESA programs, and coordinate this with the overall stormwater management program.

INDI - Industrial Stormwater Discharge Program	
BMP Objective:	Control the discharge of pollutants to the storm drainage system from existing and developing industries and municipal solid waste facilities
Strategy:	The City's industrial stormwater discharge program focuses on working with industries to ensure that permits are being followed by conducting inspections, providing input to businesses on how to comply, and providing technical information to businesses. The City will also be active with organizations to stay current on recent educational and technical issues and approaches related to addressing industrial stormwater discharges.

CON1 – Construction Site Control Program	
BMP Objective:	Implement and refine the erosion prevention and sediment control program for construction and building sites that are not subject to DEQ's 1200-C permit program.
Strategy:	The City will continue to review and improve upon the stormwater construction site control requirements developed under SRC Chapter 75. The City will continue to train and educate its staff and private engineers, builders, and contractors, and will review and update its guidance handbook for construction site controls.

Appendix D

2000 Drainage System Improvement Plan – Capital Improvement Plan

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City of Salem
Drainage System Improvement Plan

Table 5-2
Battle Creek Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
BCB1		Battle Creek from Commercial St. to I-5	Channelization/ Bioengineering/ Habitat	$ 605,319		FEMA stream LWI implications
BCB2		Battle Creek east from Battle Creek Golf Course to Commercial St.	Channelization/ Bioengineering/ Habitat; Remove/upsize small culverts on Battle, Scotch, and Powell Creeks	$ 2,176,850		FEMA stream
BCB3		Battle Creek crossing Fairway Ave.	Bridge	$ 297,500	Yes	FEMA stream, G.O. Bond F Bridge Project (2000-01)
BCB4		Battle Creek from Sunnyside Rd. to Battle Creek Golf Course	Channelization/ Bioengineering/ Habitat; Place berm along Sunnyside to prevent over-topping of road near Pawnee Circle	$ 1,431,060		FEMA stream
BCB5		Cinnamon Creek from Rees Hill Rd. to confluence w/ Battle Creek	Channelization/ Bioengineering/ Habitat; Replace undersized culvert	$ 484,755		Proposed neighborhood park upstream
BCB6		Powell Creek from Meriweather Ct. to 220 ft east of Doral Dr.	Replace undersized culvert; Channelization/ Bioengineering/ Habitat; Bridge	$ 600,236		FEMA stream, LWI implications
BCB7		Powell Creek from Sunnyside Rd. to 13th Ave.	Bridge; Channelization/ Bioengineering/ Habitat; Add parallel culvert	$ 973,828		FEMA stream, LWI implications
BCB8		Powell Creek crossing Elkins Way	Replace undersized culvert	$ 12,325		
BCB9		Scotch Creek crossing of Rees Hill Rd.	Channelization/ Bioengineering/ Habitat	$ 424,320		
BCB10		Scotch Creek crossing Sunnyside Rd.	Replace undersized culvert	$ 51,340		
BCB11		Waln Creek from Madras St. to Battle Creek	Channelization/ Bioengineering, Replace 2 small culverts	$ 1,161,100		FEMA stream
BCB12		Waln Creek crossing Madras St.	Bridge	$ 297,500		FEMA stream
BCB13		Waln Creek from Wiltsey Rd. to Madras St.	Bridge; Channelization/ Bioengineering/ Habitat	$ 808,010		FEMA stream
BCB14		Waln Creek from Woodside Dr. to Wiltsey Rd.	Channelization/ Bioengineering/ Habitat	$ 994,500		Partial USA project
BCB15		Drainage system crossing Fabry, tributary to Waln Creek	Replace undersized culvert	$ 14,790		Partial USA project
BCB16		Waln Creek from Shannon to Woodside Dr.	Channelization/ Bioengineering/ Habitat	$ 1,306,110		
BCB17		Waln Creek crossing Fabry Rd.	Bridge	$ 297,500		
BCB18		Waln Creek between 7th Ave. and Sunnyside Rd.	Channelization/ Bioengineering/ Habitat	$ 191,250		
BCB19		Waln Creek crossing pedestrian path north of Springwood Ave.	Replace undersized culvert	$ 51,680		
BCB20		Intersection of Holder Lane and Lone Oak Rd.	Replace undersized culvert; Channelization/ Bioengineering/ Habitat	$ 296,276		
BCB21		Jory Creek at Liberty Rd.	Detention Facility: Jory Creek at Liberty	$ 993,650	Yes	Proposed community park NE

City of Salem
Drainage System Improvement Plan

Table 5-2
Battle Creek Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
BCB22		Battle Creek at Liberty/Bates Road	Detention Facility: Liberty/Bates	$ 1,575,900	Yes	
			Subtotal	**$ 15,045,799**	**-**	
			Small conveyance improvement allowance	**$ 752,290**	-	This allowance is 5% of the subtotal.
			Total ($)	**$ 15,798,089**		

1. INCLUDES ALLOWANCES FOR PERMITTING, ACQUISITION, PREDESIGN, AND FINAL DESIGN (15%), ADMINISTRATION (6%), CONSTRUCTION MANAGEMENT (9%) AND CONTINGENCY (40%).

City of Salem
Drainage System Improvement Plan

Table 5-3
Croisan Creek Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
CCB1		Croisan Creek railroad crossing, 2600 block South River Road.	Bore/Jack 3 new culverts under railroad; Remove weir near railroad	$ 1,467,440		FEMA stream, remove weir as "early action"
CCB2		Croisan Creek at 2611 South River Rd.	Replace culvert w/ Bridge	$ 297,500		FEMA stream
CCB3		2600 Block South River Rd.	Replace undersized pipe	$ 45,356	Yes	Street CIP G.O. Bond F (2000-01)
CCB4		Croisan Creek at 2900 Block South River Rd.	Replace Culvert w/ Bridge	$ 297,500		FEMA stream
CCB5		Golf Course Rd. at South River Rd.	Replace undersized pipe and ditch system	$ 127,687	Yes	Partial Street CIP G.O. Bond (2000-01)
CCB6		Croisan Creek between Croisan Creek Rd. and Golf Course Rd.	Channelization/ Bioengineering/ Habitat	$ 648,635		FEMA stream
CCB7		Croisan Creek Rd. at South River Rd.	Replace undersized culvert	$ 30,689	Yes	Street CIP G.O. Bond F (2000-01)
CCB8		Croisan Creek Rd. at South River Rd.	Replace undersized box culvert	$ 297,500		FEMA Stream, Street CIP (2004-05)
CCB9		Croisan Creek, South of River Rd. West of Croisan Creek Rd.	Remove weir	$ 85,000		FEMA Stream , water rights considerations
CCB10		Croisan Creek at 3281 Croisan Creek Rd.	Bridge	$ 467,500		FEMA Stream, Street CIP (2004-05)
CCB11		Croisan Creek, Spring St. to Madrona Ave.	Channelization/ Bioengineering/ Habitat	$ 1,148,316		FEMA Stream, Street CIP (2004-05)
CCB12		Croisan Creek at Roberta Ave. South	Bridge	$ 297,500		FEMA Stream
CCB13		Croisan Creek at 4451 Croisan Creek Road to Spring St.	Channelization/ Bioengineering/ Habitat	$ 1,726,775		FEMA Stream, LWI implications
CCB14		Croisan Creek at Kuebler Rd.	Kuebler Rd. Detention Facility	$ 1,360,000	Yes	FEMA Stream, regional detention facility, proposed neighborhood park south
CCB15		Croisan Creek at Ballyntine Rd. S.	Install additional culvert	$ 49,470		Currently Marion County
			Subtotal	$ 8,346,868	-	
			Small conveyance improvement allowance	$ 417,343	-	This allowance is 5% of the subtotal.
			Total ($)	**$ 8,764,212**		

1. INCLUDES ALLOWANCES FOR PERMITTING, ACQUISITION, PREDESIGN, AND FINAL DESIGN (15%), ADMINISTRATION (6%), CONSTRUCTION MANAGEMENT (9%) AND CONTINGENCY (40%).

City of Salem
Drainage System Improvement Plan

Table 5-4
East Bank Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
EBB1		Columbia Ave between Front St and Liberty St	Replace undersized pipe	$ 182,410		Sinkhole observed
EBB2		Hickory St between the Willamette River and 4th St	Replace undersized pipe	$ 259,318		
EBB3		Parallel to Riviera Dr between the Willamette River and Maple Ave	Replace undersized pipe	$ 718,395	Yes	Bad pipe. Street CIP G.O. Bond F (2000-01)
EBB4		Liberty St. between Riviera Dr and Tryon Ave	Replace undersized pipe	$ 253,351		
EBB5		Intersection of Hickory St and Commerical St to intersection of Johnson St and Church St	Replace undersized pipe	$ 464,831	Yes	Street CIP G.O. Bond F (2000-01), Sinkhole near railroad.
EBB6		On Locust St and Maple St between Johnson and Laurel St	Replace undersized pipe	$ 200,779		Cracked pipes
EBB7		Norway St between Commercial St and Fairgrounds Rd	Replace undersized pipe	$ 780,147	Yes	Sinkhole reported. On-going maintenance problems, bad pipe.
EBB8		Fairgrounds Rd between Winter St and Capital St	Replace undersized pipe	$ 303,739		
EBB9		From Fairgrounds Rd and Norway St to Baker St, along Baker to Market St and east to 16th St	Replace undersized pipe	$ 1,143,395		Flooded basements reported. Cracked pipe, heavy roots.
EBB10		Hickory St between the Willamette River and Commercial St	Replace undersized pipe	$ 202,300		
EBB11		On Salem Pkwy between Commercial and Broadway	Replace undersized pipe	$ 349,690		
EBB12		Donna St between Highland Av and Fairgrounds Rd	Replace undersized pipe	$ 251,923		Rocks in pipe
EBB13		Sunnyview Ave between Warner St and 16th St	Replace undersized pipe	$ 77,155		Bad joints, cracked pipe
EBB14		Stark St between Willamette Dr and North River Rd.	Replace undersized pipe	$ 338,360		Heavy roots, cracked pipe
EBB15		Stark St crossing River Rd and Broadway	Replace undersized pipe	$ 95,795		
EBB16		Gaines St between the Willamette River and Front St	Replace undersized pipe	$ 32,292		
EBB17		From Front St and Gaines east to 15th and Nebraska	Replace undersized pipe	$ 1,768,969		
			Subtotal	$ 7,422,846	-	
			Small conveyance improvement allowance	$ 371,142	-	This allowance is 5% of the subtotal.
			Total ($)	**$ 7,793,988**		

City of Salem
Drainage System Improvement Plan

Table 5-4
East Bank Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments

1. INCLUDES ALLOWANCES FOR PERMITTING, ACQUISITION, PREDESIGN, AND FINAL DESIGN (15%), ADMINISTRATION (6%), CONSTRUCTION MANAGEMENT (9%) AND CONTINGENCY (40%).

City of Salem
Drainage System Improvement Plan

Table 5-5
Glenn Gibson Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
GGB1		Wallace Road north of Rogers Lane	Replace undersized pipe	$ 287,145		New ODOT system, monitor performance
GGB2		Rogers Lane	Replace undersized pipe; Replace undersized flow-equalizing culvert	$ 378,701		Currently being designed. Bad pipe, properties flooded.
GGB3		Gibson Creek at Doaks Ferry Rd.	Bridge	$ 297,500		FEMA stream
GGB4		Gibson Creek at Brush College Rd.	Bridge; Replace undersized culverts	$ 359,346	Yes	FEMA stream. Brush College street CIP G.O. Bond F (2001)
GGB5		Drainage system from Wintergreen and Brush College to Gibson Creek	Replace undersized pipe	$ 211,990	Yes	Brush College street CIP G.O. Bond F (2001)
GGB6		Drainage system along Wilark Dr.	Replace undersized culvert	$ 261,188		West Salem USA?
GGB7		Culvert across Doaks Ferry Road north of Brush College Rd.	Replace undersized culvert	$ 20,953		West Salem USA?
GGB8		Culvert across Orchard Heights, east of Grice Hill Rd. Draining to Gibson Creek.	Replace undersized culvert	$ 71,859		
GGB9		Glenn Creek crossing of Harritt Dr. 200 ft west of Wallace Rd.	Bridge	$ 297,500		FEMA stream
GGB10		Culvert crossing Harritt Dr.	Replace undersized culvert	$ 47,090		Partnership with private development
GGB11		Culvert across Linwood St.	Replace undersized culvert	$ 52,207		LWI implications
GGB12		Glenn Creek crossing of Orchard Heights Rd..	Bridge; Channelization/ Bioengineering/ Habitat	$ 629,000		FEMA stream
GGB13		Glenn Creek upstream of Orchard Heights Rd.	Channelization/ Bioengineering/ Habitat	$ 739,245		FEMA stream, LWI implications
GGB14		Pipe along Glenn Creek road east of Windemere Dr.	Replace undersized pipe	$ 57,086		
GGB15		Glenn Creek crossing of Glenn Creek Rd.	Bridge	$ 297,500		FEMA stream
GGB16		System draining to Glenn Creek from the intersection of Ptarmigan and Doaks	Replace undersized pipe	$ 128,920		West Salem USA?
GGB17		Culvert under Doaks Ferry Rd. 600 ft east of Mogul St.	Replace undersized culvert	$ 40,664		Overtopped in 1996
GGB18		Hidden Valley Detention Facility: Glen Creek just upstream of Glen Eden Ct	Add detention facility	$ 3,825,850	Yes	FEMA stream, outside UGB in Polk County
GGB19		Gladow Pond: Gibson Creek upstream of Orchard Hts. Rd.	Add detention facility at Gladow Pond, or at pond approx. 1000 ft downstream	$ 1,013,200		Outside UGB in Polk County
GGB20		Orchard Heights Park	Add detention facility	$ 1,079,500		FEMA stream
GGB21		Grice Hill Road crossing-South	Add detention facility	$ 986,850	Yes	
GGB22		Grice Hill Road crossing-North	Add detention facility	$ 1,473,900	Yes	

City of Salem
Drainage System Improvement Plan

Table 5-5
Glenn Gibson Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
GGB23		Holiday Tree Farm Pond	Add detention facility	$ 724,200		Outside UGB in Polk County
			Subtotal	**$ 13,281,393**	**-**	
			Small conveyance improvement allowance	**$ 664,070**	-	This allowance is 5% of the subtotal.
			Total ($)	**$ 13,945,462**		

1. INCLUDES ALLOWANCES FOR PERMITTING, ACQUISITION, PREDESIGN, AND FINAL DESIGN (15%), ADMINISTRATION (6%), CONSTRUCTION MANAGEMENT (9%) AND CONTINGENCY (40%).

City of Salem
Drainage System Improvement Plan

Table 5-6
Little Pudding Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
LPB1		Lake Labish Rd NE, North of Hazel Green Rd.	Replace undersized culvert; Channelization/ Bioengineering/ Habitat	$ 951,745		Currently Marion County, LWI implications
LPB2		Crossing Hazel Green Rd. NE	Bridge	$ 467,500		LWI implications
LPB3		Crossing Manning Dr.NE and Kale Rd. NE	Bridges	$ 595,000		
LPB4		Between Kale Rd. NE and Hazel Green Rd. NE	Replace undersized culvert; Channelization/ Bioengineering/ Habitat	$ 1,292,000		Proposed large urban park. LWI implications
LPB5		South of Settlers Dr. NE, Flintlock to Siesta	Replace undersized pipe	$ 718,403		
LPB6		Crossings of Hayesville, Jan Ree and Rebecca NE	Replace undersized culverts	$ 238,493		
LPB7		South of Hayesville Dr. NE	Replace undersized culvert	$ 447,083	Yes	Proposed neighborhood park. Localized flooding.
LPB8		Along Cordon Rd. NE, south of Hayesville Dr.	Replace undersized pipe	$ 299,982		
LPB9		Along Cordon Rd. NE, between Hayesville Rd. and Silverton Rd.	Replace undersized culvert; Channelization/ Bioengineering/ Habitat	$ 2,937,408		Proposed neighborhood park, LWI implications
LPB10		Herrin Rd. NE, west of Cordon Rd.	Replace undersized pipe	$ 284,665		
LPB11		Cordon Rd. NE, south of Silverton Rd.	Bridge	$ 1,020,000		
LPB12		From Indiana/Muncie to Mooreland/Mendocino NE	Replace undersized culvert; Channelization/ Bioengineering/ Habitat	$ 1,074,825		
LPB13		Oak Park Dr./ Cordon Rd.	Channelization/ Bioengineering/ Habitat	$ 1,114,520		1996 flooding
LPB14		Carolina NE south, east of San Diego	Channelization/ Bioengineering/ Habitat; Bridge	$ 912,764		
LPB15		Culverts at Sunnyview/Brown, 47th Ave/Cedro Loop	Replace undersized culverts	$ 251,498		
LPB16		East side of Salem Academy	Replace undersized culvert	$ 69,700		Possibly remove culvert?
LPB17		Center St. at Citation NE	Replace undersized culvert	$ 193,630		
LPB18		Culverts at Hudson NE, Eldin NE, State St., , Channel improvements East of Evelyn, north of Hudson	Replace undersized culvert; Channelization/ Bioengineering/ Habitat	$ 481,491		
LPB19		East of Elma, Macleay to Durbin and along Durbin SE to Beck	Replace undersized pipe	$ 534,650		
LPB20		Carolina NE at Cordon Rd.	Replace undersized culvert; Channelization/ Bioengineering/ Habitat	$ 673,540		LWI implications
LPB21		Swegle west of Royalty Dr. and west end of Future Dr. NE	Replace undersized culverts	$ 120,598		Swegle street CIP G.O. Bond F (2000-01)

City of Salem
Drainage System Improvement Plan

Table 5-6
Little Pudding Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
LPB22		Regal Dr NE, Camelot Dr NE, Kingdom Way NE, Squire Ct. NE	Replace undersized pipe	$ 1,077,018		
LPB23		South of Auburn Rd. and Cordon Rd. to Cordon Rd. north of Center St.	Replace undersized culvert; Replace undersized pipe; Channelization/ Bioengineering/ Habitat	$ 893,172		Proposed large urban park upstream, LWI implications
LPB24		From 46th and Mahrt to East of Clearwater and Avens	Replace undersized culvert; Replace undersized pipe	$ 788,197		
LPB25		Cordon Rd at Powderhorn and north of Arrowood Ct. SE	Replace undersized culvert; Channelization/ Bioengineering/ Habitat	$ 512,074		
LPB26		Wagon SE to Pennsylvania at Cordon Rd.	Replace undersized culvert; Channelization/ Bioengineering/ Habitat	$ 644,385		Localized flooding, LWI implications
LPB27		West of Seattle Slew Dr SE and across Clydesdale Dr SE	Replace undersized culvert; Channelization/ Bioengineering/ Habitat	$ 307,972		LWI implications
LPB28		Highway 22, west of Kuebler/Cordon	Replace undersized culvert	$ 387,974		ODOT, LWI implications
LPB29		Crossing Arabian Ave SE and the East end of Red Cherry Ct. SE	Replace undersized pipe	$ 201,144		
LPB30		West end of Red Cherry, Black Cherry Ct.	Replace undersized pipe	$ 121,669		
LPB31		Highway 22 and Campbell St. SE	Replace undersized culvert	$ 379,304	Yes	ODOT, LWI implications. Localized flooding.
LPB32		Across Kuebler/Cordon at HWY 22 and at the SW corner of HWY 22 and Kuebler/Cordon	Replace undersized culvert; Channelization/ Bioengineering/ Habitat	$ 424,618		Corrections Farm Redevelopment
LPB33		Buckhorn/Burntwood and 49th Ave. /Burntwood	Replace undersized pipe	$ 503,719		Localized flooding
LPB34		Shenandoah Dr. SE, 49th/Adobe, 48th Ct. SE	Replace undersized culvert; Replace undersized pipe	$ 894,387		Localized flooding
LPB35		Rickey to Macleay SE, Pennsylvania Ave SE, 46th to 47th Ave SE	Replace undersized pipe	$ 913,980		
LPB36		Cordon at Caplinger Rd. SE	Bridge	$ 467,500		LWI implications, downstream flooding
LPB37		East of Macleay Rd. between Cordon and Caplinger	Channelization/ Bioengineering/ Habitat	$ 1,088,553		LWI implications
LPB38		Macleay Rd. SE	Bridge	$ 297,500		LWI implications
LPB39		Macleay and Cordon Rd.	Channelization/ Bioengineering/ Habitat	$ 324,615		LWI implications
LPB40		Cordon at Macleay	Replace undersized culvert	$ 75,990		LWI implications
LPB41		Cordon Rd. at Gaffin and south of Gaffin	Replace undersized culvert; Channelization/ Bioengineering/ Habitat	$ 772,225		Correction Farm Redevelopment
LPB42		South of Highway 22 and east of Cordon Rd.	Channelization/ Bioengineering/ Habitat	$ 1,390,643		Corrections Farm Redevelopment, proposed large urban park

City of Salem
Drainage System Improvement Plan

Table 5-6
Little Pudding Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
LPB43		Near Arabian Ave. and crossing Macleay Rd. west of 49th	Replace undersized culverts	$ 810,815		Proposed neighborhood park
LPB44		Indiana Ave NE, west of 49th, Glendale Ave NE, Oak Park Dr NE, and Greenbrook Dr. NE	Bridges	$ 1,190,000		
			Subtotal	**$ 29,146,945**	**-**	
			Small conveyance improvement allowance	$ 1,457,347	-	This allowance is 5% of the subtotal.
			Total ($)	**$ 30,604,293**		

1. INCLUDES ALLOWANCES FOR PERMITTING, ACQUISITION, PREDESIGN, AND FINAL DESIGN (15%), ADMINISTRATION (6%), CONSTRUCTION MANAGEMENT (9%) AND CONTINGENCY (40%).

City of Salem
Drainage System Improvement Plan

Table 5-7
Mill Creek Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
MCB1		Turner Rd. north of I-5	Channelization/ Replace undersized culverts	$ 2,751,630		Impacted by Mill Creek overflows
MCB2		Turner Rd. South of Mission St.	Channelization/ Replace undersized culverts	$ 2,111,352		Turner Rd. CIP (2004-05). Impacted by Mill Creek overflows. Possibly divert high flows back to Mill Creek or Shelton Ditch.
MCB3		Mission St. SE from Airport to 20th St.	Replace undersized culverts	$ 2,738,513		ODOT coordination. Possibly divert high flows to Shelton Ditch.
MCB4		Along Airport Rd. and Ryan Dr. from Mission St. to Shelton Ditch	Replace undersized culverts	$ 731,029	Yes	Airport Rd. CIP G.O. Bond F (2000-01). May need to further upsize if Turner Rd. flows are diverted.
MCB5		NE quadrant of I-5/Highway 22 interchange	Channelization/ Replace undersized culverts	$ 266,512		ODOT
MCB6		Along Lancaster St. SE from Glenwood Dr. to Munkers St.	Replace undersized pipe; Replace undersized culverts	$ 520,109		
MCB7		East of I-5, south of Santiam Hwy	Replace undersized culvert	$ 110,908		ODOT
MCB8		Along Lancaster St SE from State St. to Mahrt St.	Replace undersized culvert	$ 201,672		
MCB9		East of I-5 near Bayonne Ct. SE	Replace undersized pipe	$ 223,633		
MCB10		Along Hawthorne Ave. near State St.	Replace undersized culvert	$ 336,663		
MCB11		Along Hawthorne Ave. NE south of Monroe Ave.	Channelization/ Bioengineering	$ 158,125		ODOT
MCB12		Along Monroe Ave. from Illinois Ave. NE to Hawthorne Ave. NE	Replace undersized culvert	$ 287,517		Coordinate with new OSP Ballfield.
MCB13		Between 25th St. NE and Blacksmith Dr.	Replace undersized pipe	$ 482,878		OSP/State Hospital responsibility
MCB14		Near 24th St. NE from Walker to Breyman	Replace undersized pipe	$ 701,749	Yes	Localized flooding/ flooded basements
MCB15		Near 23rd St. NE between State St. and Breyman	Replace undersized pipe	$ 389,246		Flooded basements
MCB16		West of 14th St. north from Lee St. to Shelton Ditch	Replace undersized pipe	$ 171,687		Railroad permit?
MCB17		Across Mission St. near 13th St.	Replace undersized pipe	$ 41,412		
MCB18		East of Liberty St. between Trade St. and Ferry St. and along Ferry St. to High St.	Replace undersized pipe	$ 153,668		
MCB19		Along Cottage St. from Ferry St. to Court St. and along Court St. east to Winter St.	Replace undersized pipe	$ 321,995	Yes	State and Court St. CIPs G.O. Bond F (2000-01)
MCB20		Along State St. from Cottage St. to Capitol St.	Replace undersized pipe	$ 304,145	Yes	State St. CIP G.O. Bond F (2000-01)
MCB21		Along 15th St. from Court St. to Chemeketa St.	Replace undersized pipe	$ 120,714		Northern Downtown Urban Renewal Improvements (2000-04). Rocks, roots,

City of Salem
Drainage System Improvement Plan

Table 5-7
Mill Creek Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
MCB22		Along Church St. from Union St. north to Mill Creek	Replace undersized pipe	$ 274,337		
MCB23		Summer St. from Marion St. north to Mill Ck, Union St. and 12th St. north to Mill Ck	Replace undersized pipe	$ 474,442		Restricted line, alignment break
MCB24		Along D St. NE from 12th St. to Mill Ck and along Winter St. from Market St. to D St.	Replace undersized pipe	$ 1,191,336		Cracked pipe. Norther Downtown Urban Renewal Improvements (2000-04)
MCB25		From the intersection of 12th St. and Nebraska St. to Stewart St. and	Replace undersized pipe	$ 439,169		Flooded basement reports
MCB26		West along B St. from 19th St. to Stewart St. and Lamberson St.	Replace undersized pipe	$ 576,330		
MCB27		Along B St. from 19th St. to Thompson St.	Replace undersized pipe	$ 459,547		
MCB28		From 23rd and B St. to B St. and Thompson St.	Replace undersized pipe	$ 369,999		1/4 full of water
MCB29		From 24th St. and Greenway Dr. to B St. and Thompson St.	Replace undersized pipe	$ 479,382	Yes	Center St. CIP G.O. Bond F (2000-01)
MCB30		Crossings of Deer Park and Aumsville Hwy	Replace undersized pipe; Replace undersized culvert	$ 173,466		
MCB31		Along Mill St. near 12th St.	Replace undersized pipe	$ 102,867		Coordinate with Mission Mill
MCB32		From Stand Ave. and Mill St. to Trade St. and 17 St.	Replace undersized pipe	$ 224,828	Yes	17th St. CIP G.O. Bond F (2000-01)
MCB33		Along Trade St. from 17th St. to Richmond Ave.	Replace undersized pipe	$ 598,259		
MCB34		Along Mill St. from 17th St. to 21st St.	Replace undersized pipe	$ 398,524	Yes	17th St. CIP G.O. Bond F (2000-01)
MCB35		Crossing Turner Rd. south of Gath Rd. SE	Replace undersized pipe	$ 16,354		
MCB36		Along Hawthorne north of Ryan Dr.	Replace undersized pipe	$ 103,150		
MCB37		Along 15th St. from Hines St. to Oak St.	Replace undersized pipe	$ 441,304		
MCB38		Crossing Kuebler east of Turner Rd.	Replace undersized culvert	$ 297,500		Downstream from Corrections Farm Redevelopment
MCB39		Crossing Kuebler south of Aumsville Hwy	Replace undersized culvert	$ 241,598		Downstream from Corrections Farm Redevelopment
			Subtotal	$ 19,987,552	-	
			Small conveyance improvement allowance	$ 999,378	-	This allowance is 5% of the subtotal.
			Total ($)	**$ 20,986,930**		

City of Salem
Drainage System Improvement Plan

Table 5-7
Mill Creek Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments

1. INCLUDES ALLOWANCES FOR PERMITTING, ACQUISITION, PREDESIGN, AND FINAL DESIGN (15%), ADMINISTRATION (6%), CONSTRUCTION MANAGEMENT (9%) AND CONTINGENCY (40%).

City of Salem
Drainage System Improvement Plan

Table 5-8
Pringle Creek Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
PCB1		Clark Creek from Lefelle to Howard	Add Additonal Pipe/Culvert	$ 785,400		
PCB2		Piped system along Oxford St.	Replace Undersized Pipe	$ 735,148		
PCB3		Clark Creek crossing Rural Ave. SE	Replace Undersized Culvert	$ 163,115		
PCB4		Clark Creek North of McGilchrist	Channelization/ Bioengineering/ Habitat	$ 49,725		
PCB5		Clark Creek at Fairview, 12th St and Bluff Rd	Replace Undersized Culverts	$ 399,500		
PCB6		Clark Creek between Winter St and Summer St; Summer St.	Replace Undersized Culvert; Channelization/ Bioengineering/ Habitat	$ 210,171		
PCB7		Clark Creek at Ratcliff Dr	Bridge	$ 297,500		
PCB8		Clark Creek upstream of Ratcliff Dr and at intersections with Ratcliff Dr and Salem Hts Ave South	Replace Undersized Culverts; Channelization/ Bioengineering/ Habitat	$ 455,175		
PCB9		Clark Creek upstream of Commercial near Hillview; Triangle Dr SE	Replace Undersized Pipe/Culvert	$ 233,767		
PCB10		Clark Creek from Ewald to Halifax	Channelization/ Bioengineering/ Habitat	$ 467,500		LWI implications
PCB11		Drainage system to Clark Creek upstream of Ewald Ave	Replace Undersized Pipe	$ 150,280		
PCB12		Clark Creek from Ewald Ave to Vine St.	Replace Undersized Pipe/Culvert; Channelization/ Bioengineering/ Habitat	$ 300,475		
PCB13		Clark Creek at Browning Ave	Replace Undersized Pipe/Culvert	$ 42,670		
PCB14		East Fork Pringle Creek from Pringle Creek to McGilchrist	Channelization/ Bioengineering/ Habitat	$ 1,776,840		FEMA stream
PCB16		East Pringle crossing 16th St.	Bridge	$ 297,500		FEMA stream
PCB17		East Pringle crossing McGilchrist; 22nd Ave SE	Bridges	$ 595,000		FEMA stream, street CIP (2004-05), LWI implications
PCB18		East Pringle from McGilchrist to 25th	Channelization/ Bioengineering/ Habitat	$ 3,096,210		FEMA stream
PCB19		East Pringle at Madrona	Bridge	$ 467,500		FEMA stream, street CIP (2004-05)
PCB20		East Pringle from Airway Dr to Madrona	Channelization/ Bioengineering/ Habitat	$ 2,983,500		FEMA stream, street CIP (2004-05)
PCB21		Culvert across Airway Drive Draining Airport; near Airway Drive	Replace Undersized Culvert	$ 160,990		
PCB22		East Fork Airway Dr to I-5	Channelization/ Bioengineering/ Habitat	$ 2,850,900		FEMA stream, LWI implications

City of Salem
Drainage System Improvement Plan

Table 5-8
Pringle Creek Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
PCB23		East Fork: Culvert Under I-5; Middle Fork near I-5	Channelization/ Bioengineering/ Habitat; New box culvert/ bridge	$ 626,025		FEMA stream
PCB24		East/Middle Fork upstream I-5 to Kuebler	Channelization/ Bioengineering/ Habitat	$ 1,657,500		
PCB25		East/Middle Fork at Treistad and Kuebler	Channelization/ Bioengineering/ Habitat; Bridge; Add Culvert	$ 457,079	Yes	LWI implications, street CIP G.O. Bond F (2000-01)
PCB26		East Middle Fork upstream of Kuebler	Channelization/ Bioengineering/ Habitat	$ 1,633,700		LWI implications, partial USA project
PCB27		Middle Fork along SPRR from Pringle Creek to Boise Cascade	Channelization/ Stream Bank Stabilizaton; Bridge	$ 1,044,701		FEMA stream
PCB28		Middle Fork crossing Madrona	Bridge	$ 467,500		FEMA stream
PCB29		Middle Fork from Madrona to Ewald; from Fairview Ind Dr to SPRR	Channelization/ Bioengineering/ Habitat	$ 1,371,900		FEMA stream
PCB30		Culvert across Marietta	Replace Undersized Culvert	$ 44,693		
PCB31		Middle Fork upstream of 27th crossing Reed Ln	Replace Undersized Culvert	$ 170,136		
PCB32		Middle Fork at Battle Creek Rd and Reed Ln.	Replace Undersized Culvert	$ 108,460		Partial USA project
PCB33		Culvert across Baxter Rd SE	Replace Undersized Culvert	$ 48,450		
PCB34		Pringle Creek from Commercial to High St	Channelization/ Bioengineering/ Special Stream Habitat	$ 1,144,168		FEMA stream: COE study, LWI implications
PCB35		Pringle Creek at Liberty St	Bridge	$ 8,500,000		FEMA stream: COE study, LWI implications. Street CIP (2004-05)
PCB36		Pringle Creek at Church St	Bridge	$ 3,400,000		FEMA stream: COE study, LWI implications
PCB37		Pringle Creek at Winter St	Bridge	$ 2,550,000		FEMA stream
PCB38		Pringle Creek at Mission St	Bridge	$ 2,550,000		FEMA stream
PCB39		Pringle Creek at Cross St	Bridge	$ 2,550,000		FEMA stream
PCB40		Pringle Creek at 13th St	Bridge	$ 2,550,000		FEMA stream
PCB41		West Pringle Creek from Oxford to McGilchrist	Channelization/ Bioengineering/ Habitat; Bridge	$ 1,961,851		FEMA stream
PCB42		West Pringle Creek at McGilchrist	Bridge	$ 850,000	Yes	FEMA stream, railroad permit, street CIP (2004-05)
PCB43		Drainage system on Pringle Rd near Vista	Replace Undersized Pipe	$ 194,489		
PCB44		Drainage system crossing Commerical near Browning	Replace Undersized Culvert	$ 214,209		

City of Salem
Drainage System Improvement Plan

Table 5-8
Pringle Creek Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
PCB45		West Pringle Creek at Commercial near Welcome Way SE	Replace Undersized Culvert	**$ 176,205**		
PCB46		Drainage system upstream of Idylwood as well as Sunnyside Rd	Replace Undersized Pipe	**$ 123,114**		LWI implications
PCB47		Drainage system upstream of Marietta Way and Coloma Dr	Replace Undersized Pipe	**$ 384,200**		
PCB48		West Pringle Creek at Woodmansee Park	Channelization/ Bioengineering/ Habitat	**$ 722,500**		
PCB49		West Pringle, Culvert across Jones Rd., upstream of Woodmansee Park	Bridge	**$ 297,500**		
PCB50		West Pringle Creek from Jones Rd to Bristol Dr and at Firdell and Lone Oak	Replace Undersized Culvert; Channelization/ Bioengineering/ Habitat	**$ 418,319**		
PCB51		West Pringle from Gardner Rd to Jones Rd SE	Channelization/ Bioengineering/ Habitat	**$ 119,000**		
PCB52		Closed system along Lone Oak and Gardner	Replace Undersized Pipe	**$ 203,363**		
PCB53		Closed system near Kuebler and Liberty	Replace Undersized Pipe	**$ 361,420**		
PCB54		West Pringle Creek near Skyline and Liberty	Channelization/ Bioengineering/ Habitat	**$ 507,238**		Proposed Canney Park improvements
PCB55		Pipe/Ditch system along Skyline downstream of Kuebler	Replace Undersized Pipe	**$ 480,675**		Street CIP G.O. Bond F (2000-01)
PCB56		Clark Creek Park at Ratcliff Dr.	Detention Facility, Clark Creek	**$ 412,250**	Yes	Upgrade existing facility
PCB57		Leslie Middle School, East Pringle Rd.	Detention Facility, West Pringle	**$ 1,458,600**	Yes	LWI implications, proposed Leslie School Park
PCB58		Webb Lake , 25th and McGilchrist	Detention Facility, East Pringle	**$ 2,210,000**	Yes	LWI implications
			Subtotal	**$ 58,488,109**	**-**	
			Small conveyance improvement allowance	**$ 2,924,405**	-	This allowance is 5% of the subtotal.
			Total ($)	**$ 61,412,514**		

1. INCLUDES ALLOWANCES FOR PERMITTING, ACQUISITION, PREDESIGN, AND FINAL DESIGN (15%), ADMINISTRATION (6%), CONSTRUCTION MANAGEMENT (9%) AND CONTINGENCY (40%).

City of Salem
Drainage System Improvement Plan

Table 5-9
Upper Claggett Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
CLB1		Hyacinth St. near Salem Industrial Dr.	Replace undersized pipe	$ 978,393		
CLB2		Claxter Rd. to Hyacinth St.	Replace undersized pipe	$ 589,560		LWI implications
CLB3		Claggett Creek at Burlington Northern Railroad	Remove culvert. Restore open channel.	$ 487,900		FEMA stream, railroad permits
CLB4		Claggett Creek at SPRR	Add parallel culvert. Requires boring	$ 303,620		FEMA stream, railroad permits
CLB5		Claggett Creek along Claggett Gravel Pit	Channelization/ Bioengineering/ Special Stream Habitat	$ 1,905,360	Yes	FEMA stream, LWI implications, Northgate Urban Renewal proposed park
CLB6		Claggett Creek at Portland Rd. NE	Bridge	$ 467,500		FEMA stream, Portland Rd. street improvement (2001-02)
CLB7		Claggett Creek at Deerhaven	Bridge	$ 297,500		FEMA stream, proposed neighborhood park
CLB8		Claggett Creek near I-5 and Hyacinth	Channelization/ Bioengineering/ Habitat	$ 274,482		FEMA stream
CLB9		Claggett Creek crossing Hyacinth near I-5	Bridge	$ 297,500	Yes	FEMA stream, Hyacinth St. CIP G.O. Bond F (2000-01)
CLB10		Claggett Creek crossing I-5	Replace undersized culvert	$ 739,160		FEMA stream, ODOT
CLB11		Claggett Creek upstream of I-5 to NE Fisher Rd.	Channelization/ Bioengineering/ Habitat, Replace undersized culvert	$ 526,065		
CLB12		Crossing Cooley Rd. NE	Replace undersized culvert	$ 97,665		
CLB13		Along Lancaster from Cooley to Stortz	Channelization/ Bioengineering/ Habitat	$ 768,825		Proposed neighborhood park
CLB14		Along Lancaster from Devonshire Ct. to Wolverine	Replace undersized pipe	$ 272,629		
CLB15		Along Lancaster from Stortz to Devonshire	Replace undersized pipe	$ 513,307		
CLB16		Along Fisher Rd. from Ward Dr. NE to Covington	Replace undersized pipe	$ 73,551		
CLB17		From crossing of Fisher Rd. northeast along Lancaster to Hayesville	Replace undersized pipe/culvert	$ 1,341,232		Proposed neighborhood park
CLB18		39th Ave NE Ward Dr. to Ivy Way	Replace undersized pipe	$ 283,475		
CLB19		East from Fisher Rd. to Lancaster	Channelization/ Bioengineering/ Habitat	$ 393,975		
CLB20		Crossing of Lancaster Dr., south of Ibex St. NE	Replace undersized culvert	$ 299,073		
CLB21		Along Ibex St. NE and Ward Dr. from Lancaster to 45th Ave. NE	Channelization/ Bioengineering/ Habitat	$ 624,143		
CLB22		Along 42nd Ave. NE from Ward Dr. to Jade St.	Replace undersized pipe	$ 311,823		

City of Salem
Drainage System Improvement Plan

Table 5-9
Upper Claggett Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
CLB23		Crossings of 45th Ave. NE and Harlan	Replace undersized culverts	$ 140,590		
CLB24		Crossings of Satter Dr. and Selby Ct. NE	Replace undersized culverts	$ 171,530		
CLB25		Crossings of Sesame St. and 47th Ave. NE	Replace undersized culvert	$ 324,020		
CLB26		East of Brown Rd. NE from Idaho Ave. to Glendale Ave.	Channelization/ Bioengineering/ Habitat	$ 638,860		
CLB27		Culvert crossing Surfwood Dr. NE	Replace undersized culvert	$ 58,752		
CLB28		Shellyanne Way south to Roselawn Dr.	Replace undersized pipe	$ 414,460		
CLB29		From Lancaster and Stortz southeast to Tierra Dr.	Replace undersized culverts	$ 509,363		
CLB30		Along Phipps Ln. NE south from Carolina Ave NE to Phipps Circle	Replace undersized culvert/ pipe	$ 810,475		
CLB31		Crossings of Scotsman Ln. and Sunnyview Rd.	Replace undersized culverts	$ 188,224		LWI implications, possibly re-route as open channel into McKey Park
CLB32		Along Lancaster Dr. south from Market St to D St. NE	Replace undersized pipe	$ 931,450	Yes	Market St. CIP G.O. Bond F (2000-01)
CLB33		Along Hawthorne from North of Felina Court to 32nd and Rockingham	Channelization/ Bioengineering/ Habitat, Replace undersized culvert	$ 784,635	Yes	ODOT coordination, Hawthorne CIP G.O. Bond F (2000-01)
CLB34		South from Wooddale Ave NE to Silverton Rd. near Hawthorne NE	Replace undersized culvert/pipe	$ 1,540,115		LWI implications
CLB35		Along Silverton Rd. near Beacon St. NE	Replace undersized pipe	$ 25,415	Yes	Partially ODOT, Silverton Rd. CIP G.O. Bond F (2000-01)
CLB36		Drainage system east of Hawthorne from Devonshire Ave. to Beverly Ave. NE	Replace undersized pipe	$ 679,626		
CLB37		Along Hawthorne from Monarch Dr. to Sunnyview Rd.NE	Replace undersized pipe	$ 782,425		ODOT coordination
CLB38		Sunnyview Rd. from Hawthorne Ave. to Fisher Rd. NE	Replace undersized pipe	$ 125,715		
CLB39		Northeast of Hawthorne Ave. and Rawlins NE	Replace undersized pipe/culvert	$ 8,670		ODOT coordination
CLB40		Near Market St. and Hawthorne Ave. NE	Replace undersized pipe	$ 96,135		
CLB41		From Hummingbird St. and Portland Rd. south to Silverton Rd. near Abrams Ave.	Replace undersized pipe	$ 1,981,350		
CLB42		From Sunnyview Rd. near Evergreen Ave. south to Evergreen Ave. near Market St.	Replace undersized pipe	$ 2,363,170	Yes	State Fair coordination, LWI implications, Silverton Rd. CIP G.O. Bond F (2000-01)
CLB43		From Sunnyview Rd. near Evergreen Ave. south to Evergreen Ave. near Market St.	Replace undersized pipe	$ 497,080		
CLB44		From Evergreen Ave. and Market St. south to D St. and Park Ave.	Replace undersized pipe	$ 748,510	Yes	Silverton Rd. CIP G.O. Bond F (2000-01)

City of Salem
Drainage System Improvement Plan

Table 5-9
Upper Claggett Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
CLB45		Along Lansing Ave. south from Silverton Rd. to Sorenson Ct.	Replace undersized pipe	$ 155,295	Yes	Silverton Rd. CIP G.O. Bond F (2000-01)
CLB46		Along Park Ave. south from Silverton Rd. to Dawn St.	Replace undersized pipe	$ 1,418,140	Yes	Flooding at Waldo Middle School, Silverton Rd. CIP G.O. Bond F (2000-01), Park Ave. CIP G.O. Bond F (2000-01)
CLB47		Along Lansing Ave. south from Sorensen Ct. to Rawlins Ave.	Replace undersized pipe	$ 804,270		Proposed Waldo School Park improvements
CLB48		Along Lansing Ave. south from Sunnyview Rd to Market St. NE	Replace undersized pipe	$ 121,771		
CLB49		West of I-5, east of Ellis Ave.	Replace undersized pipe	$ 86,700		ODOT
CLB50		East of I-5, Center St. to Manor Dr.	Replace undersized pipe	$ 1,140,360		
CLB51		East side, I-5 at Manor Dr.	Replace undersized pipe	$ 1,386,350		ODOT
CLB52		Center St. to Monroe - east of 36th	Replace undersized pipe	$ 1,173,510		Proposed neighborhood park west
CLB53		Along Center St. between 36th Ave and Lancaster Dr. NE	Replace undersized pipe	$ 295,800		Proposed neighborhood park south
CLB54		Along Lancaster Dr. from Amber St. south to State St.	Replace undersized pipe	$ 473,450		
CLB55		Along Center St. from Vinyard east to Oregon Ave. NE	Replace undersized pipe	$ 158,253		
CLB56		Salem Industrial Drive from Anunsen St. north to the Claggett Gravel Pit	Replace undersized culvert, Replace undersized culvert/pipe with new culvert/open channel	$ 853,400	Yes	Northgate Urban Renewal, Claggett Creek backwater, LWI implications
CLB57		Near Brooks Ave. and McDonald Way	Replace undersized pipe	$ 180,625		
CLB58		Along Portland Rd. near Beach Ave. NE	Replace undersized pipe	$ 161,704		Heavy roots
CLB59		Along 17th St. south from Silverton Rd. to Sunnyview Rd. NE	Replace undersized pipe	$ 891,126		State Fair coordination, LWI implications
CLB60		Claggett Gravel Pit: Claggett Creek upstream of Salem Parkway	New detention facility	$ 3,170,500	Yes	Northgate Urban Renewal, LWI implications, proposed park
			Subtotal	$ 38,138,559	-	
			Small conveyance improvement allowance	$ 1,906,928	-	This allowance is 5% of the subtotal.
			Total ($)	**$ 40,045,487**		

1. INCLUDES ALLOWANCES FOR PERMITTING, ACQUISITION, PREDESIGN, AND FINAL DESIGN (15%), ADMINISTRATION (6%), CONSTRUCTION MANAGEMENT (9%) AND CONTINGENCY (40%).

City of Salem
Drainage System Improvement Plan

Table 5-10
West Bank Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
WBB1		Wallace Rd between Orchard Hts and Taybin Rd	Replace undersized pipe	$ 224,315		
WBB2		From Wallace Rd and Glen Creek Rd to Gerth Ave and 9th	Replace undersized pipe	$ 1,181,238	Yes	Street CIP G.O. Bond F (2000-01, 2004-05) , bad pipe, alignment, debris, proposed Walker School Park
WBB3		From Cascade Drive to 9th and Gerth	Replace undersized pipe	$ 229,692	Yes	Adverse grade
WBB4		8th Ave between Gerth Ave and Rosemont Ave	Replace undersized pipe	$ 381,480	Yes	High water complaints
WBB5		Senate St between 6th Ave and the Willamette River	Replace undersized pipe	$ 725,084		Heavy roots, silt, gravel, bad joints
WBB6		Culvert across the Salem-Dallas Hwy, near Moores Wy	Replace undersized pipe	$ 238,000		ODOT coordinations, LWI implications
WBB7		Culvert across Eola Dr near the intersection of Eola Dr and Turnage St	Replace undersized culvert	$ 81,294		Street CIP (2004-05)
WBB8		Culvert across Jasper Wy near intersection with Eola Dr	Replace undersized culvert	$ 8,628		
WBB9		Along Eola Dr between Gehlar Rd and Sunwood Dr	Replace undersized pipe	$ 91,452		Street CIP (2004-05)
WBB10		Barberry St between 23rd Ct and Eola Dr	Replace undersized pipe	$ 101,065		Street CIP (2004-05)
WBB11		Eola Dr near intersection with Sunnwood Dr	Add detention capacity at Woodhaven Detention Facility	$ 748,850	Yes	
			Subtotal	$ 4,011,097	-	
			Small conveyance improvement allowance	$ 200,554.87	-	This allowance is 5% of the subtotal.
			Total ($)	**$ 4,211,652**		

1. INCLUDES ALLOWANCES FOR PERMITTING, ACQUISITION, PREDESIGN, AND FINAL DESIGN (15%), ADMINISTRATION (6%), CONSTRUCTION MANAGEMENT (9%) AND CONTINGENCY (40%).

Appendix E
Water Quality Data Summary

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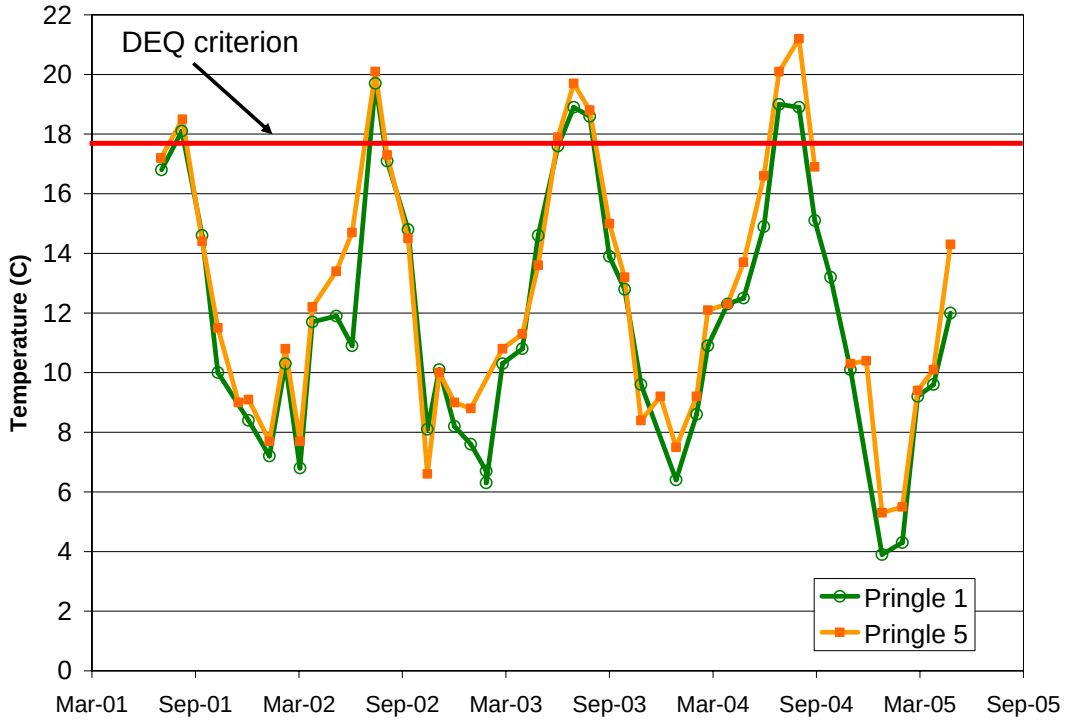

Figure E-1 Pringle Creek temperatures measured between July 2001 and May 2005.

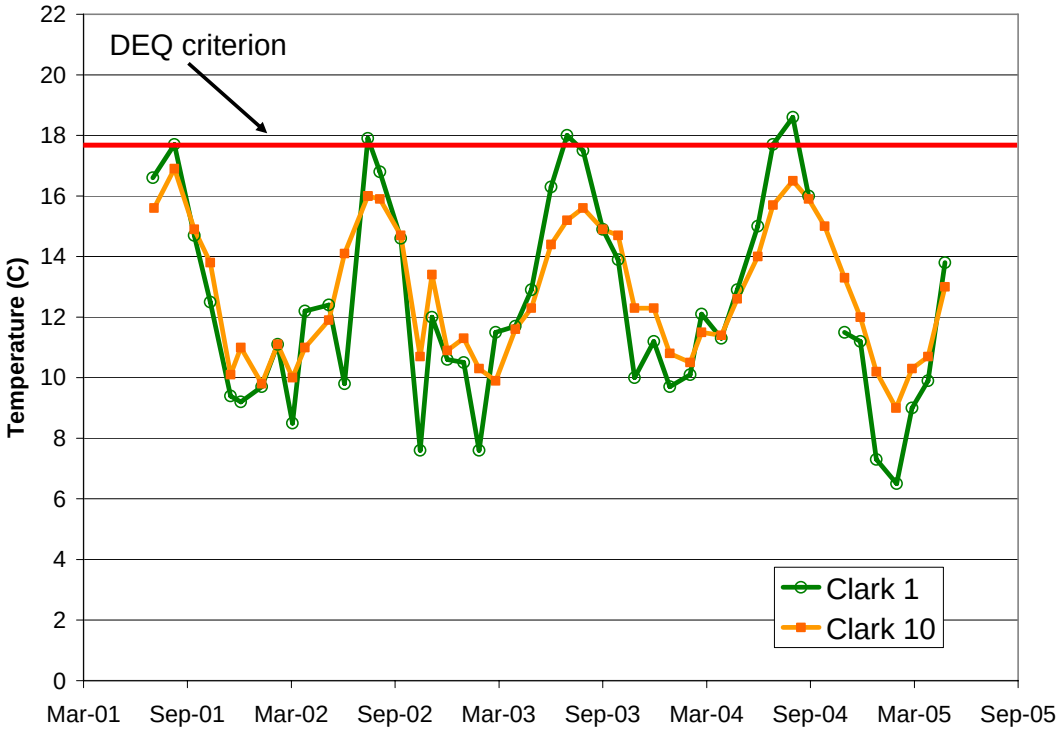

Figure E-2 Clark Creek temperatures measured between July 2001 and May 2005.

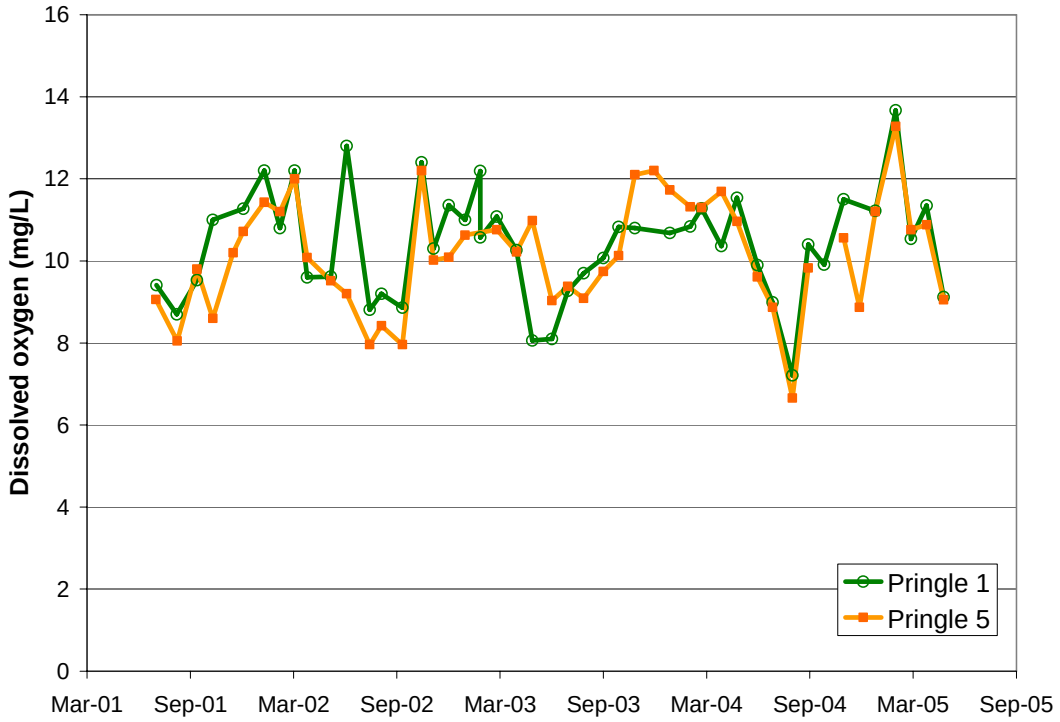

Figure E-3 Pringle Creek dissolved oxygen (DO) concentrations measured between July 2001 and May 2005.

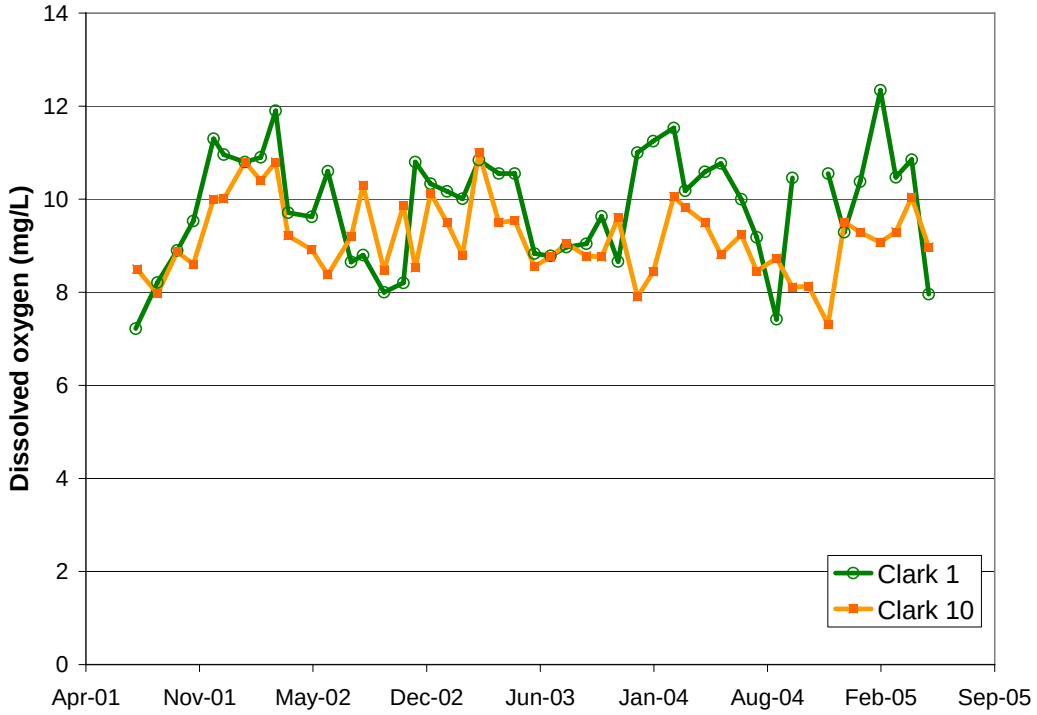

Figure E-4 Clark Creek dissolved oxygen (DO) concentrations measured between July 2001 and May 2005.

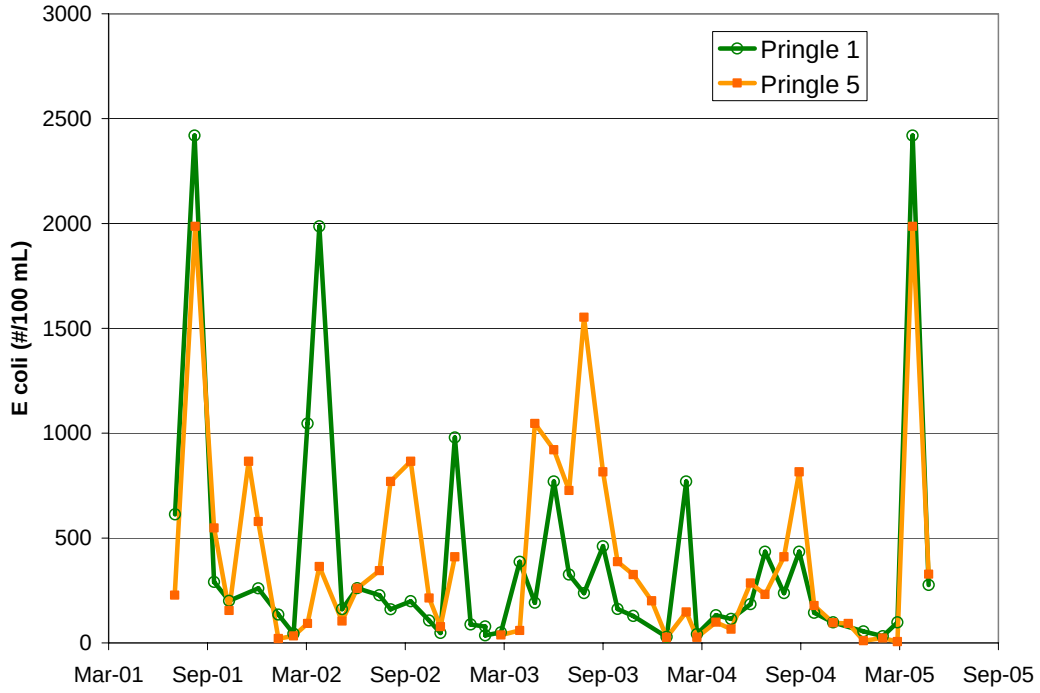

Figure E-5 Pringle Creek E. coli levels measured between July 2001 and May 2005.

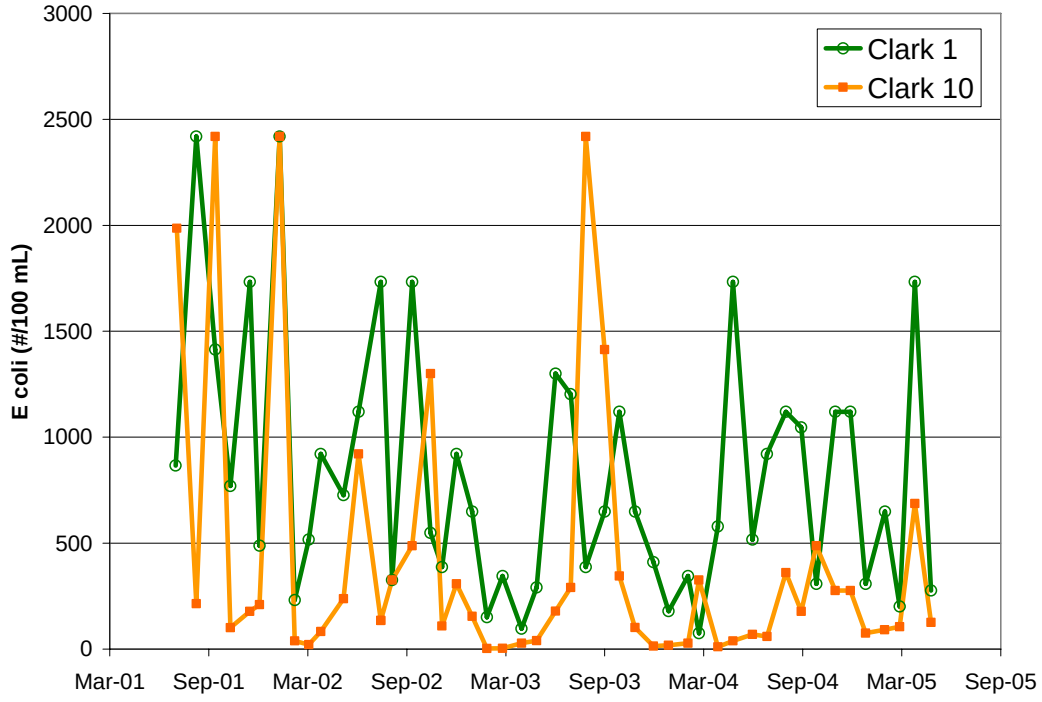

Figure E-6 Clark Creek E. coli levels measured between July 2001 and May 2005

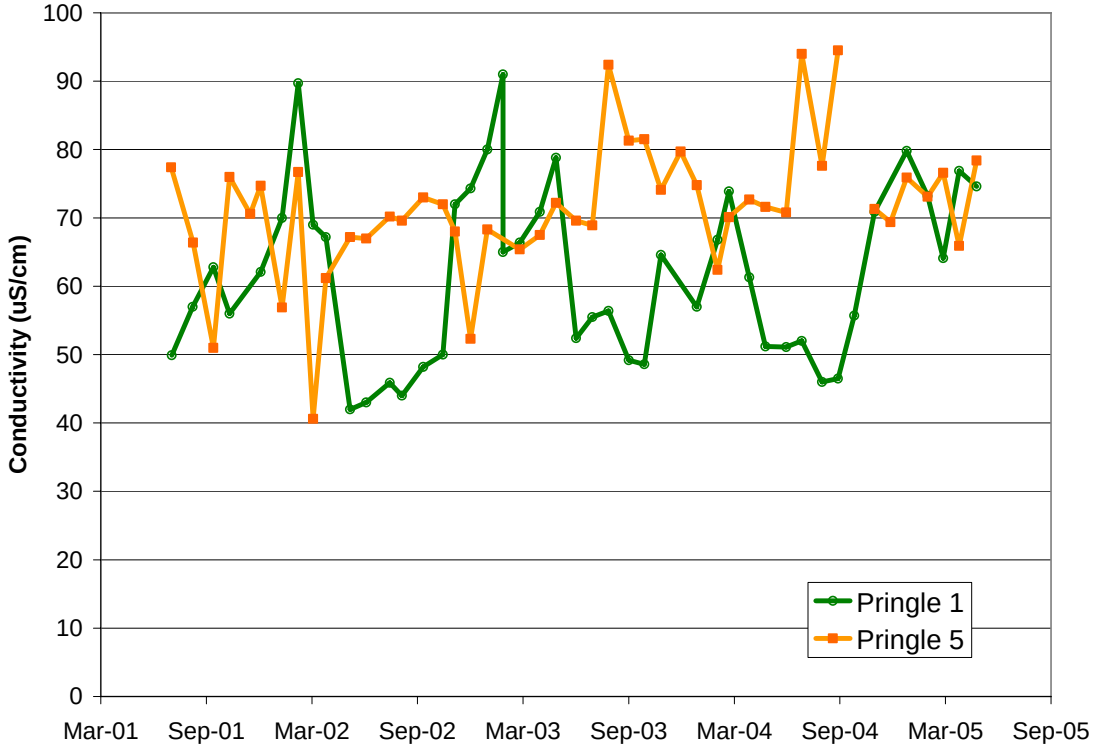

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Figure E-7 Pringle Creek. conductivity levels measured between July 2001 and May 2005.

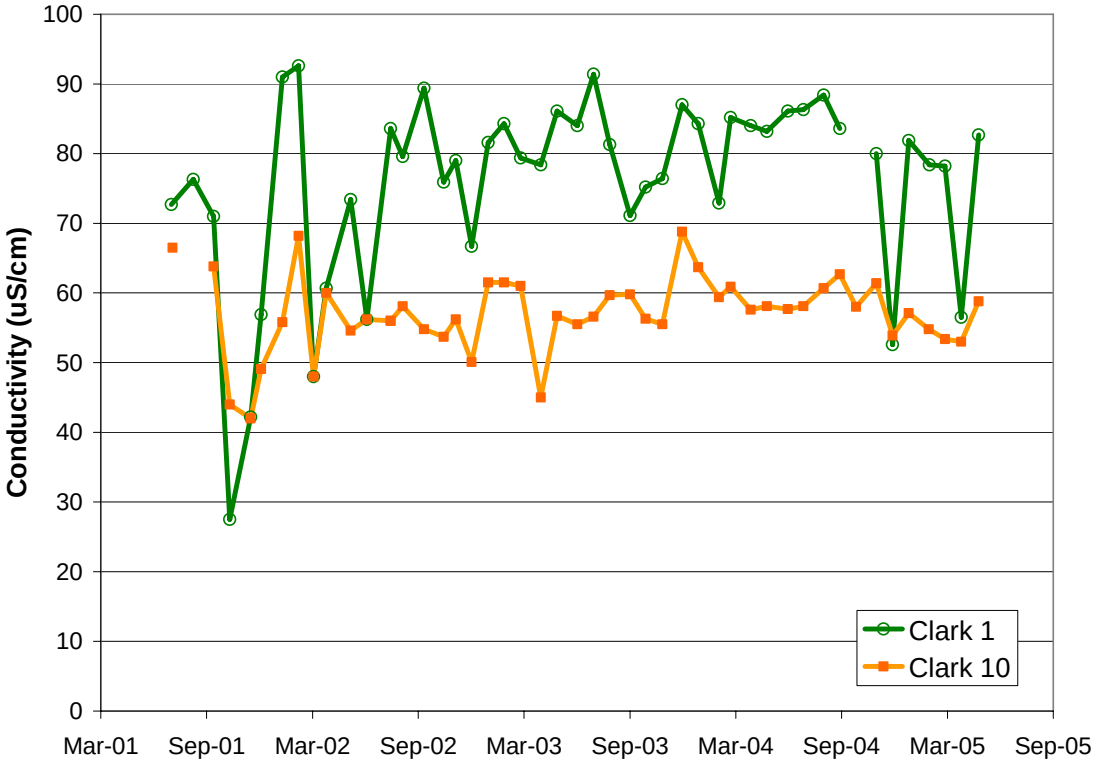

Figure E-8 Clark Creek conductivity levels measured between July 2001 and May 2005.

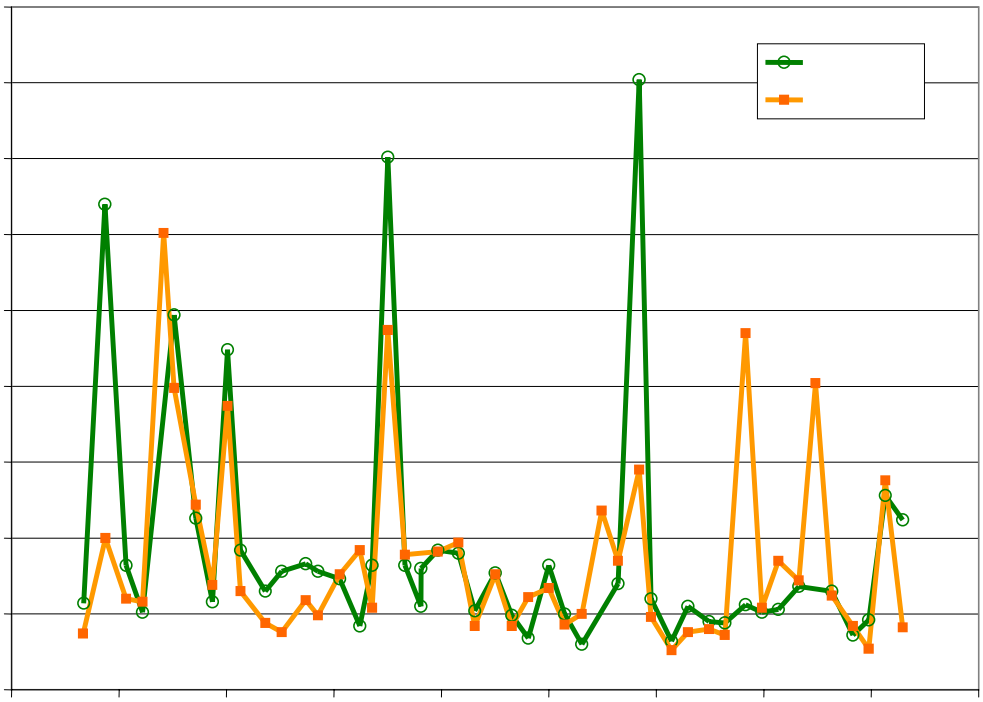

Figure E-9 Pringle Creek turbidity levels measured between July 2001 and May 2005.

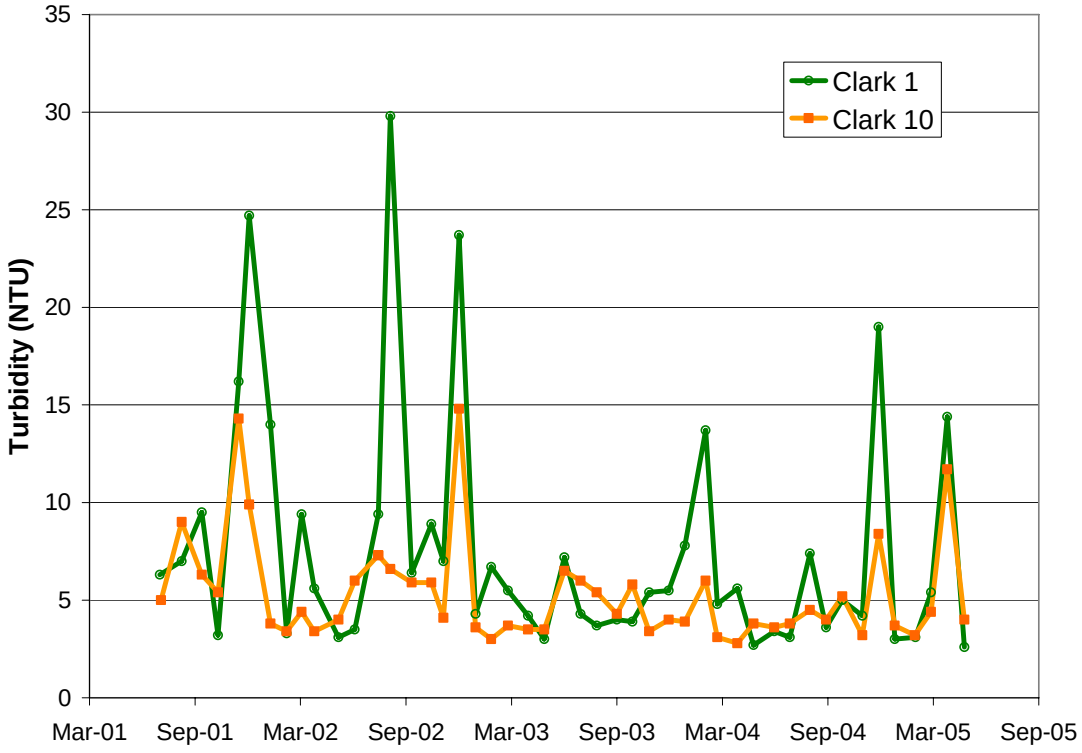

Figure E-10 Clark Creek turbidity levels measured between July 2001 and May 2005.

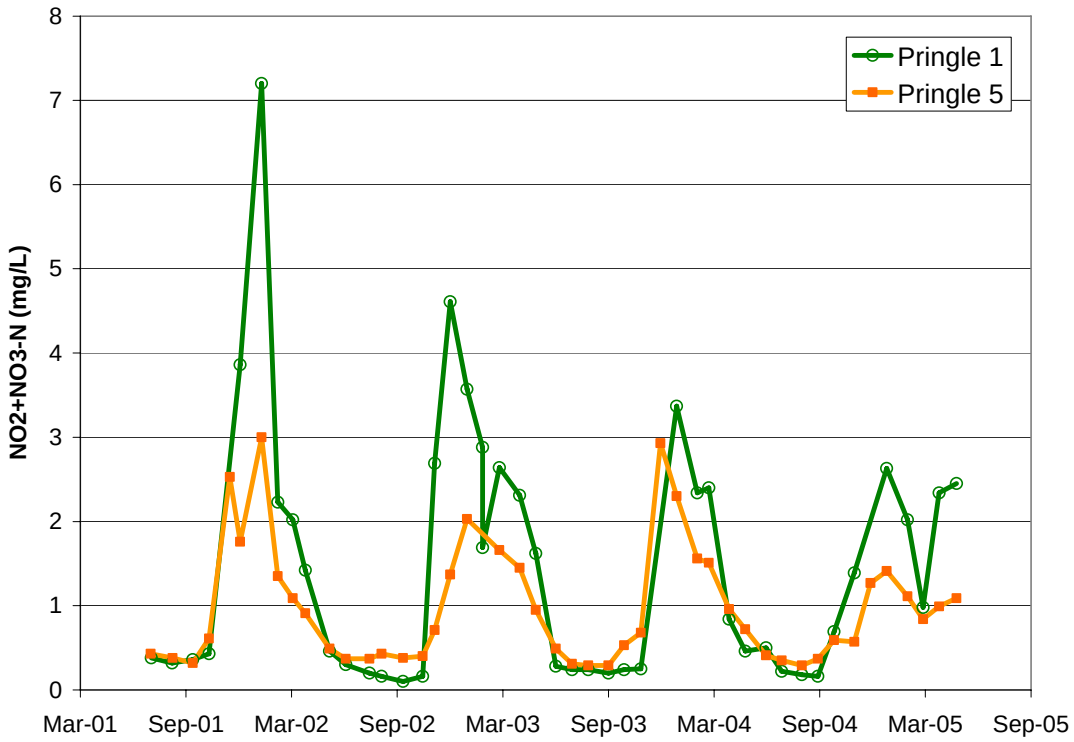

Figure E-11 Pringle Creek nitrate+nitrite levels measured between July 2001 and May 2005.

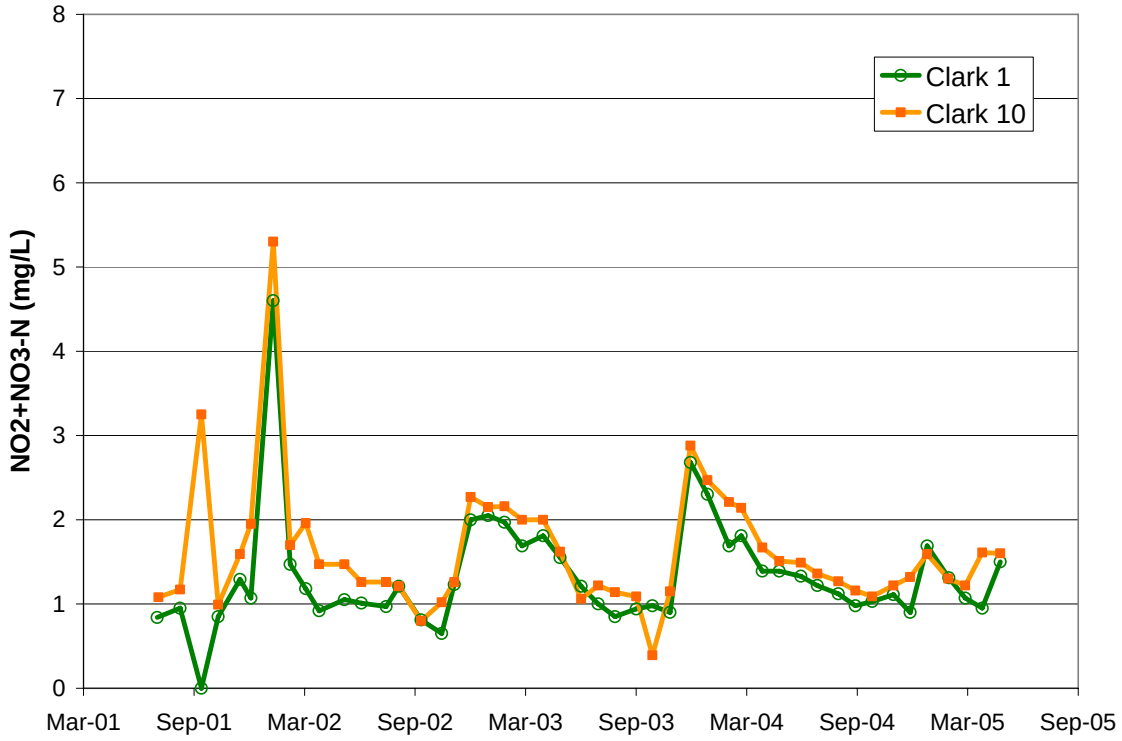

Figure E-12 Clark Creek nitrate+nitrite levels measured between July 2001 and May 2005.

Appendix F

Bioassessment Data Evaluation

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Appendix F Contents

Table F-1 Reference Sites Used in the Bioassessment Analysis
Table F-2 Reference Site Benchmarks Used in the Pringle Creek Characterization
Table F-3 Regulatory Benchmarks Used in the Pringle Creek Characterization
Table F-4 Evaluation of Habitat Condition Component Scores
Table F-5 Evaluation of Pringle Creek Indicators Relative to Benchmarks

Reference condition was based on values (averages) from the following 22 Willamette Valley and Coast Range Ecoregion reference sites from the Oregon Department of Environmental Quality (Drake 2006):

Table F-1 Reference Sites Used in the Bioassessment Analysis		
Station #	Site Name	Ecoregion Name
12215	Roaring Creek (Tualatin)	Willamette Valley
25783	Poodle Creek (Upper Willamette)	Willamette Valley
29026	Jordan Creek (Long Tom R)	Willamette Valley
29029	Alder Creek (Marys River)	Willamette Valley
29033	Bergholtzer Creek (Tualatin)	Willamette Valley
29034	Scoggins Creek (Tualatin)	Willamette Valley
29035	Lost Creek (MF Willamette)	Willamette Valley
11845	Little Nf Wilson River at RM 1.5	Coast Range
11850	Rock Creek at RM 1.5 (Alsea)	Coast Range
12518	Trout Creek at RM 0.2 (Alsea)	Coast Range
12521	Trib to Bernhardt Creek at RM 3.0	Coast Range
12530	Butler Creek at RM 2.1	Coast Range
13201	Haight Creek at RM 1.20 (Siuslaw)	Coast Range
13224	Schroeder Creek at RM 2.27 (Kilchis)	Coast Range
13227	Red Cedar Creek at Mouth (Sixes)	Coast Range
13265	Trib to Nf Wolf Cr at RM 0.45 (Nehalem)	Coast Range
17031	Nf Elk River at RM 3.3 (Sixes)	Coast Range
21842	Flynn Creek at RM 1.71 (Alsea)	Coast Range
23832	Bear Creek at RM 13.30 (Coquille)	Coast Range
25386	Harliss Creek 10 min Hike U/S From Cook Cr Rd (Nehalem)	Coast Range
26828	Slater Creek	Coast Range
26846	Lost Cr (Umpqua)	Coast Range

Table F-2 Reference Site Benchmarks Used in the Pringle Creek Characterization (Willamette and Coast Sites with gradient <4% and Bankfull width <10m)									
Component	Indicator	Phab Metric	Fair 5th / 95th Percentile	Good 25th / 75th Percentile	Mean	Min	Max	Median	Sample Size
	Bankfull width (m)	XBKF_W	4.4	4.8	6.5	2.2	9.2	6.2	22
	Thalweg depth (cm)	XDEPTH	8	17	25	8	44	25	22
	Gradient (%)	XSLOPE	0.8	1.6	2.3	0.8	4.0	2.3	22
Biological Condition	Benthic Index of Biological Integrity	BIBI04	30	40	42	28	50	43	22
Morphology	Channel sinuosity	SINU	1.0	1.1	1.2	1.0	2.2	1.1	22
	Incision height (m) above bf	XINC_H	0.86	0.64	0.42	0.00	1.56	0.49	22
	Bank angle (degrees)	XBKA	62	48	41	23	66	41	22
Complexity	Riffle percentage	PCT_FAST	23	27	45	19	71	51	20
	Glide percentage	Glide	41	32	25	0	59	26	20
	Pool percentage	PCT_POOL	11	20	30	8	61	25	20
Pool Depth	Depth of deepest residual pool (m)	RPMXDEP	29	46	85	21	257	75	22
Substrate	Course gravel and larger (%>16mm)	PCT_BIGR	10	48	61	3	93	68	22
	Embeddedness (%)	XEMBED	73	55	41	18	78	36	22
	Sand and fines (%< 2 mm)	PCT_SAFN	49	27	18	0	60	14	22
	Hardpan (%)	PCT_HP	0	0	1	0	6	0	22
	Bed substrate stability index	LRBS_BW5 Erodable	-0.96	-0.49	-0.18	-1.17	0.62	-0.11	11
		LRBS_BW5 Resistant	-1.74	-1.28	-0.80	-1.85	0.16	-0.71	3
Wood	Wood Volume Density (all)	V1TM100	5.5	15.3	45.2	0.4	168.1	32.6	20
	Wood Volume Density (large)	V4TM100	0.9	7.5	31.5	0.0	113.4	22.5	20
Cover	Natural fish cover (proportion)	XFC_NAT	0.27	0.34	0.51	0.19	1.02	0.49	22
	Large fish cover (proportion)	XFC_BIG	0.09	0.19	0.36	0.05	0.92	0.31	22
Riparian	Canopy shade mid-channel (% area)	XCDENMID	73	89	90	52	100	95	22
	Riparian canopy cover (large)	XCL	0.03	0.08	0.24	0.02	0.55	0.19	22
	Riparian canopy cover (all)	XC	0.14	0.31	0.49	0.13	0.88	0.53	22
	Proportion of reach with 3 layers vegetation	XPCMG	0.73	0.95	0.95	0.73	1.00	1.00	22
Human Disturbance	Riparian human disturbance index	W1_HALL	2.37	1.13	0.81	0.00	3.55	0.67	22

Table F-3 Regulatory Benchmark Values Used in the Pringle Creek Characterization[1]								
Component	Indicator	Phab Metric	Source	Source Indicator	Characterization			
Biological Condition	Benthic Index of Biological Integrity	BIBI04	Oregon Plan	B-IBI Genus/Species level scoring criteria	No Impairment	Slight Impairment	Moderate Impairment	Severe Impairment
					>39	30-39	20-29	<20
Morphology	Channel sinuosity	SINU	Rosgen		High Sinuosity	Moderate Sinuosity	Low Sinuosity	
					>1.5	1.2-1.5	<1.2	
					Good / Desirable / Properly functioning	Fair / At Risk		
Complexity	Pool percentage	PCT_POOL (length)	ODFW	Pool % (Area)	35	10		
Pool Depth	Depth of deepest residual pool	RPMXDEP	ODFW	Pool Depth	0.5 (BF<7)	0.2 (BF<7)		
Substrate	Course gravel and larger %	PCT_BIGR	ODFW	Substrate Gravel %	35	15		
	Embeddedness %	XEMBED	NMFS	Substrate Embeddedness (if gravel/cobble dominant)	20	30		
	Sand and fines %	PCT_SAFN	DEQ	Substrate Sand and Fines %	R 15 E 30	R 30 E 50		
	Sand and fines %	PCT_SAFN	ODFW	Substrate Silt/Sand/Organics % in Riffles	12	25		
	Bed substrate stability index	LRBS_BW5 (Erodable) LRBS_BW5 (Resistant)	DEQ	Log Relative Bed Stability	R -.75 -1	R -1.1 -2		
Wood	Wood Frequency		ODFW	Wood Frequency all sizes (.15x3 pieces/100m)	20	10		
Riparian	Canopy shade mid-channel %		ODFW	Shade % (Measured differently than EMAP)	70	60		

[1] ODFW Benchmarks from Aquatic Inventory Project (Foster 2001)
NMFS Benchmarks from Matrix of Pathways and Indicators for ESA Consultation (NMFS 1996)
DEQ Benchmarks from Drake (personnal communication, 2006)
Rosgen Characterization
Oregon Plan Benchmarks from Oregon Water Quality Monitoring Guidebook (OPSW 1999)

The following describes the methods used to evaluate the indicators and habitat components relative to reference condition and regulatory benchmarks, and identify key habitat issues. Some components (such as morphology) were evaluated semi-qualitatively

Table F-4 Evaluation of Habitat Condition Component Scores			
Habitat Component	Indicator	Characterization of Each Indicator	Combining Indicators
Overall Habitat Quality	Habitat Quality Index (HQI)	Divided into quadrants: 0-25% (very low), 25-50% (low), 50-75% (medium), 75-100% (high)	Based only on HQI Score
	Rapid Habitat Assessment (RHA)	Because there was no reference condition, divided into quadrants: 0-50 (very poor), 50-100 (poor), 100-150 (fair), 150-200 (good)	
	Benthic Index of Biological Integrity (B-IBI)	Based on Oregon Plan standards.	
Channel Morphology	Channel sinuosity	Based score on reference condition.	Used all three indicators, but based the score primarily on incision supplemented by bank angle. Averaged this with sinuosity score. If it was deeply incised, gave it a 1 or less.
	Incision height (m)	Based on reference condiiton, but used the bankfull height to determine the scale incision relative to the floodprone level.	
	Bank angle (degrees)	Only considered this indicator if the channel was incised. Based on reference condiiton.	
Channel Complexity	Riffle percentage	Based on reference condition >27% riffle good	Determined base score from amount of glide habitat. Gave one point for good riffle habitat or some pools. Must have both riffles and pools to get a 2.
	Glide percentage	Based on reference condition with the assumption that glide habitat is uncomplex, >80% glide very poor, >50% glide poor	
	Pool percentage	Based on ODFW pool area standards 0% pool very poor, <10% pool poor, <35% pool fair, >35% pool good	
Residual Pool Depth	Depth of deepest residual pool (m)	Required that the depth equals odfw standards, and that there is actually pool area throughout the reach. 0 no pools and depth <.2 (odfw) 1 no pools and depth .2-.5 2 no pools and depth > .5, pools and depth .2-.5 3 pools and depth >.5	
Substrate	Coarse gravel and larger (%)	Used ODFW and reference condition, weighted toward ODFW standards.	Averaged all except hardpan. If hardpan was poor, included it in the average. If HP > 20%, subtracted it from the score.
	Embeddedness (%)	Considered both NMFS and reference condition. Weighted towards reference for the overall substrate score.	
	Sand and fine sediments (%)	Considered DEQ, reference condition and ODFW. Averaged at all 3, but weighted toward DEO and reference.	
	Hardpan %	Based on reference condition. Only included in substrate score if >12%.	

Table F-4 Evaluation of Habitat Condition Component Scores			
Habitat Component	Indicator	Characterization of Each Indicator	Combining Indicators
	Bed substrate stability index	Used DEQ standards	
Wood	Wood density (pieces/100 m, all sizes)	ODFW uses wood density. All sites were poor by all (reference, NMFS, ODFW) wood standards, so only differentiated between sites with some wood (1) and sites with no wood (0). The exception was site 54, which had an at risk frequency (ODFW standards), but received a 1 because it had a very small volume of wood.	
Fish cover	Natural fish cover (aerial proportion)	Based evaluation on reference condition. The descriptive amount categories used during the field survey were: 0 very sparse 0-15 sparse 15-50 moderate 50-75 heavy 75-100 very heavy	Determined score from natural fish cover. Subtracted a point if there was poor large cover.
	Large fish cover (aerial proportion)	Based on reference condiiton. Only used this indicator to supplement natural fish cover.	
Riparian cover	Canopy shading mid-channel (% area)	Based on reference condition and ODFW. Weighted toward ODFW standards.	Averaged shading, canopy cover (the two combined, but weighted toward total canopy cover) and proportion with 3 layers.
	Riparian canopy cover large trees	Based on reference condition, but only used this indicator to supplement the total canopy cover.	
	Riparian canopy cover all trees > 5m tall	Based on reference condition. If was <.05, considered it no cover.	
	Proportion of reach with 3 layers of vegetation	Based on reference condition. If was <.10, considered it none.	
Human Disturbance	Human Disturbance Index	Based on reference condition. 0 if > 4.	

Table F-5 Evaluation of Pringle Creek Indicators Relative to Benchmarks							
Site / Criteria	Channel dimensions				Overall Habitat Quality		
	Stream	Bankfull width (m)	Thalweg depth (cm)	Gradient (%)	HQI Willamette Valley	Rapid Habitat Assessment	Benthic Index of Biological Integrity
		XBKF_W	XDEPTH	XSLOPE	wv-HQI	RHA Score	B-IBI
PR00-002	Pringle	8.4	30	1.0	0.72	110	16
Reference							Poor
ODFW/Rosgen							Severe Impairment
NMFS/deq							
PR00-003	Pringle	9.9	24	0.5	0.71	138	10
Reference							Poor
ODFW/Rosgen							Severe Impairment
NMFS/deq							
PR00-004	Pringle	6.5	29	0.4	0.77	131	16
Reference							Poor
ODFW/Rosgen							Severe Impairment
NMFS/deq							
PR00-005	Pringle	4.5	24	0.6	0.67	124	14
Reference							Poor
ODFW/Rosgen							Severe Impairment
NMFS/deq							
PR00-006	Pringle	3.6	18	0.6	0.38	119	12
Reference							Poor
ODFW/Rosgen							Severe Impairment
NMFS/deq							
PR00-007	Pringle	4.1	20	0.5	0.39	95	20
Reference							Poor
ODFW/Rosgen							Moderate Impairment
NMFS/deq							
PR00-008	MF Pringle	3.7	26	0.4	0.42	85	16
Reference							Poor
ODFW/Rosgen							Severe Impairment
NMFS/deq							
PR00-009	MF Pringle	5.1	39	0.9	0.36	81	20
Reference							Poor
ODFW/Rosgen							Moderate Impairment
NMFS/deq							
PR00-010	MF Pringle	3.8	16	0.2	0.46	98	18
Reference							Poor
ODFW/Rosgen							Severe Impairment
NMFS/deq							
PR00-011	MF Pringle	3.4	0	0.3	0.13	64	
Reference							
ODFW/Rosgen							
NMFS/deq							
PR00-012	MF Pringle	9.3	0	0.4	0.20	92	
Reference							
ODFW/Rosgen							
NMFS/deq							
PR00-013	MF Pringle	4.9	11	0.7	0.53	107	26
Reference							Poor
ODFW/Rosgen							Moderate Impairment
NMFS/deq							
PR00-014	MF Pringle	4.3	20	0.4	0.50	118	24
Reference							Poor
ODFW/Rosgen							Moderate Impairment
NMFS/deq							
PR00-015	MF Pringle	5.0	25	1.0	0.87	118	18
Reference							Poor
ODFW/Rosgen							Severe Impairment
NMFS/deq							
PR00-016	MF Pringle	3.4	18	1.0	0.41	65	20
Reference							Poor
ODFW/Rosgen							Moderate Impairment
NMFS/deq							

Table F-5 continued							
Site / Criteria	Morphology			Complexity			Pool Depth
	Channel sinuosity	Incision height (m) above bf	Bank angle (degrees)	Riffle percentage	Glide percentage	Pool percentage	Depth of deepest residual pool (m)
	SINU	XINC_H	XBKA	PCT_FAST	PCT_GL	PCT_POOL	RPMXDEP
PR00-002	1.1	1.54	72	18	82	0	56
Reference	Good	Poor	Poor	Poor	Poor	Poor	Good
ODFW/Rosgen	Low					None	AR
NMFS/deq							
PR00-003	1.0	1.01	58	32	68	0	35
Reference	Fair	Poor	Fair	Good	Poor	Poor	Fair
ODFW/Rosgen	Low					None	AR
NMFS/deq							
PR00-004	1.1	0.66	52	25	75	0	56
Reference	Fair	Good	Fair	Fair	Poor	Poor	Good
ODFW/Rosgen	Low					None	Desirable
NMFS/deq							
PR00-005	1.2	1.16	56	30	66	4	64
Reference	Good	Poor	Fair	Good	Poor	Poor	Good
ODFW/Rosgen	Low					Undesirable	Desirable
NMFS/deq							
PR00-006	1.0	1.75	63	26	74	0	30
Reference	Poor	Poor	Poor	Fair	Poor	Poor	Fair
ODFW/Rosgen	Low					None	AR
NMFS/deq							
PR00-007	1.0	0.60	68	7	93	0	24
Reference	Poor	Good	Poor	Poor	Poor	Poor	Poor
ODFW/Rosgen	Low					None	AR
NMFS/deq							
PR00-008	1.0	0.56	47	1	99	0	29
Reference	Poor	Good	Good	Poor	Poor	Poor	Fair
ODFW/Rosgen	Low					None	AR
NMFS/deq							
PR00-009	1.0	1.96	34	0	85	15	45
Reference	Poor	Poor	Good	Poor	Poor	Fair	Fair
ODFW/Rosgen	Low					AR	AR
NMFS/deq							
PR00-010	1.0	1.30	24	0	0	77	39
Reference	Poor	Poor	Good	Poor		Good	Fair
ODFW/Rosgen	None					Desirable	AR
NMFS/deq							
PR00-011	1.0	1.25	16	0	0	0	
Reference	Poor	Poor	Good	Poor		Poor	Poor
ODFW/Rosgen	None					None	None
NMFS/deq							
PR00-012	1.0	1.81	13	0	0	0	
Reference	Poor	Poor	Good	Poor		Poor	Poor
ODFW/Rosgen	None					None	None
NMFS/deq							
PR00-013	1.0	1.79	31	0	83	17	56
Reference	Poor	Poor	Good	Poor	Poor	Fair	Good
ODFW/Rosgen	Low					AR	Desirable
NMFS/deq							
PR00-014	1.0	1.45	73	8	92	0	41
Reference	Poor	Poor	Poor	Poor	Poor	Poor	Fair
ODFW/Rosgen	None					None	AR
NMFS/deq							
PR00-015	2.5	1.38	66	1	99	0	89
Reference	Good	Poor	Poor	Poor	Poor	Poor	Good
ODFW/Rosgen	High					None	Desirable
NMFS/deq							
PR00-016	1.3	1.27	37	8	92	0	23
Reference	Good	Poor	Good	Poor	Poor	Poor	Poor
ODFW/Rosgen	Medium					None	AR
NMFS/deq							

Table F-5 continued								
Site / Criteria	Substrate					Wood	Fish Cover	
	Course gravel and larger (%>16mm)	Embeddedness (%)	Sand and fines (%< 2 mm)	Hardpan (%)	Bed substrate stability index	Wood density (all sizes #/100m)	Natural fish cover (aerial proportion)	Large fish cover (aerial proportion)
	PCT_BIGR	XEMBED	PCT_SAFN	PCT_HP	LRBS_BW5	C1WM100	XFC_NAT	XFC_BIG
PR00-002	59	32	7	0	-0.51	0.0	0.25	0.10
Reference	Good	Good	Good		Fair		Poor	Fair
ODFW/Rosgen	Desirable		Desirable			None		
NMFS/deq		NPF	Good		High			
PR00-003	55	43	12	0	-0.32	1.6	0.12	0.07
Reference	Good	Good	Good		Good		Poor	Poor
ODFW/Rosgen	Desirable		AR			Undesirable		
NMFS/deq		NPF	Good		High			
PR00-004	38	44	17	0	-0.50	0.5	0.21	0.35
Reference	Fair	Good	Good		Fair		Poor	Good
ODFW/Rosgen	Desirable		AR			Undesirable		
NMFS/deq		NPF	Good		High			
PR00-005	54	36	14	1	-0.30	1.8	0.32	0.10
Reference	Good	Good	Good		Good		Fair	Fair
ODFW/Rosgen	Desirable		AR			Undesirable		
NMFS/deq		NPF	Good		High			
PR00-006	34	23	8	12	-0.07	0.0	0.43	0.05
Reference	Fair	Good	Good	Poor	Good		Good	Poor
ODFW/Rosgen	AR	AR	Desirable			None		
NMFS/deq			Good		High			
PR00-007	26	43	20	23	-0.03	0.0	0.47	0.18
Reference	Fair	Good	Good	Poor	Good		Good	Good
ODFW/Rosgen	AR		AR			None		
NMFS/deq		NPF	Good		High			
PR00-008	24	61	42	0	-1.63	0.0	0.22	0.20
Reference	Fair	Fair	Fair		Poor		Poor	Good
ODFW/Rosgen	AR		Undesirable			None		
NMFS/deq		NPF	Fair		Medium			
PR00-009	10	72	67	5	-2.69	0.0	0.48	0.02
Reference	Fair	Fair	Poor	Fair	Poor		Good	Poor
ODFW/Rosgen	Undesirable		Undesirable			None		
NMFS/deq		NPF	Poor		Low			
PR00-010	24	60	51	0	-1.72	0.0	1.26	0.00
Reference	Fair	Fair	Poor		Poor		Good	Poor
ODFW/Rosgen	AR		Undesirable			None		
NMFS/deq		NPF	Poor		Medium			
PR00-011	7	80	82	0		0.0	0.74	0.00
Reference	Poor	Poor	Poor				Good	Poor
ODFW/Rosgen	Undesirable		Undesirable			None		
NMFS/deq		NPF	Poor					
PR00-012	18	23	27	0		0.0	0.82	0.00
Reference	Fair	Good	Good				Good	Poor
ODFW/Rosgen	AR		Undesirable			None		
NMFS/deq		AR	Good					
PR00-013	29	56	36	0	-1.23	0.0	0.75	0.13
Reference	Fair	Fair	Fair		Good		Good	Fair
ODFW/Rosgen	AR		Undesirable			None		
NMFS/deq		NPF	Poor		Low			
PR00-014	33	51	27	4	-0.82	0.0	0.55	0.17
Reference	Fair	Good	Good	Fair	Fair		Good	Fair
ODFW/Rosgen	AR		Undesirable			None		
NMFS/deq		NPF	Good		High			
PR00-015	18	28	7	2	-0.36	0.0	0.61	0.48
Reference	Fair	Good	Good	Fair	Good		Good	Good
ODFW/Rosgen	AR		Desirable			None		
NMFS/deq		AR	Good		High			
PR00-016	29	66	50	4	-1.79	2.7	0.28	0.11
Reference	Fair	Fair	Poor	Fair	Poor		Fair	Fair
ODFW/Rosgen	AR		Undesirable			Undesirable		
NMFS/deq		NPF	Fair		Medium			

Table F-5 continued					
Site / Criteria	Riparian Cover				Human Disturbance
	Canopy shade mid-channel (% area)	Riparian canopy cover (areal proportion, large trees > 5m high	Riparian canopy cover (areal proportion, all trees)	Proportion of reach with 3 layers of vegetation	Riparian human disturbance index
	XCDENMID	XCL	XC	XPCMG	W1_HALL
PR00-002	83	0.08	0.15	0.45	6.13
Reference	Fair	Fair	Fair	Poor	Poor
ODFW/Rosgen	Desirable				
NMFS/deq					
PR00-003	88	0.20	0.32	0.90	2.23
Reference	Fair	Good	Fair	Fair	Fair
ODFW/Rosgen	Desirable				
NMFS/deq					
PR00-004	59	0.19	0.23	0.45	5.81
Reference	Poor	Good	Fair	Poor	Poor
ODFW/Rosgen	Undesirable				
NMFS/deq					
PR00-005	49	0.06	0.10	0.50	3.08
Reference	Poor	Fair	Poor	Poor	Poor
ODFW/Rosgen	Undesirable				
NMFS/deq					
PR00-006	40	0.00	0.00	0.05	4.40
Reference	Poor	Poor	Poor	Poor	Poor
ODFW/Rosgen	Undesirable				
NMFS/deq					
PR00-007	33	0.02	0.03	0.18	4.36
Reference	Poor	Poor	Poor	Poor	Poor
ODFW/Rosgen	Undesirable				
NMFS/deq					
PR00-008	28	0.00	0.01	0.28	3.64
Reference	Poor	Poor	Poor	Poor	Poor
ODFW/Rosgen	Undesirable				
NMFS/deq					
PR00-009	49	0.00	0.09	0.55	3.22
Reference	Poor	Poor	Poor	Poor	Poor
ODFW/Rosgen	Undesirable				
NMFS/deq					
PR00-010	79	0.00	0.00	0.05	1.36
Reference	Fair	Poor	Poor	Poor	Fair
ODFW/Rosgen	Desirable				
NMFS/deq					
PR00-011	30	0.00	0.01	0.23	1.51
Reference	Poor	Poor	Poor	Poor	Fair
ODFW/Rosgen	Undesirable				
NMFS/deq					
PR00-012	36	0.00	0.00	0.00	1.96
Reference	Poor	Poor	Poor	Poor	Fair
ODFW/Rosgen	Undesirable				
NMFS/deq					
PR00-013	78	0.12	0.21	0.36	2.23
Reference	Fair	Good	Fair	Poor	Fair
ODFW/Rosgen	Desirable				
NMFS/deq					
PR00-014	39	0.00	0.00	0.00	1.61
Reference	Poor	Poor	Poor	Poor	Fair
ODFW/Rosgen	Undesirable				
NMFS/deq					
PR00-015	67	0.00	0.00	0.00	3.44
Reference	Poor	Poor	Poor	Poor	Poor
ODFW/Rosgen	AR				
NMFS/deq					
PR00-016	54	0.01	0.03	0.50	2.21
Reference	Poor	Poor	Poor	Poor	Fair
ODFW/Rosgen	Undesirable				
NMFS/deq					

Table F-5 Evaluation of Pringle Creek Indicators Relative to Benchmarks							
Site / Criteria	Channel dimensions				Overall Habitat Quality		
	Stream	Bankfull width (m)	Thalweg depth (cm)	Gradient (%)	HQI Willamette Valley	Rapid Habitat Assessment	Benthic Index of Biological Integrity
		XBKF_W	XDEPTH	XSLOPE	wv-HQI	RHA Score	B-IBI
PR00-017	MF Pringle	3.4	13	1.1	0.68	110	24
Reference							Poor
ODFW/Rosgen							Moderate Impairment
NMFS/deq							
PR00-018	MF Pringle	2.1	22	0.4	0.29	101	16
Reference							Poor
ODFW/Rosgen							Severe Impairment
NMFS/deq							
PR00-020	MF Pringle	13.8	48	0.8	0.21	113	24
Reference							Poor
ODFW/Rosgen							Moderate Impairment
NMFS/deq							
PR00-023	Clarke	2.5	20	1.9	0.27	57	18
Reference							Poor
ODFW/Rosgen							Severe Impairment
NMFS/deq							
PR00-024	Clarke	3.4	18	0.5	0.52	108	14
Reference							Poor
ODFW/Rosgen							Severe Impairment
NMFS/deq							
PR00-025	Clarke	2.8	22	2.1	0.68	105	18
Reference							Poor
ODFW/Rosgen							Severe Impairment
NMFS/deq							
PR00-026	Clarke	2.4	19	1.0	0.63	104	18
Reference							Poor
ODFW/Rosgen							Severe Impairment
NMFS/deq							
PR00-027	Clarke	1.9	16	2.1	0.67	108	22
Reference							Poor
ODFW/Rosgen							Moderate Impairment
NMFS/deq							
PR00-029	Clarke	2.4	14	0.9	0.61	108	18
Reference							Poor
ODFW/Rosgen							Severe Impairment
NMFS/deq							
PR00-030	Clarke	1.9	8	2.8	0.72	111	22
Reference							Poor
ODFW/Rosgen							Moderate Impairment
NMFS/deq							
PR00-031	Pringle	2.6	31	0.9	0.62	118	18
Reference							Poor
ODFW/Rosgen							Severe Impairment
NMFS/deq							
PR00-032	Pringle	3.4	24	1.4	0.60	113	20
Reference							Poor
ODFW/Rosgen							Moderate Impairment
NMFS/deq							
PR00-033	Pringle	2.7	16	2.6	0.74	122	18
Reference							Poor
ODFW/Rosgen							Severe Impairment
NMFS/deq							
PR00-034	Pringle	4.7	21	2.6	0.79	131	16
Reference							Poor
ODFW/Rosgen							Severe Impairment
NMFS/deq							
PR00-035	Pringle	4.1	19	2.9	0.81	124	18
Reference							Poor
ODFW/Rosgen							Severe Impairment
NMFS/deq							

Table F-5 continued							
Site / Criteria	Morphology			Complexity			Pool Depth
	Channel sinuosity SINU	Incision height (m) above bf XINC_H	Bank angle (degrees) XBKA	Riffle percentage PCT_FAST	Glide percentage PCT_GL	Pool percentage PCT_POOL	Depth of deepest residual pool (m) RPMXDEP
PR00-017	1.0	0.95	77	11	89	0	22
Reference	Poor	Poor	Poor	Poor	Poor	Poor	Poor
ODFW/Rosgen	None					None	AR
NMFS/deq							
PR00-018	1.3	1.04	77	0	100	0	14
Reference	Good	Poor	Poor	Poor	Poor	Poor	Poor
ODFW/Rosgen	Medium					None	Undesirable
NMFS/deq							
PR00-020	1.2	0.58	25	0	86	14	47
Reference	Good	Good	Good	Poor	Poor	Fair	Fair
ODFW/Rosgen	Low					AR	AR
NMFS/deq							
PR00-023	2.0	0.98	66	8	92	0	
Reference	Good	Poor	Poor	Poor	Poor	Poor	Poor
ODFW/Rosgen	High					None	None
NMFS/deq							
PR00-024	1.0	0.84	92	32	63	5	35
Reference	Fair	Fair	Poor	Good	Poor	Poor	Fair
ODFW/Rosgen	Low					Undesirable	AR
NMFS/deq							
PR00-025	1.0	1.44	80	29	61	9	47
Reference	Fair	Poor	Poor	Good	Poor	Poor	Fair
ODFW/Rosgen	Low					Undesirable	AR
NMFS/deq							
PR00-026	1.2	0.88	77	38	62	0	70
Reference	Good	Poor	Poor	Good	Poor	Poor	Good
ODFW/Rosgen	Low					None	Desirable
NMFS/deq							
PR00-027	1.2	1.11	85	38	62	0	
Reference	Good	Poor	Poor	Good	Poor	Poor	Poor
ODFW/Rosgen	Low					None	None
NMFS/deq							
PR00-029	2.0	0.74	110	2	98	0	
Reference	Good	Fair	Poor	Poor	Poor	Poor	Poor
ODFW/Rosgen	High					None	None
NMFS/deq							
PR00-030	1.1	0.72	75	44	52	3	22
Reference	Good	Fair	Poor	Good	Poor	Poor	Poor
ODFW/Rosgen	Low					Undesirable	AR
NMFS/deq							
PR00-031	1.1	0.67	106	16	84	0	46
Reference	Fair	Good	Poor	Poor	Poor	Poor	Fair
ODFW/Rosgen	Low					None	AR
NMFS/deq							
PR00-032	1.0	0.97	68	20	80	0	31
Reference	Poor	Poor	Poor	Poor	Poor	Poor	Fair
ODFW/Rosgen	None					None	AR
NMFS/deq							
PR00-033	1.0	0.74	92	45	55	0	32
Reference	Poor	Fair	Poor	Good	Poor	Poor	Fair
ODFW/Rosgen	Low					None	AR
NMFS/deq							
PR00-034	1.1	0.65	93	49	49	2	47
Reference	Good	Good	Poor	Good	Poor	Poor	Fair
ODFW/Rosgen	Low					Undesirable	AR
NMFS/deq							
PR00-035	1.1	0.50	79	49	47	4	40
Reference	Fair	Good	Poor	Good	Poor	Poor	Fair
ODFW/Rosgen	Low					Undesirable	AR
NMFS/deq							

Table F-5 continued								
Site / Criteria	Substrate					Wood	Fish Cover	
	Course gravel and larger (%>16mm)	Embeddedness (%)	Sand and fines (%< 2 mm)	Hardpan (%)	Bed substrate stability index	Wood density (all sizes #/100m)	Natural fish cover (aerial proportion)	Large fish cover (aerial proportion)
	PCT_BIGR	XEMBED	PCT_SAFN	PCT_HP	LRBS_BW5	C1WM100	XFC_NAT	XFC_BIG
PR00-017	47	40	26	0	-1.09	0.7	0.38	0.27
Reference	Good	Good	Good		Fair		Good	Good
ODFW/Rosgen	Desirable		Undesirable			Undesirable		
NMFS/deq		NPF	Good		Medium			
PR00-018	11	85	76	1	-2.46	2.7	0.77	0.14
Reference	Fair	Poor	Poor		Poor		Good	Fair
ODFW/Rosgen	Undesirable		Undesirable			Undesirable		
NMFS/deq		NPF	Poor		Low			
PR00-020	0	77	78	0	-3.18	0.0	0.95	0.00
Reference	Poor	Fair	Poor		Poor		Good	Poor
ODFW/Rosgen	Undesirable		Undesirable			None		
NMFS/deq		NPF	Poor		Low			
PR00-023	5	17	18	0		0.0	0.21	0.04
Reference	Poor	Good	Good				Poor	Poor
ODFW/Rosgen	Undesirable		AR			None		
NMFS/deq		PF	Good					
PR00-024	15	47	28	12	-0.62	0.0	0.42	0.16
Reference	Fair	Good	Good	Poor	Fair		Good	Fair
ODFW/Rosgen	Undesirable		Undesirable			None		
NMFS/deq		NPF	Good		High			
PR00-025	32	38	22	12	-0.50	0.0	0.52	0.37
Reference	Fair	Good	Good	Poor	Fair		Good	Good
ODFW/Rosgen	AR		AR			None		
NMFS/deq		NPF	Good		High			
PR00-026	13	29	18	25	0.09	1.3	0.51	0.34
Reference	Fair	Good	Good	Poor	Good		Good	Good
ODFW/Rosgen	Undesirable		AR			Undesirable		
NMFS/deq		AR	Fair		High			
PR00-027	25	15	8	14		1.3	0.93	0.44
Reference	Fair	Good	Good	Poor			Good	Good
ODFW/Rosgen	AR		Desirable			Undesirable		
NMFS/deq		PF	Good					
PR00-029	22	38	36	4		0.0	1.11	0.38
Reference	Fair	Good	Fair	Fair			Good	Good
ODFW/Rosgen	AR		Undesirable			None		
NMFS/deq		NPF	Poor					
PR00-030	36	43	22	6	-0.88	0.0	0.72	0.37
Reference	Fair	Good	Good	Poor	Good		Good	Good
ODFW/Rosgen	Desirable		AR			None		
NMFS/deq		NPF	Fair		Medium			
PR00-031	8	40	36	35	-0.29	0.7	0.61	0.38
Reference	Poor	Good	Fair	Poor	Good		Good	Good
ODFW/Rosgen	Undesirable		Undesirable			Undesirable		
NMFS/deq		NPF	Fair		High			
PR00-032	24	44	32	8	-0.99	7.4	0.60	0.22
Reference	Fair	Good	Good	Poor	Fair		Good	Good
ODFW/Rosgen	AR		Undesirable			Undesirable		
NMFS/deq		NPF	Fair		High			
PR00-033	49	46	22	6	-0.56	0.0	1.06	0.44
Reference	Good	Good	Good	Poor	Fair		Good	Good
ODFW/Rosgen	Desirable		AR			None		
NMFS/deq		NPF	Good		High			
PR00-034	48	32	19	1	-0.75	0.7	0.44	0.34
Reference	Good	Good	Good		Good		Good	Good
ODFW/Rosgen	Desirable		AR			Undesirable		
NMFS/deq		NPF	Fair		High			
PR00-035	47	48	25	3	-0.95	9.4	0.71	0.36
Reference	Good	Good	Good	Fair	Good		Good	Good
ODFW/Rosgen	Desirable		AR			Undesirable		
NMFS/deq		NPF	Fair		Medium			

Table F-5 continued					
Site / Criteria	Riparian Cover				Human Disturbance
	Canopy shade mid-channel (% area)	Riparian canopy cover (areal proportion, large trees > 5m high	Riparian canopy cover (areal proportion, all trees)	Proportion of reach with 3 layers of vegetation	Riparian human disturbance index
	XCDENMID	XCL	XC	XPCMG	W1_HALL
PR00-017	82	0.24	0.46	0.50	2.70
Reference	Fair	Good	Good	Poor	Poor
ODFW/Rosgen	Desirable				
NMFS/deq					
PR00-018	41	0.00	0.00	0.00	2.72
Reference	Poor	Poor	Poor	Poor	Poor
ODFW/Rosgen	Undesirable				
NMFS/deq					
PR00-020	44	0.01	0.02	0.14	2.16
Reference	Poor	Poor	Poor	Poor	Fair
ODFW/Rosgen	Undesirable				
NMFS/deq					
PR00-023	56	0.02	0.03	0.14	5.98
Reference	Poor	Poor	Poor	Poor	Poor
ODFW/Rosgen	Undesirable				
NMFS/deq					
PR00-024	91	0.28	0.46	0.91	3.05
Reference	Good	Good	Good	Fair	Poor
ODFW/Rosgen	Desirable				
NMFS/deq					
PR00-025	74	0.16	0.21	0.68	5.57
Reference	Poor	Good	Fair	Poor	Poor
ODFW/Rosgen	Desirable				
NMFS/deq					
PR00-026	90	0.22	0.31	1.00	3.92
Reference	Good	Good	Fair	Good	Poor
ODFW/Rosgen	Desirable				
NMFS/deq					
PR00-027	78	0.09	0.11	0.32	5.40
Reference	Fair	Fair	Poor	Poor	Poor
ODFW/Rosgen	Desirable				
NMFS/deq					
PR00-029	81	0.13	0.24	0.70	2.92
Reference	Fair	Good	Fair	Poor	Poor
ODFW/Rosgen	Desirable				
NMFS/deq					
PR00-030	92	0.21	0.30	0.89	6.25
Reference	Good	Good	Fair	Fair	Poor
ODFW/Rosgen	Desirable				
NMFS/deq					
PR00-031	84	0.08	0.23	1.00	3.32
Reference	Fair	Fair	Fair	Good	Poor
ODFW/Rosgen	Desirable				
NMFS/deq					
PR00-032	87	0.04	0.08	0.50	4.40
Reference	Fair	Fair	Poor	Poor	Poor
ODFW/Rosgen	Desirable				
NMFS/deq					
PR00-033	64	0.00	0.06	0.41	3.61
Reference	Poor	Poor	Poor	Poor	Poor
ODFW/Rosgen	AR				
NMFS/deq					
PR00-034	71	0.18	0.34	0.95	4.88
Reference	Poor	Good	Fair	Good	Poor
ODFW/Rosgen	Desirable				
NMFS/deq					
PR00-035	91	0.24	0.52	1.00	3.83
Reference	Good	Good	Good	Good	Poor
ODFW/Rosgen	Desirable				
NMFS/deq					

Table F-5 Evaluation of Pringle Creek Indicators Relative to Benchmarks							
Site / Criteria	Channel dimensions				Overall Habitat Quality		
	Stream	Bankfull width (m)	Thalweg depth (cm)	Gradient (%)	HQI Willamette Valley	Rapid Habitat Assessment	Benthic Index of Biological Integrity
		XBKF_W	XDEPTH	XSLOPE	wv-HQI	RHA Score	B-IBI
PR00-036	Pringle	3.8	16	1.4	0.71	117	18
Reference							Poor
ODFW/Rosgen							Severe Impairment
NMFS/deq							
PR00-037	Pringle	2.2	13	2.2	0.57	102	18
Reference							Poor
ODFW/Rosgen							Severe Impairment
NMFS/deq							
PR00-038	Pringle	2.9	15	0.9	0.50	98	16
Reference							Poor
ODFW/Rosgen							Severe Impairment
NMFS/deq							
PR00-041	Pringle	1.6	0	2.0	0.38	55	
Reference							
ODFW/Rosgen							
NMFS/deq							
PR00-042	WMF Pringle	7.2	11	0.7	0.12	109	16
Reference							Poor
ODFW/Rosgen							Severe Impairment
NMFS/deq							
PR00-045	WMF Pringle	2.5	12	2.0	0.57	94	20
Reference							Poor
ODFW/Rosgen							Moderate Impairment
NMFS/deq							
PR00-047	EF Pringle	4.6	19	0.7	0.60	113	20
Reference							Poor
ODFW/Rosgen							Moderate Impairment
NMFS/deq							
PR00-048	EF Pringle	4.4	42	1.0	0.77	99	18
Reference							Poor
ODFW/Rosgen							Severe Impairment
NMFS/deq							
PR00-049	EF Pringle	3.9	48	0.7	0.74	122	16
Reference							Poor
ODFW/Rosgen							Severe Impairment
NMFS/deq							
PR00-050	EF Pringle	7.8	51	0.5	0.37	99	16
Reference							Poor
ODFW/Rosgen							Severe Impairment
NMFS/deq							
PR00-051	EF Pringle	3.2	25	0.7	0.61	124	30
Reference							Poor
ODFW/Rosgen							Slight Impairment
NMFS/deq							
PR00-052	EF Pringle	3.3	27	0.3	0.59	109	20
Reference							Poor
ODFW/Rosgen							Moderate Impairment
NMFS/deq							
PR00-053	EF Pringle	4.2	32	0.4	0.42	99	18
Reference							Poor
ODFW/Rosgen							Severe Impairment
NMFS/deq							
PR00-054	EF Pringle	3.9	34	0.5	0.39	95	22
Reference							Poor
ODFW/Rosgen							Moderate Impairment
NMFS/deq							
PR00-055	EF Pringle	3.5	23	0.6	0.59	115	20
Reference							Poor
ODFW/Rosgen							Moderate Impairment
NMFS/deq							

Table F-5 continued							
Site / Criteria	Morphology			Complexity			Pool Depth
	Channel sinuosity	Incision height (m) above bf	Bank angle (degrees)	Riffle percentage	Glide percentage	Pool percentage	Depth of deepest residual pool (m)
	SINU	XINC_H	XBKA	PCT_FAST	PCT_GL	PCT_POOL	RPMXDEP
PR00-036	1.1	0.59	79	51	49	0	23
Reference	Fair	Good	Poor	Good	Poor	Poor	Poor
ODFW/Rosgen	Low					None	AR
NMFS/deq							
PR00-037	1.1	0.85	78	43	56	1	26
Reference	Fair	Poor	Poor	Good	Poor	Poor	Fair
ODFW/Rosgen	Low					Undesirable	AR
NMFS/deq							
PR00-038	1.1	1.39	84	41	59	0	27
Reference	Good	Poor	Poor	Good	Poor	Poor	Fair
ODFW/Rosgen	Low					None	AR
NMFS/deq							
PR00-041	1.0	0.82	73	0	0	0	
Reference	Poor	Fair	Poor	Poor		Poor	Poor
ODFW/Rosgen	Low					None	None
NMFS/deq							
PR00-042	1.1	2.39	43	18	82	0	16
Reference	Good	Poor	Good	Poor	Poor	Poor	Poor
ODFW/Rosgen	Low					None	Undesirable
NMFS/deq							
PR00-045	1.2	0.96	83	18	82	0	32
Reference	Good	Poor	Poor	Poor	Poor	Poor	Fair
ODFW/Rosgen	Medium					None	AR
NMFS/deq							
PR00-047	1.0	1.28	36	10	90	0	41
Reference	Poor	Poor	Good	Poor	Poor	Poor	Fair
ODFW/Rosgen	None					None	AR
NMFS/deq							
PR00-048	1.3	1.80	53	11	71	18	81
Reference	Good	Poor	Fair	Poor	Poor	Fair	Good
ODFW/Rosgen	Medium					AR	Desirable
NMFS/deq							
PR00-049	1.3	0.65	41	13	73	13	91
Reference	Good	Good	Good	Poor	Poor	Fair	Good
ODFW/Rosgen	Medium					AR	Desirable
NMFS/deq							
PR00-050	1.0	1.44	20	0	100	0	67
Reference	Fair	Poor	Good	Poor	Poor	Poor	Good
ODFW/Rosgen	Low					None	Desirable
NMFS/deq							
PR00-051	1.0	2.94	60	26	74	0	43
Reference	Poor	Poor	Fair	Fair	Poor	Poor	Fair
ODFW/Rosgen	Low					None	AR
NMFS/deq							
PR00-052	1.0	1.80	63	7	93	0	39
Reference	Poor	Poor	Poor	Poor	Poor	Poor	Fair
ODFW/Rosgen	None					None	AR
NMFS/deq							
PR00-053	1.0	1.68	45	11	89	0	35
Reference	Poor	Poor	Good	Poor	Poor	Poor	Fair
ODFW/Rosgen	None					None	AR
NMFS/deq							
PR00-054	1.0	1.45	41	4	96	0	47
Reference	Poor	Poor	Good	Poor	Poor	Poor	Fair
ODFW/Rosgen	None					None	AR
NMFS/deq							
PR00-055	1.0	3.15	56	10	81	8	42
Reference	Poor	Poor	Fair	Poor	Poor	Poor	Fair
ODFW/Rosgen	None					Undesirable	AR
NMFS/deq							

Table F-5 continued								
Site / Criteria	Substrate					Wood	Fish Cover	
	Course gravel and larger (%>16mm)	Embeddedness (%)	Sand and fines (%< 2 mm)	Hardpan (%)	Bed substrate stability index	Wood density (all sizes #/100m)	Natural fish cover (aerial proportion)	Large fish cover (aerial proportion)
	PCT_BIGR	XEMBED	PCT_SAFN	PCT_HP	LRBS_BW5	C1WM100	XFC_NAT	XFC_BIG
PR00-036	57	45	23	3	-0.24	0.0	0.56	0.28
Reference	Good	Good	Good	Fair	Good		Good	Good
ODFW/Rosgen	Desirable		AR			None		
NMFS/deq		NPF	Fair		High			
PR00-037	25	30	15	30	0.05	0.0	0.36	0.23
Reference	Fair	Good	Good	Poor	Good		Good	Good
ODFW/Rosgen	AR		AR			None		
NMFS/deq		AR	Fair		High			
PR00-038	21	29	13	6	-0.40	0.0	0.72	0.29
Reference	Fair	Good	Good	Poor	Good		Good	Good
ODFW/Rosgen	AR		AR			None		
NMFS/deq		AR	Good		High			
PR00-041	14	21	23	37		0.0	0.98	0.16
Reference	Fair	Good	Good	Poor			Good	Fair
ODFW/Rosgen	Undesirable		AR			None		
NMFS/deq		AR	Fair					
PR00-042	0	37	30	51	0.30	0.0	0.20	0.00
Reference	Poor	Good	Good	Poor	Good		Poor	Poor
ODFW/Rosgen	None		Undesirable			None		
NMFS/deq		NPF	Fair		High			
PR00-045	21	41	27	2	-1.84	0.0	0.71	0.25
Reference	Fair	Good	Good	Fair	Poor		Good	Good
ODFW/Rosgen	AR		Undesirable			None		
NMFS/deq		NPF	Fair		Low			
PR00-047	40	37	15	1	-0.75	6.7	0.78	0.22
Reference	Fair	Good	Good		Fair		Good	Good
ODFW/Rosgen	Desirable		AR			Undesirable		
NMFS/deq		NPF	Good		High			
PR00-048	34	52	39	0	-1.51	0.0	0.61	0.20
Reference	Fair	Good	Fair		Poor		Good	Good
ODFW/Rosgen	AR		Undesirable			None		
NMFS/deq		NPF	Fair		Medium			
PR00-049	27	52	32	1	-1.35	0.7	0.55	0.24
Reference	Fair	Good	Good		Poor		Good	Good
ODFW/Rosgen	AR		Undesirable			Undesirable		
NMFS/deq		NPF	Fair		Medium			
PR00-050	18	49	46	1	-2.02	0.0	0.10	0.03
Reference	Fair	Good	Fair		Poor		Poor	Poor
ODFW/Rosgen	AR		Undesirable			None		
NMFS/deq		NPF	Fair		Low			
PR00-051	54	28	11	1	-0.26	0.7	0.72	0.19
Reference	Good	Good	Good		Good		Good	Good
ODFW/Rosgen	Desirable		Desirable			Undesirable		
NMFS/deq		AR	Good		High			
PR00-052	26	54	44	0	-1.09	4.7	1.06	0.22
Reference	Fair	Good	Fair		Fair		Good	Good
ODFW/Rosgen	AR		Undesirable			Undesirable		
NMFS/deq		NPF	Fair		Medium			
PR00-053	31	55	30	0	-1.20	1.9	0.49	0.05
Reference	Fair	Good	Good		Fair		Good	Poor
ODFW/Rosgen	AR		Undesirable			Undesirable		
NMFS/deq		NPF	Good		Medium			
PR00-054	31	63	47	0	-1.56	11.4	0.67	0.04
Reference	Fair	Fair	Fair		Poor		Good	Poor
ODFW/Rosgen	AR		Undesirable			AR		
NMFS/deq		NPF	Fair		Medium			
PR00-055	33	51	23	0	-0.79	4.7	1.24	0.13
Reference	Fair	Good	Good		Good		Good	Fair
ODFW/Rosgen	AR		AR			Undesirable		
NMFS/deq		NPF	Fair		Medium			

Table F-5 continued					
Site / Criteria	Riparian Cover				Human Disturbance
	Canopy shade mid-channel (% area)	Riparian canopy cover (areal proportion, large trees > 5m high	Riparian canopy cover (areal proportion, all trees)	Proportion of reach with 3 layers of vegetation	Riparian human disturbance index
	XCDENMID	XCL	XC	XPCMG	W1_HALL
PR00-036	71	0.12	0.26	0.95	4.88
Reference	Poor	Good	Fair	Good	Poor
ODFW/Rosgen	Desirable				
NMFS/deq					
PR00-037	89	0.36	0.54	1.00	3.89
Reference	Fair	Good	Good	Good	Poor
ODFW/Rosgen	Desirable				
NMFS/deq					
PR00-038	59	0.04	0.05	0.14	6.45
Reference	Poor	Fair	Poor	Poor	Poor
ODFW/Rosgen	Undesirable				
NMFS/deq					
PR00-041	68	0.09	0.13	0.55	5.00
Reference	Poor	Fair	Poor	Poor	Poor
ODFW/Rosgen	AR				
NMFS/deq					
PR00-042	33	0.00	0.00	0.09	3.69
Reference	Poor	Poor	Poor	Poor	Poor
ODFW/Rosgen	Undesirable				
NMFS/deq					
PR00-045	88	0.17	0.22	0.75	5.04
Reference	Fair	Good	Fair	Poor	Poor
ODFW/Rosgen	Desirable				
NMFS/deq					
PR00-047	58	0.10	0.16	0.36	3.08
Reference	Poor	Fair	Fair	Poor	Poor
ODFW/Rosgen	Undesirable				
NMFS/deq					
PR00-048	56	0.07	0.17	0.43	4.08
Reference	Poor	Fair	Fair	Poor	Poor
ODFW/Rosgen	Undesirable				
NMFS/deq					
PR00-049	48	0.00	0.15	0.59	3.59
Reference	Poor	Poor	Fair	Poor	Poor
ODFW/Rosgen	Undesirable				
NMFS/deq					
PR00-050	8	0.00	0.05	0.45	4.13
Reference	Poor	Poor	Poor	Poor	Poor
ODFW/Rosgen	Undesirable				
NMFS/deq					
PR00-051	46	0.00	0.03	0.27	4.00
Reference	Poor	Poor	Poor	Poor	Poor
ODFW/Rosgen	Undesirable				
NMFS/deq					
PR00-052	69	0.15	0.19	0.50	2.20
Reference	Poor	Good	Fair	Poor	Fair
ODFW/Rosgen	AR				
NMFS/deq					
PR00-053	46	0.00	0.04	0.23	1.92
Reference	Poor	Poor	Poor	Poor	Fair
ODFW/Rosgen	Undesirable				
NMFS/deq					
PR00-054	40	0.01	0.03	0.27	1.89
Reference	Poor	Poor	Poor	Poor	Fair
ODFW/Rosgen	Undesirable				
NMFS/deq					
PR00-055	86	0.00	0.09	0.59	2.21
Reference	Fair	Poor	Poor	Poor	Fair
ODFW/Rosgen	Desirable				
NMFS/deq					

Appendix G
Habitat Site Characterization
Summary Sheets

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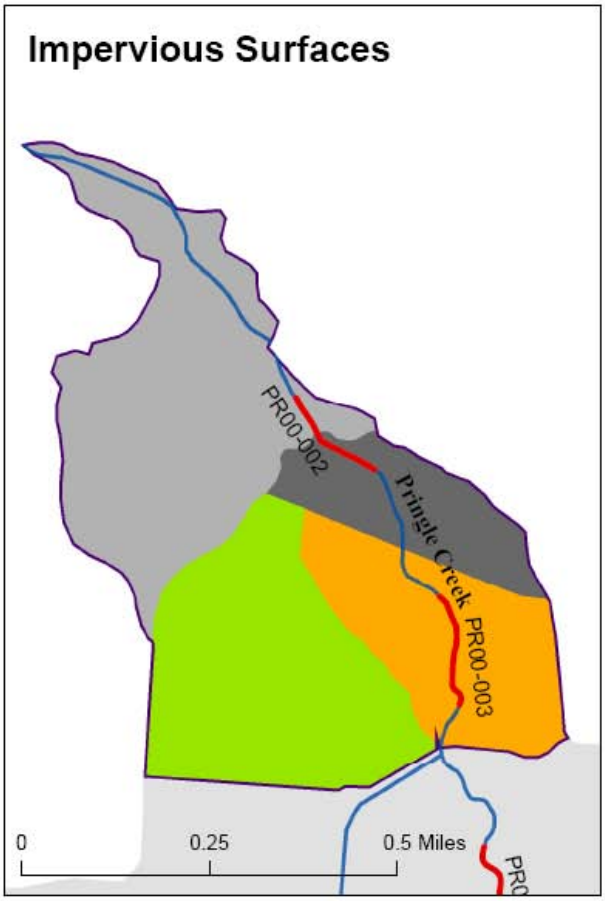
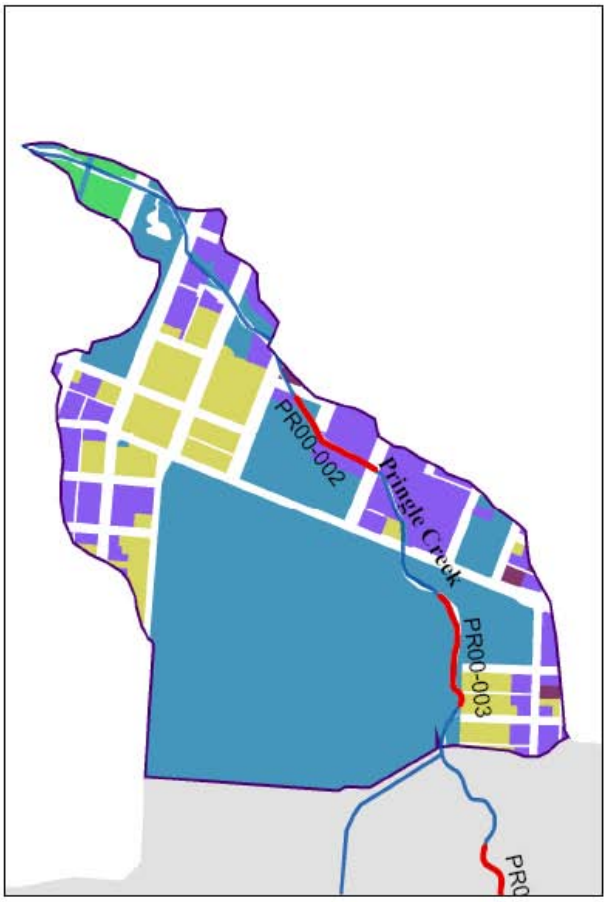
Lower Pringle Creek Subbasin





Lower Pringle Creek Subbasin
Impervious Surface and Land Use

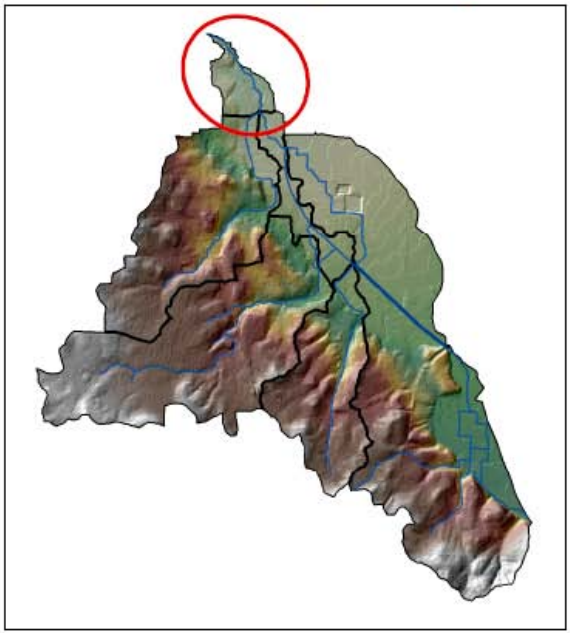
- Survey Reaches
- Streams
- Pringle Creek Subbasins

Impervious Surface Cover by Catchment

- 0 - 10
- 10 - 25
- 25 - 40
- 40 - 60
- 60 - 80

Land Use

- Commercial (29 Acres)
- Industrial (3 Acres)
- Public (116)
- Residential (22 Acres)
- Vacant (1 Acre)



Pringle Creek Site PR00-002

Reach location and description:
Pringle Creek Site 2 begins 128 meters upstream from its confluence with Shelton Ditch in Pringle Park, and extends upstream 117 meters until it reaches a long culvert under the hospital. This reach drains all of the subbasins of Pringle Creek. The reach has an average bankfull width of 8.4 meters with a mean water surface gradient of 1%. The mean thalweg depth of the reach at baseflow was 30 centimeters. The reach consists primarily of glide habitat, and is fairly straight with a low sinuosity of 1.1. The stream is incised and the western bank of the reach is constrained by a concrete wall through the park. The overall habitat quality index of this reach was 72% of least disturbed conditions. According to StreamNet (2006), this reach could potentially be used by listed Upper Willamette River spring Chinook salmon and winter steelhead ESUs, which migrate up Shelton Ditch into Mill Creek. Additionally, this reach is used by fall Chinook salmon, which spawn and rear up to the confluence with Middle Fork Pringle Creek.

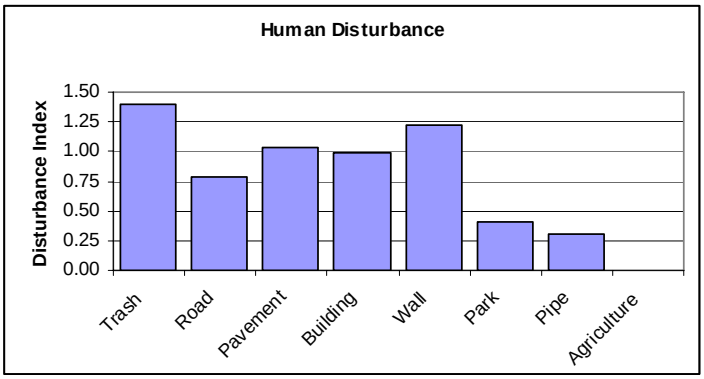
Key habitat issues:

- Channel is incised, with steep bank angles.
- Banks are armored by walls or rip-rap.
- Very little channel complexity, primarily glide habitat.
- No pool habitat.
- No wood.
- Pavement, roads and buildings within or near the riparian zone.
- Large amounts of trash.

Pringle Creek Site PR00-002 at Pringle Park in winter

Condition Summary: Pringle Creek Site PR00-002				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	2	Habitat Quality Index (HQI)	0.72	Moderate. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	110	Fair. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	16	Very poor
Channel Morphology	1	Channel sinuosity	1.1	Low, good compared to reference condition.
		Incision height	1.54	Poor, deeply incised with steep bank angles.
		Bank angle (degrees)	72	
Channel Complexity	0	Riffle percentage	18	No complexity. Primarily glide habitat with few riffles and no pools
		Glide percentage	82	
		Pool percentage	0	
Residual Pool Depth	2	Depth of deepest residual pool (m)	0.54	Some deeper slow-water habitat.
Substrate	3	Coarse gravel and larger (%)	59	Good
		Embeddedness (%)	32	Good, not properly functioning by NMFS standards.
		Sand and fine sediments (%)	7	Good
		Hardpan %	0	Good
		Bed substrate stability index	-0.51	Stable
Wood	0	Wood density (pieces/100 m, all sizes)	0.0	Very poor. No wood of any size.
Fish cover	1	Natural fish cover (aerial proportion)	0.25	Poor, moderate cover.
Riparian cover	2	Canopy shading mid-channel (% area)	83	Fair, desirable by ODFW standards.
		Riparian canopy cover (aerial proportion, large trees)	0.08	Fair canopy cover but inadequate complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.15	
		Proportion of reach with 3 layers of vegetation	0.45	
Human Disturbance	0	Human Disturbance Index (proximity-weighted sum)	6.13	Highly disturbed

The Riparian Human Disturbance Index is a proximity-weighted sum of a number of types of disturbances. The index averages the incidence of each disturbance type within a 10 meter plot around each transect, adjacent to this 10 meter plot, and within the bankfull channel. The following chart shows the contribution of each riparian disturbance type to the Riparian Human Disturbance Index for this site:



Other Site Photos:

Pringle Creek at downstream end of culvert

Pringle Creek Site PR00-003

Reach location and description:
Pringle Creek Site 3 begins in Bush Pasture Park, 2270 feet upstream of its confluence with Shelton Ditch and 430 feet upstream of the SE Mission Street Bridge. The reach is 190 meters long and is entirely contained within the park. This reach drains all of the subbasins of Pringle Creek. The reach has an average bankfull width of 9.9 meters and a water surface gradient of .5%. The average thalweg depth of the reach at baseflow was 24 cm. The reach consists primarily of glide and riffle habitat, and is unconstrained but fairly straight with a sinuosity of 1.0. The overall habitat quality index of this reach was 71% of least disturbed conditions. Site 3 received the highest qualitative rapid habitat score in the basin. According to StreamNet (2006), this reach could potentially be used by listed Upper Willamette River spring Chinook salmon and winter steelhead ESUs, which migrate up Shelton Ditch into Mill Creek. Additionally, this reach is used by fall Chinook salmon, which spawn and rear up to the confluence with Middle Fork Pringle Creek.

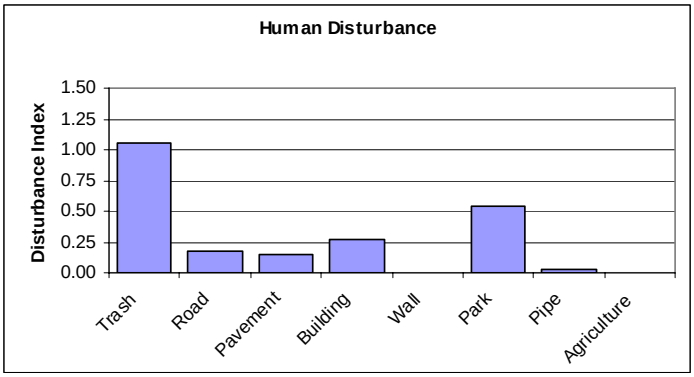
Key habitat issues:

- Little channel complexity, primarily glide habitat.
- No pool habitat.
- Very little wood, no large pieces.
- Inadequate fish cover.
- Large amounts of trash.

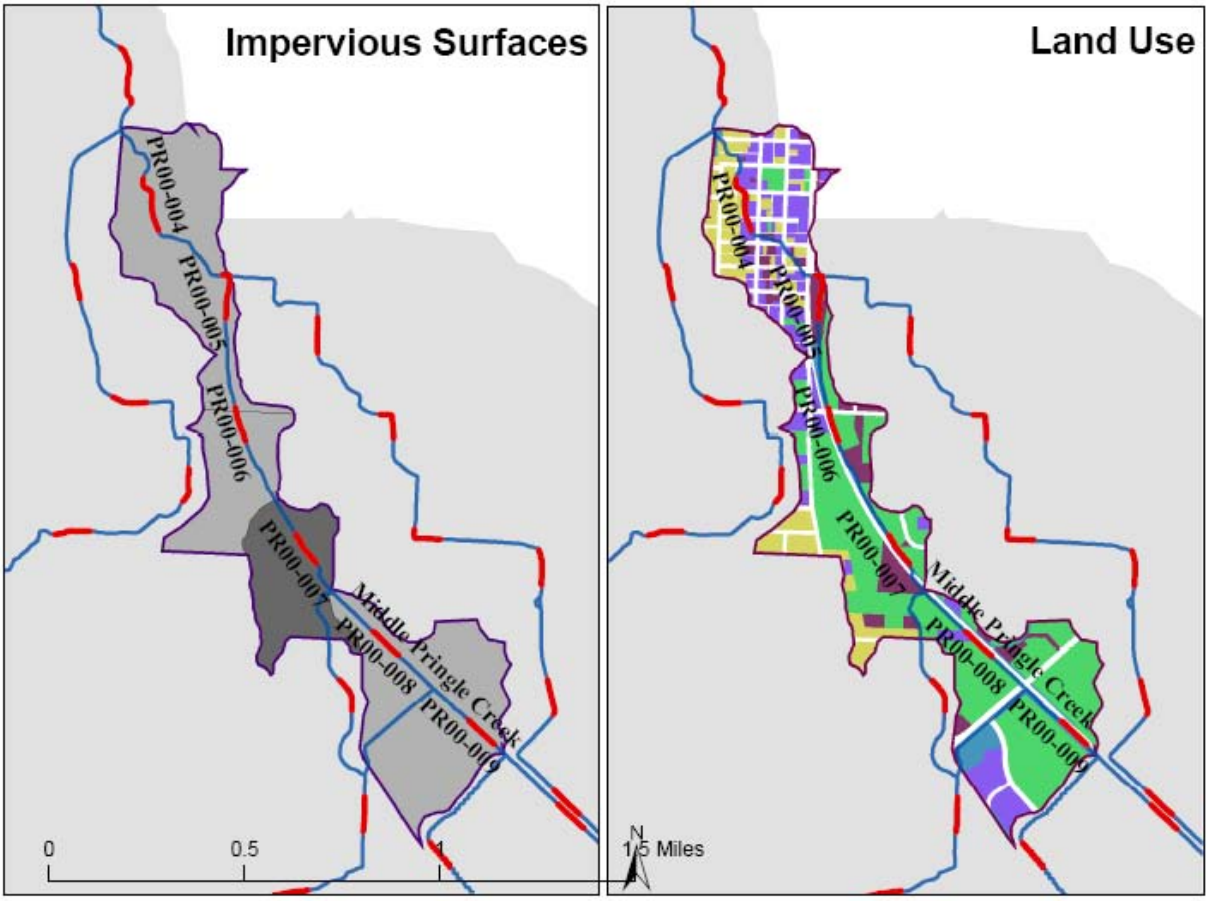
Pringle Creek Site PR00-003 at Bush Pasture Park

Condition Summary: Pringle Creek Site PR00-003				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	2	Habitat Quality Index (HQI)	0.71	Moderate. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	138	Fair. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	10	Very poor
Channel Morphology	2	Channel sinuosity	1.0	Very low, fair compared to reference condition.
		Incision height	1.01	Poor, incised with moderately steep bank angles.
		Bank angle (degrees)	58	
Channel Complexity	1	Riffle percentage	32	Some complexity. Primarily glide habitat with adequate riffles, but no pools.
		Glide percentage	68	
		Pool percentage	0	
Residual Pool Depth	1	Depth of deepest residual pool (m)	0.35	Minimal deeper, slow-water habitat.
Substrate	3	Coarse gravel and larger (%)	55	Good
		Embeddedness (%)	43	Good, not properly functioning by NMFS standards.
		Sand and fine sediments (%)	12	Good, at risk by ODFW standards.
		Hardpan %	0	Good
		Bed substrate stability index	-0.32	Stable
Wood	1	Wood density (pieces/100 m, all sizes)	1.6	Poor. Very little wood, no large pieces.
Fish cover	0	Natural fish cover (aerial proportion)	0.12	Poor, sparse cover.
Riparian cover	2	Canopy shading mid-channel (% area)	88	Fair, desirable by ODFW standards.
		Riparian canopy cover (aerial proportion, large trees)	0.20	Fair canopy cover with good large tree cover. Adequate complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.32	
		Proportion of reach with 3 layers of vegetation	0.90	
Human Disturbance	2	Human Disturbance Index (proximity-weighted sum)	2.23	Moderately disturbed

The Riparian Human Disturbance Index is a proximity-weighted sum of a number of types of disturbances. The index averages the incidence of each disturbance type within a 10 meter plot around each transect, adjacent to this 10 meter plot, and within the bankfull channel. The following chart shows the contribution of each riparian disturbance type to the Riparian Human Disturbance Index for this site:



Middle Pringle Creek Subbasin



Middle Pringle Creek Subbasin
Impervious Surface and Land Use

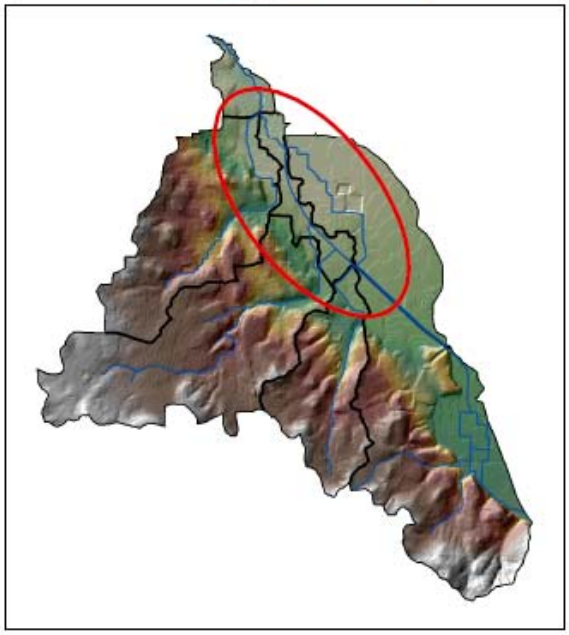
- Survey Reaches
- Streams
- Pringle Creek Subbasins

Impervious Surface Cover by Catchment

- 0 - 10
- 10 - 25
- 25 - 40
- 40 - 60
- 60 - 80

Land Use

- Commercial (47)
- Industrial (77)
- Public (7)
- Residential (35 Acres)
- Vacant (25)



Pringle Creek Site PR00-004

Reach location and description:
Pringle Creek Site 4 is located 834 feet upstream from its confluence with Clark Creek, 150 feet upsteam of the 12th Street Bridge. The reach is 208 meters long and meanders primarily through residential areas on the west bank and commercial areas on the east bank. The reach has an average bankfull width of 6.5 meters and water surface gradient of 0.4%. The mean thalweg depth at baseflow was 29 centimeters. The reach consists primarily of glide habitat, is constrained by land-use, and is fairly straight with a sinuosity of 1.1. At the time of survey there was heavy vegetation on both banks and filamentous algae in the water at the upstream end of the reach. The crew noted several dead crayfish in the reach. The overall habitat quality index of this reach was 78% of least disturbed conditions. This site received the second highest qualitative rapid habitat score of all the sites in the basin. According to StreamNet (2006), this reach is used by fall Chinook salmon, which spawn and rear up to the confluence with Middle Fork Pringle Creek.

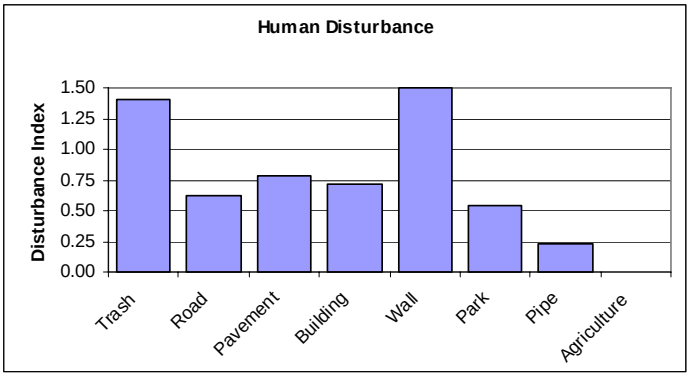
Key habitat issues:

- Banks are armored by walls or rip-rap.
- Little channel complexity, primarily glide habitat.
- No pool habitat.
- Large amounts of pavement within and near the riparian zone.
- Very little wood, no large pieces.
- Inadequate fish cover.
- Inadequate complex riparian cover and shade.
- Large amounts of trash.

Pringle Creek Site PR00-004

Condition Summary: Pringle Creek Site PR00-004				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	3	Habitat Quality Index (HQI)	0.77	High. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	131	Fair. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	16	Very poor
Channel Morphology	3	Channel sinuosity	1.1	Low, fair compared to reference condition.
		Incision height (m)	0.66	Good, with moderately steep bank angles.
		Bank angle (degrees)	52	
Channel Complexity	1	Riffle percentage	25	Little complexity. Primarily glide habitat with few riffles and no pools.
		Glide percentage	75	
		Pool percentage	0	
Residual Pool Depth	2	Depth of deepest residual pool (m)	0.56	Some deeper slow-water habitat.
Substrate	3	Coarse gravel and larger (%)	38	Fair, desirable by ODFW standards.
		Embeddedness (%)	44	Good, not properly functioning by NMFS standards.
		Sand and fine sediments (%)	17	Good, at risk by ODFW standards.
		Hardpan %	0	Good
		Bed substrate stability index	-0.50	Stable
Wood	1	Wood density (pieces/100 m, all sizes)	0.5	Poor. Very little wood, no large pieces.
Fish cover	1	Natural fish cover (aerial proportion)	0.21	Poor, moderate cover.
Riparian cover	1	Canopy shading mid-channel (% area)	59	Poor
		Riparian canopy cover (aerial proportion, large trees)	0.19	Fair canopy cover with good large tree cover. Inadequate complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.23	
		Proportion of reach with 3 layers of vegetation	0.45	
Human Disturbance	0	Human Disturbance Index (proximity-weighted sum)	5.81	Highly disturbed

The Riparian Human Disturbance Index is a proximity-weighted sum of a number of types of disturbances. The index averages the incidence of each disturbance type within a 10 meter plot around each transect, adjacent to this 10 meter plot, and within the bankfull channel. The following chart shows the contribution of each riparian disturbance type to the Riparian Human Disturbance Index for this site:



Other Site Photos:

Pringle Creek Site PR00-005

Reach location and description:
Pringle Creek Site 5 begins 110 feet downstream of its confluence with East Fork Pringle Creek, at the rail bridge near 12th and Oxford Streets. The reach begins under the bridge at the railroad yard and extends up Pringle Creek 218 meters through industrial land. The reach has an average bankfull width of 4.5 meters and water surface gradient of .6%. The mean thalweg depth at baseflow was 24 centimeters. The reach consists primarily of glide habitat, but has some riffles and a few pools. It is constrained by land use and incised, with moderately steep bank angles. It has a sinuosity of 1.2. The reach had blackberries covering both banks and some willow and snowberry. The crew noted that there were signs of beaver and large amounts of trash throughout the reach. The overall habitat quality of this reach was 67% of least disturbed conditions. According to StreamNet (2006), this reach is potentially used by fall Chinook salmon, which spawn and rear up to the confluence with Middle Fork Pringle Creek.

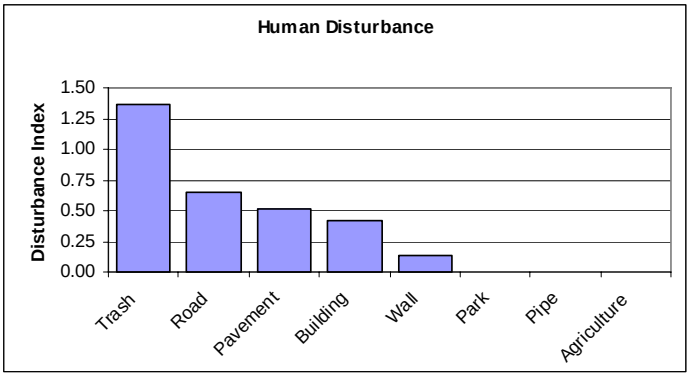
Key habitat issues:

- Little channel complexity, primarily glide habitat.
- Inadequate pool habitat.
- Very little wood, no large pieces.
- Inadequate complex riparian cover and shade.
- Large amounts of trash.

Pringle Creek Site PR00-005

Condition Summary: Pringle Creek Site PR00-005				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	2	Habitat Quality Index (HQI)	0.67	Moderate. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	124	Fair. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	14	Very poor
Channel Morphology	2	Channel sinuosity	1.2	Low, good compared to reference condition.
		Incision height (m)	1.16	Poor, incised with moderately steep bank angles.
		Bank angle (degrees)	56	
Channel Complexity	2	Riffle percentage	30	Some complexity. Primarily glide habitat with some riffles and pools. However, pool habitat is less than the recommended amount.
		Glide percentage	66	
		Pool percentage	4	
Residual Pool Depth	3	Depth of deepest residual pool (m)	0.64	Pools provide some deeper, slow-water habitat.
Substrate	3	Coarse gravel and larger (%)	54	Good
		Embeddedness (%)	36	Good, not properly functioning by NMFS standards.
		Sand and fine sediments (%)	14	Good, at risk by ODFW standards.
		Hardpan %	1	Good
		Bed substrate stability index	-0.30	Stable
Wood	1	Wood density (pieces/100 m, all sizes)	1.8	Poor. Very little wood, no large pieces.
Fish cover	2	Natural fish cover (aerial proportion)	0.32	Fair, moderate cover.
Riparian cover	1	Canopy shading mid-channel (% area)	49	Poor
		Riparian canopy cover (aerial proportion, large trees)	0.06	Poor canopy cover, but some large tree cover. Inadequate complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.10	
		Proportion of reach with 3 layers of vegetation	0.50	
Human Disturbance	1	Human Disturbance Index (proximity-weighted sum)	3.08	Highly disturbed

The Riparian Human Disturbance Index is a proximity-weighted sum of a number of types of disturbances. The index averages the incidence of each disturbance type within a 10 meter plot around each transect, adjacent to this 10 meter plot, and within the bankfull channel. The following chart shows the contribution of each riparian disturbance type to the Riparian Human Disturbance Index for this site:



Other Site Photos:

Facing downstream toward the confluence of East Fork Pringle Creek.

Pringle Creek Site PR00-006

Reach location and description:
Pringle Creek Site 6 begins 1770 feet upstream from the confluence with East Fork Pringle Creek, 26 feet north of McGilchrist Avenue. Land use in the area is industrial and the creek follows the railroad tracks along this reach. The average bankfull width of the reach is 3.6 meters with a water surface gradient of .6%. The mean thalweg depth at baseflow was 18 centimeters. The reach consists primarily of glide habitat, is channelized and deeply incised, and is very straight with a sinuosity of 1.0. Riparian vegetation consists of large amounts of dense blackberry with some willow, rose, horsetail, alder and rushes. The overall habitat quality of this reach was low at 38% of least disturbed conditions. According to StreamNet (2006), this reach is potentially used by fall Chinook salmon, which spawn and rear up to the confluence with Middle Fork Pringle Creek.

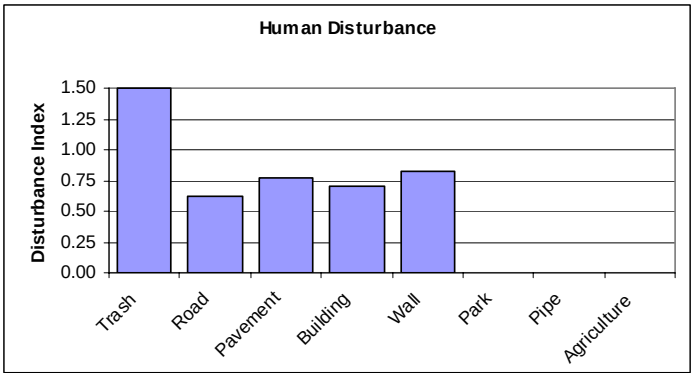
Key habitat issues:

- Channel is straight and deeply incised, with steep bank angles.
- Banks are armored by walls or rip-rap.
- Little channel complexity, primarily glide habitat.
- No pool habitat.
- Excessive hardpan.
- No wood.
- No canopy cover or complex riparian cover. Channel is inadequately shaded.
- Pavement within or near the riparian zone.
- Large amounts of trash.

Pringle Creek Site PR00-006

Condition Summary: Pringle Creek Site PR00-006				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	1	Habitat Quality Index (HQI)	0.38	Low. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	119	Fair. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	12	Very poor
Channel Morphology	0	Channel sinuosity	1.0	None. Channel is straight.
		Incision height (m)	1.75	Poor, deeply incised with steep bank angles.
		Bank angle (degrees)	63	
Channel Complexity	1	Riffle percentage	26	Little complexity. Primarily glide habitat with few riffles and no pools.
		Glide percentage	74	
		Pool percentage	0	
Residual Pool Depth	1	Depth of deepest residual pool (m)	0.30	Minimal deeper, slow-water habitat.
Substrate	2	Coarse gravel and larger (%)	34	Fair
		Embeddedness (%)	23	Good, at risk by NMFS standards.
		Sand and fine sediments (%)	8	Good
		Hardpan %	12	Poor
		Bed substrate stability index	-0.07	Stable
Wood	0	Wood density (pieces/100 m, all sizes)	0.0	Very poor. No wood of any size.
Fish cover	2	Natural fish cover (aerial proportion)	0.43	Fair, moderate cover, but sparse large cover.
Riparian cover	0	Canopy shading mid-channel (% area)	40	Poor
		Riparian canopy cover (aerial proportion, large trees)	0.00	No canopy cover or complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.00	
		Proportion of reach with 3 layers of vegetation	0.05	
Human Disturbance	0	Human Disturbance Index (proximity-weighted sum)	4.40	Highly disturbed

The Riparian Human Disturbance Index is a proximity-weighted sum of a number of types of disturbances. The index averages the incidence of each disturbance type within a 10 meter plot around each transect, adjacent to this 10 meter plot, and within the bankfull channel. The following chart shows the contribution of each riparian disturbance type to the Riparian Human Disturbance Index for this site:



Other Site Photos:

Site 6 during the winter

Pringle Creek Site PR00-007

Reach location and description:
Pringle Creek Site 7 begins 960 feet downstream of its confluence with Middle Fork Pringle Creek. The reach is 149 meters long and is a channelized reach that runs along the railroad tracks through industrial areas. The reach has an average bankfull width of 4.1 meters and water surface gradient of 0.5%. The mean thalweg depth at baseflow was 20 centimeters. The reach consists almost entirely of glide habitat and is straight with a sinuosity of 1.0. Approximately half of the reach was actively eroding. There were many species of invasive plants, with Himalayan blackberry as the most prevalent. The surveyors noted a dead nutria in the reach, and large amounts of trash strewn throughout the entire length of it. The overall habitat quality of this reach was low at 39% of least disturbed conditions. According to StreamNet (2006), this reach is potentially used by fall Chinook salmon, which spawn and rear up to the confluence with Middle Fork Pringle Creek.

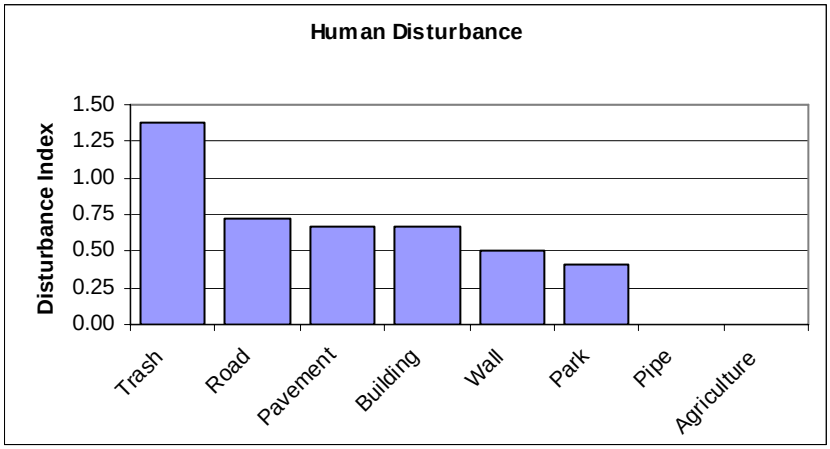
Key habitat issues:

- No channel complexity, primarily glide habitat with very few riffles.
- No pool habitat.
- Excessive hardpan.
- No wood.
- No canopy cover and inadequate complex riparian cover. Channel is inadequately shaded.
- Large amounts of trash.

Pringle Creek Site PR00-007 in late fall

Condition Summary: Pringle Creek Site PR00-007				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	1	Habitat Quality Index (HQI)	0.39	Low. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	95	Poor. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	20	Poor
Channel Morphology	2	Channel sinuosity	1.0	None. Channel is straight.
		Incision height (m)	0.60	Good, with steep bank angles.
		Bank angle (degrees)	68	
Channel Complexity	0	Riffle percentage	7	No complexity. Primarily glide habitat with few riffles and no pools.
		Glide percentage	93	
		Pool percentage	0	
Residual Pool Depth	1	Depth of deepest residual pool (m)	0.24	Minimal deeper, slow-water habitat.
Substrate	2	Coarse gravel and larger (%)	26	Fair
		Embeddedness (%)	43	Good, not properly functioning by NMFS standards.
		Sand and fine sediments (%)	20	Good, at risk by ODFW standards.
		Hardpan %	23	Poor
		Bed substrate stability index	-0.03	Stable
Wood	0	Wood density (pieces/100 m, all sizes)	0.0	Very poor. No wood of any size.
Fish cover	3	Natural fish cover (aerial proportion)	0.47	Good, moderate cover.
Riparian cover	1	Canopy shading mid-channel (% area)	33	Poor
		Riparian canopy cover (aerial proportion, large trees)	0.02	No canopy cover and inadequate complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.03	
		Proportion of reach with 3 layers of vegetation	0.18	
Human Disturbance	0	Human Disturbance Index (proximity-weighted sum)	4.36	Highly disturbed

The Riparian Human Disturbance Index is a proximity-weighted sum of a number of types of disturbances. The index averages the incidence of each disturbance type within a 10 meter plot around each transect, adjacent to this 10 meter plot, and within the bankfull channel. The following chart shows the contribution of each riparian disturbance type to the Riparian Human Disturbance Index for this site:



Other Site Photos:

Pringle Creek Site PR00-008

Reach location and description:
Middle Fork Pringle Creek Site 8 is located 770 feet upstream of its confluence with West Fork. The reach is 149 meters long and is a channelized reach that runs along the railroad tracks through industrial land use. The reach has an average bankfull width of 3.7 meters and water surface gradient of 0.4%. The mean thalweg depth at baseflow was 26 centimeters. The reach is entirely glide habitat and is straight with a sinuosity of 1.0. The reach was highly disturbed with many invasive plants, however some small native shrubs and saplings were beginning to establish along the stream banks including red alder, willow, spike rush, trailing blackberry, rose and bullrush. Nutria sign was common throughout the reach. The overall habitat quality of this reach was low at 42% of least disturbed conditions.

Key habitat issues:

- No channel complexity, entirely glide habitat with no riffles or pools.
- No pool habitat.
- No wood.
- No canopy cover and inadequate complex riparian cover. Channel is inadequately shaded.
- Large amounts of trash

Pringle Creek Site PR00-008 in fall

Condition Summary: Middle Fork Pringle Creek Site PR00-008				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	1	Habitat Quality Index (HQI)	0.42	Low. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	85	Poor. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	16	Very poor
Channel Morphology	2	Channel sinuosity	1.0	None. Channel is straight.
		Incision height (m)	0.56	Good, with moderate bank angles.
		Bank angle (degrees)	47	
Channel Complexity	0	Riffle percentage	1	No complexity. Primarily glide habitat with few riffles and no pools.
		Glide percentage	99	
		Pool percentage	0	
Residual Pool Depth	1	Depth of deepest residual pool (m)	0.29	Minimal deeper, slow-water habitat.
Substrate	2	Coarse gravel and larger (%)	24	Fair
		Embeddedness (%)	61	Fair, not properly functioning by NMFS standards.
		Sand and fine sediments (%)	42	Fair, undesirable by ODFW standards.
		Hardpan %	0	Good
		Bed substrate stability index	-1.63	Moderately stable, poor compared to reference condition.
Wood	0	Wood density (pieces/100 m, all sizes)	0.0	Very poor. No wood of any size.
Fish cover	1	Natural fish cover (aerial proportion)	0.22	Poor, moderate cover.
Riparian cover	1	Canopy shading mid-channel (% area)	28	Poor
		Riparian canopy cover (aerial proportion, large trees)	0.00	No canopy cover and inadequate complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.01	
		Proportion of reach with 3 layers of vegetation	0.28	
Human Disturbance	1	Human Disturbance Index (proximity-weighted sum)	3.64	Highly disturbed

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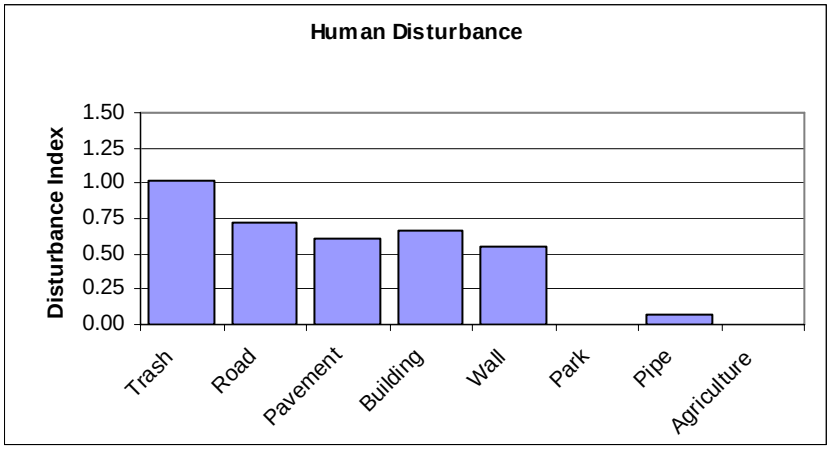

Other Site Photos:

Pringle Creek Site PR00-009

Reach location and description:
Middle Fork Pringle Creek Site 9 begins 700 feet downstream of its confluence with West Middle Fork Pringle Creek. The reach is 149 meters long and follows the railroad tracks through industrial land uses. The reach has an average bankfull width of 5.1 meters and water surface gradient of 0.9%. The mean thalweg depth at baseflow was 39 centimeters. The reach consists primarily of glide habitat and is incised and straight, with a sinuosity of 1.0. At the time of survey is appeared that some of the reach along the left bank had been recently planted and a good number of native trees and shrubs were growing along the bank. Nutria sign was common throughout the reach and there were large pieces of trash. The overall habitat quality of this reach was low at 36% of least disturbed conditions.

Key habitat issues:

- Channel is straight and incised.
- Very little channel complexity, primarily glide habitat.
- Streambed is unstable, has excessive fine sediments, and inadequate large substrates.
- Inadequate canopy cover and complex riparian cover. Channel is inadequately shaded.

Middle Fork Pringle Creek Site PR00-009 in fall

Condition Summary: Middle Fork Pringle Creek Site PR00-009				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	1	Habitat Quality Index (HQI)	0.36	Low. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	81	Poor. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	20	Poor
Channel Morphology	1	Channel sinuosity	1.0	None. Channel is straight.
		Incision height (m)	1.96	Fair, deeply incised, but with moderate bank angles.
		Bank angle (degrees)	34	
Channel Complexity	1	Riffle percentage	0	Little complexity. Primarily glide habitat with no riffles, but adequate pools
		Glide percentage	85	
		Pool percentage	15	
Residual Pool Depth	2	Depth of deepest residual pool (m)	0.45	Pools provide some deeper, slow-water habitat.
Substrate	1	Coarse gravel and larger (%)	10	Fair, undesirable by ODFW standards.
		Embeddedness (%)	72	Fair, not properly functioning by NMFS standards.
		Sand and fine sediments (%)	67	Poor
		Hardpan %	5	Fair
		Bed substrate stability index	-2.69	Unstable
Wood	0	Wood density (pieces/100 m, all sizes)	0.0	Very poor. No wood of any size.
Fish cover	2	Natural fish cover (aerial proportion)	0.48	Fair, moderate cover, but sparse large cover.
Riparian cover	1	Canopy shading mid-channel (% area)	49	Poor
		Riparian canopy cover (aerial proportion, large trees)	0.00	Poor canopy cover with no large tree cover. Inadequate complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.09	
		Proportion of reach with 3 layers of vegetation	0.55	
Human Disturbance	1	Human Disturbance Index (proximity-weighted sum)	3.22	Highly disturbed

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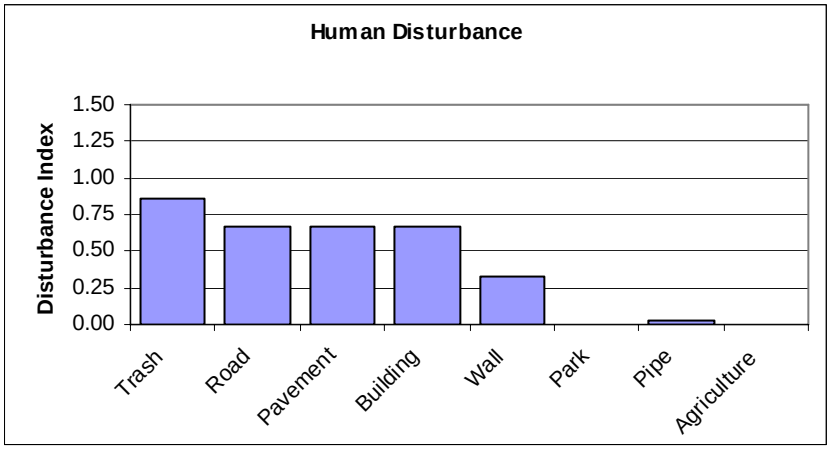
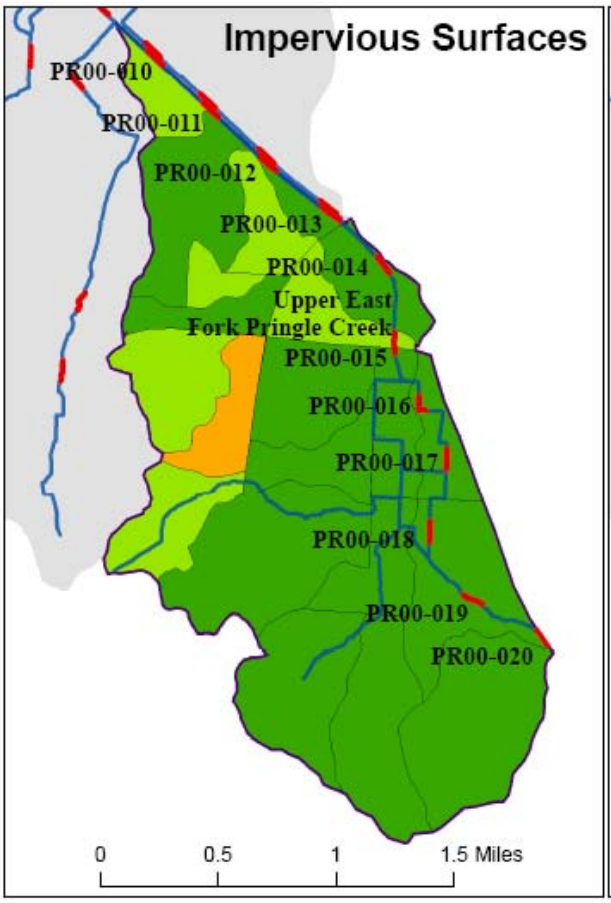
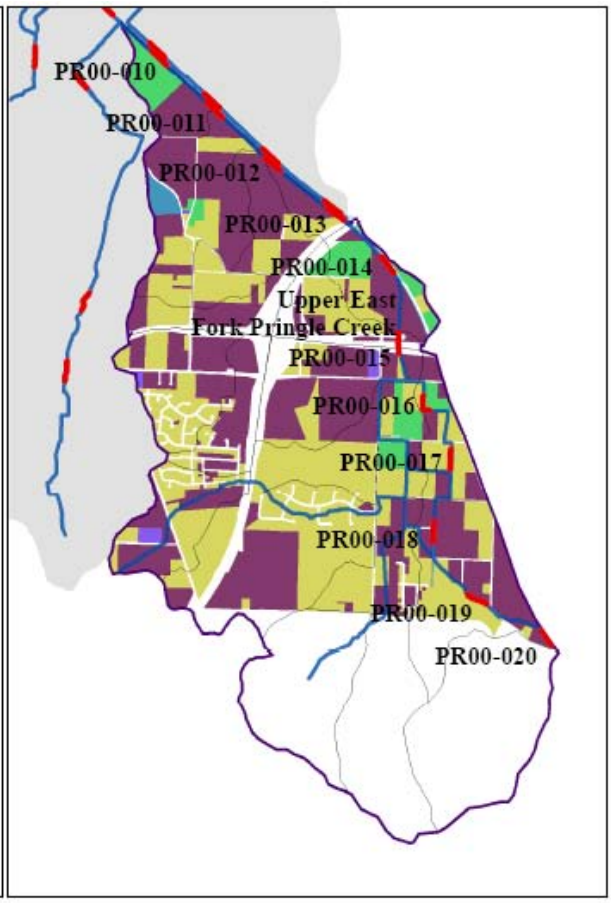


Other Site Photos:

Upper East Fork Pringle Creek Subbasin





Upper East Fork Pringle Creek Subbasin
Impervious Surface and Land Use

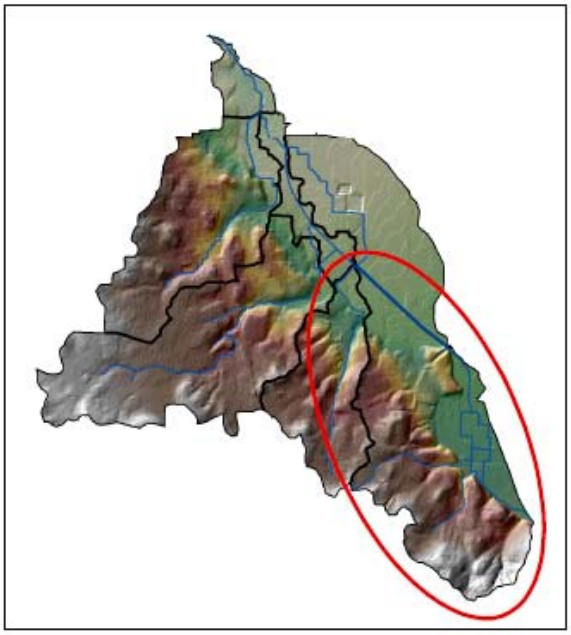
- Survey Reaches
- Streams
- Pringle Creek Subbasins

Impervious Surface Cover by Catchment

- 0 - 10
- 10 - 25
- 25 - 40
- 40 - 60
- 60 - 80

Land Use

- Commercial (8 Acres)
- Industrial (53 Acres)
- Public (18 Acres)
- Residential (823 Acres)
- Vacant (646 Acres)



Pringle Creek Site PR00-010

Reach location and description:
Middle Fork Pringle Creek Site 10 begins 975 feet upstream from its confluence with West Middle Fork Pringle Creek. The reach is 149 meters long and follows the railroad tracks through industrial lands. The reach has an average bankfull width of 3.8 meters and water surface gradient of 0.2%. The mean thalweg depth at baseflow was 16 centimeters. The reach consists primarily of pool habitat, but part of the reach consisted of dry channel at the time of survey. The channel is straight with a sinuosity of 1.0. Many small willow trees were growing within the channel; however the banks contained very few native trees and shrubs and consisted mostly of Himalayan blackberry. Nutria signs were common throughout the reach. The overall habitat quality of this reach was low at 46% of least disturbed conditions.

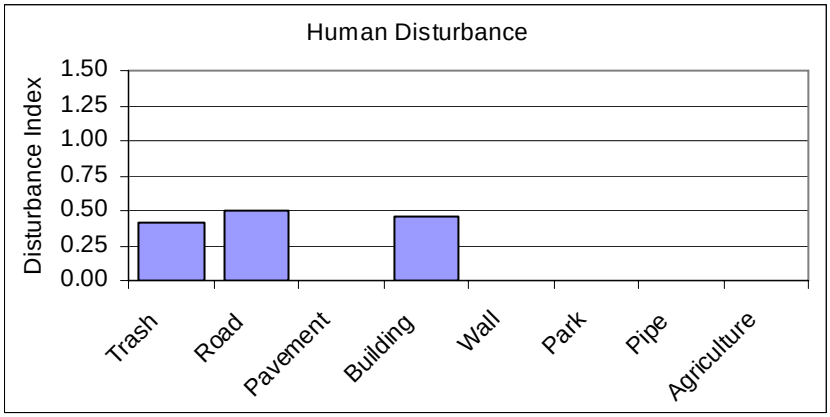
Key habitat issues:

- Channel is straight and deeply incised.
- No wood.
- No canopy cover or complex riparian cover.
- Streambed is only moderately stable with excessive fine sediments.

Middle Fork Pringle Creek Site PR00-010

Condition Summary: Middle Fork Pringle Creek Site PR00-010				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	1	Habitat Quality Index (HQI)	0.46	Low. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	98	Poor. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	18	Very poor
Channel Morphology	1	Channel sinuosity	1.0	None. Channel is straight.
		Incision height (m)	1.30	Fair, deeply incised, but with moderate bank angles.
		Bank angle (degrees)	24	
Channel Complexity	2	Riffle percentage	0	Little complexity. Primarily pool habitat
		Glide percentage	0	
		Pool percentage	77	
Residual Pool Depth	2	Depth of deepest residual pool (m)	0.39	Pools provide adequate deeper, slow-water habitat.
Substrate	2	Coarse gravel and larger (%)	24	Fair
		Embeddedness (%)	60	Fair, not properly functioning by NMFS standards.
		Sand and fine sediments (%)	51	Poor
		Hardpan %	0	Good
		Bed substrate stability index	-1.72	Moderately stable, poor compared to reference condition.
Wood	0	Wood density (pieces/100 m, all sizes)	0.0	Very poor. No wood of any size.
Fish cover	2	Natural fish cover (aerial proportion)	1.26	Fair, very heavy cover, but no large cover.
Riparian cover	1	Canopy shading mid-channel (% area)	79	Fair, desirable by ODFW standards.
		Riparian canopy cover (aerial proportion, large trees)	0.00	No canopy cover or complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.00	
		Proportion of reach with 3 layers of vegetation	0.05	
Human Disturbance	2	Human Disturbance Index (proximity-weighted sum)	1.36	Moderately disturbed

The Riparian Human Disturbance Index is a proximity-weighted sum of a number of types of disturbances. The index averages the incidence of each disturbance type within a 10 meter plot around each transect, adjacent to this 10 meter plot, and within the bankfull channel. The following chart shows the contribution of each riparian disturbance type to the Riparian Human Disturbance Index for this site:



Other Site Photos:

Pringle Creek Site PR00-011

Reach location and description:
Middle Fork Pringle Creek Site 11 begins 2680 feet upstream from its confluence with West Middle Fork Pringle Creek. The reach is 149 meters long and follows the railroad tracks. The reach has an average bankfull width of 3.4 meters and bed surface gradient of 0.3%. The stream was dry during baseflow conditions due to a diversion upstream of the reach. The reach is channelized, deeply incised and straight with a sinuosity of 1.0. Predominant vegetation at the site was invasive reed canary grass in the bed and on the banks. The overall habitat quality of this reach was very low at 12% of least disturbed conditions.

Key habitat issues:

- Channel is straight and deeply incised.
- Channel had no water during baseflow conditions.
- Excessive fine substrates and inadequate large substrates.
- No wood.
- No canopy cover and inadequate complex riparian cover.

Middle Fork Pringle Creek Site PR00-011 in fall

Condition Summary: Middle Fork Pringle Creek Site PR00-011				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	0	Habitat Quality Index (HQI)	0.13	Very low. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	64	Poor. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)		
Channel Morphology	1	Channel sinuosity	1.0	None. Channel is straight.
		Incision height (m)	1.25	Fair, incised, but with slight bank angles.
		Bank angle (degrees)	16	
Channel Complexity		Riffle percentage	0	Channel contained no water at baseflow.
		Glide percentage	0	
		Pool percentage	0	
Residual Pool Depth	0	Depth of deepest residual pool (m)		Channel contained no water at baseflow.
Substrate	0	Coarse gravel and larger (%)	7	Poor
		Embeddedness (%)	80	Poor
		Sand and fine sediments (%)	82	Poor
		Hardpan %	0	Good
		Bed substrate stability index		
Wood	0	Wood density (pieces/100 m, all sizes)	0.0	Very poor. No wood of any size.
Fish cover	2	Natural fish cover (aerial proportion)	0.74	Fair, heavy cover, but no large cover.
Riparian cover	0	Canopy shading mid-channel (% area)	30	Poor
		Riparian canopy cover (aerial proportion, large trees)	0.00	No canopy cover and inadequate complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.01	
		Proportion of reach with 3 layers of vegetation	0.23	
Human Disturbance	2	Human Disturbance Index (proximity-weighted sum)	1.51	Moderately disturbed

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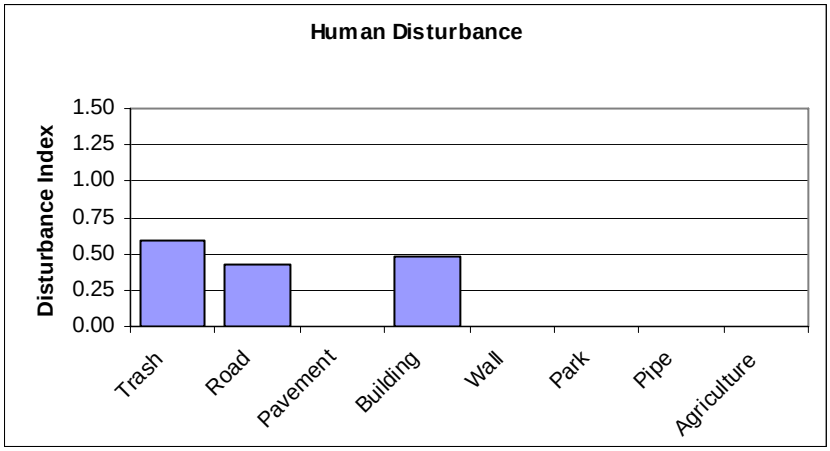


Pringle Creek Site PR00-012

Reach location and description:
Middle Fork Pringle Creek Site 12 begins 2300 feet downstream of I-5. The reach is 164 meters long and follows the railroad tracks. The reach has an average bankfull width of 9.3 meters and water surface gradient of 0.4%. The channel was dry during baseflow conditions. The reach is channelized, deeply incised and straight, with a sinuosity of 1.0. Vegetation consists of reed canary grass which entirely covers the channel. The overall habitat quality of this reach was very low at 20% of least disturbed conditions.

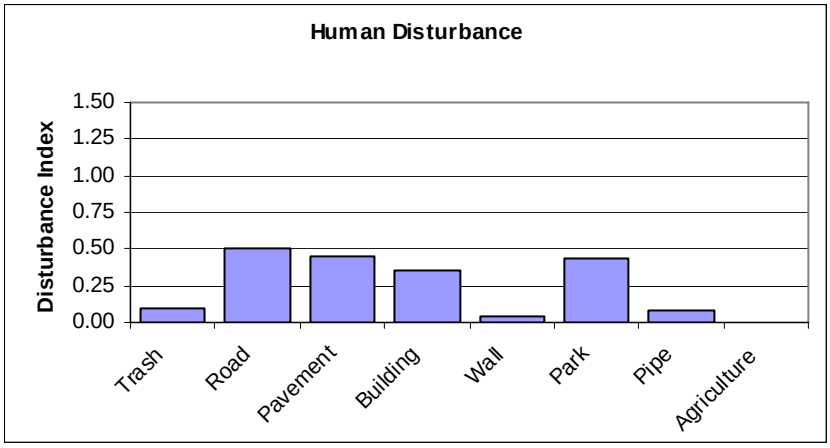
Key habitat issues:

- Channel is straight and deeply incised, with a high bankfull width to depth ratio.
- Channel had no water during baseflow conditions.
- No wood.
- No canopy cover or complex riparian cover. Channel is inadequately shaded.

Pringle Creek Site PR00-012

Condition Summary: Middle Fork Pringle Creek Site PR00-012				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	0	Habitat Quality Index (HQI)	0.20	Very low. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	92	Poor. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)		
Channel Morphology	1	Channel sinuosity	1.0	None. Channel is straight.
		Incision height (m)	1.81	Fair, deeply incised, but with slight bank angles. Bankfull width:depth (29) is higher than recommended by ODFW.
		Bank angle (degrees)	13	
Channel Complexity		Riffle percentage	0	Channel contained no water at baseflow.
		Glide percentage	0	
		Pool percentage	0	
Residual Pool Depth	0	Depth of deepest residual pool (m)		Channel contained no water at baseflow.
Substrate	2	Coarse gravel and larger (%)	18	Fair
		Embeddedness (%)	23	Good, at risk by NMFS standards.
		Sand and fine sediments (%)	27	Good, undesirable by ODFW standards.
		Hardpan %	0	Good
		Bed substrate stability index		
Wood	0	Wood density (pieces/100 m, all sizes)	0.0	Very poor. No wood of any size.
Fish cover	2	Natural fish cover (aerial proportion)	0.82	Fair, very heavy cover, but no large cover.
Riparian cover	0	Canopy shading mid-channel (% area)	36	Poor
		Riparian canopy cover (aerial proportion, large trees)	0.00	No canopy cover or complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.00	
		Proportion of reach with 3 layers of vegetation	0.00	
Human Disturbance	2	Human Disturbance Index (proximity-weighted sum)	1.96	Moderately disturbed

The Riparian Human Disturbance Index is a proximity-weighted sum of a number of types of disturbances. The index averages the incidence of each disturbance type within a 10 meter plot around each transect, adjacent to this 10 meter plot, and within the bankfull channel. The following chart shows the contribution of each riparian disturbance type to the Riparian Human Disturbance Index for this site:



Other Site Photos:

Pringle Creek Site PR00-013

Reach location and description:
Middle Fork Pringle Creek Site 13 begins 540 feet downstream of I-5. The reach is 149 meters long and follows the railroad tracks. The reach has an average bankfull width of 4.9 meters and water surface gradient of 0.7%. The mean thalweg depth at baseflow was 11 centimeters. The reach consists primarily of glide habitat and is channelized, deeply incised and straight, with a sinuosity of 1.0. The lower portions of the reach are covered in grassy vegetation. A steep slope on the left bank had many large trees and native vegetation including Douglas fir, bigleaf maple, snowberry, rose, willow, lady fern, sword fern and poison oak. The crew noted that there wer sculpin and lamprey in the reach. The overall habitat quality of this reach was 53% of least disturbed conditions.

Key habitat issues:

- Channel is straight and deeply incised.
- Very little channel complexity, primarily glide habitat.
- Streambed is slightly unstable and beginning to accumulate excessive fine sediments.
- No wood.

Middle Fork Pringle Creek Site PR00-013
(photographed in late fall)

Condition Summary: Middle Fork Pringle Creek Site PR00-013				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	2	Habitat Quality Index (HQI)	0.53	Moderate. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	107	Fair. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	26	Poor
Channel Morphology	1	Channel sinuosity	1.0	None. Channel is straight.
		Incision height (m)	1.79	Fair, deeply incised, but with slight bank angles.
		Bank angle (degrees)	31	
Channel Complexity	1	Riffle percentage	0	Little complexity. Primarily glide habitat with no riffles, but adequate pools
		Glide percentage	83	
		Pool percentage	17	
Residual Pool Depth	3	Depth of deepest residual pool (m)	0.56	Pools provide good deeper, slow-water habitat.
Substrate	2	Coarse gravel and larger (%)	29	Fair
		Embeddedness (%)	56	Fair, not properly functioning by NMFS standards.
		Sand and fine sediments (%)	36	Poor, fair relative to reference condition.
		Hardpan %	0	Good
		Bed substrate stability index	-1.23	Unstable, good compared to reference condition.
Wood	0	Wood density (pieces/100 m, all sizes)	0.0	Very poor. No wood of any size.
Fish cover	3	Natural fish cover (aerial proportion)	0.75	Good, heavy cover.
Riparian cover	2	Canopy shading mid-channel (% area)	78	Fair, desirable by ODFW standards.
		Riparian canopy cover (aerial proportion, large trees)	0.12	Fair canopy cover with good large tree cover. Inadequate complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.21	
		Proportion of reach with 3 layers of vegetation	0.36	
Human Disturbance	2	Human Disturbance Index (proximity-weighted sum)	2.23	Moderately disturbed

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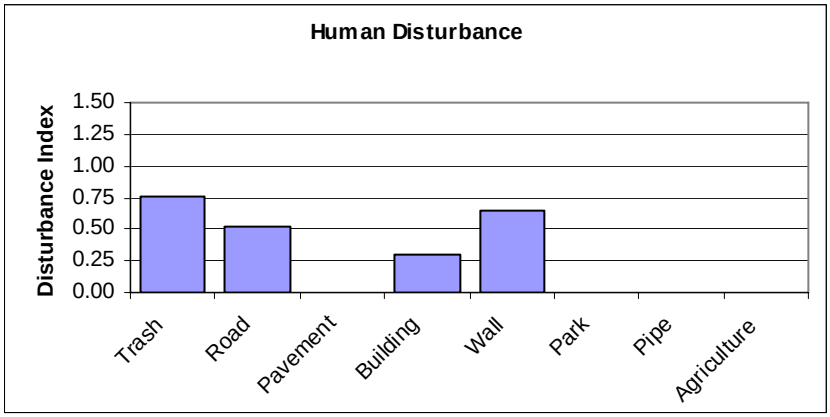

Other Site Photos:

Pringle Creek Site PR00-014

Reach location and description:
East Fork Pringle Creek Site 14 begins 1100 feet upstream of the split with Middle Fork Pringle Creek. The reach is 149 meters long, is channelized, and follows the railroad tracks through agricultural land. The reach has an average bankfull width of 4.3 meters and water surface gradient of 0.4%. The mean thalweg depth at baseflow was 20 centimeters. There are no trees along most of the reach except at the upstream end. Vegetation consists of Himalayan blackberry, bigleaf maple, ash, oak, willow, rose, Douglas spirea and bulrush. The reach consists primarily of glide habitat and is fairly straight with a sinuosity of 1. The crew noted that there were sculpin in the reach. The overall habitat quality of this reach was 50% of least disturbed conditions.

Key habitat issues:

- Channel is straight and deeply incised, with steep bank angles.
- No channel complexity. Primarily glide habitat
- No pool habitat.
- No wood.
- No canopy cover or complex riparian cover. Channel is inadequately shaded.
- Large amounts of trash.

East Fork Pringle Creek Site PR00-014

Condition Summary: East Fork Pringle Creek Site PR00-014				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	2	Habitat Quality Index (HQI)	0.50	Moderate. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	118	Fair. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	24	Poor
Channel Morphology	0	Channel sinuosity	1.0	None. Channel is straight.
		Incision height (m)	1.45	Poor, deeply incised with steep bank angles.
		Bank angle (degrees)	73	
Channel Complexity	0	Riffle percentage	8	No complexity. Primarily glide habitat with few riffles and no pools
		Glide percentage	92	
		Pool percentage	0	
Residual Pool Depth	1	Depth of deepest residual pool (m)	0.41	Minimal deeper, slow-water habitat.
Substrate	2	Coarse gravel and larger (%)	33	Fair
		Embeddedness (%)	51	Good, not properly functioning by NMFS standards.
		Sand and fine sediments (%)	27	Good, undesirable by ODFW standards.
		Hardpan %	4	Fair
		Bed substrate stability index	-0.82	Stable, fair compared to reference condition.
Wood	0	Wood density (pieces/100 m, all sizes)	0.0	Very poor. No wood of any size.
Fish cover	3	Natural fish cover (aerial proportion)	0.55	Good, heavy cover.
Riparian cover	0	Canopy shading mid-channel (% area)	39	Poor
		Riparian canopy cover (aerial proportion, large trees)	0.00	No canopy cover or complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.00	
		Proportion of reach with 3 layers of vegetation	0.00	
Human Disturbance	2	Human Disturbance Index (proximity-weighted sum)	1.61	Moderately disturbed.

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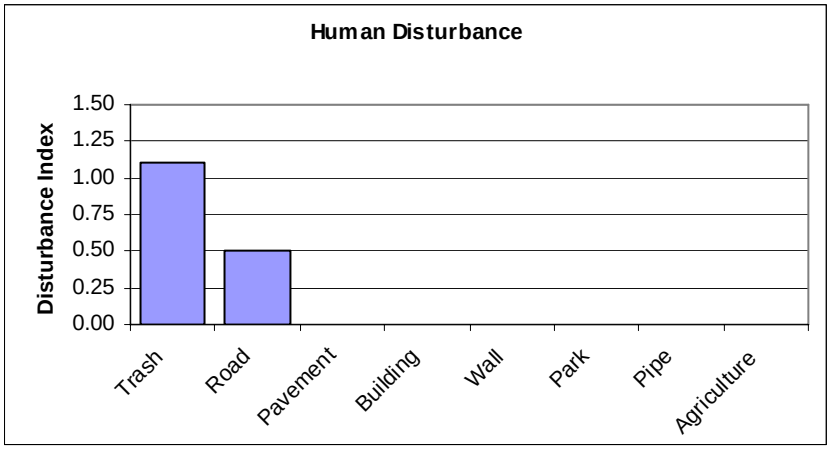

Other Site Photos:

Pringle Creek site 14 in winter

Pringle Creek site 14 in winter

Pringle Creek Site PR00-015

Reach location and description:
East Fork Pringle Creek Site 15 begins 320 feet downstream of Kuebler Blvd. The reach is 158 meters and flows through agricultural land uses, although the middle portion of the reach is inside of a culvert. The reach has an average bankfull width of 5 meters and water surface gradient of 1.0%. The mean thalweg depth at baseflow was 25 centimeters. The reach is almost entirely glide habitat and is deeply incised. Vegetation consists mostly of Himalayan blackberry with some willow. The overall habitat quality of this reach was 87% of least disturbed conditions.

Key habitat issues:
- Channel is deeply incised, with steep bank angles.
- No channel complexity, entirely glide habitat with no riffles or pools.
- No pool habitat.
- No wood.
- No canopy cover or complex riparian cover. Channel is inadequately shaded.
- Roads within or near the riparian zone.
- Agricultural disturbance within or near the riparian zone.
- Large amounts of trash.

East Fork Pringle Creek Site PR00-015 in winter

Condition Summary: East Fork Pringle Creek Site PR00-015				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	3	Habitat Quality Index (HQI)	0.87	High. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	118	Fair. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	18	Very poor
Channel Morphology	1	Channel sinuosity		Poor, incised with steep bank angles.
		Incision height (m)	1.38	
		Bank angle (degrees)	66	
Channel Complexity	0	Riffle percentage	1	No complexity. Glide habitat with no riffles or pools.
		Glide percentage	99	
		Pool percentage	0	
Residual Pool Depth	2	Depth of deepest residual pool (m)	0.89	Some deeper slow-water habitat.
Substrate	3	Coarse gravel and larger (%)	18	Fair
		Embeddedness (%)	28	Good, at risk by NMFS standards.
		Sand and fine sediments (%)	7	Good
		Hardpan %	2	Fair
		Bed substrate stability index	-0.36	Stable
Wood	0	Wood density (pieces/100 m, all sizes)	0.0	Very poor. No wood of any size.
Fish cover	3	Natural fish cover (aerial proportion)	0.61	Good, heavy cover.
Riparian cover	0	Canopy shading mid-channel (% area)	67	Poor, at risk by ODFW standards.
		Riparian canopy cover (aerial proportion, large trees)	0.00	No canopy cover or complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.00	
		Proportion of reach with 3 layers of vegetation	0.00	
Human Disturbance	1	Human Disturbance Index (proximity-weighted sum)	3.44	Highly disturbed

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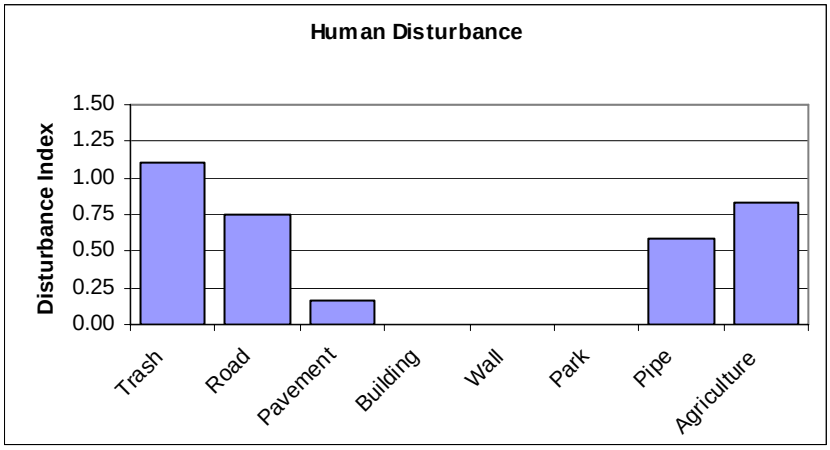


Other Site Photos:

Pringle Creek Site 15 in winter

Pringle Creek Site PR00-016

Reach location and description:
East Fork Pringle Creek Site 16 begins 1400 feet upstream of Kuebler Blvd and 290 feet from Boone Road. The reach is 149 meters long, is channelized and highly disturbed. At the time of survey the right bank had recently been graded by a bulldozer. The reach has an average bankfull width of 3.4 meters and water surface gradient of 1.0%. The mean thalweg depth at baseflow was 18 centimeters. The reach consists primarily of glide habitat and is fairly straight, with a ninety degree bend in the middle of the reach giving it a sinuosity of 1.3. The crew noted that there were sculpin and lamprey in the reach. The overall habitat quality of this reach was low at 41% of least disturbed conditions.

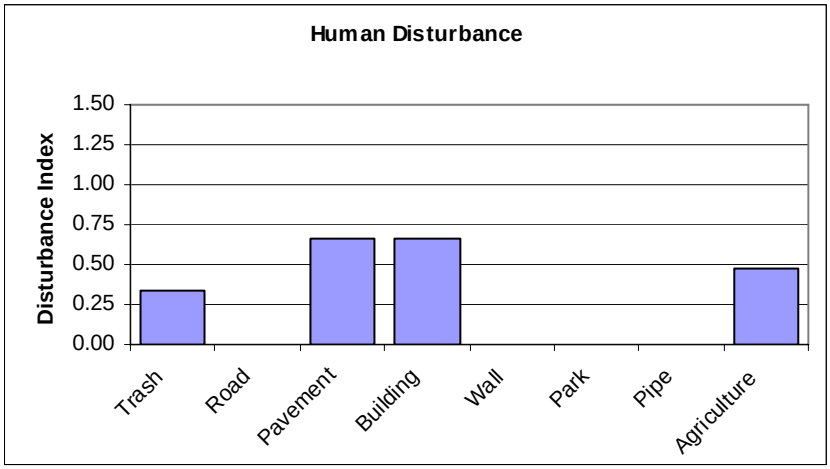
Key habitat issues:

- No channel complexity, primarily glide habitat with very few riffles.
- No pool habitat.
- Streambed is only moderately stable with excessive fine sediments.
- Very little wood, no large pieces.
- No canopy cover and inadequate complex riparian cover.

East Fork Pringle Creek Site PR00-016

Condition Summary: East Fork Pringle Creek Site PR00-016				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	1	Habitat Quality Index (HQI)	0.41	Low. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	65	Poor. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	20	Poor
Channel Morphology	2	Channel sinuosity	1.3	Medium, good compared to reference condition.
		Incision height (m)	1.27	Fair, incised, but with slight bank angles.
		Bank angle (degrees)	37	
Channel Complexity	0	Riffle percentage	8	No complexity. Primarily glide habitat with few riffles and no pools
		Glide percentage	92	
		Pool percentage	0	
Residual Pool Depth	1	Depth of deepest residual pool (m)	0.23	Minimal deeper, slow-water habitat.
Substrate	1	Coarse gravel and larger (%)	29	Fair
		Embeddedness (%)	66	Fair, not properly functioning by NMFS standards.
		Sand and fine sediments (%)	50	Poor, fair by DEQ standards.
		Hardpan %	4	Fair
		Bed substrate stability index	-1.79	Moderately stable, poor compared to reference condition.
Wood	1	Wood density (pieces/100 m, all sizes)	2.7	Poor. Very little wood, no large pieces.
Fish cover	2	Natural fish cover (aerial proportion)	0.28	Fair, moderate cover.
Riparian cover	1	Canopy shading mid-channel (% area)	54	Poor
		Riparian canopy cover (aerial proportion, large trees)	0.01	No canopy cover and inadequate complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.03	
		Proportion of reach with 3 layers of vegetation	0.50	
Human Disturbance	2	Human Disturbance Index (proximity-weighted sum)	2.21	Moderately disturbed.

The Riparian Human Disturbance Index is a proximity-weighted sum of a number of types of disturbances. The index averages the incidence of each disturbance type within a 10 meter plot around each transect, adjacent to this 10 meter plot, and within the bankfull channel. The following chart shows the contribution of each riparian disturbance type to the Riparian Human Disturbance Index for this site:



Other Site Photos:

Pringle Creek Site PR00-017

Reach location and description:
East Fork Pringle Creek Site 17 begins 150 feet upstream of Langley Road. The reach is 149 meters long and flows through agricultural land. The reach has an average bankfull width of 3.4 meters and water surface gradient of 1.1%. The mean thalweg depth at baseflow was 13 centimeters. The reach consists primarily of glide habitat with a small amount of riffle. The reach is straight with a sinuosity of 1.0 The left bank had native vegetation consisting of snowberry, Oregon white oak, Douglas fir, bigleaf maple, cherry, The most common invasive plant was Himalayan blackberry, Pacific ninebark, Oregon grape, rose, trailing blackberry, lady fern and bulrush. There were lamprey in the reach at the time of survey. The overall habitat quality of this reach was 68% of least disturbed conditions.

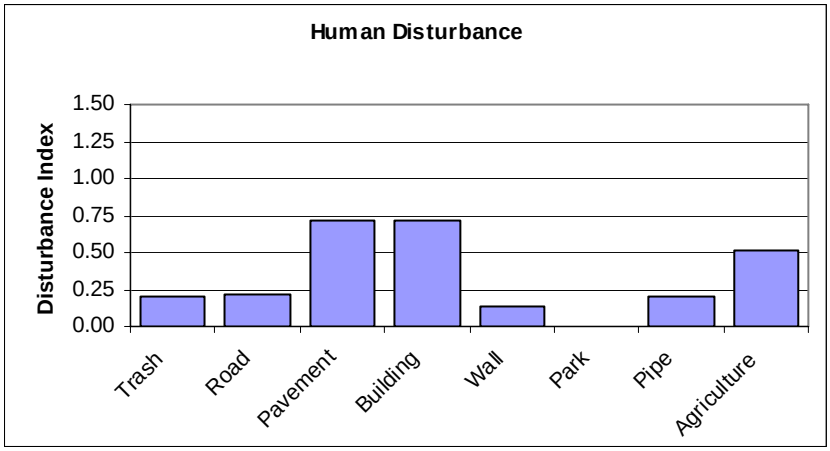
Key habitat issues:

- Channel is straight and incised, with steep bank angles.
- Very little channel complexity, primarily glide habitat.
- No pool habitat.
- Very little wood, no large pieces.

East Fork Pringle Creek Site PR00-017

Condition Summary: East Fork Pringle Creek Site PR00-017				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	2	Habitat Quality Index (HQI)	0.68	Moderate. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	110	Fair. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	24	Poor
Channel Morphology	1	Channel sinuosity	1.0	None. Channel is straight.
		Incision height (m)	0.95	Poor, incised with steep bank angles.
		Bank angle (degrees)	77	
Channel Complexity	0	Riffle percentage	11	No complexity. Primarily glide habitat with few riffles and no pools
		Glide percentage	89	
		Pool percentage	0	
Residual Pool Depth	1	Depth of deepest residual pool (m)	0.22	Minimal deeper, slow-water habitat.
Substrate	3	Coarse gravel and larger (%)	47	Good
		Embeddedness (%)	40	Good, not properly functioning by NMFS standards.
		Sand and fine sediments (%)	26	Good, undesirable by ODFW standards.
		Hardpan %	0	Good
		Bed substrate stability index	-1.09	Moderately stable
Wood	1	Wood density (pieces/100 m, all sizes)	0.7	Poor. Very little wood, no large pieces.
Fish cover	3	Natural fish cover (aerial proportion)	0.38	Good, moderate cover.
Riparian cover	2	Canopy shading mid-channel (% area)	82	Fair, desirable by ODFW standards.
		Riparian canopy cover (aerial proportion, large trees)	0.24	Good canopy cover and large tree cover. Inadequate complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.46	
		Proportion of reach with 3 layers of vegetation	0.50	
Human Disturbance	1	Human Disturbance Index (proximity-weighted sum)	2.70	Highly disturbed

The Riparian Human Disturbance Index is a proximity-weighted sum of a number of types of disturbances. The index averages the incidence of each disturbance type within a 10 meter plot around each transect, adjacent to this 10 meter plot, and within the bankfull channel. The following chart shows the contribution of each riparian disturbance type to the Riparian Human Disturbance Index for this site:



Other Site Photos:

Pringle Creek Site PR00-018

Reach location and description:
East Fork Pringle Creek Site 18 begins 470 feet upstream of Langley Road. The reach is 149 meters long and flows through agricultural land uses. The reach has an average bankfull width of 2.1 meters and water surface gradient of 0.4%. The mean thalweg depth at baseflow was 22 centimeters. The reach consists entirely of glide habitat and is moderately straight with a sinuosity of 1.3. Vegetation in the reach included blackberry and tall grass. There were sculpin in the reach at the time of survey. The overall habitat quality of this reach was low at 29% of least disturbed conditions.

Key habitat issues:

- Channel is incised, with steep bank angles.
- No channel complexity, entirely glide habitat with no riffles or pools.
- No pool habitat or deeper areas.
- Streambed is unstable and has excessive fine sediments.
- Very little wood, no large pieces.
- No canopy cover or complex riparian cover. Channel is inadequately shaded.
- Agricultural disturbance within or near the riparian zone.

East Fork Pringle Creek Site PR00-018

Condition Summary: East Fork Pringle Creek Site PR00-018				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	1	Habitat Quality Index (HQI)	0.29	Low. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	101	Fair. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	16	Very poor
Channel Morphology	2	Channel sinuosity	1.3	Medium, good compared to reference condition.
		Incision height (m)	1.04	Poor, incised with steep bank angles.
		Bank angle (degrees)	77	
Channel Complexity	0	Riffle percentage	0	No complexity. Glide habitat with no riffles or pools.
		Glide percentage	100	
		Pool percentage	0	
Residual Pool Depth	0	Depth of deepest residual pool (m)	0.14	No deeper habitat.
Substrate	0	Coarse gravel and larger (%)	11	Fair, undesirable by ODFW standards.
		Embeddedness (%)	85	Poor
		Sand and fine sediments (%)	76	Poor
		Hardpan %	1	Good
		Bed substrate stability index	-2.46	Unstable
Wood	1	Wood density (pieces/100 m, all sizes)	2.7	Poor. Very little wood, no large pieces.
Fish cover	3	Natural fish cover (aerial proportion)	0.77	Good, heavy cover.
Riparian cover	0	Canopy shading mid-channel (% area)	41	Poor
		Riparian canopy cover (aerial proportion, large trees)	0.00	No canopy cover or complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.00	
		Proportion of reach with 3 layers of vegetation	0.00	
Human Disturbance	1	Human Disturbance Index (proximity-weighted sum)	2.72	Highly disturbed

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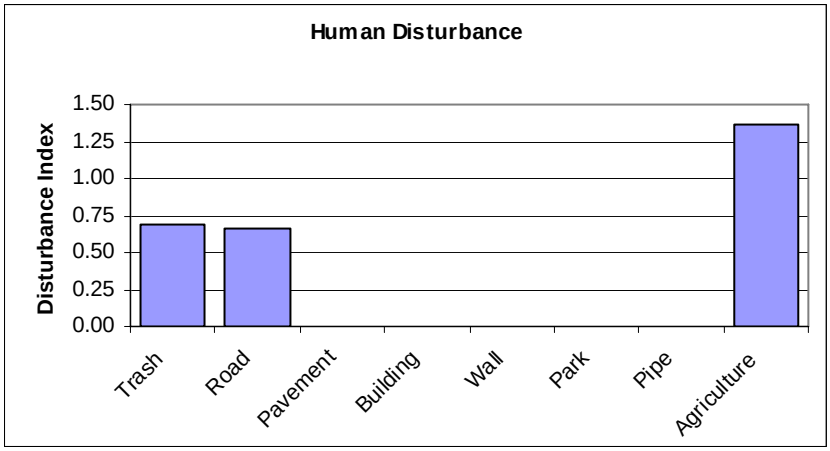

Other Site Photos:

Pringle Creek Site PR00-020

Reach location and description:
East Fork Pringle Creek Site 20 in located along the city limits of Salem. The reach is fed by a culvert that drains water from Mill Creek, and a channel that drains a nearby hillslope during rainy weather. The reach is 149 meters long and flows through agricultural land uses. The reach has an average bankfull width of 13.8 meters and water surface gradient of 0.8%. The mean thalweg depth at baseflow was 48 centimeters. The reach consists primarily of glide habitats and is straight, except for a 90 degree bend giving it a sinuosity of 1.2. Lamprey and trout were present in the reach at the time of survey. The overall habitat quality of this reach was low at 21% of least disturbed conditions.

Key habitat issues:

- Very little channel complexity, primarily glide habitat.
- Streambed is unstable, has excessive fine sediments, and inadequate large substrates.
- No wood.
- No canopy cover and inadequate complex riparian cover. Channel is inadequately shaded.
- Roads within or near the riparian zone.X

East Fork Pringle Creek Site PR00-020

Condition Summary: East Fork Pringle Creek Site PR00-020				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	0	Habitat Quality Index (HQI)	0.21	Very low. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	113	Fair. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	24	Poor
Channel Morphology	3	Channel sinuosity	1.2	Low, good compared to reference condition.
		Incision height (m)	0.58	Good, with slight bank angles.
		Bank angle (degrees)	25	
Channel Complexity	1	Riffle percentage	0	Little complexity. Primarily glide habitat with no riffles, but adequate pools
		Glide percentage	86	
		Pool percentage	14	
Residual Pool Depth	2	Depth of deepest residual pool (m)	0.47	Pools provide adequate deeper, slow-water habitat.
Substrate	0	Coarse gravel and larger (%)	0	Poor
		Embeddedness (%)	77	Fair, not properly functioning by NMFS standards.
		Sand and fine sediments (%)	78	Poor
		Hardpan %	0	Good
		Bed substrate stability index	-3.18	Unstable
Wood	0	Wood density (pieces/100 m, all sizes)	0.0	Very poor. No wood of any size.
Fish cover	2	Natural fish cover (aerial proportion)	0.95	Fair, very heavy cover, but no large cover.
Riparian cover	1	Canopy shading mid-channel (% area)	44	Poor
		Riparian canopy cover (aerial proportion, large trees)	0.01	No canopy cover and inadequate complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.02	
		Proportion of reach with 3 layers of vegetation	0.14	
Human Disturbance	2	Human Disturbance Index (proximity-weighted sum)	2.16	Moderately disturbed

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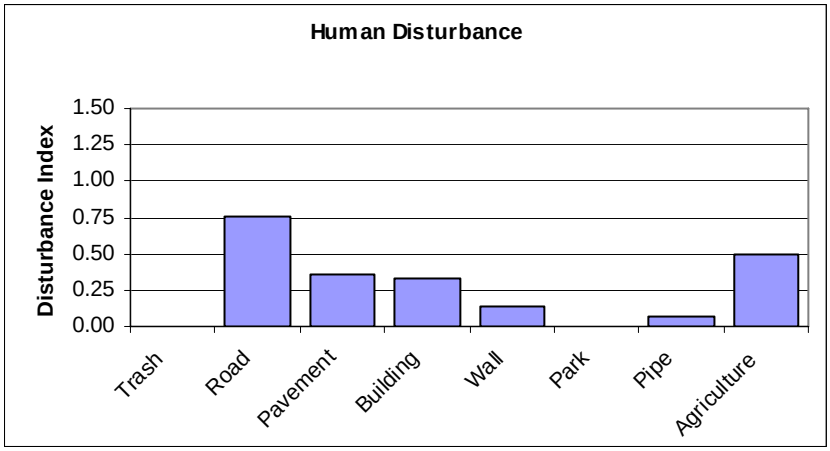
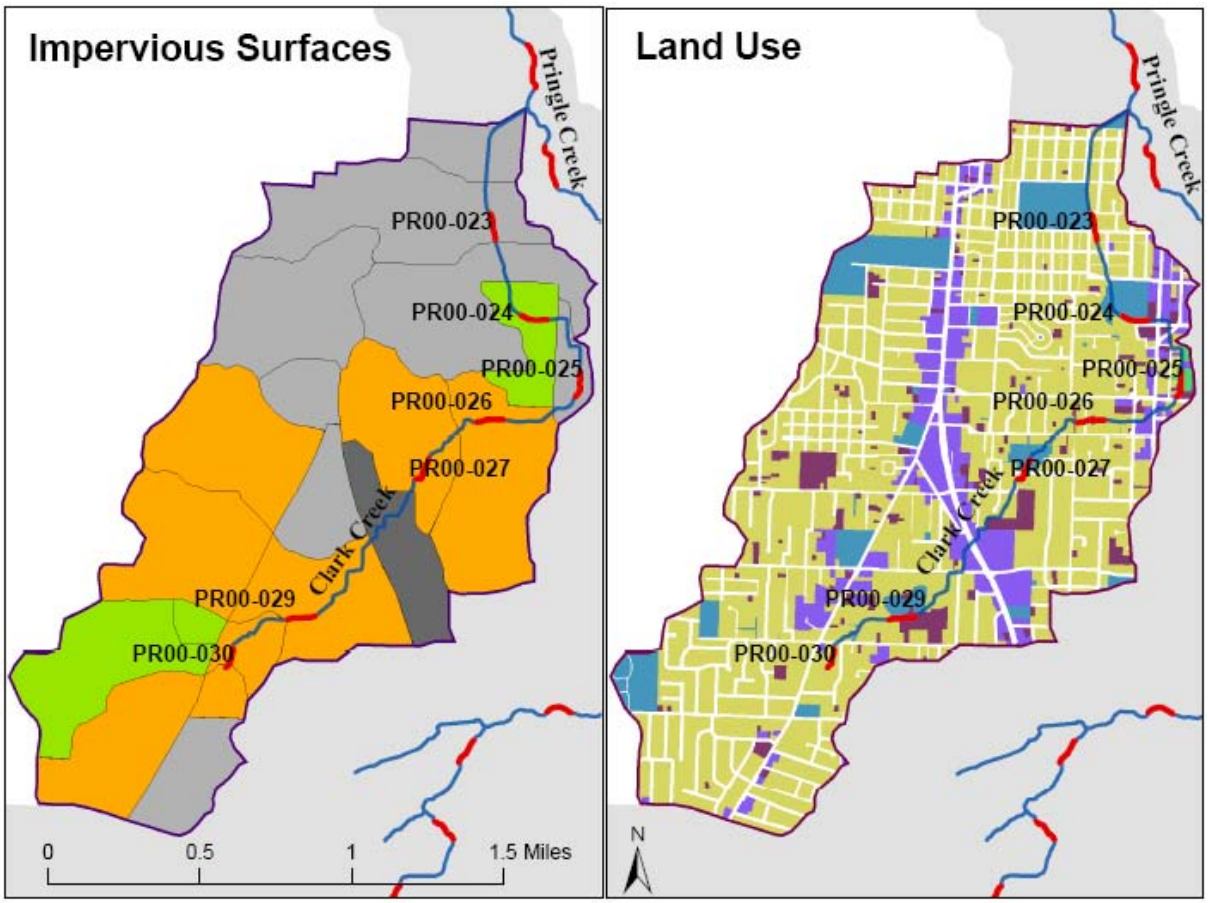


Other Site Photos:

Clark Creek Subbasin



Clark Creek Subbasin
Impervious Surface and Land Use

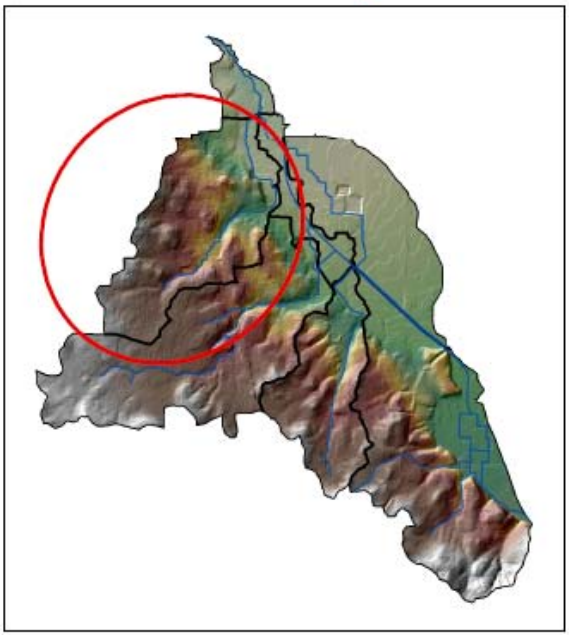
- Survey Reaches
- Streams
- Pringle Creek Subbasins

Impervious Surface Cover by Catchment

- 0 - 10
- 10 - 25
- 25 - 40
- 40 - 60
- 60 - 80

Land Use

- Commercial (138 Acres)
- Industrial (0 Acres)
- Public (124)
- Residential (890 Acres)
- Vacant (70 Acres)



Pringle Creek Site PR00-023

Reach location description:
Clarke Creek Site 23 is located 665 meters upstream of its confluence with Pringle Creek, and flows through the ball field at South Salem High School. The reach is 149 meters long and is completely contained within a concrete channel on the downstream end, and within a culvert for the uppermost 90 meters (which were not surveyed). The reach has an average bankfull width of 2.5 meters and water surface gradient of 1.9%. The mean thalweg depth at baseflow was 20 centimeters, but fluctuated visibly during the survey. The overall habitat quality of this reach is low at 27% of least disturbed conditions.

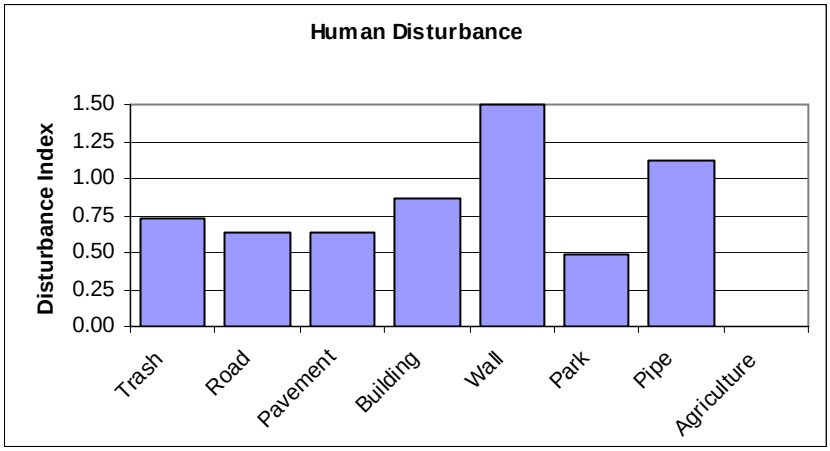
Key habitat issues:

- Channel is a concrete ditch with no floodplain connectivity or channel complexity. Primarily glide habitat.
- No pool habitat or deeper areas.
- No substrates, channel is concrete.
- No wood.
- Inadequate fish cover.
- No canopy cover and inadequate complex riparian cover. Channel is inadequately shaded.
- Buildings and pipes within or near the riparian zone.

Clarke Creek Site PR00-023

Condition Summary: Clark Creek Site PR00-023				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	1	Habitat Quality Index (HQI)	0.27	Low. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	57	Poor. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	18	Very poor
Channel Morphology	2	Channel sinuosity	2.0	High, good compared to reference condition.
		Incision height (m)	0.98	Poor, incised with steep bank angles.
		Bank angle (degrees)	66	
Channel Complexity	0	Riffle percentage	8	No complexity. Primarily glide habitat with few riffles and no pools
		Glide percentage	92	
		Pool percentage	0	
Residual Pool Depth	0	Depth of deepest residual pool (m)	0.00	No deeper habitat.
Substrate	0	Coarse gravel and larger (%)	5	Poor
		Embeddedness (%)	17	Not applicable. Substrate is concrete.
		Sand and fine sediments (%)	18	Good, at risk by ODFW standards.
		Hardpan %	0	Not applicable. Substrate is concrete.
		Bed substrate stability index		
Wood	0	Wood density (pieces/100 m, all sizes)	0.0	Very poor. No wood of any size.
Fish cover	1	Natural fish cover (aerial proportion)	0.21	Poor, moderate cover.
Riparian cover	1	Canopy shading mid-channel (% area)	56	Poor
		Riparian canopy cover (aerial proportion, large trees)	0.02	No canopy cover and inadequate complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.03	
		Proportion of reach with 3 layers of vegetation	0.14	
Human Disturbance	0	Human Disturbance Index (proximity-weighted sum)	5.98	Highly disturbed

The Riparian Human Disturbance Index is a proximity-weighted sum of a number of types of disturbances. The index averages the incidence of each disturbance type within a 10 meter plot around each transect, adjacent to this 10 meter plot, and within the bankfull channel. The following chart shows the contribution of each riparian disturbance type to the Riparian Human Disturbance Index for this site:



Other Site Photos:

Pringle Creek Site PR00-024

Reach location description:
Clarke Creek Site 24 is located at Gilmore Field, 230 meters upstream from Hoyt Street. The reach is 149 meters long and is entirely contained along the edge of the field. The reach has an average bankfull width of 3.4 meters and water surface gradient of 0.5%. The mean thalweg depth at baseflow was 18 centimeters. The reach consists primarily of glide and riffle habitat and is straight with a sinuosity of 1.0. The lower portions of the reach are shaded by large trees and thick with brush along the upper half. Vegetation consists of grand fir, Douglas fir, bigleaf maple, hazelnut, Indian plum, Pacific ninebark, willow and sword fern with reed canary grass, nightshade, English ivy and Himalayan blackberry. The overall habitat quality of this reach is 52% of least disturbed conditions.

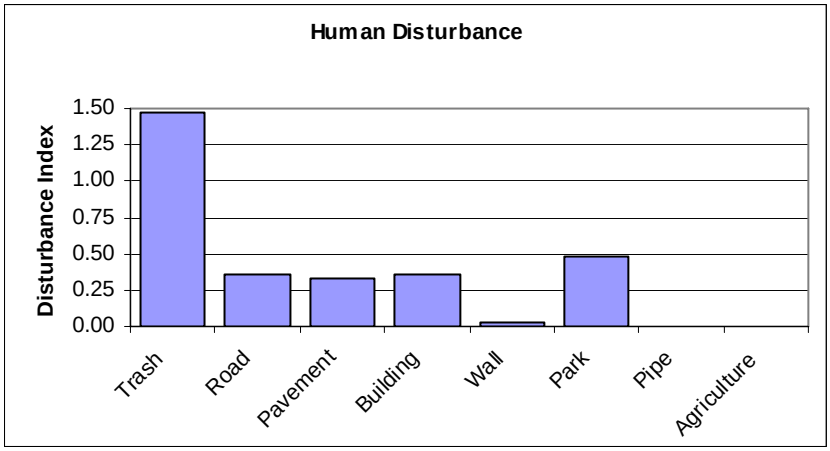
Key habitat issues:

- Little channel complexity, primarily glide habitat.
- Inadequate pool habitat.
- Excessive hardpan.
- No wood.
- Large amounts of trash.

Clarke Creek Site PR00-024

Condition Summary: Clark Creek Site PR00-024				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	2	Habitat Quality Index (HQI)	0.52	Moderate. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	108	Fair. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	14	Very poor
Channel Morphology	2	Channel sinuosity	1.0	Very low, fair compared to reference condition.
		Incision height (m)	0.84	Fair, slightly incised with very steep bank angles.
		Bank angle (degrees)	92	
Channel Complexity	2	Riffle percentage	32	Some complexity. Primarily glide habitat with some riffles and pools. However, pool habitat is less than the recommended amount.
		Glide percentage	63	
		Pool percentage	5	
Residual Pool Depth	2	Depth of deepest residual pool (m)	0.35	Pools provide some deeper, slow-water habitat.
Substrate	2	Coarse gravel and larger (%)	15	Fair, undesirable by ODFW standards.
		Embeddedness (%)	47	Good, not properly functioning by NMFS standards.
		Sand and fine sediments (%)	28	Good, undesirable by ODFW standards.
		Hardpan %	12	Poor
		Bed substrate stability index	-0.62	Stable, fair compared to reference condition.
Wood	0	Wood density (pieces/100 m, all sizes)	0.0	Very poor. No wood of any size.
Fish cover	3	Natural fish cover (aerial proportion)	0.42	Good, moderate cover.
Riparian cover	3	Canopy shading mid-channel (% area)	91	Good
		Riparian canopy cover (aerial proportion, large trees)	0.28	Good canopy cover and large tree cover. Adequate complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.46	
		Proportion of reach with 3 layers of vegetation	0.91	
Human Disturbance	1	Human Disturbance Index (proximity-weighted sum)	3.05	Highly disturbed

The Riparian Human Disturbance Index is a proximity-weighted sum of a number of types of disturbances. The index averages the incidence of each disturbance type within a 10 meter plot around each transect, adjacent to this 10 meter plot, and within the bankfull channel. The following chart shows the contribution of each riparian disturbance type to the Riparian Human Disturbance Index for this site:



Other Site Photos:

Pringle Creek Site PR00-025

Reach location description:
Clarke Creek Site 25 begins 160 meters downstream (north) of Fairview Avenue and flows 149 meters through residential and commercial areas. The reach has an average bankfull width of 2.8 meters and water surface gradient of 2.1%. The mean thalweg depth at baseflow was 22 centimeters. The reach consists primarily of glide habitat with some riffle and pool habitat. The reach is deeply incised and fairly straight with a sinuosity of 1.0. The riparian zone is highly disturbed by parking lots and buildings 5 to 10 meters from the edge of the stream, and rip rap along the banks. Vegetation consists primarily of non-native ornamental plants including large amounts of English ivy in the lower portion of the reach, with Douglas fir, cottonwood, willow in small amounts. Trout were present in the reach at the time of survey. The overall habitat quality of this reach was 68% of least disturbed conditions. The survey crew noted that this site is a good candidate for restoration because of easy access and an opportunity to increase the native tree species to stabilize the steam banks.

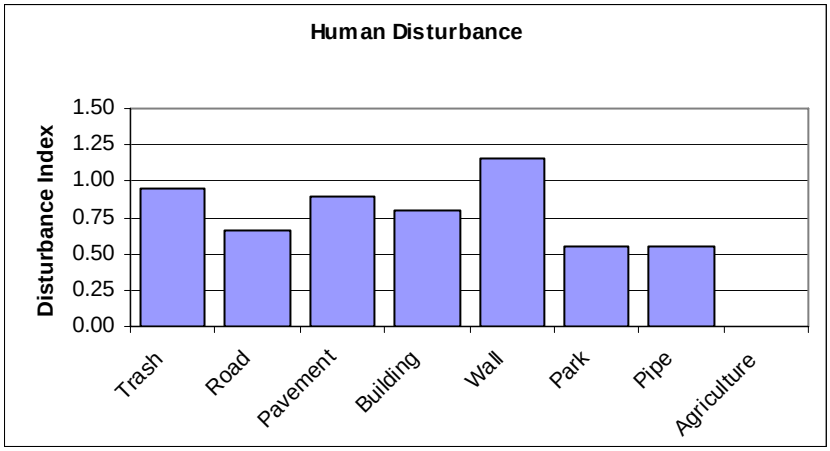
Key habitat issues:

- Channel is deeply incised, with steep bank angles.
- Banks are armored by walls or rip-rap.
- Little channel complexity, primarily glide habitat.
- Inadequate pool habitat.
- No wood.
- Inadequate complex riparian cover and shade.
- Large amounts of trash.
- Pavement and buildings within or near the riparian zone.

Clarke Creek Site PR00-025

Condition Summary: Clark Creek Site PR00-025				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	2	Habitat Quality Index (HQI)	0.68	Moderate. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	105	Fair. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	18	Very poor
Channel Morphology	1	Channel sinuosity	1.0	Very low, fair compared to reference condition.
		Incision height (m)	1.44	Poor, incised with steep bank angles.
		Bank angle (degrees)	80	
Channel Complexity	2	Riffle percentage	29	Some complexity. Primarily glide habitat with some riffles and pools. However, pool habitat is less than the recommended amount.
		Glide percentage	61	
		Pool percentage	9	
Residual Pool Depth	2	Depth of deepest residual pool (m)	0.47	Pools provide some deeper, slow-water habitat.
Substrate	2	Coarse gravel and larger (%)	32	Fair
		Embeddedness (%)	38	Good, not properly functioning by NMFS standards.
		Sand and fine sediments (%)	22	Good, at risk by ODFW standards.
		Hardpan %	12	Poor
		Bed substrate stability index	-0.50	Stable, fair compared to reference condition.
Wood	0	Wood density (pieces/100 m, all sizes)	0.0	Very poor. No wood of any size.
Fish cover	3	Natural fish cover (aerial proportion)	0.52	Good, heavy cover.
Riparian cover	1	Canopy shading mid-channel (% area)	74	Poor, desirable by ODFW standards.
		Riparian canopy cover (aerial proportion, large trees)	0.16	Fair canopy cover with good large tree cover. Inadequate complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.21	
		Proportion of reach with 3 layers of vegetation	0.68	
Human Disturbance	0	Human Disturbance Index (proximity-weighted sum)	5.57	Highly disturbed

The Riparian Human Disturbance Index is a proximity-weighted sum of a number of types of disturbances. The index averages the incidence of each disturbance type within a 10 meter plot around each transect, adjacent to this 10 meter plot, and within the bankfull channel. The following chart shows the contribution of each riparian disturbance type to the Riparian Human Disturbance Index for this site:



Other Site Photos:

Pringle Creek Site PR00-026

Reach location description:
Clarke Creek Site 26 is 149 long and flows east across Summer Street through residential areas. The reach has an average bankfull width of 2.4 meters and water surface gradient of 1.0%. The mean thalweg depth at baseflow was 19 centimeters. The reach consists primarily of glide and riffle habitat and is moderately straight with a sinuosity of 1.2. At the time of survey the banks were actively eroding leaving primarily hardpan substrates and banks. The reach had large amounts of rip rap and trash throughout the reach, and vegetation consisted of large amounts of English ivy along the banks with some ash and cottonwood in the overstory. The overall habitat quality of this reach is 63% of least disturbed conditions.

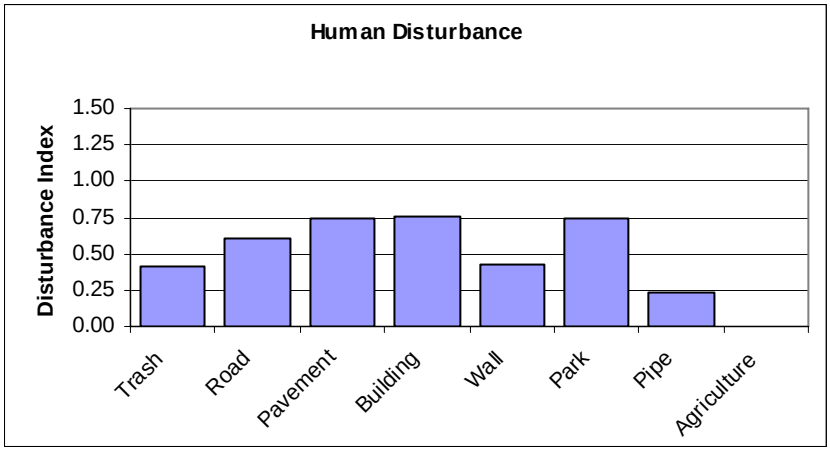
Key habitat issues:

- Channel is incised, with steep bank angles.
- Little channel complexity, primarily glide habitat.
- No pool habitat.
- Excessive hardpan.
- Very little wood, no large pieces.
- Pavement and buildings within or near the riparian zone.
- Lawns within or near the riparian zone.

Clarke Creek Site PR00-026

Condition Summary: Clark Creek Site PR00-026				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	2	Habitat Quality Index (HQI)	0.63	Moderate. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	104	Fair. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	18	Very poor
Channel Morphology	1	Channel sinuosity	1.2	Low, good compared to reference condition.
		Incision height (m)	0.88	Poor, incised with steep bank angles.
		Bank angle (degrees)	77	
Channel Complexity	1	Riffle percentage	38	Some complexity. Primarily glide habitat with adequate riffles, but no pools.
		Glide percentage	62	
		Pool percentage	0	
Residual Pool Depth	2	Depth of deepest residual pool (m)	0.70	Some deeper slow-water habitat.
Substrate	1	Coarse gravel and larger (%)	13	Fair, undesirable by ODFW standards.
		Embeddedness (%)	29	Good, at risk by NMFS standards.
		Sand and fine sediments (%)	18	Good, at risk by ODFW standards.
		Hardpan %	25	Poor
		Bed substrate stability index	0.09	Stable
Wood	1	Wood density (pieces/100 m, all sizes)	1.3	Poor. Very little wood, no large pieces.
Fish cover	3	Natural fish cover (aerial proportion)	0.51	Good, heavy cover.
Riparian cover	3	Canopy shading mid-channel (% area)	90	Good
		Riparian canopy cover (aerial proportion, large trees)	0.22	Fair canopy cover with good large tree cover. Abundant complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.31	
		Proportion of reach with 3 layers of vegetation	1.00	
Human Disturbance	1	Human Disturbance Index (proximity-weighted sum)	3.92	Highly disturbed

The Riparian Human Disturbance Index is a proximity-weighted sum of a number of types of disturbances. The index averages the incidence of each disturbance type within a 10 meter plot around each transect, adjacent to this 10 meter plot, and within the bankfull channel. The following chart shows the contribution of each riparian disturbance type to the Riparian Human Disturbance Index for this site:



Other Site Photos:

Pringle Creek Site PR00-027

Reach location description:
Clarke Creek Site 27 is located at Clark Creek Park. The reach is 149 meters long and flows through parkland and residential areas. Approximately one third of the reach was located in a culvert. The reach has an average bankfull width of 1.9 meters and water surface gradient of 2.1%. The mean thalweg depth at baseflow was 16 centimeters. The reach consists primarily of glide and riffle habitat and is incised and moderately straight with a sinuosity of 1.2. The riparian zone was 1-2 meters wide throughout the park and non-existent throughout the remainder of the reach. There were large amounts of invasive species throughout the reach including Japanese knotweed. Some native plants had been planted within the park but were less than two meters tall at the time of survey. Trout were present in the reach at the time of survey. The overall habitat quality of this reach was 67% of least disturbed conditions.

Key habitat issues:

- Channel is incised, with steep bank angles.
- Banks are armored by walls or rip-rap.
- Little channel complexity, primarily glide habitat.
- No pool habitat or deeper areas.
- Excessive hardpan
- Very little wood, no large pieces.
- Inadequate canopy cover and complex riparian cover.
- Pavement and roads within or near the riparian zone.
- Lawns within or near the riparian zone.

Clark Creek Site PR00-027

Condition Summary: Clark Creek Site PR00-027				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	2	Habitat Quality Index (HQI)	0.67	Moderate. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	108	Fair. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	22	Poor
Channel Morphology	1	Channel sinuosity	1.2	Low, good compared to reference condition.
		Incision height (m)	1.11	Poor, incised with steep bank angles.
		Bank angle (degrees)	85	
Channel Complexity	1	Riffle percentage	38	Some complexity. Primarily glide habitat with adequate riffles, but no pools.
		Glide percentage	62	
		Pool percentage	0	
Residual Pool Depth	0	Depth of deepest residual pool (m)		No deeper habitat.
Substrate	2	Coarse gravel and larger (%)	25	Fair
		Embeddedness (%)	15	Good
		Sand and fine sediments (%)	8	Good
		Hardpan %	14	Poor
		Bed substrate stability index		
Wood	1	Wood density (pieces/100 m, all sizes)	1.3	Poor. Very little wood, no large pieces.
Fish cover	3	Natural fish cover (aerial proportion)	0.93	Good, very heavy cover.
Riparian cover	1	Canopy shading mid-channel (% area)	78	Fair, desirable by ODFW standards.
		Riparian canopy cover (aerial proportion, large trees)	0.09	Poor canopy cover, but some large tree cover. Inadequate complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.11	
		Proportion of reach with 3 layers of vegetation	0.32	
Human Disturbance	0	Human Disturbance Index (proximity-weighted sum)	5.40	Highly disturbed

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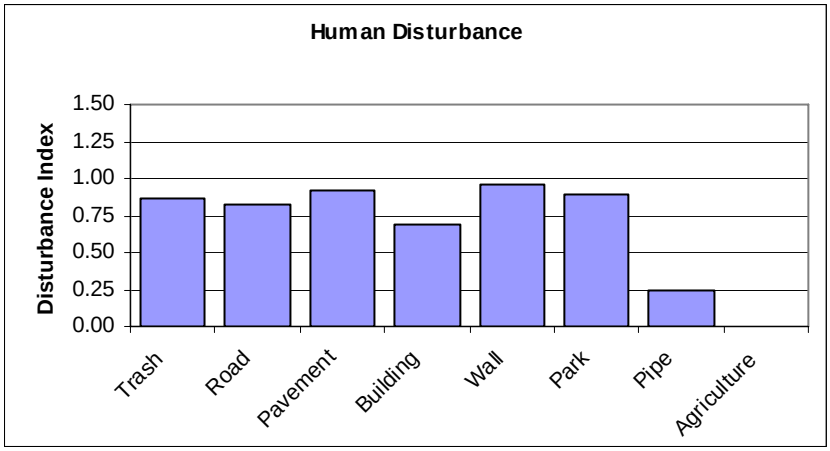


Other Site Photos:

Culvert throughout the center of the reach

Upper portions of Clark Creek site 27

Pringle Creek Site PR00-029

Reach location description:
Clarke Creek Site 29 flows along the south side of Berger Lake for 149 meters through a park-like area at a retirement community. The reach has an average bankfull width of 2.4 meters and water surface gradient of 0.9%. The mean thalweg depth at baseflow was 14 centimeters. The reach is unconstrained and consists almost entirely of glide habitat. It is highly sinuous with a sinuosity of 2.0. Vegetation consists of invasive blackberries covering the entire stream, with a few native trees in the overstory including Douglas fir, alder, oak and cottonwood. The overall habitat quality of this reach was 61% of least disturbed conditions.

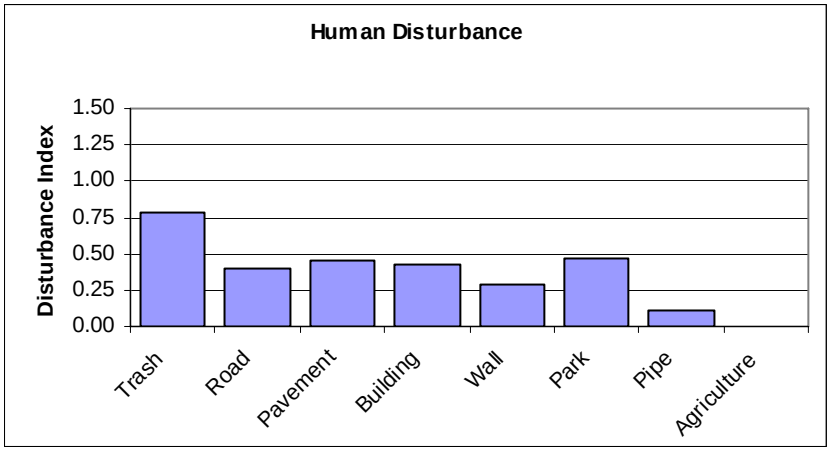
Key habitat issues:

- No channel complexity, entirely glide habitat with no riffles or pools.
- No pool habitat or deeper areas.
- No wood.

Clarke Creek Site PR00-029

Condition Summary: Clarke Creek Site PR00-029				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	2	Habitat Quality Index (HQI)	0.61	Moderate. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	108	Fair. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	18	Very poor
Channel Morphology	2	Channel sinuosity	2.0	High, good compared to reference condition.
		Incision height (m)	0.74	Fair, slightly incised with very steep bank angles.
		Bank angle (degrees)	110	
Channel Complexity	0	Riffle percentage	2	No complexity. Glide habitat with no riffles or pools.
		Glide percentage	98	
		Pool percentage	0	
Residual Pool Depth	0	Depth of deepest residual pool (m)		No deeper habitat.
Substrate	2	Coarse gravel and larger (%)	22	Fair
		Embeddedness (%)	38	Good, not properly functioning by NMFS standards.
		Sand and fine sediments (%)	36	Poor, fair relative to reference condition.
		Hardpan %	4	Fair
		Bed substrate stability index		
Wood	0	Wood density (pieces/100 m, all sizes)	0.0	Very poor. No wood of any size.
Fish cover	3	Natural fish cover (aerial proportion)	1.11	Good, very heavy cover.
Riparian cover	2	Canopy shading mid-channel (% area)	81	Good
		Riparian canopy cover (aerial proportion, large trees)	0.13	Fair canopy cover with good large tree cover. Inadequate complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.24	
		Proportion of reach with 3 layers of vegetation	0.70	
Human Disturbance	1	Human Disturbance Index (proximity-weighted sum)	2.92	Highly disturbed

The Riparian Human Disturbance Index is a proximity-weighted sum of a number of types of disturbances. The index averages the incidence of each disturbance type within a 10 meter plot around each transect, adjacent to this 10 meter plot, and within the bankfull channel. The following chart shows the contribution of each riparian disturbance type to the Riparian Human Disturbance Index for this site:



Other Site Photos:

Pringle Creek Site PR00-030

Reach location description:
Clarke Creek Site 30 begins 36 meters upstream (south) of SE Ewald Avenue and flows 134 meters through an apartment complex and residential areas. The reach has an average bankfull width of 1.9 meters and water surface gradient of 2.8%. The mean thalweg depth at baseflow was 8 centimeters. The reach has some complexity and consists of riffle and glide habitat. It is constrained by large amounts of rip rap and is fairly straight with a sinuosity of 1.1; however a small section of the upper portion of the reach is unconstrained and connected to its floodplain. The upper portion of the reach flows from a culvert that is the headwaters of Clark Creek. Vegetation at the site consisted of blackberry, English Ivey with bigleaf maple, ash, black hawthorn, snowberry and rhododendron. The overall habitat quality of this reach is 72% of least disturbed conditions.

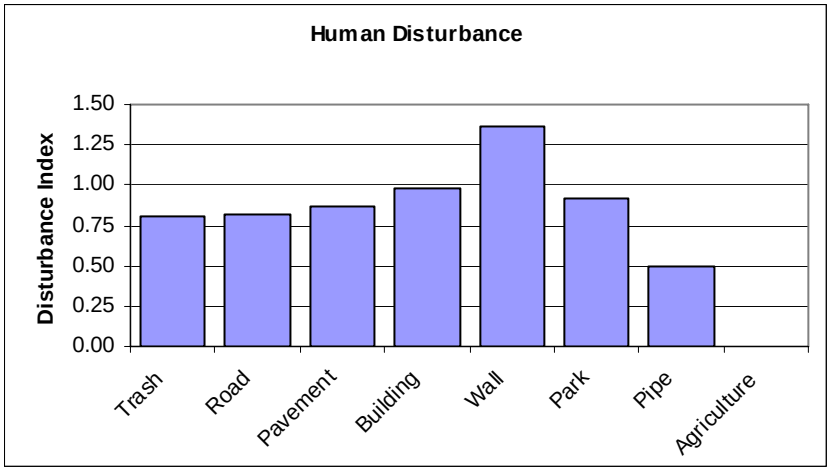
Key habitat issues:

- Banks are armored by walls or rip-rap.
- Inadequate pool habitat.
- No wood.
- Roads, pavement and buildings within or near the riparian zone.
- Lawns within or near the riparian zone.

Pringle Creek Site PR00-030

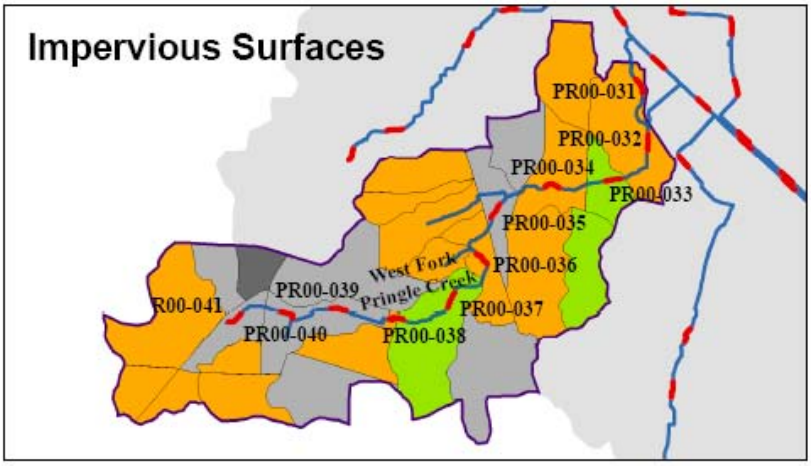
Condition Summary: Clark Creek Site PR00-030				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	2	Habitat Quality Index (HQI)	0.72	Moderate. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	111	Fair. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	22	Poor
Channel Morphology	2	Channel sinuosity	1.1	Low, good compared to reference condition.
		Incision height (m)	0.72	Fair, slightly incised with steep bank angles.
		Bank angle (degrees)	75	
Channel Complexity	2	Riffle percentage	44	Some complexity. Primarily glide habitat with some riffles and pools. However, pool habitat is minimal.
		Glide percentage	52	
		Pool percentage	3	
Residual Pool Depth	2	Depth of deepest residual pool (m)	0.22	Pools provide some deeper, slow-water habitat.
Substrate	2	Coarse gravel and larger (%)	36	Fair, desirable by ODFW standards.
		Embeddedness (%)	43	Good, not properly functioning by NMFS standards.
		Sand and fine sediments (%)	22	Fair, good relative to reference condition.
		Hardpan %	6	Poor
		Bed substrate stability index	-0.88	Moderately stable, good compared to reference condition.
Wood	0	Wood density (pieces/100 m, all sizes)	0.0	Very poor. No wood of any size.
Fish cover	3	Natural fish cover (aerial proportion)	0.72	Good, heavy cover.
Riparian cover	2	Canopy shading mid-channel (% area)	92	Good
		Riparian canopy cover (aerial proportion, large trees)	0.21	Fair canopy cover with good large tree cover. Adequate complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.30	
		Proportion of reach with 3 layers of vegetation	0.89	
Human Disturbance	0	Human Disturbance Index (proximity-weighted sum)	6.25	Highly disturbed

The Riparian Human Disturbance Index is a proximity-weighted sum of a number of types of disturbances. The index averages the incidence of each disturbance type within a 10 meter plot around each transect, adjacent to this 10 meter plot, and within the bankfull channel. The following chart shows the contribution of each riparian disturbance type to the Riparian Human Disturbance Index for this site:



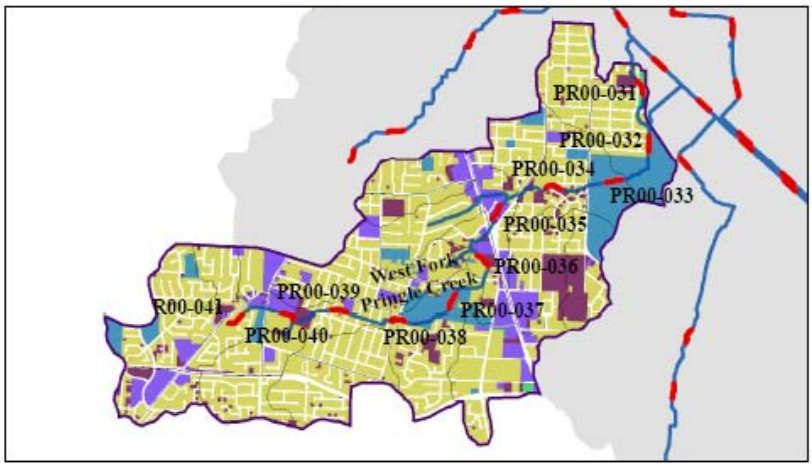
Other Site Photos:

West Fork Pringle Creek Subbasin



N

0 0.5 1 1.5 Miles



West Fork Pringle Creek Subbasin
Impervious Surface and Land Use

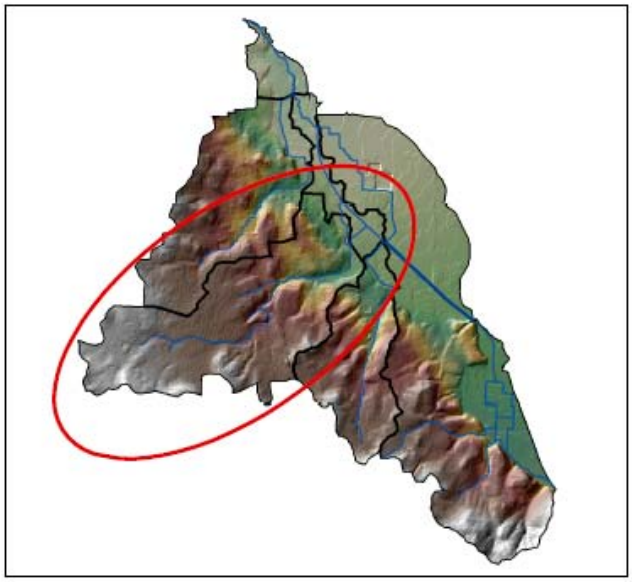
- Survey Reaches
- Streams
- Pringle Creek Subbasins

Impervious Surface Cover by Catchment

- 0 - 10
- 10 - 25
- 25 - 40
- 40 - 60
- 60 - 80

Land Use

- Commercial (167)
- Industrial (2)
- Public (178)
- Residential (1166 Acres)
- Vacant (147)



Pringle Creek Site PR00-031:

Reach location description:
Pringle Creek Site 30 begins 290 meters downstream (north) of Madrona, 418 meters upstream from its confluence with Middle Fork Pringle Creek. The reach is 149 meters long and flows through an open space in a residential area. The reach has an average bankfull width of 2.6 meters and water surface gradient of 0.9%. The mean thalweg depth at baseflow was 31 centimeters. The reach is channelized and consists primarily of glide habitat with some riffle habitat. It is fairly straight with a sinuosity of 1.1. There were a number of blown down trees across the creek. Nutria sign was common in this area. Crayfish, minnows, sculpin and lamprey were present at the time of survey. The overall habitat quality of this reach is 62% of least disturbed conditions.

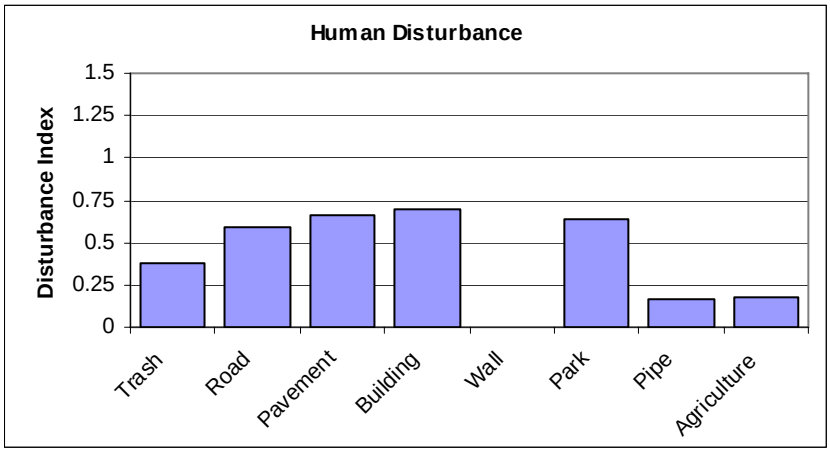
Key habitat issues:

- No channel complexity, primarily glide habitat with very few riffles.
- No pool habitat.
- Excessive hardpan, inadequate large substrates.
- Very little wood, no large pieces.

Pringle Creek Site PR00-031

Condition Summary: Pringle Creek Site PR00-031				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	2	Habitat Quality Index (HQI)	0.62	Moderate. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	118	Fair. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	18	Very poor
Channel Morphology	2	Channel sinuosity	1.1	Low, fair compared to reference condition.
		Incision height (m)	0.67	Good, little incision with very steep and some undercut banks.
		Bank angle (degrees)	106	
Channel Complexity	0	Riffle percentage	16	No complexity. Primarily glide habitat with few riffles and no pools.
		Glide percentage	84	
		Pool percentage	0	
Residual Pool Depth	1	Depth of deepest residual pool (m)	0.46	Minimal deeper, slow-water habitat.
Substrate	1	Coarse gravel and larger (%)	8	Poor
		Embeddedness (%)	40	Good, not properly functioning by NMFS standards.
		Sand and fine sediments (%)	36	Fair, undesirable by ODFW standards.
		Hardpan %	35	Poor
		Bed substrate stability index	-0.29	Stable
Wood	1	Wood density (pieces/100 m, all sizes)	0.7	Poor. Very little wood, no large pieces.
Fish cover	3	Natural fish cover (aerial proportion)	0.61	Good, heavy cover.
Riparian cover	2	Canopy shading mid-channel (% area)	84	Fair, desirable by ODFW standards.
		Riparian canopy cover (aerial proportion, large trees)	0.08	Fair canopy cover. Abundant complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.23	
		Proportion of reach with 3 layers of vegetation	1.00	
Human Disturbance	1	Human Disturbance Index (proximity-weighted sum)	3.32	Highly disturbed

Chart showing contribution of each disturbance type to the Riparian Human Disturbance Index:



Other Site Photos:

Pringle Creek Site PR00-032

Reach location description:

Pringle Creek Site 32 is located 270 meters upstream (south) of Madrona Avenue. The reach is 149 meters long and follows residential, areas along the west bank. The reach has an average bankfull width of 3.4 meters and water surface gradient of 1.4%. The mean thalweg depth at baseflow was 24 centimeters. The reach is constrained on the east bank by a dike for the entire length of the reach and is straight with a sinuosity of 1.0. It consists primarily of glide habitat with some riffle habitat. Vegetation consists of Himalayan blackberry, bigleaf maple, ninebark, rose, Oregon grape, snowberry, trailing blackberry and sword fern. The overall habitat quality of this reach is 60% of least disturbed conditions.

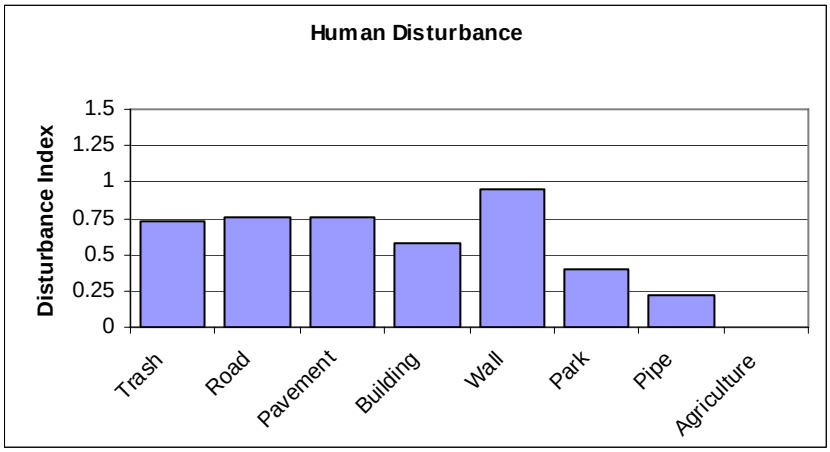
Key habitat issues:

- Channel is straight and incised, with steep bank angles.
- Banks are armored by walls or rip-rap.
- Very little channel complexity, primarily glide habitat.
- No pool habitat.
- Very little wood, no large pieces.
- Inadequate canopy cover and complex riparian cover.
- Roads and pavement within or near the riparian zone.

Pringle Creek Site PR00-032

Condition Summary: Pringle Creek Site PR00-032				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	2	Habitat Quality Index (HQI)	0.60	Moderate. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	113	Fair. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	20	Poor
Channel Morphology	1	Channel sinuosity	1.0	None. Channel is straight.
		Incision height (m)	0.97	Poor, incised with steep bank angles.
		Bank angle (degrees)	68	
Channel Complexity	0	Riffle percentage	20	No complexity. Primarily glide habitat with few riffles and no pools.
		Glide percentage	80	
		Pool percentage	0	
Residual Pool Depth	1	Depth of deepest residual pool (m)	0.31	Minimal deeper, slow-water habitat.
Substrate	2	Coarse gravel and larger (%)	24	Fair
		Embeddedness (%)	44	Good, not properly functioning by NMFS standards.
		Sand and fine sediments (%)	32	Fair, undesirable by ODFW standards.
		Hardpan %	8	Poor
		Bed substrate stability index	-0.99	Stable, fair compared to reference condition.
Wood	1	Wood density (pieces/100 m, all sizes)	7.4	Poor. Very little wood, no large pieces.
Fish cover	3	Natural fish cover (aerial proportion)	0.60	Good, heavy cover.
Riparian cover	1	Canopy shading mid-channel (% area)	87	Fair, desirable by ODFW standards.
		Riparian canopy cover (aerial proportion, large trees)	0.04	Poor canopy cover and inadequate complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.08	
		Proportion of reach with 3 layers of vegetation	0.50	
Human Disturbance	0	Human Disturbance Index (proximity-weighted sum)	4.40	Highly disturbed

Chart showing contribution of each disturbance type to the Riparian Human Disturbance Index:



Other Site Photos:

Pringle Creek Site PR00-033

Reach location description:
Pringle Creek Site 33 begins 300 meters downstream (east) of Pringle Road at Leslie Middle School between the building and soccer fields. The reach is 149 meters long and runs a straight path through a small valley. The reach has an average bankfull width of 2.7 meters and water surface gradient of 2.6%. The mean thalweg depth at baseflow was 16 centimeters. The reach has a little complexity consisting of glide and riffle habitat. At the time of survey it appeared the stream had been planted with a number of native trees in the riparian zone. Reed canarygrass was the most common invasive species and native vegetation consists of red alder, ash, willow, red-osier dogwood, rose and bull rush. Minnows and sculpin were present at the time of survey. The overall habitat quality of this reach is 74% of least disturbed conditions.

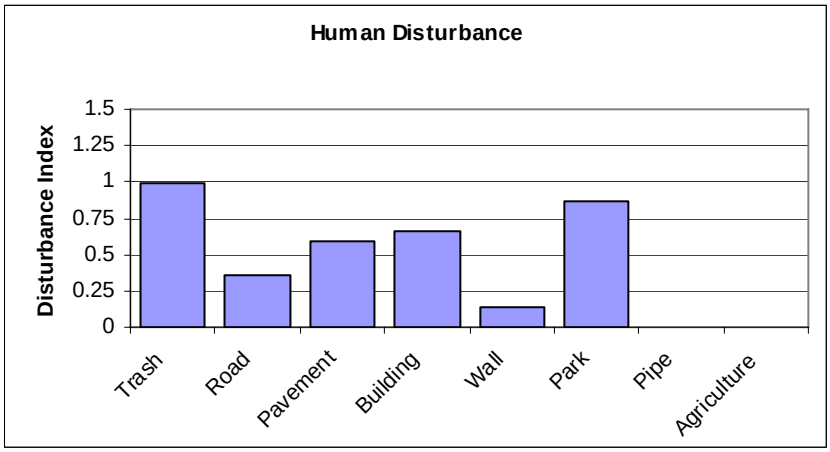
Key habitat issues:

- Channel is straight, with steep bank angles.
- Little channel complexity, primarily glide habitat.
- No pool habitat.
- No wood.
- Inadequate canopy cover and complex riparian cover. Channel is inadequately shaded.
- Lawns within or near the riparian zone.
- Large amounts of trash.

Pringle Creek Site PR00-033

Condition Summary: Pringle Creek Site PR00-033				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	2	Habitat Quality Index (HQI)	0.74	Moderate. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	122	Fair. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	18	Very poor
Channel Morphology	1	Channel sinuosity	1.0	None. Channel is straight.
		Incision height (m)	0.74	Fair, slightly incised with steep bank angles.
		Bank angle (degrees)	92	
Channel Complexity	1	Riffle percentage	45	Some complexity. Primarily glide habitat with adequate riffles, but no pools.
		Glide percentage	55	
		Pool percentage	0	
Residual Pool Depth	1	Depth of deepest residual pool (m)	0.32	Minimal deeper, slow-water habitat.
Substrate	2	Coarse gravel and larger (%)	49	Good
		Embeddedness (%)	46	Good, not properly functioning by NMFS standards.
		Sand and fine sediments (%)	22	Good, at risk by ODFW standards.
		Hardpan %	6	Poor
		Bed substrate stability index	-0.56	Stable, fair compared to reference condition.
Wood	0	Wood density (pieces/100 m, all sizes)	0.0	Very poor. No wood of any size.
Fish cover	3	Natural fish cover (aerial proportion)	1.06	Good, very heavy cover.
Riparian cover	1	Canopy shading mid-channel (% area)	64	Poor, at risk by ODFW standards.
		Riparian canopy cover (aerial proportion, large trees)	0.00	Poor canopy cover with no large tree cover. Inadequate complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.06	
		Proportion of reach with 3 layers of vegetation	0.41	
Human Disturbance	1	Human Disturbance Index (proximity-weighted sum)	3.61	Highly disturbed

Chart showing contribution of each disturbance type to the Riparian Human Disturbance Index:



Other Site Photos:

Pringle Creek Site PR00-034

Reach location description:
Pringle Creek Site 34 is located 240 meters upstream (west) of Pringle Road. The reach was 149 meters long and flows through residential areas with landscaped banks. There are many weirs of unknown function (likely from before the area was developed) and the substrate is mostly bedrock. The reach has an average bankfull width of 4.7 meters and water surface gradient of 2.6% and is fairly straight with a sinuosity of 1.1. The mean thalweg depth at baseflow was 21 centimeters. The reach has some complexity consisting of glide, riffle and pool habitat. At the time of survey a detention basin had been recently built and was separated from the stream by a rip rap berm. It had not yet been replanted. Vegetation consists of Himalayan blackberry, bigleaf maple, vine maple, ninebark, grand fir, willow, snowberry ash, alder and rose. Crayfish and sculpin were present in the reach at the time of survey. The overall habitat quality of this reach is 79% of least disturbed conditions.

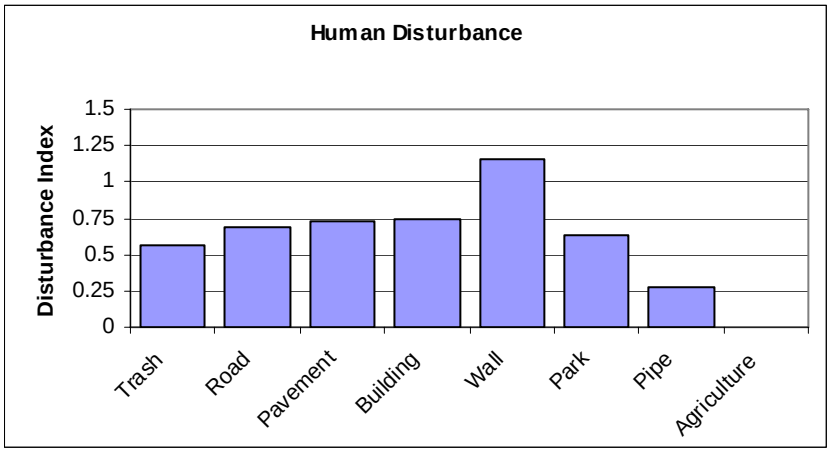
Key habitat issues:

- Banks are armored by walls or rip-rap.
- Inadequate pool habitat.
- Very little wood, no large pieces.
- Pavement and buildings within or near the riparian zone.

Pringle Creek Site PR00-034

Condition Summary: Pringle Creek Site PR00-034				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	3	Habitat Quality Index (HQI)	0.79	High. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	131	Fair. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	16	Very poor
Channel Morphology	3	Channel sinuosity	1.1	Low, good compared to reference condition.
		Incision height (m)	0.65	Good, with very steep bank angles.
		Bank angle (degrees)	93	
Channel Complexity	2	Riffle percentage	49	Some complexity. Primarily glide habitat with some riffles and pools. However, pool habitat is minimal.
		Glide percentage	49	
		Pool percentage	2	
Residual Pool Depth	2	Depth of deepest residual pool (m)	0.47	Pools provide adequate deeper, slow-water habitat.
Substrate	3	Coarse gravel and larger (%)	48	Good
		Embeddedness (%)	32	Good, not properly functioning by NMFS standards.
		Sand and fine sediments (%)	19	Fair, good relative to reference condition.
		Hardpan %	1	Good
		Bed substrate stability index	-0.75	Stable
Wood	1	Wood density (pieces/100 m, all sizes)	0.7	Poor. Very little wood, no large pieces.
Fish cover	3	Natural fish cover (aerial proportion)	0.44	Good, moderate cover.
Riparian cover	2	Canopy shading mid-channel (% area)	71	Poor, desirable by ODFW standards.
		Riparian canopy cover (aerial proportion, large trees)	0.18	Fair canopy cover with good large tree cover. Abundant complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.34	
		Proportion of reach with 3 layers of vegetation	0.95	
Human Disturbance	0	Human Disturbance Index (proximity-weighted sum)	4.88	Highly disturbed

Chart showing contribution of each disturbance type to the Riparian Human Disturbance Index:



Other Site Photos:

Pringle Creek Site PR00-035

Reach location description:
Pringle Creek Site 35 is located between the 12th Street Cutoff and Commercial Avenue, 240 meters downstream of Commercial Street. The reach is 149 meters long and flows through a moderately steep ravine through commercial and residential areas. The stream is constrained by the hill slope and has an average bankfull width of 4.1 meters and water surface gradient of 2.9%. The mean thalweg depth at baseflow was 19 centimeters. The reach consists primarily of glide habitat and is fairly straight with a sinuosity of 1.1. Substrates consist of cobble and gravel and vegetation is dominated by invasive plants including English Ivy, which has resulted in a sparse understory of native trees and shrubs. There are a number of large native trees including Douglas fir, cottonwood, red alder, ash and hazelnut with roots growing at the edge of the stream. Crayfish and sculpin were present in the reach at the time of survey. The overall habitat quality of this reach is 81% of least disturbed conditions.

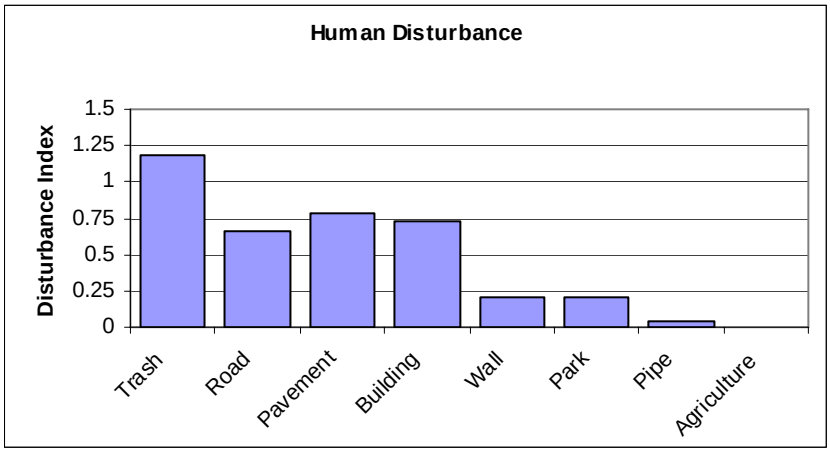
Key habitat issues:

- Inadequate pool habitat.
- Inadequate wood, no large pieces.
- Large amounts of trash.
- Pavement and buildings within or near the riparian zone.

Pringle Creek Site PR00-035

Condition Summary: Pringle Creek Site PR00-035				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	3	Habitat Quality Index (HQI)	0.81	High. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	124	Fair. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	18	Very poor
Channel Morphology	2	Channel sinuosity	1.1	Low, fair compared to reference condition.
		Incision height (m)	0.50	Good, with steep bank angles.
		Bank angle (degrees)	79	
Channel Complexity	2	Riffle percentage	49	Some complexity. Primarily glide habitat with some riffles and pools. However, pool habitat is less than the recommended amount.
		Glide percentage	47	
		Pool percentage	4	
Residual Pool Depth	2	Depth of deepest residual pool (m)	0.40	Pools provide adequate deeper, slow-water habitat.
Substrate	2	Coarse gravel and larger (%)	47	Good
		Embeddedness (%)	48	Good, not properly functioning by NMFS standards.
		Sand and fine sediments (%)	25	Fair, good relative to reference condition.
		Hardpan %	3	Fair
		Bed substrate stability index	-0.95	Moderately stable, good compared to reference condition.
Wood	1	Wood density (pieces/100 m, all sizes)	9.4	Poor. Inadequate wood, no large pieces.
Fish cover	3	Natural fish cover (aerial proportion)	0.71	Good, heavy cover.
Riparian cover	3	Canopy shading mid-channel (% area)	91	Good
		Riparian canopy cover (aerial proportion, large trees)	0.24	Good canopy cover and large tree cover. Abundant complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.52	
		Proportion of reach with 3 layers of vegetation	1.00	
Human Disturbance	1	Human Disturbance Index (proximity-weighted sum)	3.83	Highly disturbed

Chart showing contribution of each disturbance type to the Riparian Human Disturbance Index:



Other Site Photos:

Pringle Creek Site PR00-036

Reach location description:
Pringle Creek Site 36 begins 270 meters downstream of Idylwood Drive. The reach is 149 meters long and flows through a residential area with the lower half landscaped up to the banks, and the upper half covered in shrubby species. The reach has an average bankfull width of 3.8 meters and water surface gradient of 1.4% and is fairly straight with a sinuosity of 1.1. The mean thalweg depth at baseflow was 16 centimeters. The reach has some complexity with riffle and glide habitat, but no pools. There was quite a bit of erosion along the reach and the banks along first half of the reach are covered in English Ivy. The dominant invasive plant is Himalayan blackberry. Native vegetation includes grand fir, alder, ash, willow, ninebark, bigleaf maple and snowberry. The overall habitat quality of this reach is 71% of least disturbed conditions.

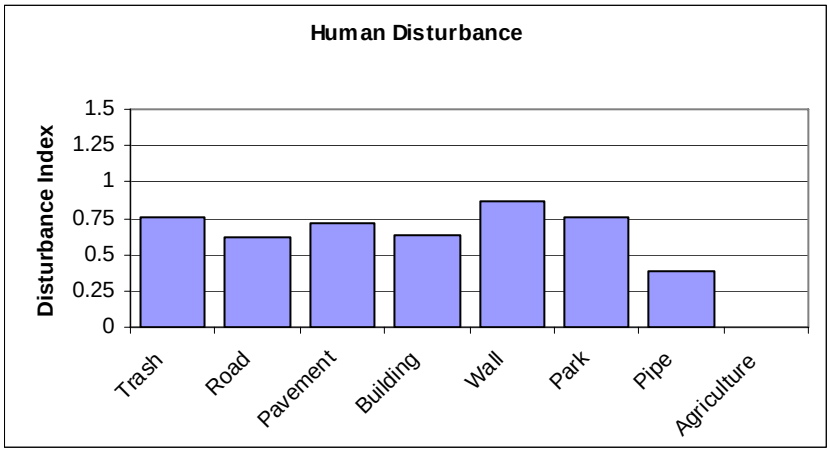
Key habitat issues:

- Banks are armored by walls or rip-rap.
- No pool habitat.
- No wood.
- Lawns within or near the riparian zone.

Pringle Creek Site PR00-036

Condition Summary: Pringle Creek Site PR00-036				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	2	Habitat Quality Index (HQI)	0.71	Moderate. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	117	Fair. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	18	Very poor
Channel Morphology	2	Channel sinuosity	1.1	Low, fair compared to reference condition.
		Incision height (m)	0.59	Good, with steep bank angles.
		Bank angle (degrees)	79	
Channel Complexity	1	Riffle percentage	51	Some complexity. Primarily glide habitat with adequate riffles, but no pools.
		Glide percentage	49	
		Pool percentage	0	
Residual Pool Depth	1	Depth of deepest residual pool (m)	0.23	Minimal deeper, slow-water habitat.
Substrate	3	Coarse gravel and larger (%)	57	Good
		Embeddedness (%)	45	Good, not properly functioning by NMFS standards.
		Sand and fine sediments (%)	23	Fair, good relative to reference condition.
		Hardpan %	3	Fair
		Bed substrate stability index	-0.24	Stable
Wood	0	Wood density (pieces/100 m, all sizes)	0.0	Very poor. No wood of any size.
Fish cover	3	Natural fish cover (aerial proportion)	0.56	Good, heavy cover.
Riparian cover	2	Canopy shading mid-channel (% area)	71	Poor, desirable by ODFW standards.
		Riparian canopy cover (aerial proportion, large trees)	0.12	Fair canopy cover with good large tree cover. Abundant complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.26	
		Proportion of reach with 3 layers of vegetation	0.95	
Human Disturbance	0	Human Disturbance Index (proximity-weighted sum)	4.88	Highly disturbed

Chart showing contribution of each disturbance type to the Riparian Human Disturbance Index:



Other Site Photos:

Pringle Creek Site PR00-037

Reach location description:
Pringle Creek Site 37 is located at Woodmansee Park and is 149 meters long. The reach has an average bankfull width of 2.2 meters and water surface gradient of 2.2% and is fairly straight with a sinuosity of 1.1. The mean thalweg depth at baseflow was 13 centimeters. The reach is incised and the banks have been trampled and compacted with the substrate dominated by clay and hardpan. Some areas have been supplemented with rip rap and the reach has some headcuts, indicating the stream is actively incising. It has some complexity consisting primarily of glide and riffle habitat. The most dominant invasive plant is English Ivy and Himalayan blackberry, and native vegetation includes oak, ash, red alder, bigleaf maple, cottonwood, black hawthorn, Indian plum and snowberry. Crayfish were present in the reach at the time of survey.The overall habitat quality of this reach is 51% of least disturbed conditions.

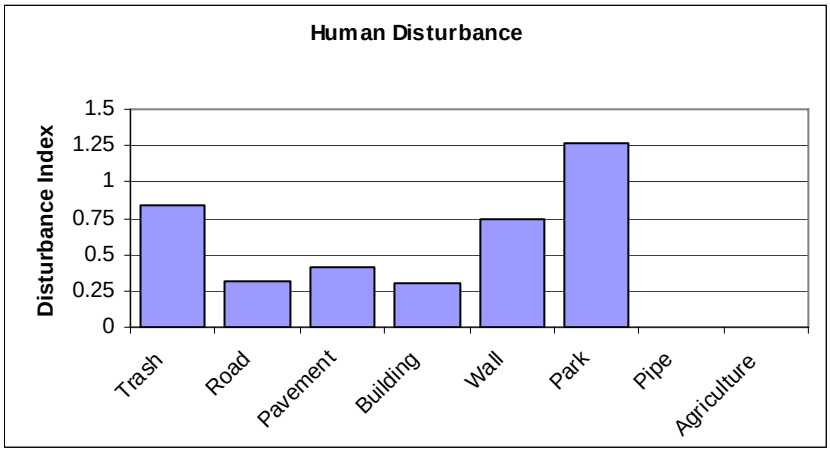
Key habitat issues:

- Channel is incised, with steep bank angles.
- Banks are armored by walls or rip-rap.
- Little channel complexity, primarily glide habitat.
- Inadequate pool habitat.
- Excessive hardpan.
- No wood.
- Lawns within or near the riparian zone.
- Large amounts of trash.

Pringle Creek Site PR00-037

Condition Summary: Pringle Creek Site PR00-037				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	2	Habitat Quality Index (HQI)	0.57	Moderate. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	102	Fair. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	18	Very poor
Channel Morphology	1	Channel sinuosity	1.1	Low, fair compared to reference condition.
		Incision height (m)	0.85	Poor, incised with steep bank angles.
		Bank angle (degrees)	78	
Channel Complexity	1	Riffle percentage	43	Some complexity. Primarily glide habitat with some riffles and pools. However, pool habitat is minimal.
		Glide percentage	56	
		Pool percentage	1	
Residual Pool Depth	2	Depth of deepest residual pool (m)	0.26	Pools provide some deeper, slow-water habitat.
Substrate	1	Coarse gravel and larger (%)	25	Fair
		Embeddedness (%)	30	Good, at risk by NMFS standards.
		Sand and fine sediments (%)	15	Fair, good relative to reference condition.
		Hardpan %	30	Poor
		Bed substrate stability index	0.05	Stable
Wood	0	Wood density (pieces/100 m, all sizes)	0.0	Very poor. No wood of any size.
Fish cover	3	Natural fish cover (aerial proportion)	0.36	Good, moderate cover.
Riparian cover	3	Canopy shading mid-channel (% area)	89	Fair, desirable by ODFW standards.
		Riparian canopy cover (aerial proportion, large trees)	0.36	Good canopy cover and large tree cover. Abundant complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.54	
		Proportion of reach with 3 layers of vegetation	1.00	
Human Disturbance	1	Human Disturbance Index (proximity-weighted sum)	3.89	Highly disturbed

Chart showing contribution of each disturbance type to the Riparian Human Disturbance Index:



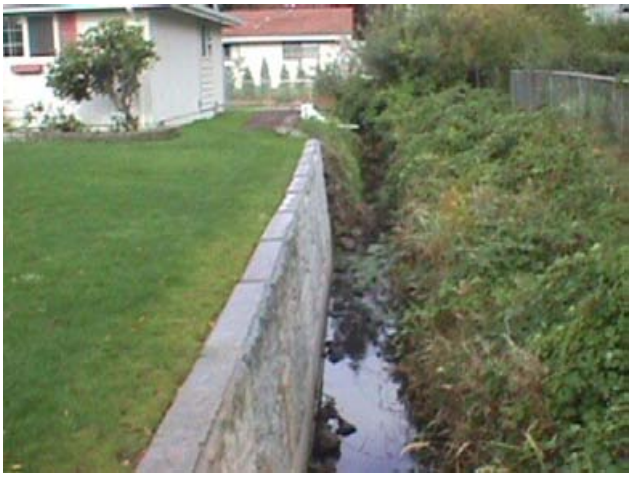
Other Site Photos:

Pringle Creek Site PR00-038

Reach location description:
Pringle Creek Site 38 begins 53 meters downstream of Jones Road near the baseball fields at Woodmansee Park. The reach is 149 meters long, and is channelized to run between property lines through a residential neighborhood. The reach is deeply incised, has an average bankfull width of 2.9 meters and water surface gradient of 0.9% and is straight with 2 turns around property lines, giving it a sinuosity of 1.1. The mean thalweg depth at baseflow was 15 centimeters. The reach has some complexity consisting of glide and riffle habitats. Vegetation consists of Himalayan blackberry, black cottonwood, bulrush and sword fern. Crayfish were present in the reach at the time of survey. The overall habitat quality of this reach is low at 50% of least disturbed conditions.

Key habitat issues:

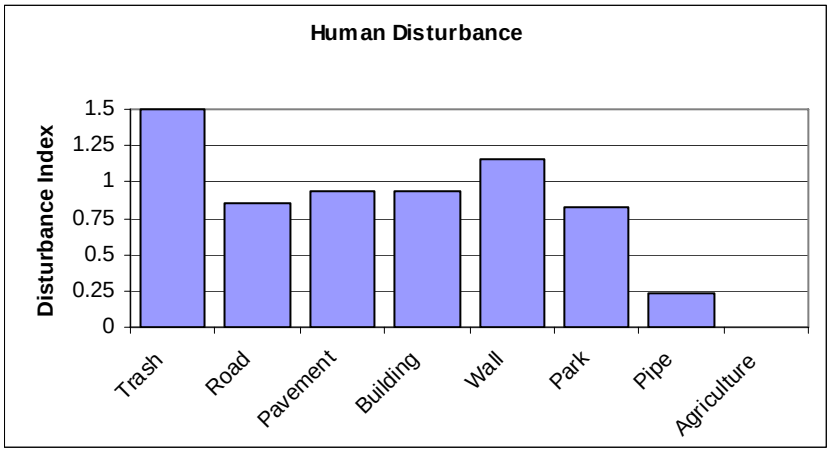
- Banks are armored by walls or rip-rap.
- Channel is deeply incised, with steep bank angles.
- Little channel complexity, primarily glide habitat.
- No pool habitat.
- No wood.
- Inadequate canopy cover and complex riparian cover. Channel is inadequately shaded.
- Roads, pavement and buildings within or near the riparian zone.
- Lawns within or near the riparian zone.
- Large amounts of trash.



Pringle Creek Site PR00-038

Condition Summary: Pringle Creek Site PR00-038				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	1	Habitat Quality Index (HQI)	0.50	Low. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	98	Poor. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	16	Very poor
Channel Morphology	1	Channel sinuosity	1.1	Low, good compared to reference condition.
		Incision height (m)	1.39	Poor, incised with steep bank angles.
		Bank angle (degrees)	84	
Channel Complexity	1	Riffle percentage	41	Some complexity. Primarily glide habitat with adequate riffles, but no pools.
		Glide percentage	59	
		Pool percentage	0	
Residual Pool Depth	1	Depth of deepest residual pool (m)	0.27	Minimal deeper, slow-water habitat.
Substrate	2	Coarse gravel and larger (%)	21	Fair
		Embeddedness (%)	29	Good, at risk by NMFS standards.
		Sand and fine sediments (%)	13	Good, at risk by ODFW standards.
		Hardpan %	6	Poor
		Bed substrate stability index	-0.40	Stable
Wood	0	Wood density (pieces/100 m, all sizes)	0.0	Very poor. No wood of any size.
Fish cover	3	Natural fish cover (aerial proportion)	0.72	Good, heavy cover.
Riparian cover	1	Canopy shading mid-channel (% area)	59	Poor
		Riparian canopy cover (aerial proportion, large trees)	0.04	Poor canopy cover, but some large tree cover. Inadequate complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.05	
		Proportion of reach with 3 layers of vegetation	0.14	
Human Disturbance	0	Human Disturbance Index (proximity-weighted sum)	6.45	Highly disturbed

Chart showing contribution of each disturbance type to the Riparian Human Disturbance Index:



Other Site Photos:

Pringle Creek Site PR00-041

Reach location description:
Pringle Creek Site 41 flows through residential areas at the headwaters of West Pringle Creek. The reach is 134 meters long and at the time of survey was a dry channel that began to flow when it began raining. The reach has an average bankfull width of 1.6 meters and bed surface gradient of 2.0%. The reach is incised and the banks are eroding in the upper portions of the reach. There is very little native vegetation and shrub species were present only on one property. Trash was present throughout the reach. The most dominant invasive species was Himalayan blackberry. Native plants include Douglas fir, willow, oak, snowberry and trailing blackberry, thimbleberry and hazelnut. The overall habitat quality of this reach is low at 38% of least disturbed conditions.

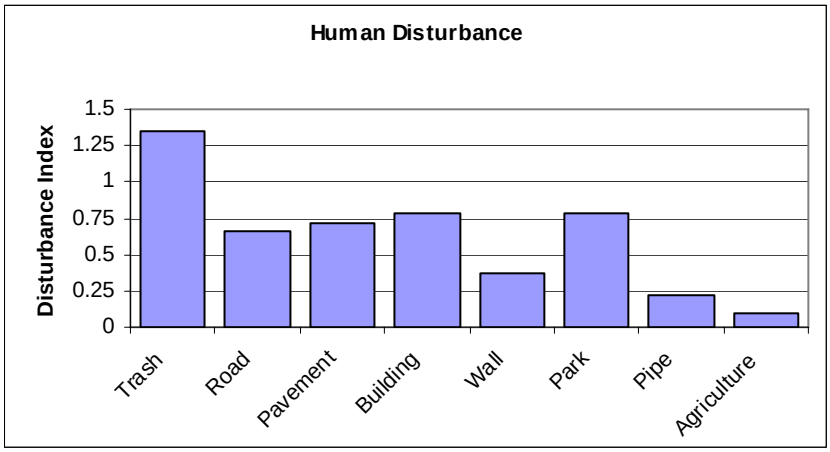
Key habitat issues:

- Channel had no water during baseflow conditions.
- Channel is straight, with steep bank angles.
- Excessive hardpan.
- No wood.
- Inadequate canopy cover and complex riparian cover. Channel is inadequately shaded.
- Buildings within or near the riparian zone.
- Lawns within or near the riparian zone.
- Large amounts of trash.

Pringle Creek Site PR00-041

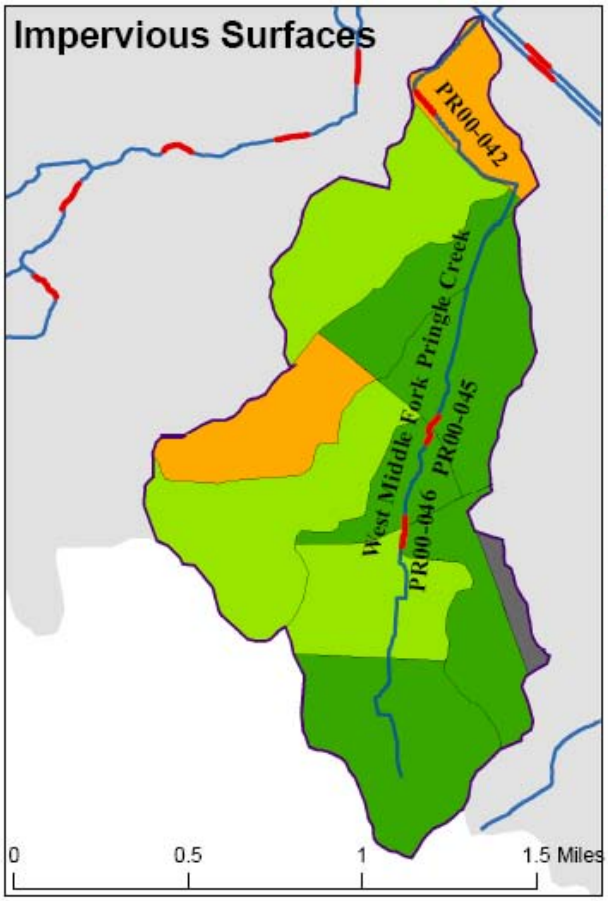
Condition Summary: Pringle Creek Site PR00-041				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	1	Habitat Quality Index (HQI) Rapid Habitat Assessment (RHA) Benthic Index of Biological Integrity (B-IBI)	0.38 55	Low. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites. Poor. Qualitative assessment with total of 200.
Channel Morphology	1	Channel sinuosity Incision height (m) Bank angle (degrees)	1.0 0.82 73	None. Channel is straight. Fair, slightly incised with steep bank angles.
Channel Complexity		Riffle percentage Glide percentage Pool percentage	0 0 0	Channel contained no water at baseflow.
Residual Pool Depth	0	Depth of deepest residual pool (m)		Channel contained no water at baseflow.
Substrate	1	Coarse gravel and larger (%) Embeddedness (%) Sand and fine sediments (%) Hardpan % Bed substrate stability index	14 21 23 37	Fair, undesirable by ODFW standards. Good, at risk by NMFS standards. Fair, good relative to reference condition. Poor
Wood	0	Wood density (pieces/100 m, all sizes)	0.0	Very poor. No wood of any size.
Fish cover	3	Natural fish cover (aerial proportion)	0.98	Good, very heavy cover.
Riparian cover	1	Canopy shading mid-channel (% area) Riparian canopy cover (aerial proportion, large trees) Riparian canopy cover (aerial proportion, all trees > 5m tall) Proportion of reach with 3 layers of vegetation	68 0.09 0.13 0.55	Poor, at risk by ODFW standards. Poor canopy cover, but some large tree cover. Inadequate complex riparian habitat.
Human Disturbance	0	Human Disturbance Index (proximity-weighted sum)	5.00	Highly disturbed

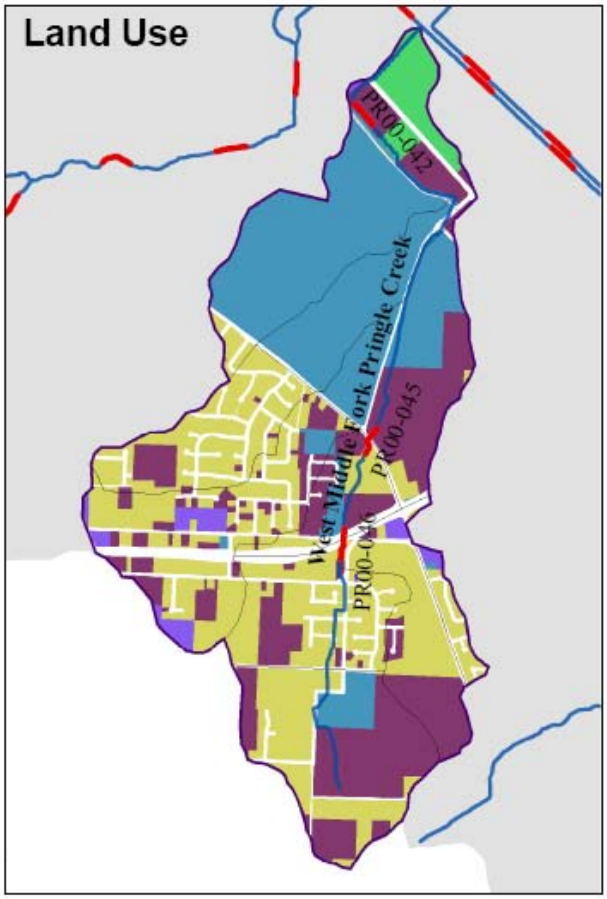
Chart showing contribution of each disturbance type to the Riparian Human Disturbance Index:



Other Site Photos:

West Middle Fork Pringle Creek Subbasin





West Middle Fork Pringle Creek Subbasin
Impervious Surface and Land Use

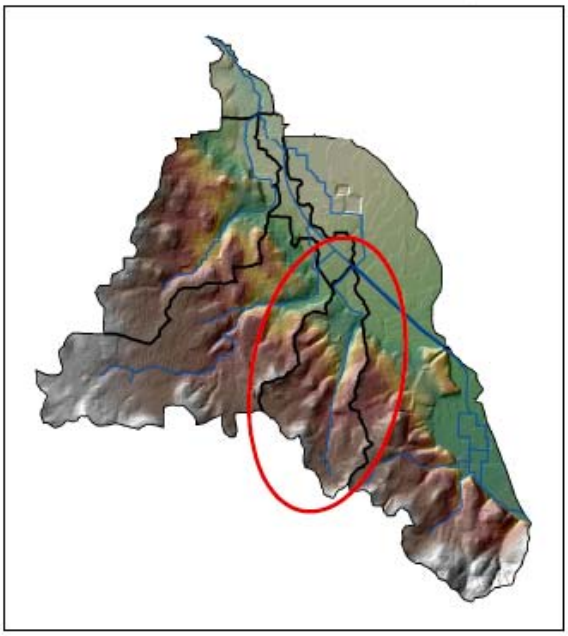
- Survey Reaches
- Streams
- Pringle Creek Subbasins

Impervious Surface Cover by Catchment

- 0 - 10
- 10 - 25
- 25 - 40
- 40 - 60
- 60 - 80

Land Use

- Commercial (15 Acres)
- Industrial (60 Acres)
- Public (287)
- Residential (289 Acres)
- Vacant (254 Acres)



Pringle Creek Site PR00-042

Reach location description:
West Middle Fork Pringle Creek Site 42 is 149 meters long and flows through an industrial area along Strong Road. The reach is channelized to flow around property boundaries but has constructed tight meanders in the bottom of the channelized area. The reach has an average bankfull width of 7.2 meters and water surface gradient of 0.7%. The mean thalweg depth at baseflow was 11 centimeters. The reach is deeply incised and despite the artificial meanders, has a low sinuosity of 1.1. Substrate consists primarily of large amounts of hardpan. Vegetation consisted of a large quantity of native species that had been re-introduced to the riparian area including Douglas fir, oak, willow, vine maple, cottonwood and dogwood, but there was not yet a large amount of shade. Nutria sign was common throughout the reach. The overall habitat quality of this reach is very low at 12% of least disturbed conditions.

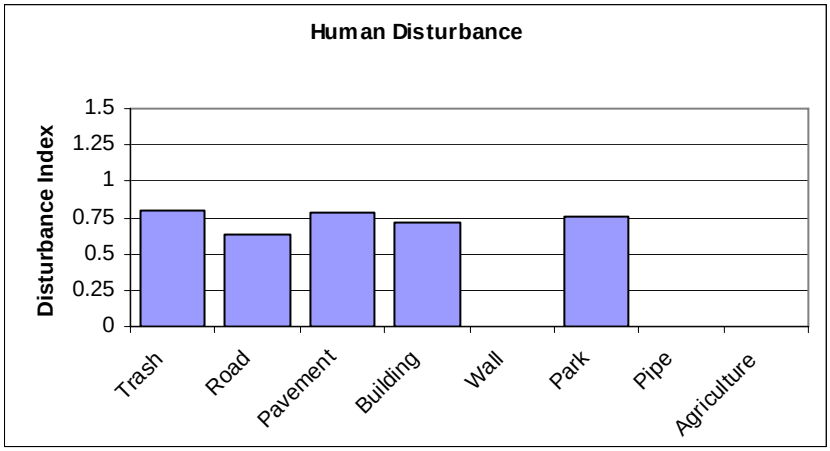
Key habitat issues:

- Channel is deeply incised.
- No channel complexity, primarily glide habitat with very few riffles.
- No pool habitat or deeper areas.
- Excessive hardpan and no large substrates.
- No wood.
- Inadequate fish cover.
- No canopy cover or complex riparian cover. Channel is inadequately shaded.
- Pavement within or near the riparian zone.
- Lawns within or near the riparian zone.

West Middle Fork Pringle Creek Site PR00-042

Condition Summary: West Middle Fork Pringle Creek Site PR00-042				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	0	Habitat Quality Index (HQI)	0.12	Very low. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	109	Fair. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	16	Very poor
Channel Morphology	1	Channel sinuosity	1.1	Low, good compared to reference condition.
		Incision height (m)	2.39	Fair, deeply incised with moderate bank angles.
		Bank angle (degrees)	43	
Channel Complexity	0	Riffle percentage	18	No complexity. Primarily glide habitat with few riffles and no pools.
		Glide percentage	82	
		Pool percentage	0	
Residual Pool Depth	0	Depth of deepest residual pool (m)	0.16	No deeper habitat.
Substrate	0	Coarse gravel and larger (%)	0	Poor
		Embeddedness (%)	37	Good, not properly functioning by NMFS standards.
		Sand and fine sediments (%)	30	Fair, undesirable by ODFW standards.
		Hardpan %	51	Poor
		Bed substrate stability index	0.30	Stable
Wood	0	Wood density (pieces/100 m, all sizes)	0.0	Very poor. No wood of any size.
Fish cover	1	Natural fish cover (aerial proportion)	0.20	Poor, moderate cover but no large cover.
Riparian cover	0	Canopy shading mid-channel (% area)	33	Poor
		Riparian canopy cover (aerial proportion, large trees)	0.00	No canopy cover or complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.00	
		Proportion of reach with 3 layers of vegetation	0.09	
Human Disturbance	1	Human Disturbance Index (proximity-weighted sum)	3.69	Highly disturbed

Chart showing contribution of each disturbance type to the Riparian Human Disturbance Index:



Other Site Photos:

West Middle Fork Pringle Creek in winter

West Middle Fork Pringle Creek in winter

Pringle Creek Site PR00-045

Reach location description:
West Middle Fork Pringle Creek Site 45 begins 52 meters downstream of Battle Creek Road. The reach is 149 meters long and flows through an agricultural area and crosses the road in the middle of the reach. The reach has an average bankfull width of 2.5 meters and water surface gradient of 2%. The mean thalweg depth at baseflow was 12 centimeters. The banks have been trampled by livestock and the riparian area is narrow along the reach, but it does contain a diversity of plants. The reach consists primarily of glide habitat and is fairly straight with a sinuosity of 1.2. The overall habitat quality of this reach is 57% of least disturbed conditions.

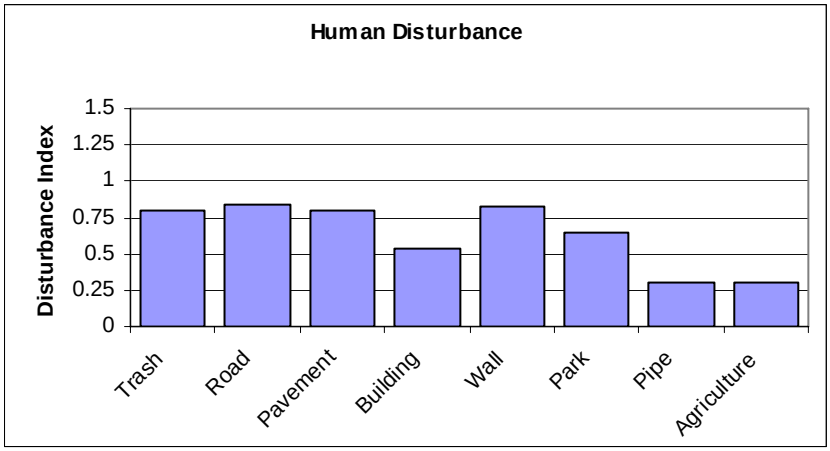
Key habitat issues:

- Banks are armored by walls or rip-rap.
- No channel complexity, primarily glide habitat with very few riffles.
- No pool habitat.
- No wood.
- Roads and pavement within or near the riparian zone.

West Middle Fork Pringle Creek Site PR00-045

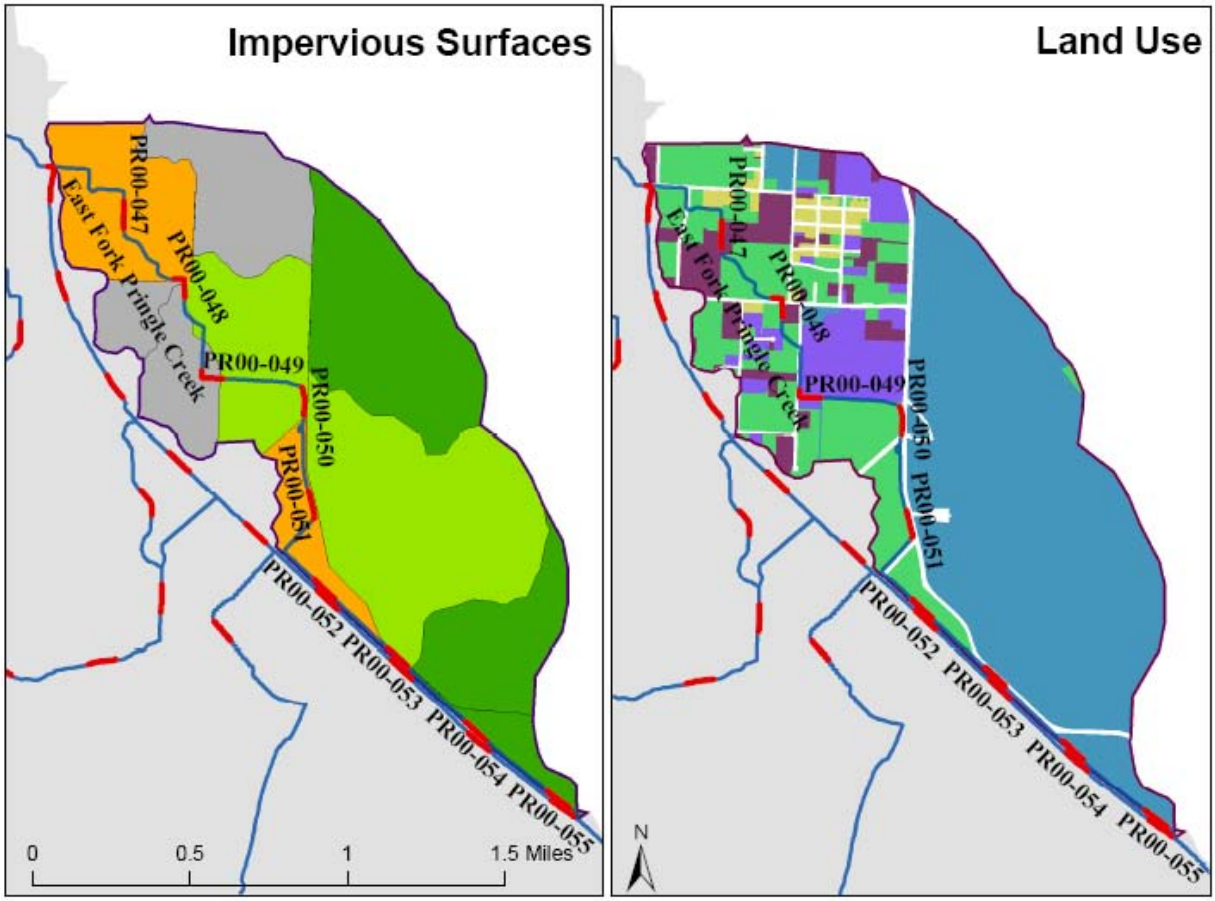
Condition Summary: West Middle Fork Pringle Creek Site PR00-045				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	2	Habitat Quality Index (HQI)	0.57	Moderate. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	94	Poor. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	20	Poor
Channel Morphology	2	Channel sinuosity	1.2	Medium, good compared to reference condition.
		Incision height (m)	0.96	Poor, incised with steep bank angles.
		Bank angle (degrees)	83	
Channel Complexity	0	Riffle percentage	18	No complexity. Primarily glide habitat with few riffles and no pools.
		Glide percentage	82	
		Pool percentage	0	
Residual Pool Depth	1	Depth of deepest residual pool (m)	0.32	Minimal deeper, slow-water habitat.
Substrate	2	Coarse gravel and larger (%)	21	Fair
		Embeddedness (%)	41	Good, not properly functioning by NMFS standards.
		Sand and fine sediments (%)	27	Fair, undesirable by ODFW standards.
		Hardpan %	2	Fair
		Bed substrate stability index	-1.84	Unstable
Wood	0	Wood density (pieces/100 m, all sizes)	0.0	Very poor. No wood of any size.
Fish cover	3	Natural fish cover (aerial proportion)	0.71	Good, heavy cover.
Riparian cover	2	Canopy shading mid-channel (% area)	88	Fair, desirable by ODFW standards.
		Riparian canopy cover (aerial proportion, large trees)	0.17	Fair canopy cover with good large tree cover. Inadequate complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.22	
		Proportion of reach with 3 layers of vegetation	0.75	
Human Disturbance	0	Human Disturbance Index (proximity-weighted sum)	5.04	Highly disturbed

Chart showing contribution of each disturbance type to the Riparian Human Disturbance Index:



Other Site Photos:

East Fork Pringle Creek Subbasin



East Fork Pringle Creek Subbasin
Impervious Surface and Land Use

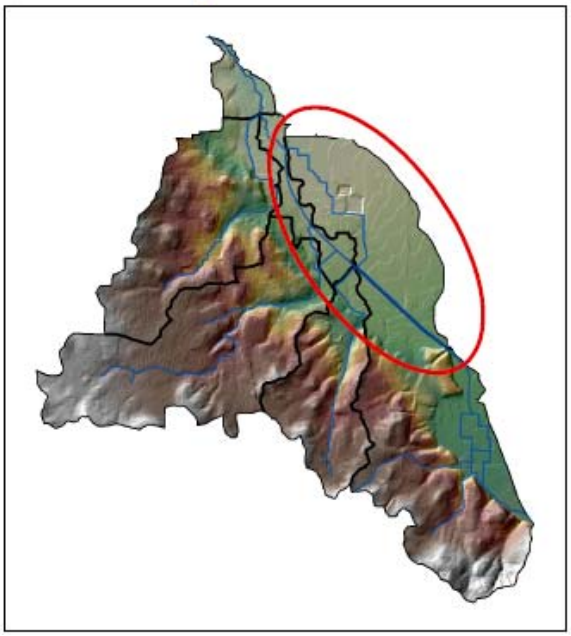
- Survey Reaches
- Streams
- Pringle Creek Subbasins

Impervious Surface Cover by Catchment

- 0 - 10
- 10 - 25
- 25 - 40
- 40 - 60
- 60 - 80

Land Use

- Commercial (98)
- Industrial (282)
- Public (709)
- Residential (23 Acres)
- Vacant (80)



Pringle Creek Site PR00-047

Reach location description:
East Fork Pringle Creek Site 47 is 149 meters long and flows through an industrial area downstream of Walling Pond. The reach has an average bankfull width of 4.6 meters and water surface gradient of 0.7% and is straight, with a sinuosity of 1.0. The mean thalweg depth at baseflow was 19 centimeters. The reach is incised and consists primarily of glide habitat. The banks had a bit of erosion at the time of survey, especially the left bank which is steep and covered in blackberry. The right bank had quite a few native plants including cottonwood, oak, black hawthorn, snowberry and bulrush and the reach had many small willows along the banks. There were two debris jams in the upper part of the reach containing large wood, brush and trash, including pallets and old road signs. Trout were present in the reach at the time of survey. The overall habitat quality of this reach is 60% of least disturbed conditions.

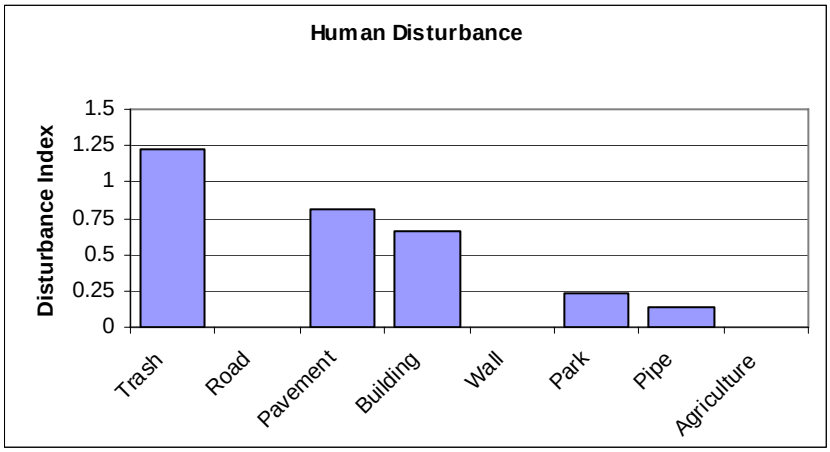
Key habitat issues:

- Channel is straight and incised.
- No channel complexity, primarily glide habitat with very few riffles.
- No pool habitat.
- Inadequate wood, no large pieces.
- Inadequate complex riparian cover and shade.
- Pavement within or near the riparian zone.
- Large amounts of trash.

East Fork Pringle Creek Site PR00-047

Condition Summary: East Fork Pringle Creek Site PR00-047				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	2	Habitat Quality Index (HQI)	0.60	Moderate. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	113	Fair. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	20	Poor
Channel Morphology	1	Channel sinuosity	1.0	None. Channel is straight.
		Incision height (m)	1.28	Fair, incised, but with slight bank angles.
		Bank angle (degrees)	36	
Channel Complexity	0	Riffle percentage	10	No complexity. Primarily glide habitat with few riffles and no pools.
		Glide percentage	90	
		Pool percentage	0	
Residual Pool Depth	1	Depth of deepest residual pool (m)	0.41	Minimal deeper, slow-water habitat.
Substrate	3	Coarse gravel and larger (%)	40	Fair, desirable by ODFW standards.
		Embeddedness (%)	37	Good, not properly functioning by NMFS standards.
		Sand and fine sediments (%)	15	Good, at risk by ODFW standards.
		Hardpan %	1	Good
		Bed substrate stability index	-0.75	Stable, fair compared to reference condition.
Wood	1	Wood density (pieces/100 m, all sizes)	6.7	Poor. Inadequate wood, no large pieces.
Fish cover	3	Natural fish cover (aerial proportion)	0.78	Good, heavy cover.
Riparian cover	1	Canopy shading mid-channel (% area)	58	Poor
		Riparian canopy cover (aerial proportion, large trees)	0.10	Fair canopy cover, but inadequate complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.16	
		Proportion of reach with 3 layers of vegetation	0.36	
Human Disturbance	1	Human Disturbance Index (proximity-weighted sum)	3.08	Highly disturbed

Chart showing contribution of each disturbance type to the Riparian Human Disturbance Index:



Other Site Photos:

Pringle Creek Site PR00-048

Reach location description:
East Fork Pringle Creek Site 48 is located near 22nd Avenue and McGilchrist. The reach is 149 meters long and flows through a steep, blackberry-covered ravine through an industrial area. The reach has an average bankfull width of 4.4 meters and water surface gradient of 1.0%. The mean thalweg depth at baseflow was 42 centimeters. The reach is deeply incised, is moderately sinuous at 1.3, and consists primarily of glide habitat but with riffles and pools. The crew noted a beaver dam and deep pool in the reach. Nutria sign was common throughout the reach. The dominant invasive plant is Himalayan blackberry with black Hawthorne, Indian plum, Pacific serviceberry, snowberry and bull rush. The overall habitat quality of this reach is 77% of least disturbed conditions.

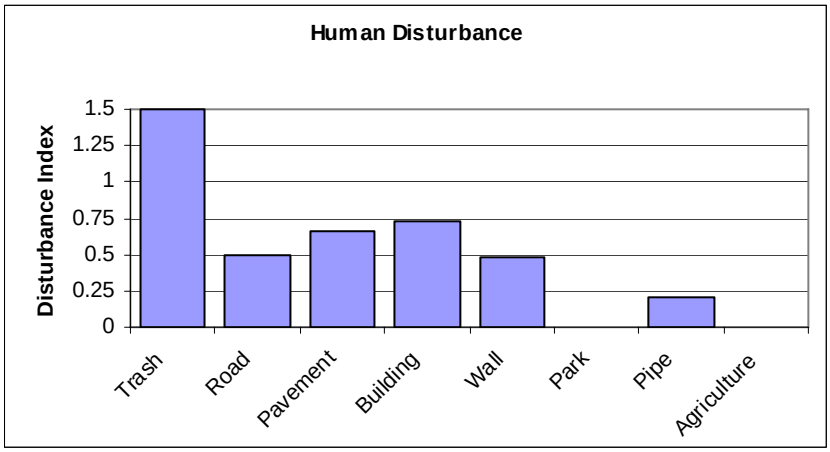
Key habitat issues:

- Channel is deeply incised.
- Little channel complexity, primarily glide habitat.
- No wood.
- Inadequate complex riparian cover and shade.
- Buildings within or near the riparian zone.
- Large amounts of trash.

East Fork Pringle Creek Site PR00-048

Condition Summary: East Fork Pringle Creek Site PR00-048				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	3	Habitat Quality Index (HQI)	0.77	High. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	99	Poor. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	18	Very poor
Channel Morphology	1	Channel sinuosity	1.3	Medium, good compared to reference condition.
		Incision height (m)	1.80	Fair, deeply incised with moderate bank angles.
		Bank angle (degrees)	53	
Channel Complexity	1	Riffle percentage	11	Little complexity. Primarily glide habitat with few riffles, but adequate pools.
		Glide percentage	71	
		Pool percentage	18	
Residual Pool Depth	3	Depth of deepest residual pool (m)	0.81	Pools provide good deeper, slow-water habitat.
Substrate	2	Coarse gravel and larger (%)	34	Fair
		Embeddedness (%)	52	Good, not properly functioning by NMFS standards.
		Sand and fine sediments (%)	39	Fair, undesirable by ODFW standards.
		Hardpan %	0	Good
		Bed substrate stability index	-1.51	Moderately stable, poor compared to reference condition.
Wood	0	Wood density (pieces/100 m, all sizes)	0.0	Very poor. No wood of any size.
Fish cover	3	Natural fish cover (aerial proportion)	0.61	Good, heavy cover.
Riparian cover	1	Canopy shading mid-channel (% area)	56	Poor
		Riparian canopy cover (aerial proportion, large trees)	0.07	Fair canopy cover, but inadequate complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.17	
		Proportion of reach with 3 layers of vegetation	0.43	
Human Disturbance	0	Human Disturbance Index (proximity-weighted sum)	4.08	Highly disturbed

Chart showing contribution of each disturbance type to the Riparian Human Disturbance Index:



Other Site Photos:

Pringle Creek Site PR00-049

Reach location description:
East Fork Creek Site 49 is 149 meters long and flows through the industrial area between SE 22nd Street and Webb Lake. The reach has an average bankfull width of 3.9 meters and water surface gradient of 0.7% and is straight, except for a 90 degree bend around the lake. The mean thalweg depth at baseflow was 48 centimeters. The reach is channelized but has some complexity consisting of glide, riffle and pool habitats, caused by a beaver dam midway through the reach. A dike separates the stream from the lake along the right bank, and rip rap armored the left bank along SE 22nd Street and the banks are eroding heavily throughout the reach. The most prevalent invasive plant was Himalayan blackberry with nightshade lower on the banks. Nutria sign was common throughout the reach. Minnows and sculpin were present in the stream at the time of survey. The overall habitat quality of this reach is 74% of least disturbed conditions.

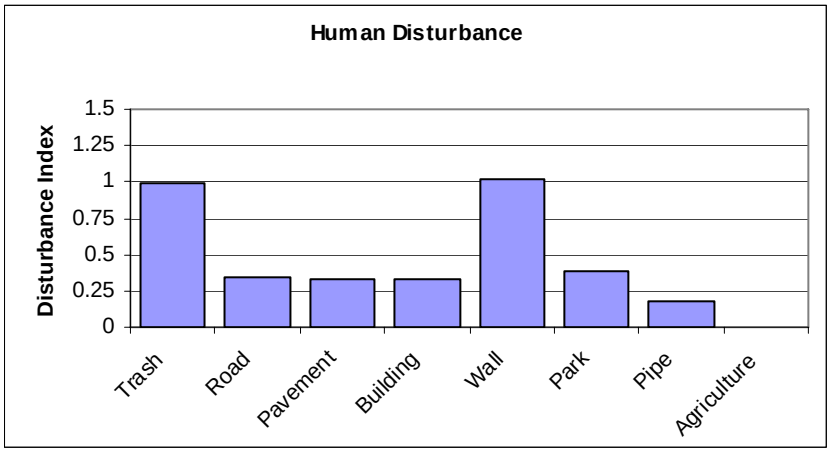
Key habitat issues:

- Banks are armored by walls or rip-rap.
- Little channel complexity, primarily glide habitat.
- Very little wood, no large pieces.
- Inadequate complex riparian cover and shade.
- Large amounts of trash.

East Fork Pringle Creek Site PR00-049

Condition Summary: East Fork Pringle Creek Site PR00-049				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	2	Habitat Quality Index (HQI)	0.74	Moderate. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	122	Fair. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	16	Very poor
Channel Morphology	3	Channel sinuosity	1.3	Medium, good compared to reference condition.
		Incision height (m)	0.65	Good, with slight bank angles.
		Bank angle (degrees)	41	
Channel Complexity	1	Riffle percentage	13	Little complexity. Primarily glide habitat with few riffles, but adequate pools.
		Glide percentage	73	
		Pool percentage	13	
Residual Pool Depth	3	Depth of deepest residual pool (m)	0.91	Pools provide good deeper, slow-water habitat.
Substrate	2	Coarse gravel and larger (%)	27	Fair
		Embeddedness (%)	52	Good, not properly functioning by NMFS standards.
		Sand and fine sediments (%)	32	Fair, undesirable by ODFW standards.
		Hardpan %	1	Good
		Bed substrate stability index	-1.35	Moderately stable, poor compared to reference condition.
Wood	1	Wood density (pieces/100 m, all sizes)	0.7	Poor. Very little wood, no large pieces.
Fish cover	3	Natural fish cover (aerial proportion)	0.55	Good, heavy cover.
Riparian cover	1	Canopy shading mid-channel (% area)	48	Poor
		Riparian canopy cover (aerial proportion, large trees)	0.00	Fair canopy cover, but inadequate complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.15	
		Proportion of reach with 3 layers of vegetation	0.59	
Human Disturbance	1	Human Disturbance Index (proximity-weighted sum)	3.59	Highly disturbed

Chart showing contribution of each disturbance type to the Riparian Human Disturbance Index:



Other Site Photos:

Pringle Creek Site PR00-050

Reach location description:
East Fork Pringle Creek Site 50 is 149 meters long and flows through industrial areas along SE 25th Street, south of Webb Lake. The reach has an average bankfull width of 7.8 meters and water surface gradient of 0.5%, and is straight, with a sinuosity of 1.0. The mean thalweg depth at baseflow was 51 centimeters. The reach is channelized and consists entirely of glide habitat. Vegetation consists primarily of grass, which is landscaped along the lower portions of the reach. Nutria sign was common in the reach and lamprey and sculpin were present at the time of survey. The overall habitat quality of this reach is low at 37% of least disturbed conditions.

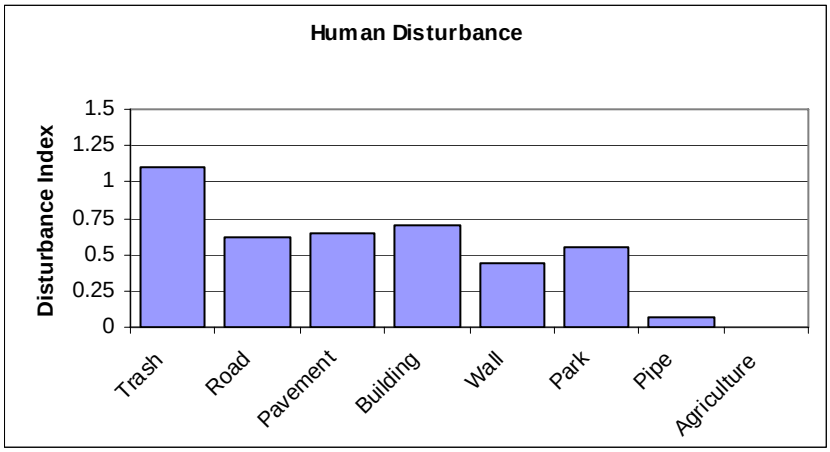
Key habitat issues:

- No channel complexity, entirely glide habitat with no riffles or pools.
- No pool habitat.
- No wood.
- Inadequate fish cover.
- No canopy cover and inadequate complex riparian cover. Channel is inadequately shaded.
- Large amounts of trash.

East Fork Pringle Creek Site PR00-050

Condition Summary: East Fork Pringle Creek Site PR00-050				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	1	Habitat Quality Index (HQI)	0.37	Low. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	99	Poor. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	16	Very poor
Channel Morphology	2	Channel sinuosity	1.0	Low, fair compared to reference condition.
		Incision height (m)	1.44	Fair, incised, but with slight bank angles.
		Bank angle (degrees)	20	
Channel Complexity	0	Riffle percentage	0	No complexity. Glide habitat with no riffles or pools.
		Glide percentage	100	
		Pool percentage	0	
Residual Pool Depth	2	Depth of deepest residual pool (m)	0.67	Some deeper slow-water habitat.
Substrate	2	Coarse gravel and larger (%)	18	Fair
		Embeddedness (%)	49	Good, not properly functioning by NMFS standards.
		Sand and fine sediments (%)	46	Fair, undesirable by ODFW standards.
		Hardpan %	1	Good
		Bed substrate stability index	-2.02	Unstable
Wood	0	Wood density (pieces/100 m, all sizes)	0.0	Very poor. No wood of any size.
Fish cover	1	Natural fish cover (aerial proportion)	0.10	Poor, sparse cover.
Riparian cover	0	Canopy shading mid-channel (% area)	8	Poor
		Riparian canopy cover (aerial proportion, large trees)	0.00	No canopy cover and inadequate complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.05	
		Proportion of reach with 3 layers of vegetation	0.45	
Human Disturbance	0	Human Disturbance Index (proximity-weighted sum)	4.13	Highly disturbed

Chart showing contribution of each disturbance type to the Riparian Human Disturbance Index:



Other Site Photos:

Pringle Creek Site PR00-051

Reach location description:
East Fork Pringle Creek Site 51 flows for 149 meters along SE 25th Street near Ewald Avenue through industrial areas. The reach has an average bankfull width of 3.2 meters and water surface gradient of 0.7% and is straight, with a sinuosity of 1.0. The mean thalweg depth at baseflow was 25 centimeters. The reach is channelized and deeply incised, and consists primarily of glide habitat with some riffle habitat. There was very little bank erosion at the time of survey. The substrate consisted almost entirely of gravel and cobble. Riparian vegetation had been planted recently at the time of survey. Sculpin and crayfish were also present in the reach. The overall habitat quality of this reach is 61% of least disturbed conditions.

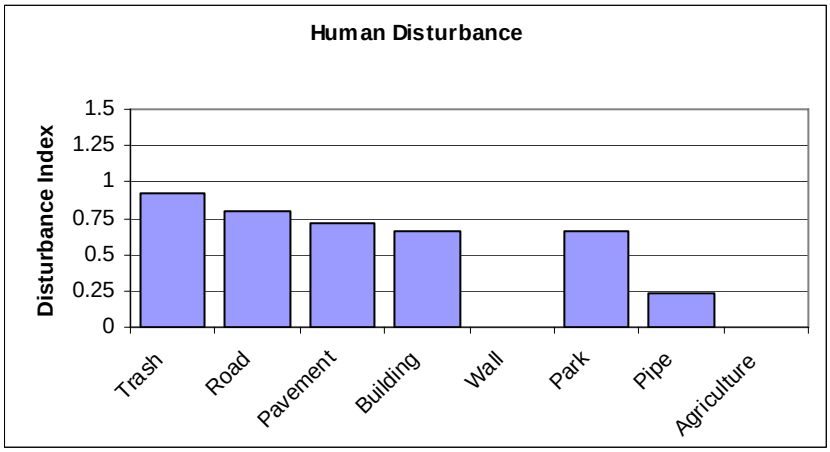
Key habitat issues:

- Channel is straight and deeply incised.
- Very little channel complexity, primarily glide habitat.
- No pool habitat.
- Very little wood, no large pieces.
- No canopy cover and inadequate complex riparian cover. Channel is inadequately shaded.
- Roads within or near the riparian zone.

East Fork Pringle Creek Site PR00-051

Condition Summary: East Fork Pringle Creek Site PR00-051				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	2	Habitat Quality Index (HQI)	0.61	Moderate. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	124	Fair. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	30	Poor
Channel Morphology	0	Channel sinuosity	1.0	None. Channel is straight.
		Incision height (m)	2.94	Poor, deeply incised with moderately steep bank angles.
		Bank angle (degrees)	60	
Channel Complexity	1	Riffle percentage	26	Little complexity. Primarily glide habitat with few riffles and no pools.
		Glide percentage	74	
		Pool percentage	0	
Residual Pool Depth	1	Depth of deepest residual pool (m)	0.43	Minimal deeper, slow-water habitat.
Substrate	3	Coarse gravel and larger (%)	54	Good
		Embeddedness (%)	28	Good, at risk by NMFS standards.
		Sand and fine sediments (%)	11	Good
		Hardpan %	1	Good
		Bed substrate stability index	-0.26	stable
Wood	1	Wood density (pieces/100 m, all sizes)	0.7	Poor. Very little wood, no large pieces.
Fish cover	3	Natural fish cover (aerial proportion)	0.72	Good, heavy cover.
Riparian cover	0	Canopy shading mid-channel (% area)	46	Poor
		Riparian canopy cover (aerial proportion, large trees)	0.00	No canopy cover and inadequate complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.03	
		Proportion of reach with 3 layers of vegetation	0.27	
Human Disturbance	1	Human Disturbance Index (proximity-weighted sum)	4.00	Highly disturbed

Chart showing contribution of each disturbance type to the Riparian Human Disturbance Index:



Other Site Photos:

Pringle Creek Site PR00-052

Reach location description:
East Fork Pringle Creek Site 52 flows for 149 meters along the railroad tracks through industrial areas. The reach has an average bankfull width of 3.3 meters and water surface gradient of 0.3%. The mean thalweg depth at baseflow was 27 centimeters. The reach is channelized, deeply incised and straight, with a sinuosity of 1.0. It consists almost entirely of glide habitat with a small amount of riffle. The banks are very steep and erosion was evident throughout the reach. Many native shrubs and trees have colonized the riparian area with an approximately 10m meter wide riparian area on the left bank, and a 5 meter riparian area on the right bank. Himalayan blackberry was the dominant invasive species. Lamprey, sculpin and crayfish were present in the reach at the time of survey. The overall habitat quality of this reach is 59% of least disturbed conditions.

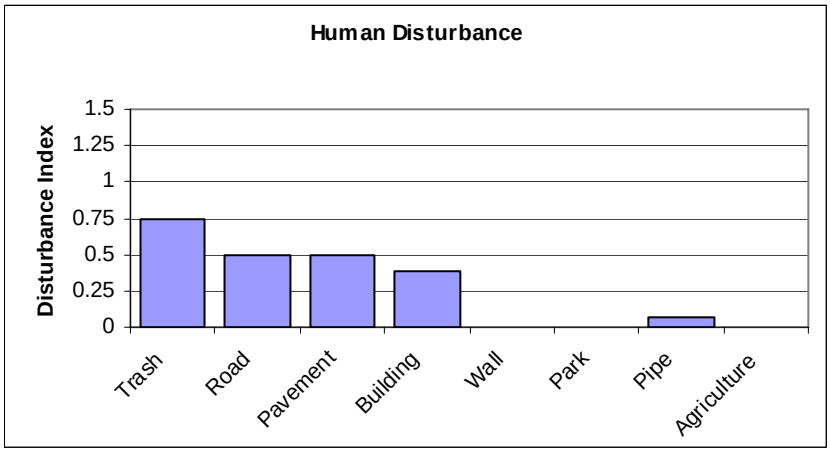
Key habitat issues:

- Channel is straight and deeply incised, with steep bank angles.
- No channel complexity, primarily glide habitat with very few riffles.
- No pool habitat.
- Very little wood, no large pieces.
- Inadequate complex riparian cover and shade.

East Fork Pringle Creek Site PR00-052

Condition Summary: East Fork Pringle Creek Site PR00-052				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	2	Habitat Quality Index (HQI)	0.59	Moderate. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	109	Fair. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	20	Poor
Channel Morphology	0	Channel sinuosity	1.0	None. Channel is straight.
		Incision height (m)	1.80	Poor, deeply incised with steep bank angles.
		Bank angle (degrees)	63	
Channel Complexity	0	Riffle percentage	7	No complexity. Primarily glide habitat with few riffles and no pools.
		Glide percentage	93	
		Pool percentage	0	
Residual Pool Depth	1	Depth of deepest residual pool (m)	0.39	Minimal deeper, slow-water habitat.
Substrate	2	Coarse gravel and larger (%)	26	Fair
		Embeddedness (%)	54	Good, not properly functioning by NMFS standards.
		Sand and fine sediments (%)	44	Fair, undesirable by ODFW standards.
		Hardpan %	0	Good
		Bed substrate stability index	-1.09	Moderately stable
Wood	1	Wood density (pieces/100 m, all sizes)	4.7	Poor. Very little wood, no large pieces.
Fish cover	3	Natural fish cover (aerial proportion)	1.06	Good, very heavy cover.
Riparian cover	1	Canopy shading mid-channel (% area)	69	Poor, at risk by ODFW standards.
		Riparian canopy cover (aerial proportion, large trees)	0.15	Fair canopy cover with good large tree cover. Inadequate complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.19	
		Proportion of reach with 3 layers of vegetation	0.50	
Human Disturbance	2	Human Disturbance Index (proximity-weighted sum)	2.20	Moderately disturbed

Chart showing contribution of each disturbance type to the Riparian Human Disturbance Index:



Other Site Photos:

Pringle Creek Site PR00-053

Reach location description:
East Fork Pringle Creek Site 53 flows for 158 meters along the railroad tracks through agricultural and industrial areas. The reach is channelized and flows through a deeply incised, steep-banked channel with blackberries along the banks for the entire reach. It has an average bankfull width of 4.2 meters and water surface gradient of 0.4% and is straight, with a sinuosity of 1.0. The mean thalweg depth at baseflow was 32 centimeters. It contained large amounts of fine sediments in the lower portions, with gravel and cobble in the upper third of the reach. East Fork Pringle Creek along the railroad tracks contains more native vegetation than the parallel sections of Middle Fork Pringle Creek. Beaver sign, trout and sculpin were present in the reach at the time of survey. The overall habitat quality of this reach is low at 42% of least disturbed conditions.

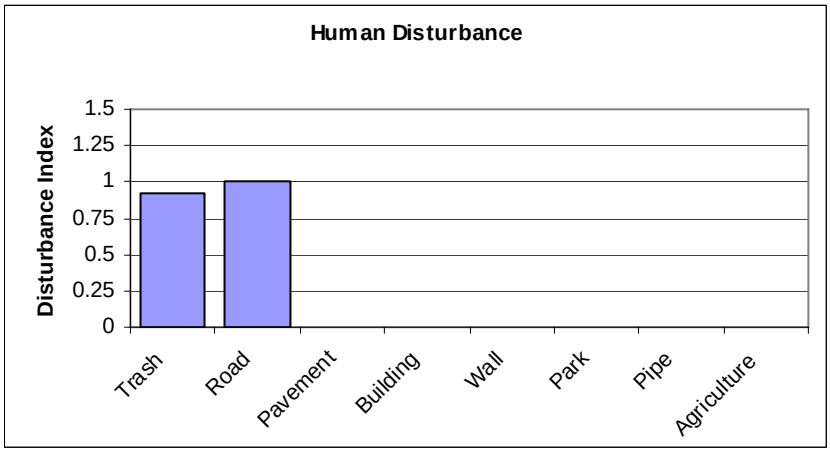
Key habitat issues:

- Channel is straight and deeply incised.
- No channel complexity, primarily glide habitat with very few riffles.
- No pool habitat.
- Very little wood, no large pieces.
- No canopy cover and inadequate complex riparian cover. Channel is inadequately shaded.
- Roads within or near the riparian zone.

East Fork Pringle Creek Site PR00-053

Condition Summary: East Fork Pringle Creek Site PR00-053				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	1	Habitat Quality Index (HQI)	0.42	Low. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	99	Poor. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	18	Very poor
Channel Morphology	1	Channel sinuosity	1.0	None. Channel is straight.
		Incision height (m)	1.68	Poor, deeply incised but with slight bank angles.
		Bank angle (degrees)	45	
Channel Complexity	0	Riffle percentage	11	No complexity. Primarily glide habitat with few riffles and no pools.
		Glide percentage	89	
		Pool percentage	0	
Residual Pool Depth	1	Depth of deepest residual pool (m)	0.35	Minimal deeper, slow-water habitat.
Substrate	2	Coarse gravel and larger (%)	31	Fair
		Embeddedness (%)	55	Good, not properly functioning by NMFS standards.
		Sand and fine sediments (%)	30	Good, undesirable by ODFW standards.
		Hardpan %	0	Good
		Bed substrate stability index	-1.20	Moderately stable
Wood	1	Wood density (pieces/100 m, all sizes)	1.9	Poor. Very little wood, no large pieces.
Fish cover	3	Natural fish cover (aerial proportion)	0.49	Good, heavy cover.
Riparian cover	0	Canopy shading mid-channel (% area)	46	Poor
		Riparian canopy cover (aerial proportion, large trees)	0.00	No canopy cover and inadequate complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.04	
		Proportion of reach with 3 layers of vegetation	0.23	
Human Disturbance	2	Human Disturbance Index (proximity-weighted sum)	1.92	Moderately disturbed

Chart showing contribution of each disturbance type to the Riparian Human Disturbance Index:



Other Site Photos:

Pringle Creek Site PR00-054

Reach location description:
East Fork Pringle Creek Site 54 is 149 meters long and flows along the railroad tracks through agricultural and industrial areas. The reach has an average bankfull width of 3.9 meters and water surface gradient of 0.5%. The mean thalweg depth at baseflow was 34 centimeters. The reach is channelized, straight, and incised, with no channel complexity as it consists entirely of glide habitat. Substrate consisted of deep, fine sediments. The reach has a 5 meter riparian area on the left bank, between the stream and the railroad tracks. Vegetation in the reach was primarily thickets of Himalayan blackberry. Lamprey, sculpin and a newt were present in the reach at the time of survey. The overall habitat quality of this reach is low at 39% of least disturbed conditions.

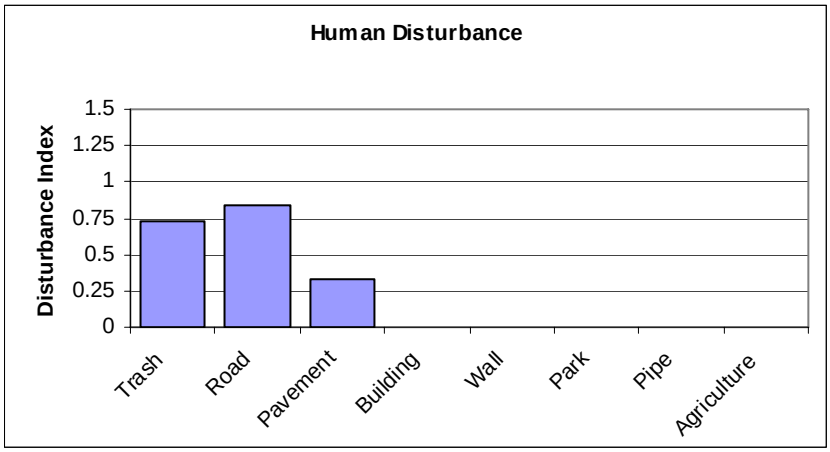
Key habitat issues:

- Channel is straight and incised.
- No channel complexity, entirely glide habitat with no riffles or pools.
- No pool habitat.
- Inadequate wood, no large pieces.
- No canopy cover and inadequate complex riparian cover. Channel is inadequately shaded.
- Roads within or near the riparian zone.

East Fork Pringle Creek Site PR00-054

Condition Summary: East Fork Pringle Creek Site PR00-054				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	1	Habitat Quality Index (HQI)	0.39	Low. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	95	Poor. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	22	Poor
Channel Morphology	1	Channel sinuosity	1.0	None. Channel is straight.
		Incision height (m)	1.45	Poor, incised but with slight bank angles.
		Bank angle (degrees)	41	
Channel Complexity	0	Riffle percentage	4	No complexity. Glide habitat with no riffles or pools.
		Glide percentage	96	
		Pool percentage	0	
Residual Pool Depth	1	Depth of deepest residual pool (m)	0.47	Minimal deeper, slow-water habitat.
Substrate	2	Coarse gravel and larger (%)	31	Fair
		Embeddedness (%)	63	Fair, not properly functioning by NMFS standards.
		Sand and fine sediments (%)	47	Fair, undesirable by ODFW standards.
		Hardpan %	0	Good
		Bed substrate stability index	-1.56	Moderately stable, poor compared to reference condition.
Wood	1	Wood density (pieces/100 m, all sizes)	11.4	Poor. Inadequate wood, no large pieces.
Fish cover	2	Natural fish cover (aerial proportion)	0.67	Fair, heavy cover, but no large cover.
Riparian cover	0	Canopy shading mid-channel (% area)	40	Poor
		Riparian canopy cover (aerial proportion, large trees)	0.01	No canopy cover and inadequate complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.03	
		Proportion of reach with 3 layers of vegetation	0.27	
Human Disturbance	2	Human Disturbance Index (proximity-weighted sum)	1.89	Moderately disturbed

Chart showing contribution of each disturbance type to the Riparian Human Disturbance Index:



Other Site Photos:

Pringle Creek Site PR00-055

Reach location description:
East Fork Pringle Creek Site 55 is 149 meters long and flows along the railroad tracks through agricultural and industrial areas. The reach has an average bankfull width of 3.5 meters and water surface gradient of 0.6% and is straight, with a sinuosity of 1.0. The mean thalweg depth at baseflow was 23 centimeters. The reach is channelized and deeply incised, and it consists primarily of glide habitat. Native vegetation consists of saw thimbleberry, ninebark, lupine and rose.The overall habitat quality of this reach is 59% of least disturbed conditions.

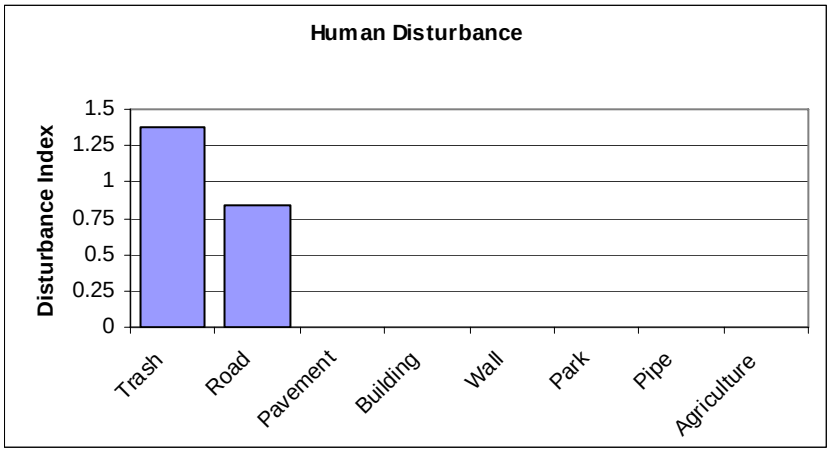
Key habitat issues:

- Channel is straight and deeply incised.
- Very little channel complexity, primarily glide habitat.
- Inadequate pool habitat.
- Inadequate wood, no large pieces.
- Inadequate canopy cover and complex riparian cover. Channel is inadequately shaded.
- Roads within or near the riparian zone.
- Large amounts of trash.

East Fork Pringle Creek Site PR00-055

Condition Summary: East Fork Pringle Creek Site PR00-055				
Habitat Category	Condition	Index	Value	Characterization
Overall Habitat Quality	2	Habitat Quality Index (HQI)	0.59	Moderate. Proportion of the least disturbed condition as compared to the mean of 8 Willamette Valley reference sites.
		Rapid Habitat Assessment (RHA)	115	Fair. Qualitative assessment with total of 200.
		Benthic Index of Biological Integrity (B-IBI)	20	Poor
Channel Morphology	0	Channel sinuosity	1.0	None. Channel is straight.
		Incision height (m)	3.15	Poor, deeply incised with moderate bank angles.
		Bank angle (degrees)	56	
Channel Complexity	1	Riffle percentage	10	Little complexity. Primarily glide habitat with few riffles and pools.
		Glide percentage	81	
		Pool percentage	8	
Residual Pool Depth	2	Depth of deepest residual pool (m)	0.42	Pools provide adequate deeper, slow-water habitat.
Substrate	2	Coarse gravel and larger (%)	33	Fair
		Embeddedness (%)	51	Good, not properly functioning by NMFS standards.
		Sand and fine sediments (%)	23	Fair, good relative to reference condition.
		Hardpan %	0	Good
		Bed substrate stability index	-0.79	Moderately stable, good compared to reference condition.
Wood	1	Wood density (pieces/100 m, all sizes)	4.7	Poor. Inadequate wood, no large pieces.
Fish cover	3	Natural fish cover (aerial proportion)	1.24	Good, very heavy cover.
Riparian cover	1	Canopy shading mid-channel (% area)	86	Fair, desirable by ODFW standards.
		Riparian canopy cover (aerial proportion, large trees)	0.00	Poor canopy cover with no large tree cover. Inadequate complex riparian habitat.
		Riparian canopy cover (aerial proportion, all trees > 5m tall)	0.09	
		Proportion of reach with 3 layers of vegetation	0.59	
Human Disturbance	2	Human Disturbance Index (proximity-weighted sum)	2.21	Moderately disturbed

Chart showing contribution of each disturbance type to the Riparian Human Disturbance Index:



Other Site Photos:

Appendix H
Early Action Project Descriptions

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Proj. # Name: **Creek Improvement and Public Awareness: Confluence of Pringle Creek and Clark Creek in Bush Park**

Project Type:
Channel improvements (bank stabilization and riparian improvement)

Summary:
The improvements consist of removing previous bank stabilization materials and invasive species, laying back Clark Creek banks to slide slopes no greater than 1:2, and revegetating with native species to increase bank stability. Project also includes a reinforced soil lift toe to create a bench or shelf to protect the cutback banks. Additionally, this project is highly visible to the public and can include signage on-site to inform the public about the project objectives and benefits to the urban watershed.

Justification:
Reduces incising of Clark Creek, a possible public safety hazard, increases park aesthetics, and provides an opportunity to increase public awareness of urban watershed functions. The stream reach is designated as an early action project because it is located on City property.

Location:
The project is located along Clark Creek (RM 0) in the Pringle Creek watershed at the confluence of Pringle and Clark Creeks near the south-east parking lot and baseball field in Bush Park.

Current Conditions:
The entire Clark Creek drainage is very urbanized. Clark Creek is a heavily modified creek that runs from the South Salem hills north into downtown Salem, entering Pringle Creek in Bush Park and the Willamette River just over 1 mile downstream. Clark Creek flows into a 900 foot concrete channel right before going under ground into a pair of 6-foot and 4-foot culverts for nearly 1,700 feet. As Clark Creek leaves the culvert system and before entering Pringle Creek, the channel is in very poor condition. The channel conditions include steep banks, poor vegetation, and previous bank stabilization attempts that are failing. The previous bank stabilization efforts included the use of concrete debris as riprap and scattered plantings. Apparently, the vegetation could not hold the stabilization fabric in place resulting in undercut banks.

The bank height above channel bottom ranges from 20 to 15 feet heading downstream. The bank is sloped 1:1 for the first part of the channel, but in the undercut area, the bank is at least vertical for 6 feet before a grade reduction to approximately 1:1. The concrete debris appears to have moved from its original location, creating a toe that encourages scour near the opening of the 4 foot culvert. Additionally the 6 foot culvert is raised several inches above the streambed creating a drop and resulting scour hole - these two areas could benefit from debris removal and riprap installed below bed grade and on the steep leftbank to stabilize the culvert outfalls.

Project Plan:
At a distance approximately 120 feet downstream from the culvert outfalls, a toe with a tree exists on the left bank with a more sustainable bank slope of approximately 1:2. It is recommended that the channel improvements reproduce this condition. This tree should not be lost due to construction activities. This toe will also guide the construction of a bank “shelf” to help protect the toe of the slope. This shelf will be constructed from 2 soil lifts 1 foot high and reinforced on all sides with stabilization fabric and underlain with riprap. These lifts will be heavily planted with appropriate vegetation that will stabilize the banks as the stabilization fabric degrades over the next 10 years. At approximately 65 feet downstream of the culvert outfalls, a tree has established itself on the top of the bank and in order to stabilize the bank the tree may be lost as banks are pulled back to approximately 1:2.

Stabilization fabric will also be placed on the bank for the entire length of the construction work to allow plants to take hold and create a thickly vegetated bank. The fabric will be anchored at the top and bottom to prevent undercutting and will degrade over 10 years leaving (with proper maintenance and care) a bank thick with native vegetation.

During project construction, a sign will be posted describing the project and its objectives and the benefits to the watershed. This sign will remain at the project site as an educational tool to teach citizens about ways to protect or restore important watershed functions.

Hydrologic Criteria:
This project is not expected to have any effects on local hydrology.

Ecological Criteria:
All pertinent permits requirements should be obtained and followed, including Oregon Division of State Lands Removal-Fill permit and US Army Corps of Engineers Section 404 permit. Construction-related erosion and sedimentation control measures should be implemented.

- Riparian plantings should provide enough structure to inhibit erosion on steep slopes.
- Reducing erosion in this reach will help improve stream health downstream by reducing fine-sediment loading

Maintenance and Long-term Protection:
During the first few years the bank and toe will need to be monitored frequently to ensure that vegetation is taking hold, surviving summer low flow conditions, and not being overrun by undesirable vegetation. Some of the activities that may be required to help the bank thrive through its first few years are irrigation, weeding, mowing, debris monitoring, checking temporary fences, movement or exposure of riprap, and effects on the right bank from increasing the stability and roughness of the left bank.

Opportunities for Partnerships or Public Participation:
To be determined.

Map:

Preliminarv Cost Summarv

Bank stabilization and revegetation at confluence of Pringle and Clark Creeks

Description	No.	Unit	Unit Cost	Item Cost
Survey	1	LS	$ 4,000.00	$ 4,000.00
Channel Improvements/Restoration				
Excavation	1100	CY	$ 20.00	$ 22,000.00
Clearing and Grubbing (including concrete disposal)	1	AC	$ 10,000.00	$ 10,000.00
Vegetation				$ -
Grass	5000	SF	$ 0.25	$ 1,250.00
Shrub	5000	SF	$ 0.30	$ 1,500.00
Existing Tree Protection	1	LS	$ 1,000.00	$ 1,000.00
Amended Topsoil	300	CY	$ 25.00	$ 7,500.00
Class 200 Riprap	100	CY	$ 45.00	$ 4,500.00
Stabilization Fabric (including installation)	10000	SF	$ 2.00	$ 20,000.00
Erosion Control	1	LS	$ 2,000.00	$ 2,000.00
Channel Improvement Subtotal				**$ 73,750.00**
Project Subtotal				**$ 73,750.00**
Contingency (30%)				$ 22,125.00
Project Subtotal				**$ 95,875.00**
Design/Construction Administration (30%)				$ 28,762.50
Environmental Permitting (10%)				$ 9,587.50
Administration (14%)				$ 13,422.50
Project Total				**$ 147,647.50**

Maintenance efforts will comprise 2 visits per year: mowing in June, herbicide application in September; initial maintenance effort will occur ~1 year following channel restructuring

Clark Creek Outfalls - 6-foot (left) and 4-foot (right) Culverts.

Clark Creek Looking Downstream

Proj. # Name: **Creek Improvement and Public Awareness: Pringle Park, Channel Reconstruction**

Type of Project:
Channel improvements (channel configuration and materials)

Summary:
The improvements consist of removing the concrete and riprap retaining wall and bringing the bank back to a more natural slope (3:1). This recommendation does not include meandering the channel for increased complexity. That would require more of the existing park be removed to accommodate the increased area required and increased materials and excavation due to the increased stream length.

Justification:
Removing the retaining wall will restore a more natural configuration to the channel cross-section and increase channel capacity. The channel widening also provides floodplain benefits to help reduce flood flow impacts.

Design Issues:
Since Pringle Park is confined by Pringle Creek and Shelton ditch, removing the retaining walls and pulling back the banks will decrease the park area by removing at least 21 feet along the channel from the useable park area. The lost space is approximately 0.3 acres. Additionally large old oak trees, and the current footbridge will all be lost due to the channel widening. Park lighting and power poles will need to be relocated.

Location:
The project is located at the confluence of Pringle Creek and Shelton Ditch. Pringle Park is encompassed by these waterways.

Current Conditions:
Both Pringle Creek and Shelton Ditch are confined by retaining walls and steep slopes in the Pringle Park area. These retaining walls do not allow the stream to behave dynamically or connect with its floodplain. Currently the Pringle Creek channel is 24 feet wide and the walls are 7 feet high. The Shelton Ditch channel is 60 feet wide with walls 8 feet wide.

Project Plan:
The project plan is to remove the concrete wall and excavate the soil to meet the desired bank slope of 3:1. This will create a sloped bank 21 feet wide along Pringle Creek for the length of the Pringle Park reach. If the City is interested in pursuing it, an early action plan will be developed for a meandering channel configuration, and an additional plan for removing the Shelton Ditch retaining wall in addition to the Pringle Creek retaining wall.

Once the retaining wall is removed, a trench will be excavated and filled with riprap to streambed grade to support three 1-foot high soil lifts that will create a solid toe for the new bank configuration. These lifts and the bank above will be heavily vegetated to resist erosion and create a more natural stream appearance. It is preferable to plant with shrubs and grasses to create a complex root layer; this “look” is generally not found in urban parks.

If desired, the city can place channel enhancement rock to create porous weirs that will help develop a pool-riffle system that will add complexity to the stream and increase the quality of fish habitat in the stream. The pool-riffle system will cause scour pools to form downstream of each weir and deposition above the weirs.

Hydrologic Criteria:
This project is not expected to have major effects on local hydrology, but additional channel width and bank area can provide improved flood flow benefits. The channel hydraulics will need to be evaluated as part of the design process.

Ecological Criteria:
All pertinent permits should be obtained and followed, including the Oregon Division of State Lands Removal-Fill permit and US Army Corps of Engineers Section 404 permit. Construction-related erosion and sediment control measures should be implemented. City permits may be needed to remove the oak trees currently on the site.

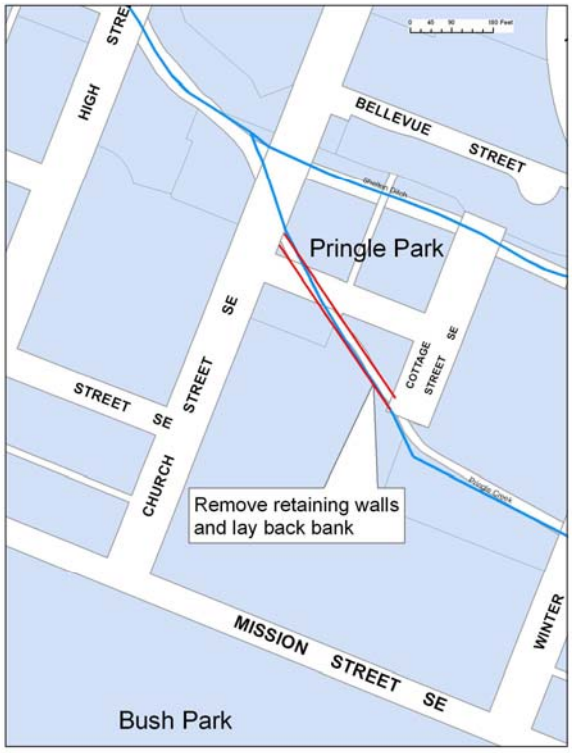
- Riparian plantings should provide enough structure to inhibit erosion on steep slopes.
- Creating channel complexity by creating a pool-riffle system will help gravel deposit in the

channel and not under the Church Street Bridge (optional to include in design).

Maintenance and Long-term Protection:
During the first few years the bank and toe will need to be monitored frequently to ensure that vegetation is taking hold, surviving summer low flow conditions, and not being overrun by undesirable vegetation. Some of the activities that may be required to help the bank thrive through its first few years are irrigation, weeding, mowing, debris monitoring, checking temporary fences, exposure of riprap, movement of porous weir rocks, and effects on the left bank from decreasing the stability and increasing the roughness of the left bank.

Opportunities for Partnerships or Public Participation:
Public outreach and input for this project should be conducted. This is a heavily used park and some of the old oak trees will need to be removed as part of this project.

Map:



Preliminary Cost Summary

Pringle Park - removal of stone and mortar retaining walls, lay back banks and revegetate

Description	No.	Unit	Unit Cost	Item Cost
General				
Traffic Control		Hour	$ 110.00	$ -
Survey	1	LS	$ 10,000.00	$ 10,000.00
Utility Relocation	1	LS	$ 100,000.00	$ 100,000.00
Footbridge removal and replacement	1	LS	$ 100,000.00	$ 100,000.00
Public outreach	1	LS	$ 50,000.00	$ 50,000.00
General Operations Subtotal				**$ 260,000.00**
Channel Improvements/Restoration				
Mobilization (10%)	1	LS	$ 50,000.00	$ 50,000.00
Excavation	1900	CY	$ 30.00	$ 57,000.00
Clearing and Grubbing	2	AC	$ 10,000.00	$ 20,000.00
Vegetation				
Grass	13000	SF	$ 0.50	$ 6,500.00
Shrub	13000	SF	$ 2.00	$ 26,000.00
Temporary Landscaping Irrigation	1	LS	$ 8,000.00	$ 8,000.00
Existing Tree Protection	1	LS	$ 10,000.00	$ 10,000.00
Amended Topsoil	1000	CY	$ 30.00	$ 30,000.00
Construct new Footpath	3000	SF	$ 6.00	$ 18,000.00
Channel Enhancement Logs	4	Each	$ 800.00	$ 3,200.00
Channel Enhancement Rocks	20	CY	$ 70.00	$ 1,400.00
Class 200 Riprap	300	CY	$ 45.00	$ 13,500.00
Stabilization Fabric (including installation)	3900	SY	$ 4.00	$ 15,600.00
Channel Improvement Subtotal				**$ 209,200.00**
Project Subtotal				**$ 469,200.00**
Contingency (30%)				$ 140,760.00
Project Subtotal				**$ 609,960.00**
Design/Construction Administration (30%)				$ 182,988.00
Environmental Permitting				$ 30,000.00
Administration				$ 40,000.00
Land Acquisition				
Environmental Areas (ESRA, Buffers, etc)		SF	$ 1.00	$ -
Residential		SF	$ 10.00	$ -
Commercial		SF	$ 10.00	$ -
Industrial		SF	$ 10.00	$ -
Project Total				**$ 862,948.00**

Proj. # Name: **Creek Improvement and Public Awareness:**
Pringle Creek Near Mission St. SE and Capitol St. SE

Project Type:
Channel stabilization

Summary:
At the location of the eroded bank, the improvements consist of installing riprap below the streambed up to the ordinary high water line with soil lifts to bring the new bank to the existing bank height. The system will include installation of a small rock barb upstream to help move the thalweg away from the impacted area. By stabilizing this bank the City will be preserving the Bush Park jogging trail that follows Pringle Creek. Additionally this project is highly visible to the public and can include signage onsite to inform that public about the project objectives and benefits to the urban watershed.

Justification:
The project will improve channel stabilization in this section of Pringle Creek and reduce erosion. By stabilizing this bank the City will be preserving the Bush Park jogging trail that follows Pringle Creek. The stream reach is identified as an early action project because it is located on City property.

Location:
The project location is just south of the Mission Street bridge over Pringle Creek in Bush Park. The eroding bank is along the jogging trail, east of the north parking lot.

Current Conditions:
Within Bush Park, Pringle Creek is a dynamic stream that naturally erodes banks and deposits gravel. Both functions are occurring at this site: the left bank is eroding because the thalweg is moving closer to the bank and the stream navigates a slight turn and gravel deposits are happening throughout the reach but especially under the Mission Street bridge. The eroded bank looks as if it could have been generated by a tree falling and leaving an unprotected section of the bank. Now the shear face is approximately 15 feet away from the popular jogging trail that circles Bush Park. The largest occurrence of deposition in this reach is the gravel bar, which does not seem to be hindering flow under the Mission Street bridge even with the current vegetation growing on it.

The current bank height of the eroded section is approximately 8 feet off of the streambed and 25 feet wide. The erosion extends into the bank about 8 feet.

Project Plan:
Installing Class 200 riprap below grade will stabilize the fill used to stabilize the bank. The riprap will be carried up to the ordinary high water depth, assumed to be three feet. The slope of the riprap will be at slightly greater than 1:1 and the soil lifts placed above the rip rap will be at 1:1 to form a base for the topsoil cap at a 2:1 slope. The entire soil system will be heavily vegetated to establish a resilient bank.

Just upstream of the eroded area, a rock barb will be installed to direct flow more toward the middle of the channel, moving the thalweg away from the eroded bank. The barb is designed to be submerged at ordinary high water-level flows and exposed at low flow. The barb will use the same Class 200 riprap as the fill project and will have approximate dimensions of 3.5 feet tall (buried 2.5 feet), 3 feet long, and 2.5 feet wide.

Hydrologic Criteria:
This project is not expected to have any major effects on local hydrology. Channel hydraulics will be modified and will need to be evaluated as part of the design process.

Ecological Criteria:
All pertinent permits requirements should be obtained and followed, including Oregon Division of State Lands Removal-Fill permit and US Army Corps of Engineers Section 404 permit. Construction-related erosion and sedimentation control measures should be implemented.

- Erosion protection must be carefully considered for this project.
- Temporary water management will be difficult for this project - it is recommended that a full plan be developed and documented by each contractor when the project is bid upon.

Maintenance and Long-term Protection:
During the first few years the bank and toe will need to be monitored frequently to ensure that bank is structure is staying in place. Some of the activities that may be required to help the bank thrive through its first few years debris monitoring, checking temporary fences, movement or exposure of riprap, and

effects on the banks due to the curvature of the stream channel. The bank downstream of the

<u>Opportunities for Partnerships or Public Participation:</u>
To be determined.

Map:

Preliminary Cost Summary

Bush Park bank stabilization and rock barb to fill and protect eroding bank

Description	No.	Unit	Unit Cost	Item Cost
Survey	1	LS	$ 1,200.00	$ 1,200.00
Channel Improvements/Restoration				
Mobilization (10%)	1	LS	$1,500	$ 1,500.00
Excavation	50	CY	$ 50.00	$ 2,500.00
Clearing and Grubbing	0.25	AC	$ 10,000.00	$ 2,500.00
Vegetation				
Grass	500	SF	$ 0.50	$ 250.00
Shrub	500	SF	$ 2.00	$ 1,000.00
Amended Topsoil	30	CY	$ 50.00	$ 1,500.00
Class 200 riprap	35	CY	$ 45.00	$ 1,575.00
Existing Tree Protection	1	LS	$ 1,000.00	$ 1,000.00
Stabilization Fabric (including installation)	300	SF	$ 5.00	$ 1,500.00
Erosion Control	1	LS	$ 2,000.00	$ 2,000.00
Channel Improvement Subtotal				**$ 16,525.00**
Project Subtotal				**$ 17,485.00**
Contingency (30%)				$ 5,245.50
Project Subtotal				**$ 22,730.50**
Design/Construction Administration (30%)				$ 6,819.15
Environmental Permitting (10%)				$ 2,273.05
Administration (14%)				$ 3,182.27
Project Total				**$ 35,004.97**

Proj. # Name: **Creek Improvement and Public Awareness: Pringle Creek in Woodmansee Park**

Project Type:
Channel improvements (adding meanders, bank stabilization, and riparian improvement)

Summary:
The improvements consist of constructing a new channel for the creek that adds 5 percent to the current stream length inside Woodmansee Park, removing invasive species, laying back Pringle Creek banks to slide slopes no greater than 1:3, and revegetating with native species to increase bank stability. Project also includes a reinforced soil lift toe to create a bench or shelf to protect the nearly vertical banks. By increasing channel length and capacity it is possible that this project may help abate flooding problems immediately downstream of the park. Additionally, this project is highly visible to the public and can include signage on-site to inform the public about the project objectives and benefits to the urban watershed.

Justification:
Creates a more natural channel configuration for Pringle Creek, reduces incising, a possible public nuisance, increases park aesthetics, and provides an opportunity to increase public awareness of urban watershed functions. The stream reach is designated as an early action project because it is located on City property.

Location:
The project is located along Clark Creek (RM ?) in the upper Pringle Creek watershed in Woodmansee Park, approximately where Commercial Street SE becomes Sunnyside Rd. SE and intersects Idylwood Drive SE.

Current Conditions:
The entire Pringle Creek watershed is very urbanized which generally means channels have been straightened and confined. Through Woodmansee park the channel is generally of gentle gradient with nearly vertical banks and park lawn mowed right up to the creek. There is not much complexity in this reach. One positive aspect of the park is that there are large, established conifers providing cover. A downfall of the park is the two footbridges which are paved-over culverts which are impeding flow. On the downstream side of one of the footbridges channel widening has occurred as the culvert creates a chute which increases the energy in the stream and therefore erosive capabilities.

Ground cover is poor throughout much of the reach. In many locations the clayey soils forming the creek banks have been stripped clean of any root structure and are being undercut by the creek. Some locations are lawn with gentle slopes to the creek, but these sites are not in a majority.

Project Plan:
Pringle Creek through Woodmansee Park presents an opportunity to adjust the channel to include meanders, or sweeping curves, that increase channel length and therefore capacity in this reach. For Woodmansee Park the estimated channel length increase is 5 percent, or 90 feet. Meanders increase the aesthetics of the reach and encourage habitat development due to the decreased channel velocities. Increasing stream length and roughness both decrease channel velocities. It is possible that more gravel and sediment deposition will occur in this reach due to the modifications and this may attract fish.

The channel will be modified to begin at the park in the same location and cross under the current pedestrian bridge in the wooded area. It is recommended that the current footbridges atop culverts be replaced by true footbridges that span the channel at high flow. These types of bridges are more scenic and tend to do less damage to the creek as they do not confine or impinge it. The other improvements will be construction of the new channel and filling the old channel. There is potential to use the soil removed from the new channel to back fill the old channel if it is evaluated as appropriate for this application. Riprap will be included in the junctions where the new channel encounters the old to prevent avulsion to the original route.

Hydrologic Criteria:
This project is not expected to have any major effects on local hydrology. Possible delay of the peak of small storms is possible due to the increase in channel roughness and small increase in channel length.

Ecological Criteria:
All pertinent permits requirements should be obtained and followed, including Oregon Division of State

Lands Removal-Fill permit and US Army Corps of Engineers Section 404 permit. Construction-related erosion and sedimentation control measures should be implemented.

- Riparian plantings should provide enough structure to inhibit erosion on steep slopes.
- Reducing velocities in this reach will help create natural deposits of sediment over the clay hardpan.
- Erosion protection must be carefully considered for this project.
- Temporary water management will be difficult for this project - it is recommended that a full plan be developed and documented by each contractor when the project is bid upon.

Maintenance and Long-term Protection:
During the first few years the bank and toe will need to be monitored frequently to ensure that vegetation is taking hold, surviving summer low flow conditions, and not being overrun by undesirable vegetation. Some of the activities that may be required to help the bank thrive through its first few years are irrigation, weeding, mowing, debris monitoring, checking temporary fences, movement or exposure of riprap, and effects on the banks due to the curvature of the stream channel. It is recommended that mowing be infrequent within a 15 foot buffer of the stream to encourage vegetation to take hold, habitat to develop, and to discourage the public and dogs from playing in the creek.

Opportunities for Partnerships or Public Participation:
To be determined.

Map:

Preliminary Cost Summary

Restore Pringle Creek channel complexity and geomety in Woodmansee Park, diversify riparian zone.

Description	No.	Unit	Unit Cost	Item Cost
Channel Improvements/Restoration				
Excavation	1000	CY	$ 30.00	$ 30,000.00
Clearing and Grubbing	4.5	AC	$ 10,000.00	$ 45,000.00
Vegetation				
Grass	19000	SF	$ 0.50	$ 9,500.00
Shrub	19000	SF	$ 2.00	$ 38,000.00
Amended Topsoil	2000	CY	$ 30.00	$ 60,000.00
Channel Enhancement Logs	10	Each	$ 800.00	$ 8,000.00
Channel Enhancement Rocks		CY	$ 70.00	$ -
Stabilization Fabric	9000	SY	$ 4.00	$ 36,000.00
Existing Tree Protection	1	LS	$ 5,000.00	$ 5,000.00
Concrete Disposal	1	LS	$ 5,000.00	$ 5,000.00
Erosion Control	1	LS	$ 15,000.00	$ 15,000.00
Class 200 Riprap	10	CY	$ 45.00	$ 450.00
Channel Improvement Subtotal				**$ 251,950.00**
Project Subtotal				**$ 251,950.00**
Contingency (30%)				$ 75,585.00
Project Subtotal				**$ 327,535.00**
Design/Construction Administration (30%)				$ 98,260.50
Environmental Permitting (10%)				$ 20,000.00
Administration (14%)				$ 45,854.90
Land Acquisition				
Environmental Areas (ESRA, Buffers, etc)		SF	$ 1.00	$ -
Residential		SF	$ 10.00	$ -
Commercial		SF	$ 10.00	$ -
Industrial		SF	$ 10.00	$ -
Project Total				**$ 491,650.40**

[1]Maintenance efforts will comprise 2 visits: mowing in June, herbicide application in September; initial maintenance effort will occur ~1 year following 'Clearing and Grubbing' efforts.

Appendix I
Summary of Key Potential
Funding Sources

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Table 9-4. Summary of Key Potential Funding Sources				
Grant/Funding Name	Description	Restrictions	Assistance	Contact
United States Fish and Wildlife				
Partners for Fish and Wildlife Program	Provides technical and financial assistance to private landowners interested in voluntarily restoring or otherwise improving native habitats for fish and wildlife on their lands	Plan must be agreeable to landowner	Not given	Branch of Habitat Restoration - Partners for Fish and Wildlife Program - 4401 North Fairfax Drive, Room 400 - Arlington, VA 22203 - 703/358 2201 [FAX: 703/358 2232] http://ecos.fws.gov/partners/viewContent.do?viewPage=home http://www.uta.edu/ra/GCS/funding_view?id=1298
Fish Screening and Passage Program	Focused on improving fish passage, specifically for anadromous species. Fish passage projects could include culvert or bridge replacement or retrofitting as well as providing passage over an obstacle (e.g., dam) or improving channel conditions to allow for passage (e.g., low flow)	Blockage must be in ODFW database	Typically between $1,000 and $50,000, 50% cost share encouraged	ODFW at 503) 947-6224 http://www.dfw.state.or.us/fish/passage/grants.asp
North American Wetlands Conservation Act Grants	Supports projects in Canada, the United States, and Mexico that involve long-term protection, restoration, and/or enhancement of wetlands and associated uplands habitats	Both are competitive grants programs and require that grant requests be matched by partner contributions at no less than a 1-to-1 ratio. Funds from U.S. Federal sources may contribute towards a project, but are not eligible as match. Small grants program: Grant requests may not exceed $75,000	Standard Grant amount not stated. Small Grant up to $75,000.	U.S. Standard Grants proposals: David Buie (david_buie@fws.gov), (301) 497-5870, or Rodecia McKnight (rodecia_mcknight@fws.gov), (703) 358-2266. Canada Standard Grants Program: Sarah Mott (sarah_p_mott@fws.gov), (703) 358-1910. Mexico Standard Grants Program: Ellen Murphy (ellen_murphy@fws.gov), (703) 358-1937. Small Grants Program Coordinator: Keith Morehouse (keith_morehouse@fws.gov), (703) 358-1888. http://www.fws.gov/birdhabitat/Grants/NAWCA/Small/index.shtm
United States Environmental Protection Agency				

Table 9-4. Summary of Key Potential Funding Sources				
Grant/Funding Name	Description	Restrictions	Assistance	Contact
Five-Star Restoration Program	Program provides funds to intermediary organizations, which then make subgrants to support community-based wetland and riparian restoration projects. NFWF oversees the grant process for this program	Projects that are part of mitigation or regulatory requirement are not eligible for funding	Funding levels are from $5,000 to $20,000, with $10,000 as the average amount awarded per project. Matching encouraged.	Program Coordinator Contacts: Matthew Hurley - National Fish and Wildlife Foundation - 1120 Connecticut Avenue, NW Suite 900 - Washington, DC 20036 - (202) 857-0166 - matthew.hurley@nfwf.org - Erik Johnston - National Association of Counties - 440 First Street, NW Suite 800 - Washington, DC 20001 - (202) 942-4246 - ejohnston@naco.org - Otto Loggers - Wildlife Habitat Council - 8737 Colesville Rd., Suite 800 - Silver Spring, MD 20910 - (301) 588-8994 - ologgers@wildlifehc.org - Myra Price - USEPA Wetlands Division - Room 6105 (4502 T) - 1200 Pennsylvania Avenue, NW - Washington, DC - (202) 566-1382 - price.myra@epa.gov
Targeted Watersheds Grant Program	Encourages coalition-based strategies for attaining water quality standards and improving water resource protection and watershed restoration.	Nominations must be submitted by a governor or tribal leader	Grants range from $600,000 to $900,000 and a 25% non-Federal match is required	Willamette River - Oregon The Willamette Partnership - David Primozich, primozich@verizon.net - (503) 434-8033 http://www.epa.gov/twg/index.html
Section 104(b)(3) - Wetland Program Development Grants	Provides financial assistance for wetland protection/enhancement	Funding under this program may not be used for the operation or maintenance of existing wetlands programs	Range is $10,000 to $500,000; 25 % match required, higher match encouraged	David Kulman US EPA Region 10, 1200 Sixth Avenue Seattle, WA, 98101 Phone: (206) 553-6219; kulman.david@epa.gov http://www.epa.gov/owow/wetlands/grantguidelines/
Smart Growth Initiative	Program assists local agencies in redeveloping current land (e.g. brownfields) and protecting open space		$140,000 for first year with a ceiling of $725,000	Megan Susman U.S. EPA Development Community and Environment Division Office of Policy, Economics and Innovation 1200 Pennsylvania Avenue NW Mail code 1807 T Washington, D.C. 20004 Phone: (202) 566-2861 http://www.epa.gov/smartgrowth/grants/index.htm
National Fish and Wildlife Foundation				

Table 9-4. Summary of Key Potential Funding Sources				
Grant/Funding Name	Description	Restrictions	Assistance	Contact
General Matching Grants Program	A conservation grants program that awards matching grants, on a competitive basis, to eligible grant recipients, including federal, tribal, state, and local governments, educational institutions, and non-profit conservation organizations.	$2 must be raised for each federal dollar	$25,000 to $250,000	Northwest Regional Office - 806 SW Broadway, Suite 750 - Portland, OR 97205 - Phone: 503-417-8700 - Regional Director: Krystyna Wolniakowski http://www.nfwf.org/guidelines.cfm
Bring Back the Natives	Program supports on-the-ground habitat restoration projects that benefit native aquatic species in their historic range	$2 must be raised for each federal dollar	The average grant size is about $60,000 and can support direct project-related salaries, contractual services and materials needed for on-the-ground restoration.	Corey Grace - NFWF Southwest Office - 28 Second Street, 6th Floor - San Francisco, CA 94105 - 415-778-0999 - corey.grace@nfwf.org http://www.nfwf.org/programs/bbn.cfm
Native Plant Conservation Initiative (NPCI)	Supports on-the-ground conservation projects that protect, enhance, and/or restore native plant communities on public and private land.	Several specific recommendations listed on website	from $5,000 to $40,000 with an average grant size of $40,000	Ellen G. Gabel - Re: NPCI Grant Program - National Fish and Wildlife Foundation - 1120 Connecticut Ave., NW, Suite 900 - Washington, DC 20036 http://www.nfwf.org/programs/npci_application.cfm
National Resources Conservation Service				
Wetlands Reserve Program	Voluntary program provides landowners with financial incentives to restore and protect wetlands in exchange for retiring marginal agricultural land	Participant must have owned land for a minimum of 1 year. Wetland must have some connection to agriculture (e.g., historic wetland was drained for agricultural use and restoration is proposed).	No limit; 1:1 matching required	Locate your county NRCS field office by going to: http://www.or.nrcs.usda.gov/contact/ Further information on programs may be found at: www.or.nrcs.usda.gov/programs/
Wildlife Habitat Incentives Program	Voluntary program for people who want to develop and improve wildlife habitat on private lands	Can only be used for technical assistance or on-the-ground projects. Cooperative agreement required.	No limit; Permanent easements can be funded 100 %; remaining projects typically require a 25 % match	Locate your county NRCS field office by going to: http://www.or.nrcs.usda.gov/contact/ Further information on programs may be found at: www.or.nrcs.usda.gov/programs/
National Oceanic and Atmospheric Administration				
Community-Based Restoration Program	Funds for small, locally driven habitat restoration projects that foster natural resource stewardship within communities	Progress reports required after application and acceptance. See ideal partnership qualities at http://www.nmfs.noaa.gov/habitat/restoration/projects_programs/crp/partners_funding/FY07%20CRP%20Partnership%20FFO.pdf	$5,000- $150,000 for regional projects. $5,000 to $2,000,000 for national projects	http://www.nmfs.noaa.gov/habitat/restoration/funding_opportunities/funding_nwr.html Melanie Gange or Robin Bruchner at (301) 713-0174 or Melanie.Gange@noaa.gov or Robin.Bruchner@noaa.gov

Table 9-4. Summary of Key Potential Funding Sources				
Grant/Funding Name	Description	Restrictions	Assistance	Contact
US Army Corps of Engineers				
Section 14- Emergency Streambank and Shoreline Protection	Gives the Army Corps of Engineers authority to plan and construct emergency stream bank and shoreline protection projects to protect endangered highways, highway bridge approaches, public facilities such as water and sewer lines, churches, public and private nonprofit schools and hospitals, and other non profit public facilities	The sponsor must contribute in cash a minimum of 5 percent of the total project cost. The sponsor must also pay for and obtain all lands, easements, rights of way and relocations (LERR) for the project. If the value of LERR plus the cash contribution does not equal or exceed 35 percent of the project cost, the sponsor must pay the additional amount necessary so that the sponsor's total contribution equals 35 % of the project cost. Total Federal project funding is limited to $1,000,000. All project costs above this limit are 100% non-Federal.	No limit given	Mr. Philip E. Berkeley - Continuing Authorities Program Manager - Planning Branch - Philip.E.Berkeley@usace.army.mil - 716-879-4145 http://www.lrb.usace.army.mil/missions/Missions.html
Section 1135: Project Modification to Improve the Environment	May no longer be available as website was hard to find and does not seem updated.	The process for Section 1135 projects begins after a non-federal sponsor requests Corps of Engineers assistance under the program. When funding is available, the Corps of Engineers prepares a Preliminary Restoration Plan (PRP) paid for by the federal government.	Limited to $5 million for planning and construction; Cost share is 75 % federal; in-kind matching allowed, but 5% must be case	The request should be submitted by a state or local government agency1 to Mr. John Kennelly, Chief, Planning Branch, U.S. Army Corps of Engineers, New England District, 696 Virginia Road, Concord, MA 01742-2751. For more information call Larry Oliver of the Project Planning Section at 978-318-8347. http://www.nae.usace.army.mil/pservices/rest1135.htm
Federal Highway Administration				
Transportation Equity Act for the 21st Century Funding Programs	Funds numerous transportation programs to improve the nation's transportation infrastructure, enhance economic growth, and protect the environment	Grant awards have typically gone towards trail construction and recreation access	No limit; partnerships encouraged	Steve Leep Highway Finance Office Oregon Department of Transportation 355 Capitol Street, NE Transportation Bldg. Room 434 Salem OR 97301-3871 (503) 986-3691; istea.reauthorization@fhwa.dot.gov http://www.fhwa.dot.gov/tea21/ -or- http://www.epa.gov/owow/tea/ http://www.oweb.state.or.us/directory/documents/TEA21.pdf
Department of the Interior, National Park Service				
Land and Water Conservation Fund	Supports the creation of state and local park and recreation areas that guarantee perpetual public outdoor recreation opportunities	See http://egov.oregon.gov/OPRD/GRANTS/lwcf.shtml#Required_in_application for requirements	Minimum federal share is $12,500; $25,000 total project costs.	Oregon Director - 725 Summer Street, Suite C - Salem, OR 97301 - 503-986-0729 http://www.nps.gov/lwcf/

Table 9-4. Summary of Key Potential Funding Sources				
Grant/Funding Name	Description	Restrictions	Assistance	Contact
Oregon Watershed Enhancement Board (OWEB)				
Watershed Restoration Grants	OWEB is dedicated to promoting and implementing programs to restore, maintain and enhance watersheds. Practically any person or organization may request funding, advice, or assistance from OWEB to develop a watershed project	Include checklist; do not include materials that are difficult to copy. If you do use items that are difficult to copy, include 25 copies. Sheets should be 8.5 x 11" unbound, unstapled.	Information not provided. Contact Willamette Basin representative	http://www.oregon.gov/OWEB/GRANTS/docs/RG_instructions.pdf Willamette Basin Pat Oman, Program Representative OWEB 775 Summer St. NE, Suite 360 Salem, Oregon 97301-1290 Phone: (503) 986-0057 Fax: (503) 986-0199 pat.oman@state.or.us
Watershed Assessment and Monitoring	Same as above	Same as above.	Same as above.	Same as above.
Watershed Education and Outreach	Same as above	Same as above.	Same as above.	Same as above.
Land or Water Acquisition	Same as above	Same as above.	Same as above.	Same as above.
Watershed Council Support	Same as above	Same as above.	Same as above.	Same as above.
Oregon Department of Environmental Quality (DEQ)				
Clean Water State Revolving Fund (CWSRF) (Loan Program)	Program helps Oregon communities manage a range of water pollution concerns to maintain water quality	Restricted to Oregon's public agencies: include cities, counties, sanitary districts, soil and water conservation districts, irrigation districts and various special districts.	Each time new monies become available, those monies are allocated to as many unfunded or partially funded projects as possible.	NW Region: Richard Santner - (503) 229-5219 - santner.richard@deq.state.or.us http://www.deq.state.or.us/wq/loans/srfintro.htm

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