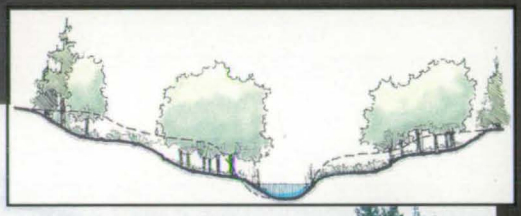
JUNE 2001

Johnson Creek Restoration Plan



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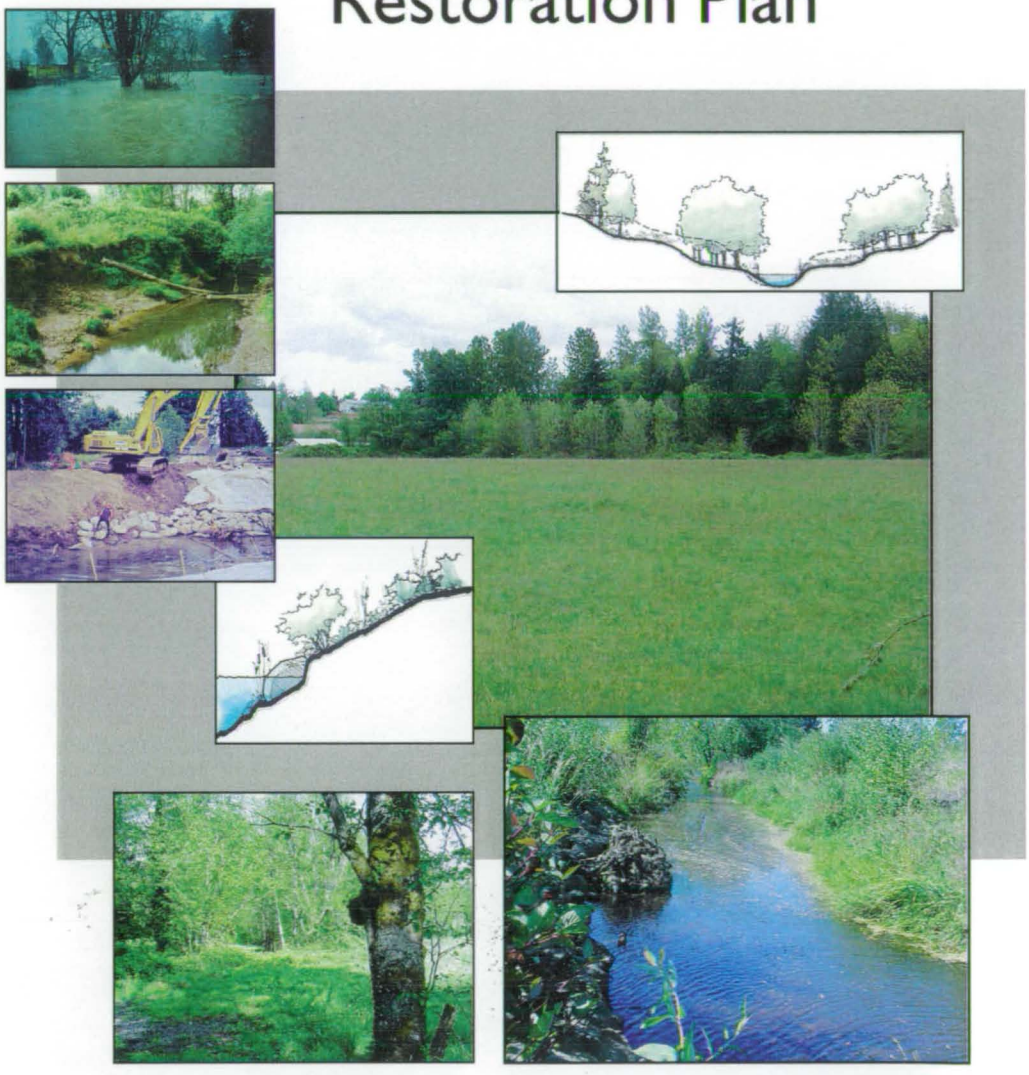

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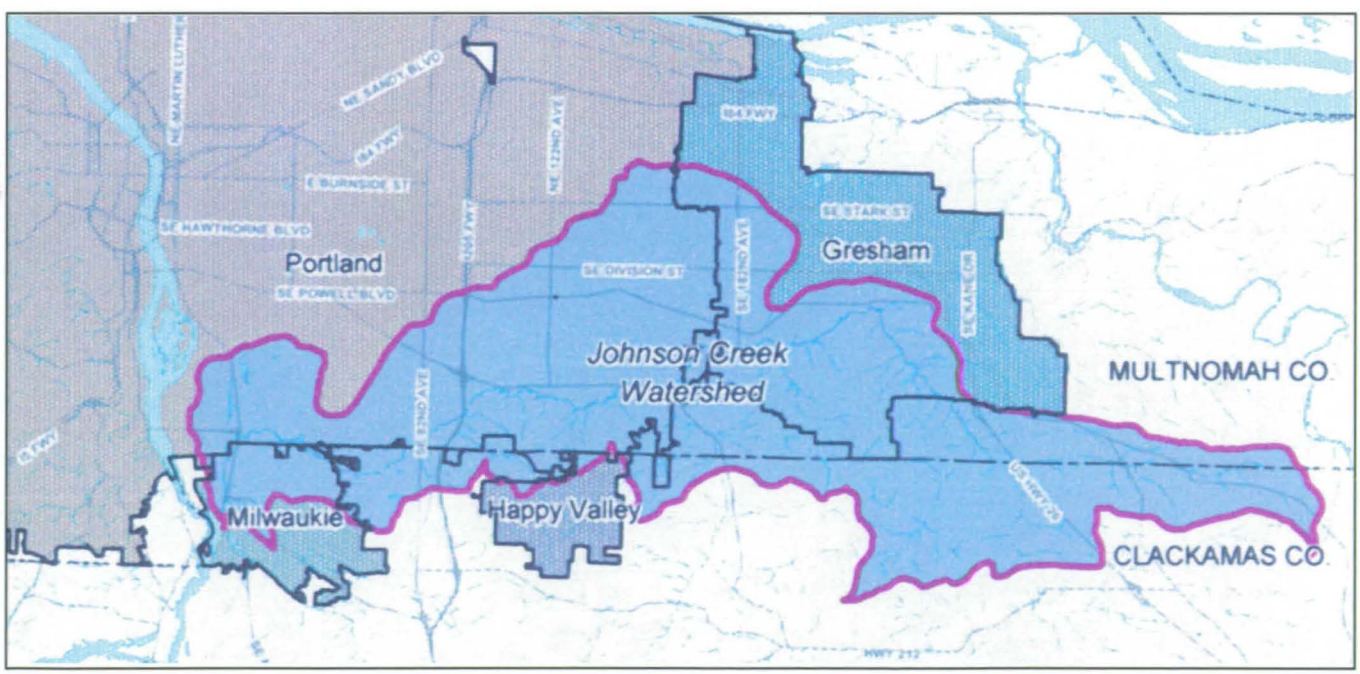
Introduction

The Johnson Creek watershed is a 52-square-mile area of varied landscapes that drains six jurisdictions: the Cities of Milwaukie, Portland, Gresham, and Happy Valley and the Counties of Clackamas and Multnomah (Figure 1-1). Johnson Creek is one common feature linking the six jurisdictions. Although each jurisdiction is responsible for managing and regulating development activities within its boundaries, all six share the resources of Johnson Creek.

For more than 70 years, various local, regional, state, and federal agencies have worked toward understanding the dynamics of the Johnson Creek watershed and have attempted to resolve recurring flooding, water quality, and other environmental problems in the watershed. Both implemented projects and those left on the planning shelf have been learning experiences and reflect the various approaches to watershed management during the era in which they were performed.

Figure 1-1: Johnson Creek Watershed



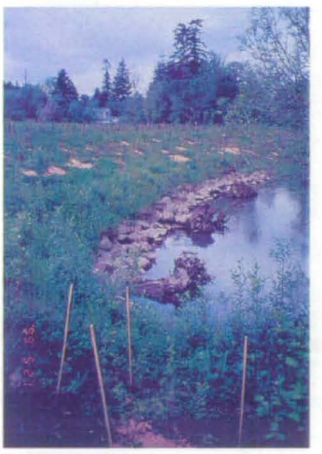
Today, the quality of Johnson Creek and the condition of its channels represent the integrated history of how nature and man have influenced it. Geological, hydrological, and other natural processes are the primary factors that define the watershed. In addition, residents have altered the watershed and used the natural resources found throughout for their respective needs and benefits. The combination of these factors has reduced the natural stability of the watershed and its ability to support fish and wildlife. Until natural conditions (physical, chemical, and biological) and a natural flow regime can be restored to Johnson Creek, it will be impossible to achieve restoration objectives.

WPA rock lining and channelization (1930s)

Alteration of the natural floodplain has eliminated many of the areas that once absorbed and conveyed floods through the watershed. The most significant alteration was performed in the 1930s by the Works Progress Administration (WPA), when Johnson Creek was subjected to extensive rock-lining, channel deepening, and straightening to control flooding. These activities caused adverse impacts to the natural resources and ecological integrity of the creek, yet flood damage continued. Continued development has further changed the creek's hydrological capacity to rapidly move large volumes of water through the watershed to the detriment of residents, fish and wildlife, and water quality.

Floodplain reconnection and revegetation at Brookside (1997)

The Johnson Creek Restoration Plan is a call to action for the watershed partners to cooperate in implementing projects that achieve multiple objectives, such as reducing nuisance flooding, increasing water quality, and improving fish and wildlife habitat. The plan acknowledges the influence of people in creating the current watershed conditions and recognizes their role in ensuring the plan's goals and implementation. Watershed restoration is expected to evolve over a period of years to a more naturally functioning system that meets ecological and human needs and benefits both current and future residents.



Brookside area after construction (1998)

This report was prepared under the auspices of the City of Portland's Bureau of Environmental Services (BES). BES is responsible for protecting water quality in the lower Willamette River and its tributaries, promoting healthy ecosystems in City watersheds, and managing stormwater, in addition to providing wastewater treatment and collection services. Throughout the analysis of the watershed and the development of recommendations, the Johnson Creek Watershed Interjurisdictional Committee provided valuable comments and support. The Johnson

Creek Policymakers, comprising elected officials from the six watershed jurisdictions and the Metropolitan Service District, and Congressman Earl Blumenauer's office provided the platform for interagency cooperation and support.

In the past, control of Johnson Creek floodwaters was the main focus. Due to increased regulations (e.g., Endangered Species Act and water quality), however, flooding is no longer the only challenge facing the watershed. It has become necessary to adopt a multi-objective focus and present projects directed toward meeting various restoration objectives, as well as flooding issues. This report recommends specific projects that adhere to the principles of rehabilitating Johnson Creek watershed's natural functions. Work efforts included incorporating the findings of previous studies, performing an environmental analysis, and developing an action plan with descriptions of potential projects ready for design and implementation.

Chapter 2 of this report provides a brief history of the Johnson Creek watershed and associated planning efforts. Chapter 3 outlines the approach used to apply the existing data, incorporate updated scientific and engineering analysis, and develop project recommendations. Chapter 4 describes recommended restoration techniques and assessments. Recommended projects and actions are described for each reach of the stream, and priority project areas are highlighted.

History

Before urbanization, the Johnson Creek watershed was a diverse area of upland and wetland forests with extensive vegetative growth on the forest floors, marshes, and scrub-shrub habitats. In the uplands, Douglas-fir, bigleaf maple, western hemlock, western redcedar, and oak trees dominated the landscape. The lowlands and floodplains were characterized by black cottonwood forests with an understory of willow.

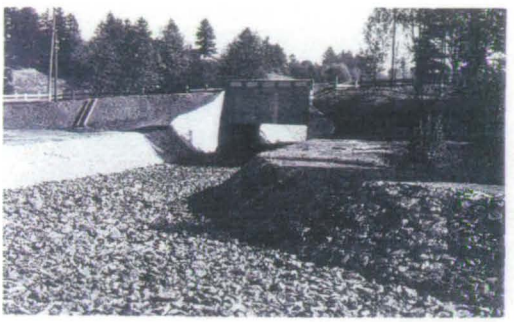
Survey maps from the mid-1800s indicate wetlands in the lower 3 miles of Johnson Creek and Crystal Springs. Salmon and trout were present throughout the mainstem and in most of the tributaries. Wildlife, such as elk, deer, smaller mammals, and bird species known to the Willamette Valley and surrounding lowland hills, are thought to have also thrived in the diverse environment of Johnson Creek.

Native Americans traversed and set up summer camps throughout the watershed as they fished, hunted, and foraged for seasonally available foods. There are a few known archeological sites in the vicinity of Reed College and along the canyon area of SE 45th to SE 82nd Avenue. It is assumed that there are more archeological sites remaining to be discovered.

As pioneers settled along the banks of Johnson Creek, the large ancient trees were cut mostly for railroad ties and housing material. Many sawmills were built along the banks, using the creek for power and damming it to create holding ponds for logs in the surrounding floodplains. In the lower portions of the watershed, the wetlands along the creek were filled and Crystal Springs was channelized for residential development.

The middle floodplains were cleared for farming to take advantage of the fertile soil deposited by frequent floods. In the Lents area, farmers added severe bends to the creek to back up the water and flood the fields. Settlers in the upper watershed cleared land for vegetable and berry farming, dairies, and ranching.

The rail line from Portland to Gresham (later extended to Estacada) was instrumental in furthering the eastward urbanization of Johnson Creek. Reaching its peak usage in the early 1900s, the electric interurban line, trolley, and rail line declined due to the growing popularity of the automobile. By the 1920s, many residential areas had sprung up in the northwestern area of the watershed, together with the supporting infrastructure for water and sewer services. Impervious surfaces covered the previously well-draining and fast-infiltrating soils.



As this urbanization moved eastward, more homes were built on floodplains, thus increasing the number of structures damaged by repeated flooding. In the 1930s, the Works Progress Administration widened, deepened, rock-lined, and channelized 15 miles of Johnson Creek in an effort to prevent future flooding. Nonetheless, flooding continued, on average, every other year.

After World War II, another boom in urbanization occurred. Gresham expanded, replacing nurseries and berry fields with urban development. Industries were built in areas along the creek in Milwaukie and Gresham and along SE Johnson Creek Boulevard. Portland, Gresham, and Milwaukie all experienced new growth during the post-war period.

Salmon and trout were once plentiful in Johnson Creek, and at one time there was a small commercial fishery near SE 45th Avenue and Johnson Creek Boulevard. The last sightings of Johnson Creek "thick with salmon" range from the late 1940s to the early 1960s, although sightings of plentiful trout have been documented right up to the 1980s.

In 1964, Johnson Creek underwent one of the largest floods known to date. Approximately 1,200 structures were flooded, and over the next several years many attempts were made to address flooding problems. The Soil Conservation Service, the U.S. Army Corps of Engineers, and the Metropolitan Service District (Metro) all attempted to find solutions to frequent flooding. Residents in the watershed were divided between those living in the floodplains and those living in the uplands. Heated debates over how flood control was to be paid for and what the remedy, or remedies, should be has left many plans for reservoirs, channelization projects, and regional detention facilities on the shelf.

The 1970s marked a smaller period of residential growth in the watershed. Infill took place in the already densely urban areas. Many of the smaller farms in the upper watershed were converted to large nursery operations.

The late 1980s through the 1990s have brought several developmental pressures to the watershed. These activities include development on the slopes of the Boring Lava Domes, expansion of the urban growth boundary in the Kelley Creek tributary, urban renewal in Lents, and further infill to the last of the frequently flooded areas along Johnson Creek.

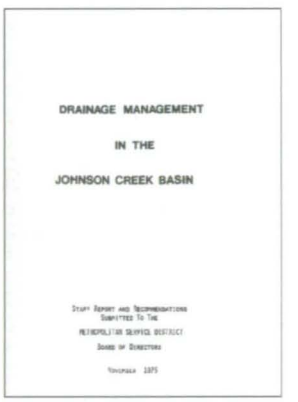
In 1995, the Johnson Creek Resources Management Plan (RMP) was adopted by all the jurisdictions in the watershed—Multnomah and Clackamas Counties and the Cities of Portland, Gresham, Milwaukie, and Happy Valley. The RMP outlined conceptual projects in four major categories: flooding, water quality, fish and wildlife habitat, and stewardship. It was the first plan to address flooding in the context of habitat, water quality, and stewardship. This 2001 restoration plan updates the concepts in the RMP while adding design objectives, project ideas, and management strategies that will respond to the challenges facing Johnson Creek today.

The following time line illustrates the evolving need for coordination and integration of strategies for managing Johnson Creek. Although the time line presents an overview of local, state, and federal studies and planning efforts, the chronology also documents the longstanding struggle to address flooding, water quality, and fisheries issues in Johnson Creek.

1933-1934 WPA revetment work, channel widening, and clearing and construction of a fish ladder completed.

1949 Southeast Johnson Creek Water Control District (Portland) established to promote a solution to recurring floods.

1950 The 81st Congress authorized the U.S. Army Corps of Engineers (COE) to provide improvements at an estimated cost of $535,000 federal and $275,000 non-federal funds.


DRAINAGE MANAGEMENT

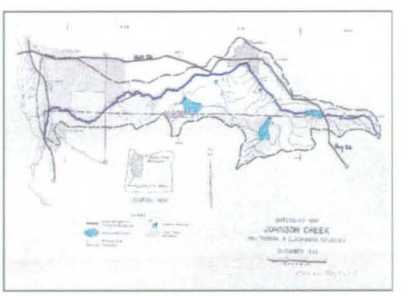
IN THE

JOHNSON CREEK BASIN

1958 Advance engineering and planning completed (COE Design Memorandum).

1960 Johnson Creek Water Control District began raising revenue from an assessment, and easements were secured until November 1964.

1964 Construction levy defeated (June). Johnson Creek Water Control District dissolved by vote of the people (November). Record flood occurred (December).

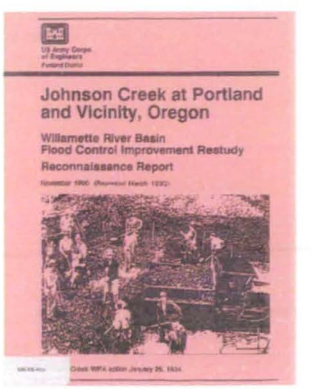


1966 Water Service District proposed but defeated by popular vote. COE placed Johnson Creek channel improvement project on initiative list.

1969 Soil Conservation Service plan recommended three reservoir and channel improvements on upper creek (cost of proposed project, $4.8 million).

1970 Formation of Metropolitan Service District (Metro) approved by voters.

1971 Metro signed contract with COE, giving assurance the District would sponsor a project.


Johnson Creek at Portland and Vicinity, Oregon

Willamette River Basin
Flood Control Improvement Restudy
Reconnaissance Report

1972 Congress authorized $55,000 to update 1958 COE Design Memorandum.

1975 COE Design Memorandum completed at a cost of $72,000. New project cost estimated at $2,250,000 federal and $1,136,000 non-federal. Metro secured grants from Cities of Gresham and Portland and from Multnomah and Clackamas Counties to investigate

funding alternatives for a project. Workshops conducted with citizen input.

1975 _____ Department of Environmental Quality (DEQ) conducted a study of the water quality in Johnson Creek.

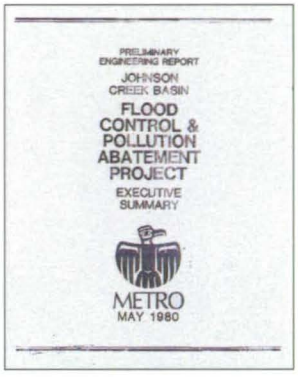
1976 _____ Metro drainage management proposal for Johnson Creek basin found unacceptable to citizens and State Water Resources Department. The department declined to sponsor request for funds. Metro failed to reply to inquiry from COE for sponsorship.

1978 _____ Metro reorganized. The district retained authority for regional flood control projects (surface water control).

1979 _____ City of Milwaukie completed comprehensive plan.

1979 _____ Sewer system for the Lents and Foster-Powell neighborhood areas completed.

1980 _____ Metro conducted more studies and published several reports, including the Johnson Creek Background, Preliminary Engineering Report and the Proposed Local Improvement District Public Involvement Report.



1980 _____ City of Gresham published its Community Development Plan.

1981 _____ Metro published *Along Johnson Creek: A Guide to Historical Sites and Natural Resources.*

1981 _____ Portland State University conducted a water quality monitoring program on Johnson Creek.

1982 _____ Metro published a Regional Stormwater Management Plan.

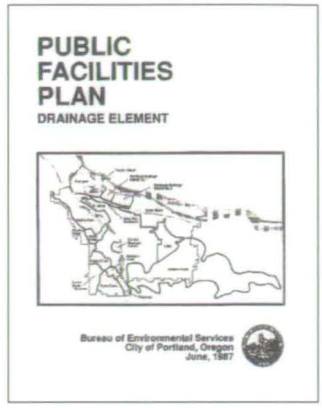
1982 _____ Meyers Consultants performed hydrology/hydraulics modeling of Johnson Creek for existing and future development conditions.

1984 _____ Portland Bureau of Environmental Services (BES) published its sewerage system facility plan for the Interstate 205 corridor and the Johnson Creek Basin.

1985 _____ Both a study to investigate sump impacts on groundwater quality in East Multnomah County and a Lents area sump suitability study were conducted (consultant).

1986 _____ Federal Emergency Management Agency conducted a flood insurance study.

1987 _____ BES completed the Drainage Element of Public Facilities Plan, including computer modeling of rainfall/runoff relationships.



1988-1989 __ Clackamas County completed a public facilities plan for sanitary sewers and storm drainage system.

1988-1990 __ U.S. Geological Survey conducted a surface-water quality assessment of the Johnson Creek Basin.

1989 _____ BES developed a proposal and plan for the Johnson Creek Resources Management Program.

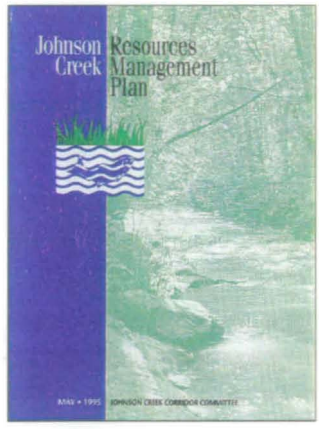
1990 _____ COE performed a reconnaissance flood control study and published its Reconnaissance Report Summary.

1990 _____ A Fisheries Information Summary was completed for Johnson Creek. An inventory, analysis, and regulation for the conservation and general management of wetlands, water bodies, open spaces, and wildlife habitat areas was completed.

1990 _____ Johnson Creek Corridor Committee formed.

1991 _____ BES conducted a reconnaissance-level physical habitat survey.

1991 _____ BES initiated the Johnson Creek Resources Management Program.



1992 _____ BES published the Johnson Creek Resources Management Plan Background Report.

1995 _____ Johnson Creek Resources Management Plan was finalized and adopted by each jurisdiction in the watershed.

1998 _____ BES initiated the Johnson Creek Restoration Project to implement the Resources Management Plan.

Approach

▷ Framework

The Johnson Creek Restoration Plan offers a multi-objective, watershed approach as the overriding strategy for developing solutions to a broad suite of problems in the Johnson Creek watershed. The Restoration Plan recognizes that nuisance flooding, water quality problems, and fish and wildlife declines have related causes and that a common solution requires the restoration of natural watershed functions. The following paragraphs describe the development of the goal to restore natural functions, outline the multi-objective approach, and identify the scientific foundation for the Plan's restoration components.

The Johnson Creek Restoration Plan focuses on implementation and builds on an earlier plan developed in 1995 by the Johnson Creek Corridor Committee. This group was made up of concerned residents and business owners joined by representatives of government agencies to begin seeking solutions to Johnson Creek's problems. The RMP was a comprehensive plan for managing resources in the Johnson Creek watershed that sought to "maintain Johnson Creek in as natural a state as possible within an urban and urbanizing environment." To ensure that Johnson Creek will be "managed as a natural waterway in an urban area rather than as a flood control channel," the Johnson Creek Restoration Plan goal is to rehabilitate the watershed's natural functions, which naturally resolve flooding problems, rather than relying on flood control structures to alleviate the problem. It is believed that this approach will simultaneously address water quality and fish and wildlife issues in the watershed. To achieve this goal, the plan recommends restoration components that are compatible with natural watershed functions, such as the restoration of floodplains, riparian buffers, wetlands, and in-stream habitat complexity.

The plan recognizes that actions are important only to the degree they are accepted by the residents of the watershed. Because Johnson Creek is situated within an urbanizing social and cultural

system, watershed residents have an important role to play in achieving the many objectives of the Johnson Creek Restoration Plan. For example, restoration will require an understanding of stream ecosystem processes, such as the function of floodplains in providing both flood storage and off-channel salmon habitat during flood events.

Limitations of Plan

The Johnson Creek Restoration Plan is not intended to be a stand-alone document, nor an end in itself. Rather, it is intended to be a base from which further investigations and recommendations for the remainder of the watershed can be implemented. As additional work is completed, it will be folded into the plan, continuing the goal of restoring and protecting the health of the watershed. The plan must be coordinated with other watershed programs and policies, as well as continued research and investigations, because the condition of the creek is directly tied to the healthy functioning of the entire watershed.

Due to the amount of work required and the limited resources available in the watershed, the focus of the Restoration Plan is the mainstem of Johnson Creek. Consequently, some aspects of watershed restoration are not substantively addressed in this plan. Recommendations concerning protection and restoration of upland areas, tributary protection, and salmon recovery are limited. Upland areas were determined to be beyond the scope of the Restoration Plan, and therefore were not specifically targeted for protection and restoration in the plan. As for tributaries, only the junctions and a short distance off the mainstem were identified for protection and enhancement. The identification of tributaries was limited to the most current available data. Finally, the plan offers recommendations that are consistent with salmon recovery efforts but does not focus on all the aspects necessary to achieve salmon recovery in Johnson Creek.

Although the plan is not a tributary and upland restoration/ protection plan or a salmon recovery plan, the recommended restoration components would still assist in the recovery of salmon, the restoration of tributary junctions, and identification of upland pathways for wildlife in the Johnson Creek watershed. Uplands and tributaries are considered vitally important to the *overall* health and quality of the watershed. And it is this overall health that will affect the ability of the creek to restore its salmonid populations. When evaluating opportunities within the watershed, jurisdictions

will need to be aware of the impacts of uplands and tributaries on the creek and work to enhance these elements of the watershed system that feeds Johnson Creek

The success of this Restoration Plan depends on the implementation and effectiveness of other city and county programs that address impacts to Johnson Creek. Due to their scope, many of these impacts could not be addressed in a single plan. In a given jurisdiction, these programs might include, but are not limited to (1) reducing stormwater impacts by following guidelines in Stormwater Management Manuals; (2) controlling sediment and erosion control in accordance with Erosion Control Manuals; (3) providing alternative means to reduce impervious surfaces through additional programs and policy; (4) protecting riparian areas through Environmental Zoning Code directives; and (5) assisting in the recovery of salmon through the Framework for an Endangered Species Act (ESA) Recovery Plan. The type and extent of programs will vary among the jurisdictions. These types of plans and policies are intended to work in conjunction with this Restoration Plan in restoring the watershed to a stable functioning system that can be inhabited and maintained.

Restoration of Natural Functions

There are several reasons for focusing on the restoration of natural functions as a dominant strategy. The first is that past recommendations for structural flood control options, such as regional detention/retention storage facilities and on-site detention storage facilities, as well as nonstructural options such as dredging, realigning, clearing, and widening the channel, have been rejected for a variety of reasons. The effectiveness of upstream reservoirs to adequately capture enough volume to reduce flooding has been questioned in recent years. In addition, ESA listing of two species of salmon – steelhead and chinook – has elevated the need to consider alternatives beyond simple flood control. Alternatives must be considered that address the conditions that have contributed not only to increased flooding, but also to the decline of salmon.

It will appear to the reader that the plan's primary focus is on flood control. Because of the history of flooding and the growing concerns of watershed residents, the City of Portland took on the responsibility of finding a solution. But, due to ESA concerns, as well as growing water quality problems in the watershed, the focus was broadened to resolve multiple problems.

Flooding, erosion, channel meandering, and sediment deposits are well-documented natural processes in the watershed. Traditional flood control efforts to overcome or control these processes have not been successful. The Johnson Creek Corridor Committee reflected this in its publication, *Johnson Creek Vision: A look at the future of Johnson Creek watershed (1992)*;

> *"Experience has shown that fighting a creek's natural tendencies is often more costly and ineffective for a long-term solution. Many traditional flood control options conflict with natural resource management and enhancement goals, water quality improvement objectives, and recreational opportunities. It is now recognized that it may be more cost-effective and environmentally sound to work within the creek's natural dynamics."*

Much of this thinking is a direct result of experience gained from the Mississippi River floods in 1993. The Army Corps of Engineers has taken a second look at its century-old efforts to hold back flooding rivers with dams, levees, diversion structures, and drainage ditches. An assessment of the effectiveness of these structures revealed widespread failures, resulting not only in structures being topped by increasingly smaller flood events than they were designed for, but also in rising flood damage costs. Rather than rebuilding old flood control structures, federal authorities armed with congressional funding have been buying up property in the Mississippi floodplain and allowing floodwaters access to the historic floodplain.

Traditional management of streams and rivers has often been piecemeal in approach, focusing on single issues or small sections of the stream rather than attempting to understand the entire watershed and its tributaries as a functioning ecological unit. While there is universal agreement about the severe degradation that currently exists in urban watersheds such as Johnson Creek, there is less agreement about the degree to which this degradation can be reversed. *While the return to historical conditions is in many cases not possible, it does not mean that important ecosystem functions cannot be restored.* In fact, conditions leading to nuisance flooding, contaminated soils, and polluted waters, as well as declines in aquatic and terrestrial species, are often the result of similar causes – land use decisions that have not considered the broader consequences of their actions. The lack of understanding regarding the complexities of stream ecosystems and a belief that creeks and

rivers must serve a direct human need in order to have value have contributed greatly to the conditions of many urban watersheds today.

The Johnson Creek Restoration Plan was developed under the premise that there are ways to restore watersheds and streams for both people and the natural environment. Strategies were designed to achieve multiple objectives, including the reduction of nuisance flooding, improvement of water quality and restoration of fish and wildlife habitat. Due to the listing of steelhead and chinook under the Endangered Species Act, the strategies included an emphasis on restoring salmonid habitat.

The following section outlines various restoration components, their scientific foundation, and the ways they will be used to achieve objectives. These components provide a means to move from ideas to actual, on-the-ground recommendations and implementation strategies. The restoration components include floodplain reconnection, riparian restoration, wetland restoration, fish habitat restoration, and water quality improvement.

▷ Restoration Components

Floodplain Reconnection

Restoration of natural watershed functions will require recognition of floodplains as an essential functional component of the Johnson Creek watershed for flood storage and as key off-channel habitat for salmonids. Development in the Johnson Creek watershed has largely constrained the creek. The creek has been channelized by fill in the floodplain, dredging, and placement of the WPA rock walls. The relatively deep and narrow channel exhibits high velocity flows and elevated water surface levels that increase erosion and flood damage along the creek. Re-establishing floodplain connections on a creek whose flow has been denied access to the floodplain for decades is seen as a means to restore processes important for slowing velocities, lowering local water surface elevation, and detaining some floodwaters via depression storage, infiltration, and decreased travel time. It will also restore the processes important for the survival of threatened salmonid species. Allowing floodwaters access to the floodplain and connecting backwater channels (old channels, oxbows, and depressions of the main channel) to the creek will allow for the

creation of off-channel habitat for juvenile salmonids. During winter months juvenile salmonids may use these off-channel habitats as a refuge from adverse main-channel conditions, such as flooding (high flow velocities), large volumes of suspended sediments, high temperatures, or large concentrations of pollutants.

Due to the extent of build-out in the Johnson Creek watershed, re-establishment of the full spectrum of historical stream/floodplain interactions is not feasible. Careful management of floodplains can be used to partially restore important ecological functions for fish and to provide a means for re-establishing channel processes such as flood storage and sediment deposition.

The current strategy is to first identify areas where flooding can be allowed to occur naturally and purchase properties through a "willing seller" program. Second, efforts will be made to work with additional property owners adjacent to the creek to implement terracing activities. Through such activities these lands can then be restored to reconnect the floodplain and, in the process, enhance the natural functions of storage and fish and wildlife habitat. This multi-objective approach requires that the life history strategies of salmonids be considered in the design of restoration strategies. The complex rearing strategies of multiple salmonid species requires that floodplains and off-channel habitat be accessible throughout the range of salmonids in the watershed. A full understanding of the possible life history strategies exhibited in Johnson Creek is not available at this time. Based on capture data by the Oregon Department of Fish and Wildlife (ODFW) and the City of Portland, the distribution of chinook, steelhead, and cutthroat suggest that floodplain reconnection throughout the watershed is a high priority in Johnson Creek.

These larger concepts are implemented in the Restoration Plan through the use of target functions. Target functions are a way to evaluate opportunities in specific reaches of the creek. The target function of floodplain reconnection is quantified through opportunities to implement constructed wetlands, enhanced wetlands, and stream bank restoration. These types of actions are described in more detail in Chapter 4.

Riparian Restoration

The riparian zone is subject to many definitions. Based on a functional rather than vegetative or topographic definition, the riparian zone is the area of direct interaction between aquatic and terrestrial environments. As the riparian buffer is the interface

between the stream and upland, it is a zone of numerous interactions important to both terrestrial and aquatic components of watershed ecosystems. It is this interaction between the two ecosystems – aquatic and terrestrial – that creates a unique floodplain and riparian ecosystem.

Riparian areas are essential for the protection of water quality and fish and wildlife habitat. Specific riparian functions that have been identified as critical are stream shading, large wood and fine organic litter recruitment, bank stabilization, sediment control, and nutrient exchange. Inundation of floodplain areas is a keystone process that helps facilitate these functions between the stream and floodplain and allows access for aquatic organisms, such as salmonids, to off-channel refuge areas during winter peak flows.

The Restoration Plan uses target functions as a way to implement the concept of riparian restoration. This is quantified through opportunities identified for floodplain reconnection as well as upland habitat patches. These target function actions are described in more detail in Chapter 4.

Wetland Restoration

Historically, floodplains in the Johnson Creek watershed were most likely similar to other 19th century watersheds, which consisted of seasonally inundated wetlands capable of naturally storing floodwaters. Floodplain wetlands fulfill important watershed functions. They store water, decrease peak flows, allow slow percolation of water into ground water, and increase the base flow of the creek during summer months when the creek flow is at its lowest volume.

The role of wetlands to mitigate downstream flood hazards has been recommended as a strategy for the Willamette basin as a whole (see P. Willams and Associates, Ltd., *An Evaluation of Flood Management Benefits through Floodplain Restoration on the Willamette River, Oregon, 1996*). Incorporating the purchase or restoration of wetlands into the range of strategies proposed for complementing flood management is due to the fact that, like historic floodplains, wetland hydric soils are generally indicators of low topography, which overbank floodwaters can easily occupy.

The current strategy is to build constructed wetlands is areas where there are no existing wetlands or where existing wetland function is seriously degraded. Areas that currently exhibit wetland characteristics would be enhanced to maximize wetland functions.

Wetland storage is an attractive option because it addresses several major restoration goals. Wetlands and their associated native species improve wildlife habitat and provide water quality benefits in the form of filtration and uptake. For flood management, the primary goal is to decrease flow rates downstream by holding flood volume for 24 to 72 hours.

Dispersed wetland restoration sites throughout the Johnson Creek watershed are preferred to a single flood retention project so that additional ecological and flood hazard benefits can be gained throughout the watershed. Many wetland areas that previously existed throughout the watershed have been filled or drained. These sites may be small but their cumulative benefits could lead to a substantial amount of storage and habitat throughout the watershed.

The Restoration Plan uses target functions as a way to achieve the larger concept of wetland restoration. Recommended actions specific to the target function of floodplain reconnection help to quantify the action of wetland restoration. These target functions are described in more detail in Chapter 4.

Fish Habitat Restoration

The downstream parts of Johnson Creek tend to collect and magnify the effects of land use modifications and practices throughout the watershed. The cumulative impacts of channelization, bank hardening, encroachment into riparian areas and floodplains, and infilling of wetlands are readily apparent. These result in conditions that are exhibited by changes in the magnitude and frequency of flood events, channel incision, extensive bank erosion, and loss of in-channel habitat complexity such as the number of stable, deep pools and large wood structures.

The fish community and in-stream habitat are often the first to exhibit changes resulting from watershed land use modifications. As a result, the status of salmon populations is an obvious indicator of the condition of the creek and watershed. Salmon have evolved diverse life history strategies reflecting adaptations to diverse channel characteristics, including use of the floodplain during flood events. Spawning and rearing habitats are tied to in-channel and off-channel features created by floods.

In order to restore salmon it will be important to find ways to accommodate the dynamic nature of flooding and the resultant

channel-forming processes into a restoration strategy. The proposed multi-objective approach for Johnson Creek allows for this. Floodplains that are purchased for flood storage will also provide off-channel opportunities for salmon.

Reconnecting floodplains to stream channels and restoring floodplain function has emerged as a prominent strategy for salmon and stream restoration. Salmon rely on the interconnection of the stream and its floodplain. Annual floods that have access to floodplains allow for the creation of off-channel habitats. Off-channel habitat allows juvenile salmonids the opportunity to escape adverse conditions in the main channel resulting from high flows, high temperatures, and high pollutant loads, as well as provides feeding and other rearing opportunities.

Flooding also allows for the formation of large wood jams. Stable and persistent large wood structures create important hydraulic controls that provide a variety of functions for fish and in-channel processes, such as deep pool formation, channel bed stability, and erosion control.

This strategy to increase in-stream complexity by supplying large wood to Johnson Creek must be balanced with the creek's ability to convey floodwaters. The extensive channelization that has occurred in Johnson Creek has inhibited the flood conveyance abilities of the channel. There are also active efforts to remove wood from the creek due to perceptions that wood can increase floods. It will be important to be aware of this in devising strategies to place large wood in Johnson Creek. Large wood could be one of a number of objectives that are tied to efforts to reconnect floodplains for the purpose of flood storage and creation of off-channel habitat.

The Restoration Plan uses the idea of target functions as a way to achieve the concept of fish habitat restoration. This is quantified through the same opportunities stated for floodplain reconnection, as well as through instream complexity and fish barrier targets. These target functions or actions are described in more detail in Chapter 4.

Water Quality Improvement

The Johnson Creek Corridor Committee recognized that water quality in Johnson Creek was poor. The *Johnson Creek Vision* listed high temperatures, failing septic systems, and toxic chemical spills

as some of the negative impacts affecting water quality in Johnson Creek. The *Vision* discussed the changes that have occurred as urbanization in the watershed has progressed. Increased impervious surfaces, and the related loss of plants and trees that once filtered stormwater runoff before it entered the creek, have profoundly influenced the hydrology and channel geometry of the creek. The historic flows – both winter peaks and summer lows – that the plant and animal communities evolved with have changed dramatically. Increases in impervious surfaces have increased the amount and rate of stormwater runoff reaching the creek. Loss of the trees and topsoil that allowed rainfall to percolate into the groundwater table, supplementing summer base flows, has also changed the system significantly.

Development and urbanization have also simplified the structural diversity of Johnson Creek. The physical diversity and biotic communities it once sustained, from bacterium to fish, contributed to the creek's ability to assimilate and process nutrients and other materials. The reasoning behind this is that streams and their biotic communities exert a certain amount of "top down" control on water quality within the stream, as long as input from the terrestrial component (e.g., stormwater) is not so concentrated as to have a toxic effect on the aquatic community. In theory, the more physically complex (e.g., large wood, pools, vegetated banks) a stream system, the greater its potential capacity to capture and entrain nutrients through a variety of pathways, ultimately maintaining water quality and maximizing aquatic productivity. The corollary is that the simpler the physical structure of the stream, the shorter the retention times for nutrient storage and the poorer the water quality due to rapid turnover from simple organisms.

This process may explain why many damaged and simplified streams exhibit relatively poor water quality despite attempts to control point sources of pollution. It implies that the protection and rehabilitation of fish habitat in urban streams such as Johnson Creek can contribute to the improvement of water quality.

The objectives of restoring natural conditions and processes in Johnson Creek will help achieve water quality objectives. Reconnecting floodplains and restoring complex habitat features both in- and off-channel will be important strategies. Restoring riparian buffers where appropriate will allow for a variety of functions, including temperature control. The temperature in Johnson Creek exceeds the maximum weekly average of 18°C

during the summer in all reaches below Gresham. Increasing riparian buffers will be one important strategy to help reduce summer stream temperatures.

The Restoration Plan will rely on stormwater, erosion, and environmental zone programs to complement the in-stream, floodplain, and riparian restoration actions of the plan. Most important, Stormwater Management Plans (such as the City of Portland's) are intended to control and/or manage "sources" of stormwater inputs that are adversely affecting the creek. The Restoration Plan is intended to complement this strategy by increasing the channel's ability to accommodate varying flow conditions.

During its aquatic habitat inventory throughout Johnson Creek, ODFW identified numerous stormwater outfalls that discharge directly into the creek. In recognition of the increased volume of water that these contribute to the watershed's natural hydrology, treatment of outfalls will be incorporated into floodplain reconnection and wetland restoration designs, creating opportunities to allow the flow to be metered before it enters the creek.

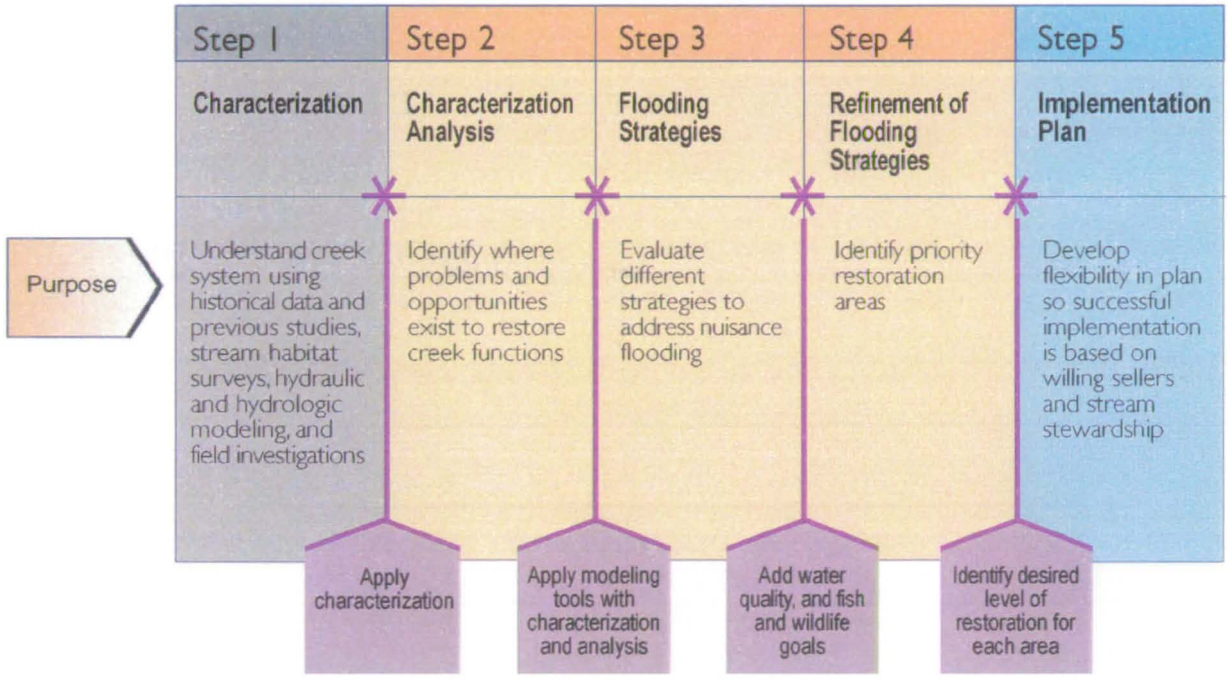
The Restoration Plan uses the idea of target functions as a way to achieve the larger concept of water quality improvement. This is quantified through the same opportunities stated for floodplain reconnection (constructed wetland, enhanced wetland, stream bank restoration) as well as pipe crossings, priority outfalls, and impervious surface mitigation. These target functions or actions are described in more detail in Chapter 4.

Process

A well-conceived and developed plan is critical to any restoration effort. This Restoration Plan establishes a framework for documenting the processes, forms, and natural functions operating within a riparian corridor; identifying disturbances that disrupt or eliminate those functions; and planning and implementing restoration activities. This chapter describes the process used to establish such a framework for Johnson Creek, including the development of recommendations. Figure 3-1 summarizes the steps taken to develop recommendations.

In 1998, BES initiated the Johnson Creek Restoration Plan Project to develop implementable projects based on previous planning documents and incorporating new hydraulic analysis and fish habitat data. The goal of the resulting recommendations is to address flooding, fish and wildlife habitat, and water quality in a comprehensive manner.

Figure 3-1: Restoration Planning Process



Characterization

Development in the Johnson Creek watershed has followed the typical pattern of population growth seen throughout the Pacific Northwest with the removal of vegetation and an increase in impervious surfaces, channel straightening, and bank hardening. These changes have reduced in-stream channel stability and complexity and increased stormwater runoff. The physical and hydrologic changes have necessitated an increasing reliance on engineered structures, such as stormwater detention facilities, bypass pipelines, and dikes and revetments (e.g., WPA walls), to reduce the impacts of increased flooding and bank erosion in order to protect and enhance the landscape for human needs. These changes have further affected the complex ecological functions necessary for many aquatic and terrestrial species. Recent ESA

listings have heightened concerns about the adverse effects of these changes on threatened salmonid populations.

Understanding the biological, chemical, and physical watershed conditions was the foundation for the approach used to develop recommendations. In addition to the historical record of the Johnson Creek watershed (Chapter 2), other tools and data sources for this study included the following:

- Previous studies and existing regulations
- Hydraulic and hydrologic watershed model
- Stream habitat survey
- Field investigations

Previous Studies and Existing Regulations

Resources Management Plan

A wealth of information was collected during the development of the 1995 *Johnson Creek Resources Management Plan*. The work involved in developing this plan incorporated much of the RMP information. Two primary elements of the RMP needed refining. First, many of the RMP recommendations regarding flood management could not be implemented; and second, the ESA has intensified the need to solve problems affecting salmonids.

The flood management plan element of the RMP was intended to offer a reasonable level of flood protection to existing structures while preventing new development from adding to flooding problems. The element included the following actions:

1. Construct on-stream detention basins with a combined capacity of 400 acre-feet in the upper watershed. Provide off-stream storage with a capacity of 200 to 600 acre-feet in the Lents neighborhood, east of Interstate 205. The off-stream storage facilities in the Lents area were intended to have multiple purposes: improving water quality, expanding wildlife habitat in the vicinity of Beggars tick Marsh, and creating recreational opportunities.

2. Restrict filling in the 100-year floodplain to prevent loss of floodwater storage and consequent increases in floodwater levels.
3. Maintain stream channels regularly so that their capacity to convey floodwaters does not decline unacceptably.
4. Establish emergency response procedures to minimize damage during floods.
5. Limit future increases in peak flow by requiring new developments to include floodwater storage facilities.
6. Acquire the most vulnerable structures in the floodplain as they become available from willing sellers.

The intent of these flood management provisions was to manage the creek as a natural waterway in an urban area, rather than as a flood control channel. However, Items 1 and 3—major components of the plan—were not accepted by the public and also conflicted with the approach to re-establish floodplain functions. This Restoration Plan project has therefore focused on updating the flood management plan element by evaluating the effectiveness of various storage options within the boundaries of public acceptance and ESA requirements.

Endangered Species Act

The Endangered Species Act first became an issue for Johnson Creek when steelhead were listed in March 1998. Subsequent listings of chinook in March 1999 and pending listings of coastal cutthroat have created a legal and environmental responsibility for the City of Portland. The 4(d) rule, released on June 20, 1999, makes it illegal to "take" a listed species. The term is broadly defined to mean that a species listed under the ESA cannot be killed or harmed in any way. The definition of take has also been interpreted to include habitat conditions—that is, habitat that a species depends on cannot be destroyed or altered in any way that jeopardizes the existence of that species.

Johnson Creek is used by two species of anadromous salmonids that have been listed as threatened under the ESA: winter steelhead (*Oncorhynchus mykiss*) and spring chinook salmon (*O. tshawytscha*). Cutthroat trout (*O. clarki*) also inhabit the watershed and have been proposed for listing as a threatened species.

The RMP acknowledged that restoration of native salmonid runs in Johnson Creek and its tributaries would not be feasible without substantial improvements to existing habitat conditions. The

recommended overall strategy for fish habitat restoration has three major components:

Cutthroat

1. Gradually restore the creek to a more natural, salmonid-friendly condition. Improvements of this sort will take many years and can be expected to improve the salmonid populations only in the long term.
2. Initiate some immediate physical improvements to fish habitat that will produce benefits within a year or two.
3. Take advantage of any opportunities for habitat improvements that arise as a result of streamside construction or other activities unrelated to the RMP.

The RMP described site-specific recommendations for habitat improvement. This Restoration Plan incorporates those recommendations in the reaches of Johnson Creek, combined with flood management strategies.

Rainbow

Each jurisdiction has developed and adopted regulations for managing development within its boundaries. The recent listing of lower Columbia salmon has focused attention on how these six partners plan to manage activities within the watershed for the benefit of fish and wildlife as well as residents. Review of these regulations suggests they are complementary across the watershed and are consistent with the Restoration Plan recommendations.

Floodplain Management Ordinances

Residential properties in areas prone to frequent flooding present risk exposure for property owners and agencies responsible for public health and safety. Although only 6 percent of the City's floodplains are in the Johnson Creek watershed, 78 percent of the properties undergoing repetitive loss are located here. At present, 132 residential structures (both single family and multifamily) in the watershed are at risk of frequent flooding. An additional 183 commercial, industrial, and public buildings are located in the nuisance flood area.

All six jurisdictions participate in the National Flood Insurance Program (NFIP) administered through the Federal Emergency Management Administration (FEMA). Jurisdictions participating in this program must adopt and enforce minimum floodplain management standards. The floodplain management requirements prevent development from increasing the existing flood threat and protect new and existing buildings from anticipated flood threats. Through the NFIP, property owners can purchase insurance protection against flood losses.

Communities can adopt floodplain management standards that are stricter than the minimum required under the NFIP. Most of the Johnson Creek jurisdictions have adopted Floodplain Balance Cut and Fill Standards. These standards acknowledge the existence and importance of preserving known floodplain areas throughout the watershed. Development that fills floodplains must either remove the fill or excavate an adjacent area that equals the flood storage volume lost due to filling.

Stormwater Management Regulations

All six jurisdictions have regulations for managing stormwater within their boundaries. The Federal Clean Water Act requires municipalities to develop stormwater standards for mitigating and managing the impacts of stormwater runoff on receiving water bodies. These regulations deal with the water quality and flow control aspects of surface waters. All of the jurisdictions have obtained National Pollution Discharge Elimination System (NPDES) Permits during the 1990s.

Typically, stormwater regulations have focused on three specific management areas:

1. Water quality pollution prevention and best management practices (BMPs). This approach aims to control pollutants at their source. Pollution-prevention BMPs include public education and stewardship, system maintenance, inspection, system and road maintenance, sampling, monitoring, and detection of illicit discharges.
2. Water quality stormwater treatment BMPs. This approach focuses on treating entrained pollutants in stormwater and removing them before they discharge into a water body. Water quality BMPs include design and construction of constructed wetlands, water quality manholes, swales, oil-water separators and absorbent booms, treatment ponds, stream bank restoration, and vegetation.
3. Water quantity flow control (e.g., detention/retention) to limit both the rate and volume of runoff. This approach attempts to characterize the natural hydrology of a site after its development. These flow control regulations support floodplain regulations. The City of Portland updated its stormwater management regulations by adopting a Stormwater Management Manual in September 2000. Other jurisdictions are in the process of updating their practices.

Water Quality Regulations

Pursuant to Oregon Administrative Rules (OAR), the Oregon Water Resources Commission establishes beneficial uses for waters of the state. The Department of Environmental Quality (DEQ) has identified Johnson Creek as waters of the state, with all designated beneficial uses applicable.

In 1998, DEQ added Johnson Creek to the list of waterbodies on its 303(d) list. A waterbody that is water quality limited for certain parameters is placed on this list under section 303(d) of the federal Clean Water Act. Johnson Creek is listed as water quality limited for bacteria, summer temperature, and toxics (DDT and dieldrin). The listing includes the entire stream, from the mouth to the headwaters. After a waterbody is placed on the 303(d) list, the next step is the development of total maximum daily loads (TMDLs) for the listed parameter(s). DEQ is scheduled to establish TMDLs for Johnson Creek by 2003.

All six jurisdictions will be affected by these current and future water quality regulations. When TMDLs are established for Johnson Creek, it will be up to the jurisdictions to work with DEQ to ensure that regulations are in place to meet the state requirements. Johnson Creek faces many problems with respect to the degradation of water quality.

Riparian Protection

The establishment of riparian protection buffers to protect identified resource areas complements habitat protection measures. Riparian areas are richest in terms of species diversity and complexity. The importance of protecting these areas is directly associated with maintaining the natural resources of a watershed. Buffer widths protect natural resource areas from development and are part of each jurisdiction's plan to meet State Land Use Planning Goal 5 requirements.

Since 1995, all six of the jurisdictions have adopted riparian protection buffers into their local zoning codes. Buffer widths among the jurisdictions vary from a minimum of 15 feet up to a maximum of 300 feet. The value of protecting and setting aside a riparian corridor along Johnson Creek complements other regulatory requirements previously discussed.

Erosion Control

Sediment in Johnson Creek is a significant problem recognized by local and state agencies. Excessive sediment from development and construction impairs water quality and adversely affects both fish and wildlife. Development is a major cause of sediment in the stream. Rainfall on unprotected slopes precipitates significant volumes of sediment entering local watercourses and ending up in Johnson Creek. Increased runoff rates resulting from development scour channels and sediments and also cause down-cutting of the stream channel.

Each watershed jurisdiction recognizes these problems and has adopted ordinances and new development standards to address such issues. Gresham and Multnomah County have had ordinances in place since 1991. Other jurisdictions are updating their existing ordinances to be compatible with newly adopted development standards. A stop-work order is the primary method for enforcing these regulations. All jurisdictions enforce these regulations through their construction inspectors.

Hydraulic and Hydrologic Watershed Model

A watershed model was developed as a primary tool for use in the characterization and analytical phases of this project. During the characterization phase, the model was used to identify reaches of the creek with high velocities, areas inundated by flooding events, and subbasins contributing high runoff rates. During the analysis phase, the model was used to identify and simulate the effectiveness of various flood management strategies.

Nuisance Flood Definition

The first objective was to define the level of flooding protection that the Restoration Plan recommendations would provide. As recommended by the RMP, this effort needed to develop solutions to more frequent and troublesome floods, such as the flooding that has occurred several times during the 1994-1996 period. This targeted level of protection has been termed the "nuisance flood" or the "frequent flood" to indicate the desire to focus on flood events that occur repeatedly and cause "nuisance" or frequent damage.

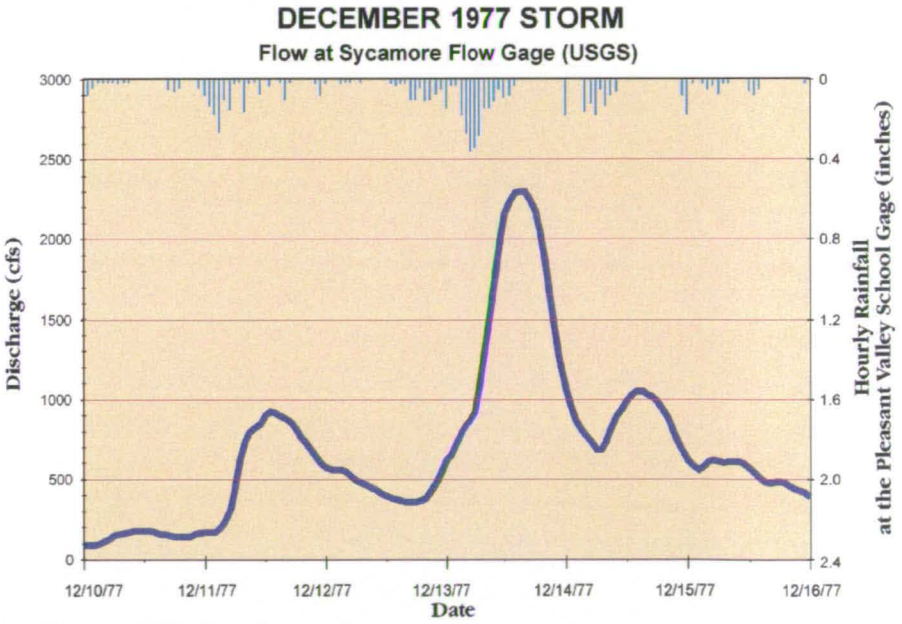
Initially, based on experience in the watershed, the nuisance flood was described as either a 5-year or 10-year return period flood event that approached the 210-foot elevation in the Lents area. A

three-tiered analysis was performed to develop the full technical definition of the nuisance flood and its characteristics, as follows:

1. Statistical analysis of rainfall and flood flow data to explicitly determine the controlling rainfall patterns that have caused Johnson Creek to flood historically
2. Review of historical flood maps to determine distinct repeated patterns of flooding and identify those patterns that have changed over time
3. Flood frequency impacts analysis to evaluate the potential impacts to the watershed and local properties for flood events that vary from a 2-, 5-, 10-, 20-, 50-, and 100-year return period

Conclusions from the Statistical Analysis. The statistical analysis team reviewed available stream flow data from the U.S. Geological Survey (USGS), historical rainfall data from the City's rain gage network, and data from the National Weather Service Portland Airport rain gage (Figure 3-2).

Figure 3-2: December 1977 Rainfall for the Nuisance Flood Storm



Peak flow = 2,250 cfs, ~13-yr event
Peak 24-hr volume = 3,000 acre-ft, ~10-yr event
Peak 72-hr volume = 5,700 acre-ft, ~10-yr event

The analysis determined the following:

- Flood events in Johnson Creek occur only in the winter months (November to March) when there has been sufficient rainfall to saturate the natural storage within the vegetation and soil.

- The 3-day rainfall depth is the strongest indicator of flooding events, including the maximum water surface level and flow volume. For example:
  - 2-year floods are typically generated by about 3.2 inches of rainfall over 3 days.
  - 5-year floods are typically generated by about 4.7 inches of rainfall over 3 days.
  - 10-year floods are typically generated by about 5.7 inches of rainfall over 3 days.
- Short, intense rainfall bursts (one hour in duration) will not by themselves generate a nuisance flood event. The watershed is too large to respond to short-duration rainfall bursts.

Conclusions from the Review of Historical Flood Maps. A review of historical flood maps indicated the following:

- Significant changes in flooding patterns in the Lents area have occurred over time due to channel improvements, development activities, and filling on properties.
- Many of the areas that flood frequently at this time are now publicly owned properties.
- Due to the changes in Johnson Creek and the watershed, the extent and locations of flooding for a 5-year or 10-year flood are much different today than before 1980. The historical floods mapped prior to 1980 show a much different shape of floodplain compared with the pattern seen in the Lents area during the 1994-1996 period.

Conclusions from the Review of Flood Frequency Impacts Analysis. The frequency impacts analysis showed that there is a clear breakpoint around the 10-year return period flood at which most of the important economic and environmental areas of concern are affected. Therefore, managing the 10-year flood will likely provide a level of protection that is cost-effective yet maximizes environmental benefits.

Conclusions from the Future Conditions Analysis. The hydrologic and hydraulic model was used to examine the change in flood flow rate and volume that might result from increases in impervious area due to future development expected in the watershed. The land use distribution that defines future conditions was derived from the City's Comprehensive Plan and Metro's Regional Plan. Unfortunately, the model simulations are not sufficient to adequately quantify the change in flood flows and volume. This problem occurs because the model was constructed to simulate large flood events involving highly saturated conditions and significant winter rainfall periods. As a result, the model simulates the nuisance flood well and is calibrated for those large

storms. It is not, however, able to simulate the true increase in flows and volumes due to a change in the imperviousness, surface area, and soil runoff routing that occurs in future development. BES is pursuing a more comprehensive watershed modeling tool to address this problem, but it will be a few years before a more sophisticated modeling system can be applied to the Johnson Creek watershed.

Nuisance Flood Characteristics

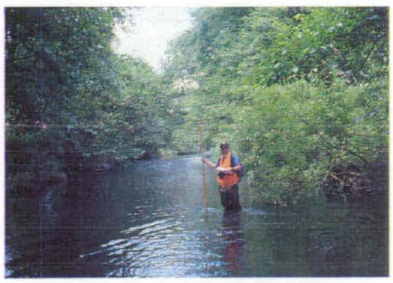
The Johnson Creek restoration team reviewed the results of the nuisance flood analysis and recommended that the design flood standard for the project be based on the following definition of a nuisance flood:

- The flood event is a 10-year return period.
- Rainfall should be derived from an actual, historical 3-day or longer rainfall pattern in the watershed that generated an actual 10-year flood event in Johnson Creek.

The best candidate event is the December 1977 flood, which reflects an early wet period followed by a true 10-year flood event with the following characteristics:

- Maximum measured flow rate = 2,250 cubic feet per second (cfs)
- Maximum 24-hour flow volume = 3,000 acre-feet
- Maximum 3-day flow volume = 5,700 acre-feet

The watershed model selected to model Johnson Creek was XP-SWMM, a proprietary version of the U.S. Environmental Protection Agency Storm Water Management Model. XP-SWMM was chosen because of its capability to simulate dynamic conditions. Table 3-1 summarizes the principal data used. Detailed documentation of the model development is presented in a separate technical memorandum titled Johnson Creek Watershed Analysis - Development and Calibration of Johnson Creek Watershed Model No. 2000.



Stream Habitat Survey

The Oregon Department of Fish and Wildlife was contracted to conduct a stream habitat survey of Johnson Creek during the summers of 1999 and 2000. The survey measured in-stream and streamside physical habitat parameters considered beyond the scope of previous surveys. These parameters included chemical and physical water quality, water quantity, and food production and

distribution parameters. The major assumption underlying the physical habitat parameters is that they are indicators of the basic structural components of the stream that salmonids use during the various stages of their life histories.

Method

The Oregon Department of Fish and Wildlife Aquatic Inventories Project Physical Habitat Surveys 1999/200 delineated 23 reaches along the mainstem of Johnson Creek from the confluence of Johnson Creek and the Willamette River to the headwaters near Cottrell. Selected tributaries of Johnson Creek were also surveyed. Each reach delineation was based on specific changes in channel type (e.g., stream reaches tightly confined by WPA walls, vegetation changes, bridges).

Reaches were further subdivided into channel geomorphic units, which are relatively homogeneous lengths of the stream that are classified by channel bed form, flow characteristics, and water surface slope. These units were generally categorized as pools, riffles, cascades, steps, rapids, and beaver dams. Within each unit, a range of physical features was defined and measured. These features generally included surface slope of water, as well as length, width, and depth of pools, riffles, and other geomorphic categories; number and size of wood pieces; channel bed form and substrate condition; and bank condition, among others. In addition to specific categorization and measurements within each unit, streamside measures were taken at every 10th unit (i.e., floodplain, terrace height, and active channel width) and every 30th unit (i.e., riparian vegetation characterization).

Results

The results of the ODFW surveys indicated that in the first 15 reaches much of the physical habitat complexity normally associated with salmonid streams has been simplified, modified, or eliminated. Reach 16—in the vicinity of the City of Gresham—is an anomaly and was described by the ODFW surveyors as one of the most natural reaches they encountered. The character of Johnson Creek changes continuously over the last seven reaches, where land use patterns dominate the overall character of the watershed and have significant impact on the in-steam habitat. Elsewhere, there is extensive channelization, bank hardening, and modification throughout the surveyed reaches.

Severe bank erosion is evident in many reaches; bed substrate is dominated by silts, organics (mud) and sand; and wood is basically absent. Shallow riffles dominate the survey reaches, and very few pools are more than 1 meter in depth. Although channel incision was not measured, the surveyors noted that this condition is extensive in a number of the reaches. Off-channel refuge areas for salmonids from winter high flows in the form of alcoves, backwater areas, and side channels were rare throughout the surveyed reaches.

Table 3-1: Watershed Model Data Sources and Assumptions

Data Type	Description	Source
Hydraulic facilities	Pipes, manholes, culverts, sumps, diversion structures	City of Portland Facility Maps, construction as-builts, field surveys
Creek system data	Cross sections, channel centerline, bridges, etc.	City of Portland survey data, U.S. Army Corps of Engineers HEC-RAS model, Metro-RLIS database
Streamflow data	Stage and flow data from Milport (mile 0.9) and Sycamore (mile 10.7) stations	U.S. Geological Survey
Rainfall data	Series of six gages throughout the watershed (1976 to present)	City of Portland HYDRA Raingage System
Existing land use	Used to determine existing impervious area in regions without building, parking lot, and street area data	City of Portland Bureau of Planning current zoning maps
Future zoning	Used to determine future impervious area	City of Portland Bureau of Planning's 1999 Comprehensive Plan within Portland city limits; Metro 2040 zoning elsewhere
Building & parking lot area	Impervious area component	Aerial photographs (1998)
Street area	Impervious area component	Aerial photographs (1998)
Existing system impervious area	Total of building, parking lot, and street areas within city limits; values based on existing land use were used elsewhere	Building and parking lot area, street area; existing land use
Vegetative cover	Used to determine extent of riparian corridor	Aerial photographs (1998)
Soil types	Used to determine soil infiltration rates	National Resource Conservation Service (data) and Metro (geometry)
Slope	Used to determine how quickly runoff enters the creek	USGS Digital Terrain Model

A thorough, continuous description of riparian vegetation was not provided since the survey protocol only measured riparian features every 30 units. Existing data indicate extensive alteration of the riparian forest related to development of a variety of building structures, agricultural and grazing land uses, removal of native conifers and deciduous species, and replacement by invasive species.

The survey results of in-stream and streamside conditions of Johnson Creek can be summarized by the following: extensive bank erosion, few pools, little to no wood, homogenous channel bedform, channel bed substrate dominated by fine sediments, frequent evidence of channel incision, and little connection to floodplain refuge areas due to highly channelized and artificially hardened bank conditions.

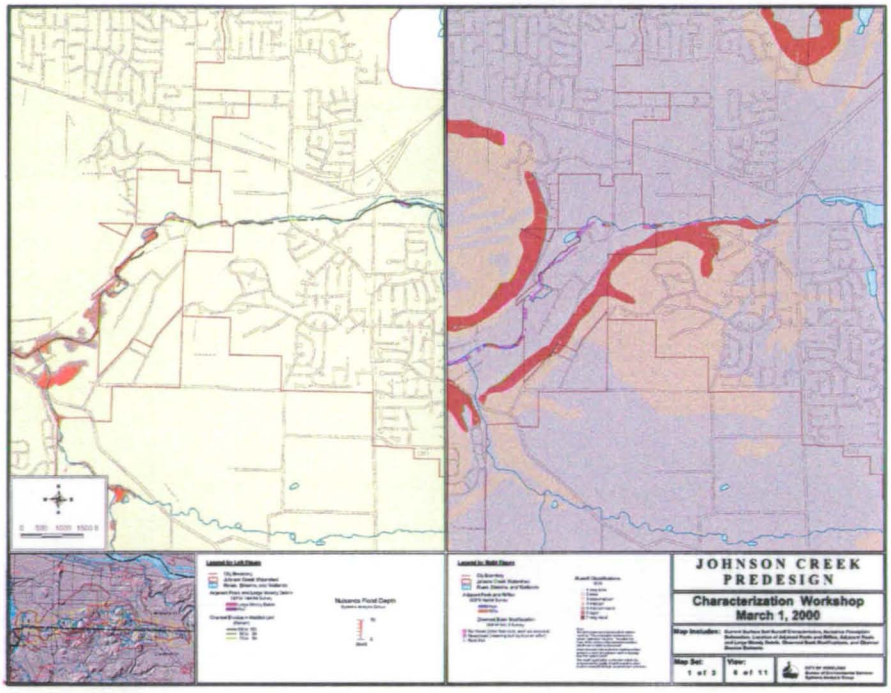
Field Investigations

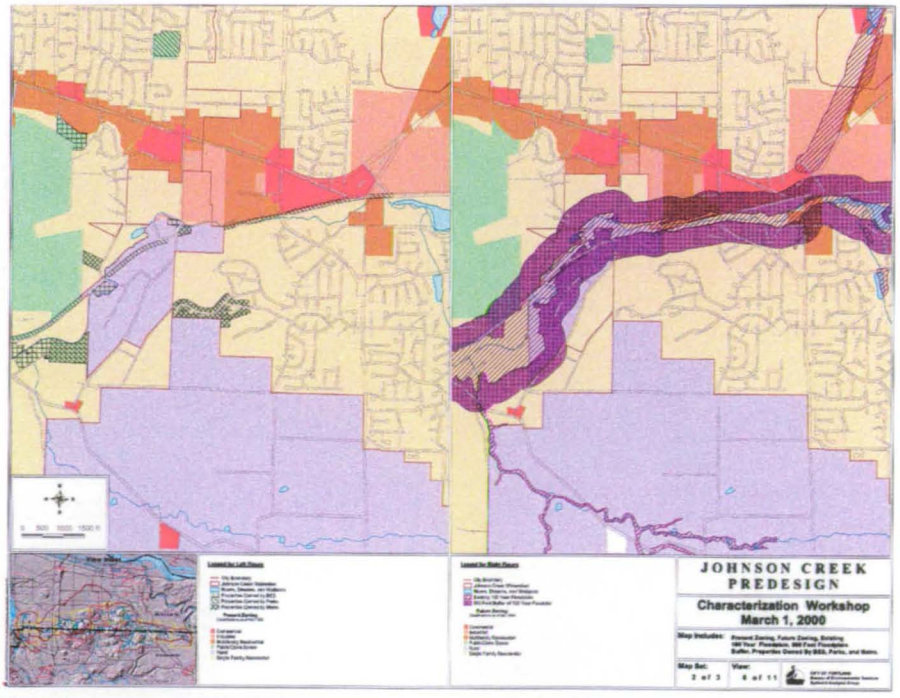
Field investigations in Johnson Creek, conducted between October 1999 and September 2000, identified areas of opportunity to reconstruct critical lost functions. Formal vegetative, wildlife, habitat and hydrologic surveys studies will be required to obtain more detailed information during the early design phases for each area selected as a project. The following criteria were considered during initial field assessments of reaches.

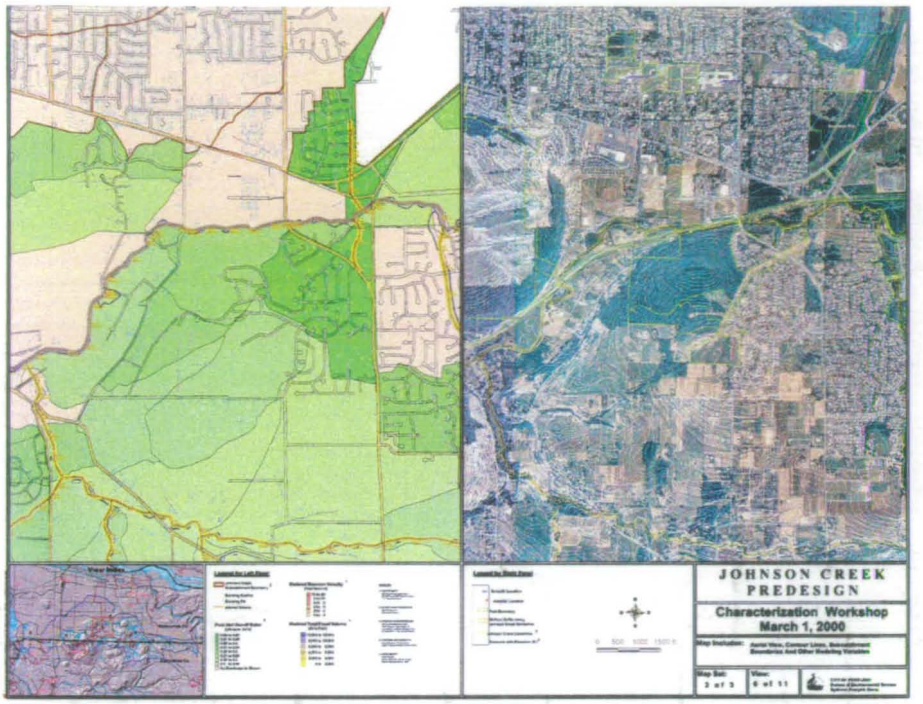
- Visual assessment of existing floodplain function
- Visual assessment of floodplain reconnection/passive flood storage potential
- Dominant vegetation (primarily trees and shrubs)
- Diversity and abundance of species present
- Occurrence of species in Johnson Creek watershed (i.e., relative rarity)
- Presence of wetland vegetation
- Notable presence of native wildlife
- Presence of non-native species (plants and animals)
- Visible hydrology
- Condition of banks (erosion and incision)
- Presence of seeps/springs
- Current land use (e.g., residential, industrial, open space)
- Proximity and connection to existing open space
- Number and condition of tributaries
- Visual assessment of water quality

Characterization Analysis

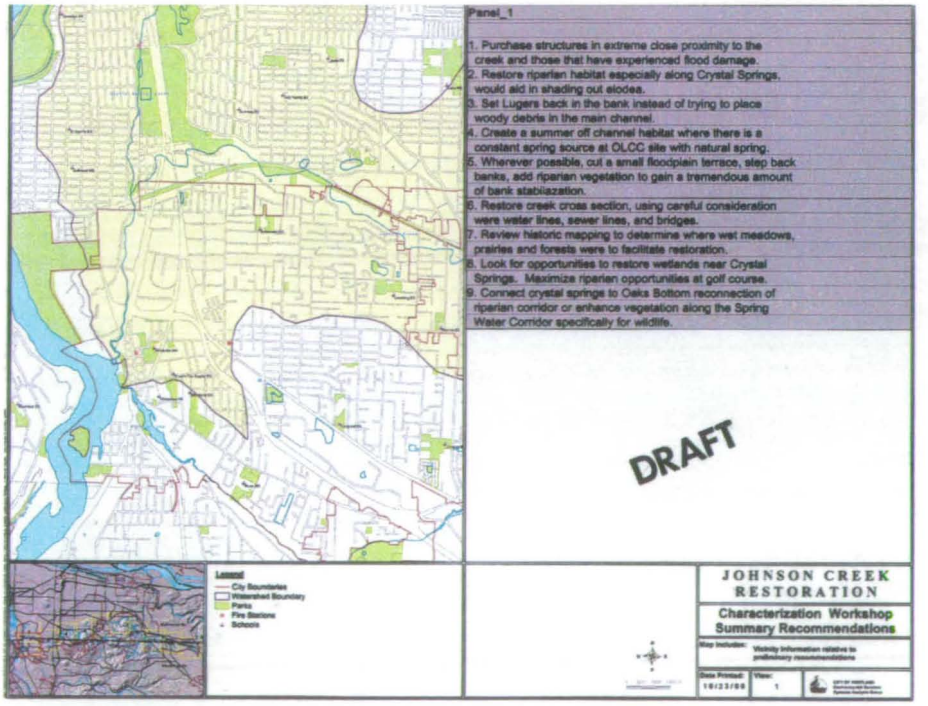
The characterization results were applied using a geographic information system (GIS). Johnson Creek was divided into 11 reaches, and representative characteristics were mapped to identify where problems and opportunities coincided. Examples of the GIS map sets used during this phase are shown in the following three panels.







This analysis resulted in concepts for each of the 11 reaches, as shown in the panel below. These concepts were later used to develop specific recommendations once the effectiveness of flood storage options was evaluated.



Plan Strategy Development

After characterization was completed, it was necessary to determine a strategy that would addresses nuisance flooding and also restore and maintain natural functions within Johnson Creek. To accomplish this, the project team first identified three strategies (outlined below) to address nuisance flooding. These three strategies were then compared with one another by using a set of criteria (benefits, feasibility, and cost) to determine the strengths and weaknesses of each strategy. The focus of this process was to choose a strategy that would simultaneously meet multiple objectives.

Strategies

Strategy 1—Protect and Restore the Resources and Functions of Floodplains (Full Restoration Project Implementation)

Strategy 1 was used to evaluate the effectiveness of restoration projects on flood reduction. The creek was divided into 58 restoration reaches of similar length and physical characteristics. Each reach was modeled to maximize the potential floodplain reconnection and passive flood storage that could be achieved. Considerations for Strategy 1 were:

- Maximize the creation of off-channels and in-stream complexity for fish habitat
- Maximize the creation of vegetation and stream bank improvements
- Maximize passive flood storage sites by removing fill and structures in the historical floodplain

Strategy 2—Modify Flooding (Large Off-channel Storage)

Strategy 2 was developed to determine the level of flood reduction that could be achieved by storing relatively large quantities of water in a few selected locations. Off-stream reservoirs were assumed because they would tend to have less impact on fish passage and habitat and offer more potential for habitat improvement. On-stream reservoirs were not considered implementable based on past experience and the current regulatory environment. Considerations for Strategy 2 were:

- Reduce or eliminate flooding in the Lents area during the nuisance storm

- Minimize impacts to fish passage
- Minimize the number of sites throughout the watershed
- Minimize the height of perimeter berms at stormwater detention facilities
- Create a system that operates passively, thus avoiding the requirement for mechanical controls

Strategy 3—Modify Susceptibility to Flood Damage and Disruption (Purchase At-risk Structures/Properties)

Strategy 3 was used to evaluate the purchase of properties containing structures that are prone to flooding during a nuisance flood event. No attempt was made to modify the flood hydrograph. As opportunities occur, acquired areas would be restored to maximize natural functions.

Evaluation Criteria

Three categories of criteria were developed to assess how well the strategies performed in relation to specific measures, such as technical benefits, feasibility, and cost.

Technical benefit criteria measured how the strategies performed in addressing the issues of flooding, improving fish and wildlife habitat, and improving water quality. The quantifiable benefits selected for evaluation were:

- Number of private properties removed or protected from nuisance flooding
- Dollar value of the structures removed or protected from nuisance flooding
- Acres of floodplains and riparian corridor created or restored
- Linear feet of in-stream complexity created or restored
- Linear feet of off-channel habitat created or restored
- Acres of groundwater-fed seeps and springs created or restored
- Acres of riparian shade canopy protected
- Number of stormwater outfalls improved

Feasibility criteria measured the risks associated with project implementation. These criteria were evaluated on the basis of public involvement feedback, the project team's experience with similar projects, and discussions with resources agency representatives from the National Marine Fisheries Service, Oregon Department of Fish and Wildlife, Oregon Division of State Lands,

U.S. Army Corps of Engineers, and city and county land use planning departments. The criteria were:

- Public acceptance (considering issues such as landowner concerns, condemnation, expected community support, expected political support)
- Regulatory support (feasibility and ease of permitting)
- Implementability (considering such issues as construction difficulty and new techniques)

A cost criterion was used to compare the capital cost of each strategy. The assumptions used in the cost estimates for the strategy evaluation and recommendations are detailed in the last section of this chapter.

Initial Evaluation Results

Based on the three evaluation criteria outlined above, the strategies were ranked on a scale from 1 (lowest) to 5 (highest). Table 3-2 summarizes the results of this ranking.

Table 3-2. Summary of Flood Strategy Ranking

Strategy	Benefits Ranking	Feasibility Ranking	Cost Ranking	Average Rank
1. Full Restoration Project Implementation	3.6 (med.)	3.9 (med.)	0.7 (low)	2.5 (med.)
2. Large off-channel storage	1.1 (low)	1.3 (low)	4.4 (high)	2.3 (med.)
3. Purchase of at-risk structures/properties	1.9 (low)	4.7 (high)	4.2 (high)	3.6 (high)

Low (0-2), medium (2-4), high (4-5)

The results of the evaluation were used as a tool for comparing the different strategies with each other and determining each strategy's respective strengths and weaknesses. The strategy of acquiring frequently inundated structures or properties was ranked highest, based on an evaluation of benefits, feasibility, and costs. Even though this strategy ranked the highest, the project team recognized that acquisition, by itself, would not adequately address the objectives of improving fish and wildlife habitat and water quality. Likewise, the strategy of large, off-channel storage areas was deemed inadequate in meeting the multiple goals already identified. This was reflected in the average rank of this strategy—low ranking for benefits and feasibility. The strategy of full restoration project implementation was judged to effectively address multiple

objectives but was considered somewhat cost-prohibitive. Through this ranking evaluation it was decided that a combination of strategies would best meet the multiple project objectives.

Refinement of Strategy

It was necessary to choose a strategy that would meet multiple objectives. Because none of the three strategies alone proved adequate, the project team decided that a combination of the evaluated strategies was necessary. A combination of strategy 1 (full restoration project implementation) and strategy 3 (purchase of at-risk structures/properties) was determined to be the best approach. By combining the benefits of strategy 3 (removing structures to avoid damage caused by flooding) and incorporating the benefits of strategy 1 (increased passive flood storage, maximization of off-channel habitat, increased in-stream complexity, riparian corridor revegetation, and stream bank restoration), a multi-objective approach can be achieved.

To refine this approach, it was necessary to identify which components of strategy 1 and strategy 3 should be retained. The process required that the project team determine which restoration actions from strategy 1 would provide the highest benefits compared to costs. To determine which of the 58 reaches would provide the highest benefits, restoration actions outlined in strategy 1 were ranked on a reach-by-reach basis in terms of their respective benefits to fish, wildlife, and water quality and on the estimated cost of the actions. This information was then further refined with additional information reflecting unique functions and problem areas, spatial proximity, and existing opportunities in the watershed (detailed below). The final result was a series of recommendations aimed at affecting nuisance flooding and achieving restoration and protection of the mainstem of Johnson Creek.

Eight of these projects were determined to be priority projects. Their selection was based on the factors stated above (high benefit/cost) and two additional factors: (1) spatially distributing projects so that they are equitably dispersed among the six jurisdictions, and (2) taking advantage of areas of existing opportunities in order to design projects more efficiently and effectively. All jurisdictions are considered to have a role in restoring Johnson Creek.

As mentioned earlier, unique functions and known problem areas were used as evaluation criteria in identifying high-benefit reaches of the creek. Examples of these functions are the confluence of

Johnson Creek and the Willamette River, as well as tributary junctions (areas known to have high ecological values for fish and wildlife), seeps and cold water springs, and areas of abundant fish (e.g., Kelley Creek). Examples of identified problem areas are those with high priority outfalls, culvert barriers, and pipeline crossings.

A spatial approach was also used to evaluate individual reaches of the creek. This type of approach addressed three issues: salmonid use, equitable distribution among jurisdictions, and existing opportunities. Salmon exhibit a variety of behaviors during their freshwater stage. This includes incubation in the redds, rearing, and emigration to the sea as smolts. Because it is not fully understood how salmonids utilize Johnson Creek, a "patch dynamic" approach was used. That is, sites were identified throughout the watershed that provide, or could provide, important habitat function if restored properly. Distances between project areas were chosen based on the following assumptions: project areas separated by a distance of 2 miles or more were assumed to be less than ideal spatially and to offer only minimum improvement; project areas within a mile of each other were considered a moderate enhancement; and project areas that could be established within half a mile of each other were considered of high restoration value.

Basis of Cost Estimates

The Johnson Creek restoration plan is based on an evaluation of current creek conditions along the entire length of the creek, which has been divided into 58 individual segments or reaches. Within each of these reaches, a specific set of actions, or project elements, has been identified that addresses the criteria described earlier. An estimated cost has been developed for each reach based on these proposed actions, which are described in more detail in Chapter 4 of this report. Table 3-3 provides the basis for the associated reach costs. Restoration actions, construction specifications, estimated costs, and sources of cost information are all listed. Total estimated costs are provided for each of the 58 reaches described in Chapter 4.

In addition to the estimated costs for individual actions, a 1.45-multiplier was applied to construction costs to account for the cost of engineering services. No operation and maintenance costs were applied to the current cost estimates.

Table 3-3: Basis for Reach Cost Estimates

Identified Restoration Actions	Specifications / Notes	Estimated / Associated Costs
Acquire properties containing inundated structures	Properties identified as containing inundated structures and not zoned Industrial/ Multifamily or currently publicly owned	Property in Milwaukie Industrial District = $1,000,000 per acre.
		Property in jurisdiction of the cities of Portland and Gresham = $145,000 per acre
		Property in jurisdiction east of Gresham = $45,000 per acre
Design and build constructed wetland	Excavation of 3.5 feet of material across entire site	Property acquisition as described above
		$10 per cubic yard of material removed
		$30,000 an acre for wetland grading and vegetation
Design enhanced wetland	No proposed excavation	$25,000 an acre for wetland grading and vegetation
Implement stream bank stabilization and floodplain reconnection	Terrace 50 feet of creek bank with maximum depth of 3.5 feet of excavation	$10 per cubic yard of material removed
		$10,000 per acre for general riparian planting
Protect Johnson Creek tributaries	Associated cost applies to general riparian planting	$10,000 per acre for general riparian planting
Protect cool/cold water seeps and springs	No costs currently associated with action	Associated costs determined to be covered by other restoration actions
Remove fish barriers (culverts)	Flat rate	$40,000 per culvert modification
Increase in-stream complexity	Based on feet of channel contained in reach	$100 per linear foot of creek channel
Mitigate impervious surface	Based on a per-acre assessment	$20,000 per acre of impervious surface
Educate property owners adjacent and near Johnson Creek	Applied to properties identified as opportunities to work with landowners	$15,000 per property
Mitigate outfalls	Action will be addressed under stream bank stabilization and floodplain reconnection actions	Associated costs covered under stream bank stabilization and floodplain reconnection actions
Protect and restore wildlife corridors	Associated cost applies to general riparian planting	$10,000 per acre for general riparian planting
Protect and restore riparian vegetation	Associated cost applies to general riparian planting	$10,000 per acre for general riparian planting
Mitigate pipe crossings	Action will be addressed under floodplain reconnection actions	Cost associated with cost of floodplain reconnection actions
Acquire conservation easements	Action applied to properties identified as work with opportunities.	$0.27 per square foot, applied to 10% of property size of properties identified as possible work with along Johnson Creek

Recommendations

Recommended Actions

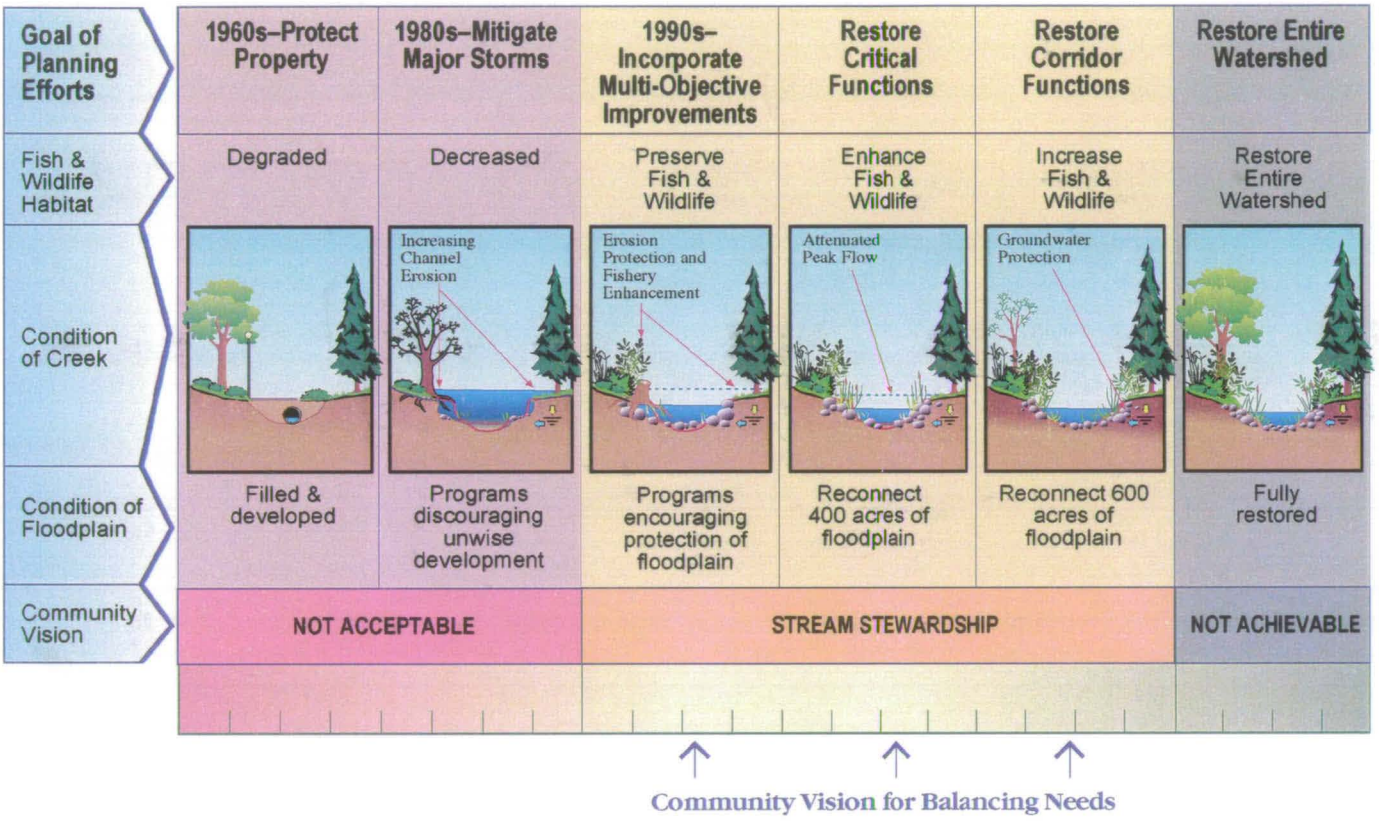
To achieve the goals of the Restoration Plan, this report recommends projects that, collectively, manage nuisance flooding and reduce damage to structures and threats to public safety by rehabilitating Johnson Creek's natural functions. Techniques are recommended for all reaches of the stream corridor. These techniques work with creek processes by protecting and restoring riparian, forest, and floodplain functions, as well as increasing in-channel complexity.

Since recommendations are only meaningful to the degree they are accepted by the residents of the watershed, stewardship and education are important elements in the implementation and long-term sustainability of recommended projects. The recommendations take into consideration the urban, suburban, and rural landscapes that make up the watershed and the characteristics of the neighborhoods and jurisdictions through which the creek runs.

This chapter describes recommended actions for the mainstem of Johnson Creek, which has been divided into 58 reaches for purposes of this report. Eight top priority projects, comprising 26 reaches, are recommended for early implementation. The community is also encouraged to implement restoration actions in areas outside the eight priority project reaches.

The level of restoration for Johnson Creek will greatly depend on the community's vision for balancing varying interests and concerns in the watershed. Figure 4-1 depicts the evolution of restoration approaches for Johnson Creek.

Figure 4-1: Evolution of Restoration Visions for Johnson Creek



Target Functions

The recommendations are specific enough to set a direction and begin implementation, yet flexible enough to respond to property owners' desires in achieving the goals of the Restoration Plan. This plan used the criteria established in the evaluation process to quantify restoration targets for each reach. These targets establish a way to quantify the expected benefits and measure improvements over time.

Reach descriptions include photographs of potential locations of target functions, based on where these functions would occur naturally or could be created most efficiently. These are suggested locations only; there are many opportunities to improve Johnson Creek's functions.

The following eight target functions were used to characterize the intended reach objectives:

1. Floodplain reconnection
2. In-stream complexity
3. Wildlife corridors and habitat patches
4. Inundated properties
5. Fish barriers
6. Priority outfalls
7. Pipe crossings
8. Impervious surfaces

Floodplain Reconnection

Flooding, water quality, and fish and wildlife habitat are all affected by Johnson Creek's connectivity with its original floodplain areas. Nutrients are cycled between floodplains and creeks during flood events. Floodwaters deposit sediments and nutrient-rich detritus onto floodplains, elements that are critical components of the terrestrial food chain. In turn, floodwaters draw large wood debris and other organic matter from floodplains. Large pieces of wood are deposited in-stream, where they provide crucial habitat for fish and other aquatic species and also help to collect suspended sediments. Organic matter is broken down and eventually becomes detritus, a key component in the food chain of streams. Riparian areas along floodplains are essential for filtering pollutants and sediments from overland runoff and providing shade along creeks to help cool water temperatures.

The relationship between creeks and their floodplains is also critical for minimizing damage to human safety caused by flooding. Flooding is a natural occurrence for creeks; floodplains provide space for water storage, which helps to attenuate flood peaks downstream. Floodplains also provide space for creeks to meander and migrate during flood events. BES may undertake a combination of the following actions to rehabilitate the floodplain along Johnson Creek.

Stream Bank Restoration (Terracing and Revegetation)

Floodplain reconnection focuses on restoring a creek's natural access to the floodplain. The idea is to provide additional space in which Johnson Creek can expand during high water periods. This may be accomplished by cutting back the banks in a series of terraces so that floodwaters may access the floodplain at lower water surface elevations. Allowing the water to spread into the floodplain results

in lower velocities, lower local water surface elevations, and some detention of the floodwaters via depression storage, infiltration, and increased travel time.

The proposed process involves working with willing property owners adjacent to the creek and/or wetland areas. For properties along the creek, the banks will be terraced back as much as possible to allow for increased connection. The actual amount of terracing and reconnection achieved will vary on a site-by-site basis. Figure 4-2 is a cross-section sketch of what floodplain reconnection will look like. It is also possible that methods for reactivating the historical floodplain based on less excavation (placement of large wood) may also be used where artificial fill has not been placed.

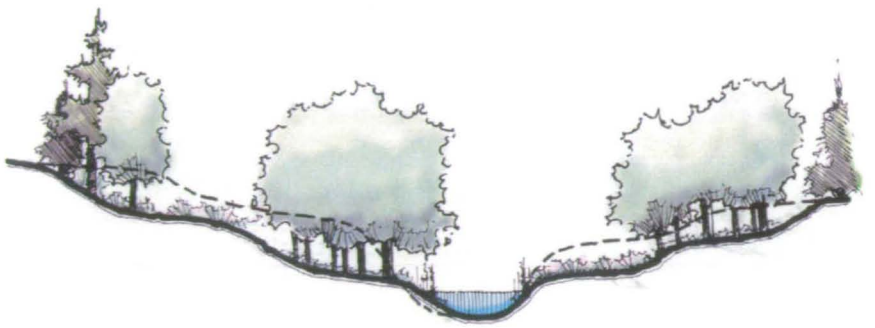
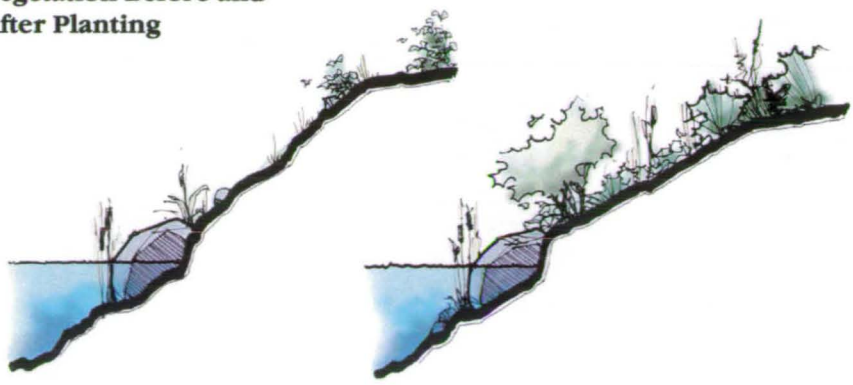


Figure 4-2: Typical Floodplain Reconnection

Once stream banks have been terraced as necessary, they will be vegetated with native riparian vegetation. Planting banks devoid of vegetation with native species is an ideal way to stabilize eroding banks and provide resistance to flow, thereby helping reduce creek velocities. Replacing invasive plant species with native species improves wildlife habitat as well. These activities will serve both to reconnect Johnson Creek with its original floodplain and to enhance and restore the riparian corridor. The restoration of the riparian corridor will provide shade to the creek and, in the process, decrease water temperatures in the summer months. Riparian corridor vegetation also acts to filter sediment and pollutants from runoff, thereby improving water quality and reducing impacts of increased runoff to Johnson Creek. Reducing water temperature and improving water quality are key elements in providing ideal habitat for salmonids. Figure 4-3 is a sketch of a stream before and after re-vegetation.

Figure 4-3: Stream Bank Vegetation Before and After Planting



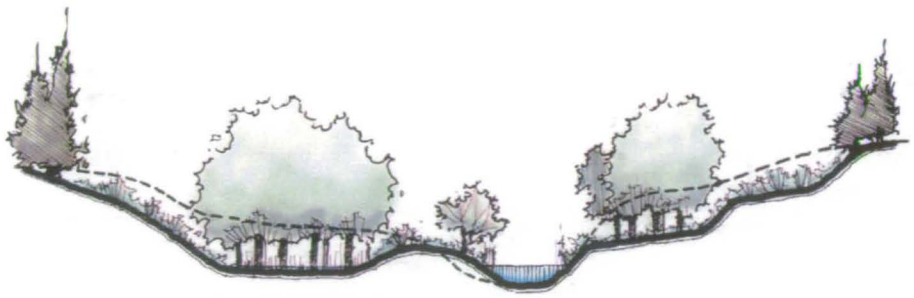
Constructed Wetland

Constructed wetlands are another, more intensive way to reconnect Johnson Creek with its historic floodplain. This process requires constructing an area that is not currently functioning as a wetland. Areas chosen for the purpose of constructed wetlands exhibit features that indicate they were once part of the original Johnson Creek floodplain and may at some point have been wetlands. Wetland storage is an attractive option because it addresses several major restoration goals. Wetlands and their associated native species improve wildlife habitat and provide water quality benefits in the form of filtration and uptake. Wetlands also provide floodwater storage during high flow events. The primary goal is to decrease flow rates downstream by holding flood volume for 24 to 72 hours.

The process of building a constructed wetland requires grading the banks of Johnson Creek and the adjacent property to allow creek waters to access the area on a consistent basis. These facilities will be created with existing topography together with some excavating and berming to make best use of the project area. In some cases, passive methods for floodplain reconnection involving large wood jams may also be used where appropriate. An average of 3.5 feet of excavation is assumed for this type of activity. An inflow channel will direct floodwaters from the creek into the wetland; an outlet channel, with some form of outlet control, will limit the outflow rate. An emergency spillway will be provided to handle any overflow from the facility. After the property is graded, current vegetation will be removed as necessary to allow for revegetation of the area with native wetland and/or riparian trees and plants. Once the wetland and/or riparian habitat has been created, it will be maintained and allowed to mature.

There are many different types of wetlands, all of which perform important functions. Meadow, emergent, scrub/shrub, and forested wetlands are all effective in storing and filtering waters, providing habitat, and allowing waters to infiltrate and replenish groundwater supplies. Riparian and wetland forests, which were historically common in the Johnson Creek watershed, are especially valuable areas. They are frequently inundated during the rainy season and can hold large amounts of water in the soil while simultaneously providing vital fish and wildlife habitat. When floodwaters are dispersed into a wide area through the understory and around trunks, much of the energy of a flood can be dissipated, resulting in lower velocities. Figure 4-4 is a cross section of a typical wetland/forest storage area.

Figure 4-4: Typical Wetland/Forest Storage Area



Connection of backwater channels (existing and new) and increasing sinuosity of the creek are additional actions that are expected to be carried out in areas where constructed wetland/wet forest areas are designed. Backwater channels consist of old channels, oxbows, and depressions off the main channel through which water will backflow as surface elevations rise. During high flow events, these channels are especially important for fish seeking refuge from high flow velocities in the creek's mainstem. They also serve to store floodwaters.

Recommendations include both connecting existing backwater channels to the creek and creating new channels. Figure 4-5 is a three-dimensional sketch of a typical backwater channel.

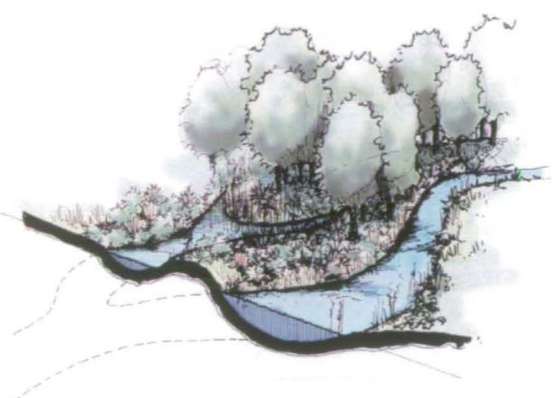


Figure 4-5: Typical Backwater Channel

Enhanced Wetland (and Riparian Area)

Wetlands and riparian areas provide vital functions to a healthy creek system. By enhancing areas that already exhibit wetland and/or riparian conditions, these functions can be obtained with reduced effort while also reconnecting Johnson Creek with its original floodplain. This strategy is more cost-effective than designing new constructed wetland areas because areas that already exhibit wetland conditions will require less grading and replanting to achieve maximum functionality. This process initially entails the identification of areas that currently function as wetlands or riparian habitat. The purpose of enhancing these areas is to increase their size and augment their natural functions. This can be accomplished by grading adjacent properties where necessary to provide Johnson Creek with access to those areas or by restoring appropriate native vegetation to the site.

A major threat to the health of existing wetlands and riparian areas is the intrusion of non-native, invasive vegetation that often "out-competes" existing native vegetation. Examples of such vegetation include reed canarygrass, purple loosestrife, Himalayan blackberry, English ivy, Japanese knotweed, Scot's broom, hedge bindweed or morning glory, and European bittersweet or nightshade. These plants often establish themselves as mono-crops and limit ecosystem function because they provide little biodiversity or habitat for wildlife. Non-native and invasive vegetation in existing natural areas will be removed and replaced with native plant species. Regular maintenance will be provided to ensure that native plants thrive and non-native plants are not re-established.

Wildlife Corridors and Habitat Patches

Protecting the remaining native riparian vegetation in the Johnson Creek watershed is an important part of maintaining and restoring the natural functions of the watershed. Once natural functions and resource areas are lost to development and conditions have been degraded, it becomes much harder to re-establish natural functions on these lands. Protecting healthy natural areas is the first step in restoring natural functions to the watershed as a whole. Continued reduction of current resources will diminish the gains achieved through implementation of restoration activities. Johnson Creek is already in a degraded state and cannot afford to lose any additional natural functions.

Various areas along Johnson Creek have been identified as containing native riparian vegetation. Under this target, these areas will be restored and enhanced with native riparian vegetation where necessary.

Wildlife Corridors/ Upland Connections

Wildlife corridors and connections to upland areas are essential components of the overall health of the Johnson Creek watershed. Wildlife living within the watershed must have access to the creek for survival. The creek and floodplain areas provide food and habitat for diverse wildlife species throughout the year. Upland connections also provide access to nutrients necessary for sustaining a healthy watershed. Species living in Johnson Creek (e.g., salmonids) rely on these connections for the continued abundance of food and nutrients needed for their survival.

Tributary Protection

Johnson Creek tributaries are important resources and provide valuable functions to the creek and watershed. Tributaries are the primary drainage ways through which waters from the upland areas of the watershed are transmitted to the mainstem of Johnson Creek. They provide habitat for fish and wildlife, as well as nutrients to the creek. Many tributaries are headwater streams with important spawning habitat. Moreover, tributary junctions tend to flood and therefore are key sites for stream and floodplain reconnection. If tributaries are not protected and subsequently degrade, they become potential pathways for pollutants and contribute to increased velocity and volume of water entering the mainstem of the creek. Increased velocities and volumes lead to bank erosion, creek channel incising, and flooding. Tributary connections are also areas that naturally exhibit higher levels of in-stream complexity. This characteristic is extremely important because salmonids need these types of areas to survive and prosper. These connections should be some of the first areas identified for protection and restoration and actions to address in-stream complexity. This Restoration Plan identifies tributaries to the best of its ability. There are tributaries that have been missed or may have been misidentified. Each jurisdiction will need to do additional investigation within its own areas to fill in any gaps in this plan.

In-stream Complexity

In-stream complexity (e.g., large wood, pool/riffle sequences, deep pools, and sinuosity) provides essential habitat for the life cycles of salmonids as well as other fish and wildlife in Johnson Creek. ODFW staff extensively surveyed a large portion of Johnson Creek and observed that the creek is degraded with regard to in-stream complexity. They also identified many areas of the creek that exhibit severe erosion (i.e., more than 70 percent of the bank). The lack of

variable habitat and the increased levels of sediment in the creek make it very difficult for the survival of salmonids. Increased levels of salmonid activity cannot be expected until the quantity and quality of in-stream habitat improves.

One strategy of this plan is to increase the amount of large wood in Johnson Creek. Large wood, logs, and branches that have fallen into the stream perform several highly desirable functions. Large wood helps reduce erosive flow velocities and sediment movement, while aiding the formation of ideal fish habitat by providing pools, shade, and shelter. In Johnson Creek, the riparian corridor that provides the source of large wood is very narrow, and even nonexistent in some places. The higher flow velocities and depths common in channelized streams make it difficult for large wood to become established within the channel. In addition, property owners along the creek often clear the creek of such woody jams. Increasing the amount of large wood in the creek will entail placing and anchoring wood in the stream at appropriate locations. The presence of large wood increases resistance to flow and constricts the channel flow area, resulting in elevated water surface elevations. For this reason, it is important to make sure over-bank properties will not be adversely affected by the increased flood stages. On the other hand, this also makes large wood an excellent method for moving floodwaters out of channel and into reconnected floodplains or constructed wetlands. Figure 4-6 is an illustration of in-stream woody debris.

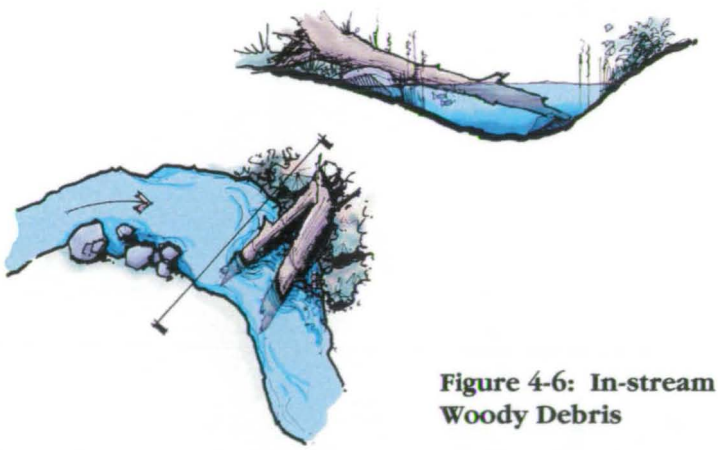


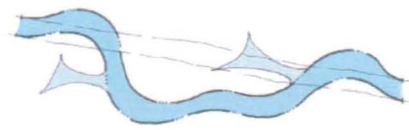
Figure 4-6: In-stream Woody Debris

Streams are naturally adapted to withstand a certain amount of sediment deposition and erosion based on the typical, healthy volume and velocity of in-stream flows. However, as watershed conditions are degraded and larger volumes of water are transmitted into the creek system, flow velocities increase. Increased velocities in turn intensify the erosion of creek banks and incision of the creek

channel, both of which lead to increased sediment loading of the creek. Larger sediment loads negatively affect both water quality and fish and wildlife habitat. More specifically, increased sedimentation fills in gravel beds necessary for salmonid spawning and rearing. Increased levels of sediment are also linked to increases in pollutant loading, as numerous chemical constituents may be contained in sediment that washes into the creek. Sediments in Johnson Creek have been identified as a constituent of concern. The strategy for dealing with eroding stream banks will be implemented in conjunction with other restoration activities focused on stream bank restoration and revegetation. As banks are terraced to increase floodplain connections, invasive species will be removed and planted with native riparian vegetation, increasing stabilization.

Increasing sinuosity and restoring the creek's natural meander are highly beneficial to the creek. They can reduce flow velocities by forcing channel flows to change direction, thus losing energy. The resulting changes in flow direction promote pool/riffle development important to fish and their macroinvertebrate food supply. However, reducing the flow velocities will raise the water surface elevations. Care must be taken to ensure that property damage does not occur as a result of restoration efforts. Combining changes in sinuosity with floodplain reconnection will provide a wider floodplain and mitigate rising water levels. Figure 4-7 illustrates increased channel sinuosity.

Figure 4-7: Adding Length to Stream by Increasing Sinuosity



Inundated Properties

Properties prone to flooding during nuisance events were identified primarily by hydraulic modeling. Additional identification methods included using historical flood surveys and photographs and records of flooding complaints. The hydraulic model data are useful for planning purposes but are not intended to identify these properties definitively.

Fish Barriers

A number of culverts along Johnson Creek have been identified as restricting fish passage through the creek system. Replacing or upgrading these impassable culverts has been identified as a key strategy in restoring salmon to Johnson Creek. This action will make it easier for fish to access the upper stretches of Johnson Creek and, as a result, will increase the numbers of salmonids using the creek system.

Priority Outfalls

Numerous stormwater outfalls discharge directly into Johnson Creek, thereby increasing the volume of water that enters the creek system. As volumes increase, so do flow velocities, which in turn have an impact on flooding, water quality, and fish and wildlife habitat. In addition to velocities, the discharges adversely affect water quality in the creek.

Recommendations regarding properties that contain identified outfalls include measures designed to reduce the impacts of those outfalls on Johnson Creek. The level of design and construction necessary to mitigate outfall effects will be site-specific. This work will be implemented in conjunction with other restoration projects along the creek and will be combined where appropriate.

Pipe Crossings

Installed pipes cross the channel bottom throughout Johnson Creek. Due to increased channel erosion and incising, some of these pipes have been uncovered and are exposed at ground surface. Once exposed, pipes are subject to undercutting by water currents, thereby increasing the rate of exposure and possibly contributing to pipe instability. They can also create barriers to fish passage.

Locations of uncovered pipes in Johnson Creek have been identified. The specific details of addressing the identified problems will be determined during the design phase.

Impervious Surfaces

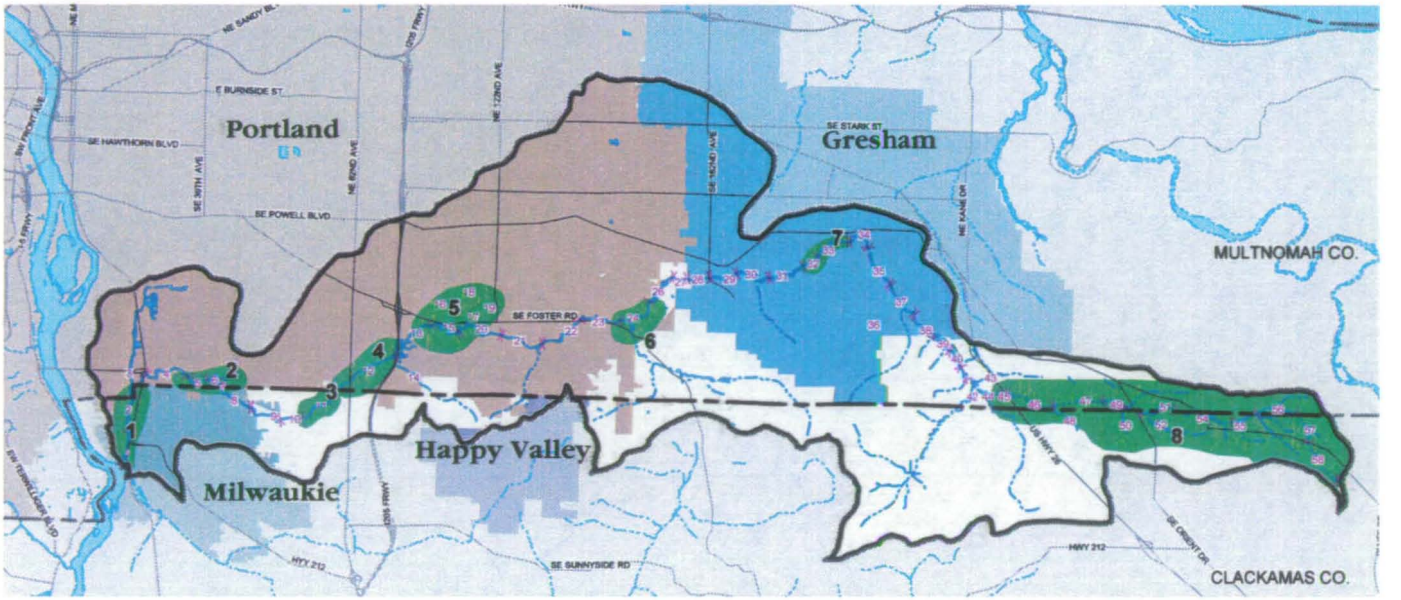
Impervious surfaces have the effect of increasing direct runoff to Johnson Creek. Rainwater cannot soak into the ground and instead runs off as surface water, picking up pollutants such as oil and grease from streets and parking lots along the way. This increase in direct runoff to the creek increases flooding potential and adversely affects water quality and fish and wildlife habitat.

Large areas of impervious surface that have a direct impact on Johnson Creek have been identified near the creek. Recommendations include measures to mitigate the effects of these surfaces. Drainage swales and retrofits will be recommended on a site-by-site basis. The purpose of these actions is to reduce the amount of direct runoff entering the creek.

High Priority Projects

Eight early action projects have been identified that present the greatest opportunities within the watershed to implement restoration actions. These suggested locations are located throughout the watershed in the jurisdictions of the Cities of Portland, Milwaukie, and Gresham, and in Clackamas and Multnomah Counties. The projects comprise one or several of the 58 reaches described later in this chapter. Figure 4-8 shows the locations of the eight early action projects.

Figure 4-8: Eight Priority Area Locations



Project 1

Lower Johnson Creek Restoration priority area is located at the mouth of Johnson Creek and the Willamette River in the jurisdiction of the City of Milwaukie and covers Reaches 1 and 2. This project provides opportunities to improve fish habitat where it is severely limited. An additional focus is to enhance and restore the riparian corridor through this heavily industrialized section of creek. Opportunities are also present to reduce the effects of large areas of impervious surface through the use of drainage swales and infiltration trenches.

High Priority Recommendations:

1. Lower Johnson Creek Restoration (Milwaukie)
2. Tideman Johnson Nature Park (Portland)
3. Bell Station Flood Mitigation Project (Clackamas County)
4. West Lents Flood Mitigation Project (Portland)
5. Lents Alternatives (Portland)
6. Alsop Floodplain Restoration (Portland and Urban Reserve)
7. Gresham Stream Corridor (Gresham)
8. Upper Reaches Riparian Improvements (Clackamas and Multnomah Counties)

Project 2

Tideman Johnson Nature Park priority area, located in the jurisdiction of the City of Portland, includes Reaches 5 and 6. Opportunities exist within this area to create enhanced wetlands, which are useful in providing for flood storage, as well as water quality and fish and wildlife benefits. This area also presents an opportunity to create a wildlife corridor and to protect a high-value natural resource tributary to Johnson Creek. Mitigation of an uncovered pipe that crosses Johnson Creek has also been identified as a priority action within this area. Additional opportunities exist to enhance and create fish habitat and to promote the migration of salmon and steelhead through the creek.

Project 3

Bell Station Flood Mitigation priority area is located in Reach 11 in the jurisdiction of Clackamas County. This area presents opportunities to reconnect Johnson Creek with its original floodplain through the removal of fill and the design of a constructed wetland area. This type of wetland area would help provide increased flood storage to reduce localized flooding and in turn reduce the costs and damage incurred during nuisance flood events. Additional wetlands will also help to improve both water quality and fish and wildlife habitat. This project also provides an opportunity to increase in-stream complexity to improve fish habitat conditions.

Project 4

West Lents Flood Mitigation priority area is located in Reach 12 in the jurisdiction of the City of Portland, just upstream from Project 3. This area presents opportunities to reconnect Johnson Creek with its original floodplain through the design of a constructed wetland area. This type of wetland area would help provide increased flood storage to reduce localized flooding and in turn reduce the costs and damage incurred during nuisance flood events. Additional wetlands will also help to improve both water quality fish and wildlife habitat. This project also provides an opportunity to increase in-stream complexity to improve fish habitat conditions.

Project 5

Lents Alternatives priority area is the Lents neighborhood located in the jurisdiction of the City of Portland. This area contains Reaches 15 through 19 along Johnson Creek and a series of wetland areas. Several alternatives have been developed for effective storage of floodwaters using wetlands and open space. Only one of the alternatives is presented in this chapter. Other alternatives will be evaluated, and a decision will be made within the Lents neighborhood in conjunction with the Lents Urban Renewal Plan.

Project 6

Alsop Floodplain Restoration priority area, located within the jurisdiction of the City of Portland and Urban Reserve 4, includes Reach 24. The focus of this area is to create over 50 acres of constructed wetland and open space designed for flood storage as well as enhancement of water quality and habitat for fish and wildlife. Opportunities also exist within this priority restoration area to improve in-stream conditions of the creek and to provide recreational opportunities adjacent to Powell Butte and the Springwater Corridor.

Project 7

Gresham Stream Corridor priority area is in the jurisdiction of the City of Gresham and covers Reaches 32 and 33. Opportunities exist within this area to reconnect Johnson Creek with its original floodplain through the design of enhanced wetlands. This action will help provide increased flood storage during periods of high water within the creek. In addition, this area will provide benefits for water quality and for fish and wildlife habitat. The design of an enhanced wetland area includes the benefit of restoring and enhancing the riparian corridor along the creek. This area also provides recreational opportunities for adjacent neighborhoods and connections to the Springwater Corridor.

Project 8

Upper Reaches Riparian Improvements priority area focuses on the upper watershed located in the jurisdictions of Clackamas and Multnomah Counties. This area covers Reaches 44 through 58. The project addresses the need to restore the riparian corridor in the upper watershed of Johnson Creek. Benefits for water quality as well and fish and wildlife can be achieved through enhancement and

restoration of the riparian corridor and floodplain reconnection actions. Actions implemented in the upper watershed have effects on the entire length of the creek. Restoration and protection of the upper watershed will be vital to achieving identified opportunities and benefits within priority areas in the lower portions of the creek.

Recommendations by Reach

The eight high priority project areas discussed above are intended to provide a starting point to address issues concerning restoration and protection of natural functions within the Johnson Creek corridor. The remainder of this chapter covers recommendations for individual reaches extending the entire length of the creek.

Reach Descriptions

For the purpose of focusing recommendations, Johnson Creek was divided into 58 segments or reaches. As detailed in the previous section, each reach was evaluated for its respective opportunities to address flooding concerns as well as restoration and protections of natural resources. These opportunities have been quantified in terms of target functions, also detailed in a previous section. Each of these target functions is a way of quantifying and adding specific values to restoration actions, such as floodplain reconnection and habitat corridors. These recommendations, target functions, and corresponding values serve to provide direction in identifying opportunities. These opportunities are in no way meant to be the only way to achieve restoration of natural functions, just a place to start.

Each set of reach recommendations is linked to three corresponding maps. The first is a large-scale aerial photograph of the particular reach (or series of reaches). The second map provides visual coverage of target functions, on the same scale as the aerial map. The third map, a small inset, is a smaller scale representation of the

function map. Recommended actions are presented as guidelines for what can be achieved within each separate reach. In addition, each reach description includes a brief summary of existing conditions, a list of identified opportunities, an estimated project cost, and ODFW stream survey information and closes with an itemized list of recommended actions.

Reach Ecosystem Ratings

The description of existing conditions for each reach includes a rating of its ecosystem values. Marks ranging from 1+ to 3- were assigned to reaches (or segments of reaches), based subjectively on the criteria outlined in Chapter 3, Field Investigations. Rating values reflect the overall quality of the area, not the presence or absence of specific criteria. Thus, many alternative combinations of the listed criteria could result in the same rating. For example, a small area in a residential neighborhood with impressive species diversity and absence of invasive species may be rated as 1. But a parcel with fewer native plants, some invasive plants, and direct connection to native forested upland may receive the same rating. In general, ratings may be characterized as follows:

- 1+, 1, 1-

  Apparent healthy and appropriate ecosystem functions, native species present, few to no invasive species, large parcel of open space or proximity to it
- 2+, 2, 2-

  Some ecosystem functions, some native species, presence of invasive species, proximity to land uses that may affect ecosystem functions
- 3+, 3, 3-

  Significant loss of ecosystem functions, few to no native species, presence of many invasive species or lack of vegetation, direct impact from land uses that affect ecosystem functions

Vegetation

Plants recommended for use in revegetation activities in the Johnson Creek watershed are listed in Table 4-1. The various plants identified in the 58 Johnson Creek reaches are listed in Table 4-2.

Table 4-1: Plants Recommended for Revegetation Projects

Wetland/Riparian Species	Upland Species
Western redcedar *(Thuja plicata)*	Douglas-fir *(Pseudotsuga menziesii)*
Red alder *(Alnus rubra)*	Western hemlock *(Tsuga heterophylla)*
Oregon ash *(Fraxinus latifolia)*	Grand fir *(Abies grandis)*
Black cottonwood *(Populus trichocarpa)*	Beaked hazelnut *(Corylus cornuta)*
Bigleaf maple *(Acer macrophyllum)*	Douglas' hawthorn *(Crataegus douglasii)*
Pacific willow *(Salix lucida var. lasiandra)*	Nootka rose *(Rosa nootkana)*
Hooker's willow *(Salix hookeriana)*	Indian plum *(Oemleria cerasiformis)*
Sitka willow *(Salix sitchensis)*	Red huckleberry *(Vaccinium parvifolium)*
Scouler's willow *(Salix scouleriana)*	Salal *(Gaultheria shallon)*
Vine maple *(Acer circinatum)*	Dull Oregon grape *(Berberis nervosa)*
Red osier dogwood *(Cornus stolonifera)*	Tall Oregon grape *(Berberis aquifolium)*
Salmonberry *(Rubus spectabilis)*	Thimbleberry *(Rubus parviflorus)*
Sword fern *(Polystichum munitum)*	Red elderberry *(Sambucus racemosa)*
Pacific ninebark *(Physocarpus capitatus)*	Snowberry *(Symphoricarpos albus)*
Douglas' spiraea *(Spiraea douglasii)*	Bracken fern *(Pteridium aquilinum)*
Swamp rose *(Rosa pisocarpa)*	Serviceberry *(Amelanchier alnifolia)*
Lady fern *(Athyrium filix-femina)*	
Slough sedge *(Carex obnupta)*	
Dense sedge *(Carex densa)*	
Hare's foot sedge *(Carex leporina)*	
Creeping spikerush *(Eliocharis palustris)*	
Tall mannagrass *(Glyceria elata)*	
Reed mannagrass *(Glyceria grandis)*	
Skunk cabbage *(Lysichiton americanum)*	
Soft rush *(Juncus effusus)*	
Taper-tipped rush *(Juncus acuminatus)*	
Three-stamen rush *(Juncus ensifolius)*	

Table 4-2: Existing Plant Species in Johnson Creek Reaches

Native Species	Non-Native/Invasive Species
Beaked hazelnut *(Corylus cornuta)*	Birch (*Betula* spp.)
Bigleaf maple *(Acer macrophyllum)*	Black locust (*Robinia pseudoacacia*)
Bitter cherry *(Prunus emarginata)*	Cherry (*Prunus* spp.)
Black cottonwood *(Populus trichocarpa)*	Clematis (*Clematis* spp.)
Bracken fern *(Pteridium aquilinum)*	English ivy (*Hedera felix*)
Cattail *(Thypha latifolia)*	European bittersweet (*Solanum dulcamara*)
Common hawthorn *(Crataegus monogyna)*	Hedge bindweed (*Convolvulus sepium*)
Douglas' hawthorn *(Crataegus douglasii)*	Himalayan blackberry (*Rubus discolor*)
Douglas' spiraea *(Spiraea douglasii)*	Holly (*Ilex aquifolium*)
Douglas-fir *(Pseudotsuga menziesii)*	Horse chestnut (*Aesculus hippocastanum*)
Goat'sbeard *(Aruncus dioicus)*	Laurel (*Prunus laurocerasus*)
Grand fir *(Abies grandis)*	Purple loosestrife (*Lythrum salicaria*)
Indian plum *(Oemleria cerasiformis)*	Reed canarygrass (*Phalaris arundinacea*)
Inside-out flower *(Vancouveria hexandra)*	Scot's broom (*Cytisus scoparius*)
Jewelweed *(Impatiens noli-tangere)*	Watercress (*Rorippa nasturtium-aquaticum*)
Lady fern *(Athyrium filix-femina)*	
Native rose *(Rosa spp.)*	
Oceanspray *(Holodiscus discolor)*	
Oregon ash *(Fraxinus latifolia)*	
Oregon grape *(Berberis spp.)*	
Oregon white oak *(Quercus garryana)*	
Pacific ninebark *(Physocarpus capitatus)*	
Red alder *(Alnus rubra)*	
Red elderberry *(Sambucus racemosa)*	
Red osier dogwood *(Cornus stolonifera)*	
Red-flowering currant *(Ribes sanguineum)*	
Salmonberry *(Rubus spectabilis)*	
Serviceberry *(Amelanchier alnifolia)*	
Skunk cabbage *(Lysichiton americanum)*	
Snowberry *(Symphoricarpos albus)*	
Stinging nettle *(Urtica dioica)*	
Sword fern *(Polystichum munitum)*	
Thimbleberry *(Rubus parviflorus)*	
Vine maple *(Acer circinatum)*	
Western hemlock *(Tsuga heterophylla)*	
Western redcedar *(Thuja plicata)*	
Willow *(Salix spp.)*	

Note: Some reaches are not located adjacent to Johnson Creek, but have been identified as restoration areas within the Johnson Creek Watershed.

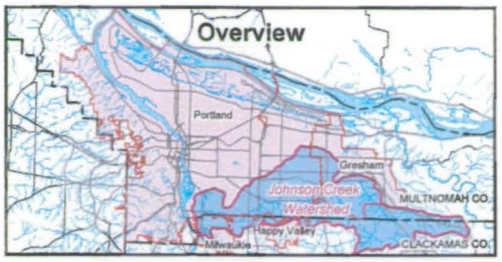
JOHNSON CREEK RESTORATION

REACHES
1 - 58

Johnson Creek Watershed

JURISDICTIONS INCLUDED

CITY OF PORTLAND
CITY OF MILWAUKIE
CITY OF GRESHAM
HAPPY VALLEY
CLACKAMAS COUNTY
MULTNOMAH COUNTY



Legend
- Watershed Boundary
- City Boundaries
- County Line
- Reach Divider

NORTH

0 3000 6000 9000 Feet

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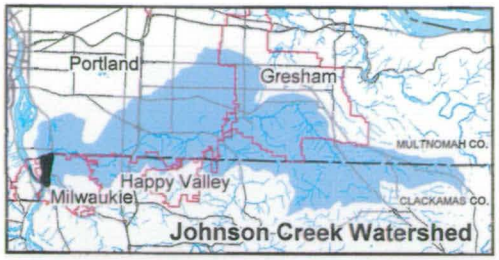
JOHNSON CREEK RESTORATION

REACHES
1, 2

Aerial Map

JURISDICTIONS INCLUDED
CITY OF MILWAUKIE



Legend

- Reach Divider
- City Boundary
- County Line

Aerial Images Source:
Spencer Gross, 1998.

NORTH

0 250 500 1000 Feet

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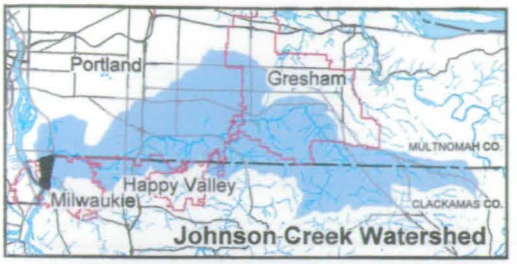
JOHNSON CREEK RESTORATION

REACHES
1, 2

Functions

JURISDICTIONS INCLUDED
CITY OF MILWAUKIE



Legend

- Reach Divider
- Fish Barrier
- Pipe Crossing
- Inundated Properties
- Wildlife Corridors and Habitat Patches
- Floodplain Reconnection
- Impervious Surface

NORTH

0 250 500 1000 Feet

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Reach 1

Reach 1 - Description	Target	Units
Floodplain Reconnection	13	acres
Wildlife Corridors and Habitat Patches	6	acres
In-stream Complexity	2,493	feet
Inundated Properties	2	number
Fish Barriers	0	number
Priority Outfalls	0	number
Pipe Crossings	0	number
Impervious Surface	10	acres

Existing Conditions

Reach 1 begins at the confluence of Johnson Creek and the Willamette River and runs along SE McLoughlin Boulevard to SE Millport Road. This reach is located in the jurisdiction of the City of Milwaukie. The area consists primarily of industrial uses with limited vegetation. The riparian corridor upstream of the mouth of Johnson Creek is very narrow, with a limited number of large trees, providing little shade. Native vegetation consists primarily of black cottonwood, willow, red alder, and bigleaf maple. Invasive Himalayan blackberry, English ivy, and reed canarygrass are also present. The mouth of Johnson Creek contains gravel bar features that should be maintained and enhanced. Current conditions in this reach are rated 2/2- at the confluence, where a substantial amount of trash and debris should be removed, and as 2-/3+ at the north end of the area.

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Protect and restore riparian vegetation
- Protect and enhance the confluence of Johnson Creek and the Willamette River
- Increase in-stream complexity of the creek
- Reduce adverse effects of impervious surface
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $10,720,000

ODFW Survey Results

ODFW Stream Habitat Survey Results pertaining to this reach include the following observations:

- Stream habitat is dominated by riffles and scour pools.
- Average pool depth is 13 cm.
- Stream substrate is dominated by gravel and fine sediments, with some bedrock near its confluence with the Willamette River.
- Wood volume is extremely low.

- Riparian vegetation is dominated by small and medium-sized hardwoods, including willow, alder and bigleaf maple.
- The reach consists of one confined channel.
- Banks are predominantly constrained by WPA tiles, riprap, and builders' waste.
- Numerous culvert outfalls in this reach, coming from roads, parking lots, and unidentified sources, quickly become active during even a light rain, thus increasing the turbidity, flow, and water depth significantly over a short period of time.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, and erosion and sediment control.
- Place wood in stream to provide in-channel habitat diversity and hydraulic "roughness" for cover, pool formation, and channel bed stability.
- Provide off-channel habitat.
- Reduce the rate and magnitude of stormwater runoff by working with adjacent property owners to decrease impervious surfaces and by identifying areas where stormwater outfalls can be treated before entering the creek.

Recommended Actions

1. Work toward acquiring properties at the confluence through the Willing Seller Program as opportunities arise (see Photos 1-1 and 1-2). Once properties are purchased, the banks will be terraced back to enhance the floodplain along this stretch; the floodplain will be opened up as much as the properties will allow (50 to 200 feet); existing riparian vegetation will be protected as much as possible; open areas will be planted with additional native riparian vegetation; and the banks directly along the creek will be revegetated with appropriate trees that will provide shade for the creek.

   Existing native trees at the confluence of the creek and river should be protected. Space is limited on the southeastern side of the creek due to its proximity to Highway 99E. Consequently, it is very important to use all space available to buffer the creek from the effects of highway runoff. Any outfalls located in this area will be addressed as necessary while completing restoration activities.

2. Work with willing property owners adjacent to Johnson Creek for the purpose of reconnecting Johnson Creek with its original floodplain (see Photos 1-3 and 1-4). Restoration activities on such properties will be property-specific and to the degree deemed appropriate by the property owner. Floodplain reconnection will entail removal of invasive species from the banks of the creek, as

Photo 1-1:

Looking northeast at the confluence of Johnson Creek and the Willamette River. Gravel bars and native vegetation will be protected as floodplain is restored.

Photo 1-2:

Facing east, looking upstream from the confluence of Johnson Creek and the Willamette River. Floodplain reconnection presents opportunities to protect and enhance the riparian corridor, increasing in-stream complexity, adding native vegetation to shade the creek, and creating wildlife habitat.

well as removal of the WPA wall where appropriate. The banks will then be regraded to open up additional area for the creek to spread. After banks are terraced, they will be replanted with native riparian vegetation.

3. Increase in-stream complexity throughout the length of the creek running through this reach. This work, which will be done in conjunction with other projects in the reach, will consist of creating areas with large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase (see Photo 1-2).
4. Work with landowners along Johnson Creek whose properties contain large areas of impervious surface. Mitigating the effects of impervious surface by applying current technology, such as drainage swales, green rooftops, and infiltration basins, will reduce surface runoff, improve water quality, and contribute to groundwater recharge.
5. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering identified habits and practices to better protect and enhance Johnson Creek.

Photo 1-3:

Facing north, looking upstream along Johnson Creek. Both banks present potential opportunities for floodplain reconnection and riparian restoration.

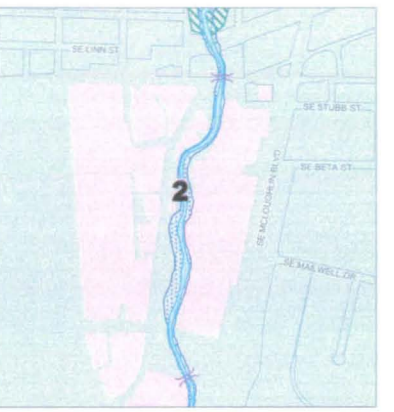
Photo 1-4:

Looking east from west bank of Johnson Creek. This stand of native red alders should be preserved and the native vegetation enhanced to improve the riparian corridor along this section of the creek. Outfall pipes, such as the one shown here, that discharge directly into Johnson Creek will be addressed through restoration efforts.

Reach 2

Existing Conditions

Reach 2 is located north of the confluence of Johnson Creek and the Willamette River, running along SE McLoughlin Boulevard just downstream from the confluence of Johnson Creek and Crystal Springs. This reach extends from just south of SE Millport Road to SE Ochoco Street. It is in the jurisdiction of the City of Milwaukie. The reach consists primarily of industrial complexes with large areas of impervious surface and little to no vegetation. The riparian corridor is very narrow (5 to 10 feet), with very few shade trees throughout this stretch of Johnson Creek. The dense canopy of black cottonwood, red alder, and willow in the southern portion of this reach quickly thins in the northern portion, with numerous breaks in-between. Understory vegetation consists primarily of non-native Himalayan blackberry, reed canarygrass, and hedge bindweed. Creek banks at the north end of this reach are steep due to the WPA wall. Current conditions in this reach are rated as 2 at the south end and as 2- at the north end.



Reach 2 - Description	Target	Units
Floodplain Reconnection	5	acres
Wildlife Corridors and Habitat Patches	0	acres
In-stream Complexity	2,535	feet
Inundated Properties	1	number
Fish Barriers	0	number
Priority Outfalls	0	number
Pipe Crossings	0	number
Impervious Surface	63	acres

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Increase in-stream complexity of the creek
- Reduce adverse effects of impervious surface
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $2,720,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by riffles and glides.
- Average pool depth is 103 cm.
- Stream substrate is dominated by cobble and gravel.
- Wood volume is extremely low.
- Riparian vegetation is dominated by small and medium-sized willow and alder. Shade cover is moderate.
- The reach consists of one confined channel.

- Banks are largely constrained by WPA tiles.
- Numerous culvert outfalls in this reach, coming from roads, parking lots, and unidentified sources, quickly become active during even a light rain, thus increasing the turbidity, flow, and water depth significantly over a short period of time.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, and erosion and sediment control.
- Place wood in stream to provide in-channel habitat diversity and hydraulic "roughness" for cover, pool formation, and channel bed stability.
- Provide off-channel habitat.
- Reduce the rate and magnitude of stormwater runoff by working with adjacent property owners to decrease impervious surfaces and by identifying areas where stormwater outfalls can be treated before entering the creek.

Recommended Actions

1. Work toward acquiring frequently flooded properties near the Mill End store area through the Willing Seller Program as opportunities arise (see Photo 2-1). On acquired properties, structures will be removed, creek banks will be terraced back as appropriate to reconnect the floodplain and replanted with native vegetation, and the riparian corridor will be protected and enhanced to the maximum extent possible.
2. Work with willing property owners adjacent to Johnson Creek for the purpose of reconnecting Johnson Creek with its original floodplain (see Photos 2-2, 2-3, and 2-4). Restoration activities on such properties will be property-specific and to the degree deemed appropriate by the property owner. Floodplain reconnection will entail the removal of invasive species from the

Photo 2-1:

Looking east at property along Johnson Creek that floods frequently. Opportunities exist to remove invasive plants and restore the riparian corridor with native vegetation, providing shade and habitat along the creek.

banks of the creek, as well as removal of the WPA wall where appropriate. The banks will then be regraded and terraced as much as possible to open up the original floodplain to Johnson Creek. Native riparian vegetation.will be planted along the riparian corridor to shade the creek.

3. Increase in-stream complexity throughout the length of the creek running through this reach. This work, which will be done in conjunction with other projects in the reach, will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase.
4. Work with landowners along Johnson Creek whose properties contain large areas of impervious surface. Mitigating the effects of impervious surface by applying current technology, such as drainage swales, green rooftops, and infiltration basins, will reduce surface runoff, improve water quality, and contribute to groundwater recharge.
5. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering identified habits and practices to better protect and enhance Johnson Creek.

Photo 2-2:

Facing north, looking upstream from Millpoint Road overpass at an empty lot adjacent to Johnson Creek. Such open space presents opportunities for floodplain reconnection and riparian enhancement actions.

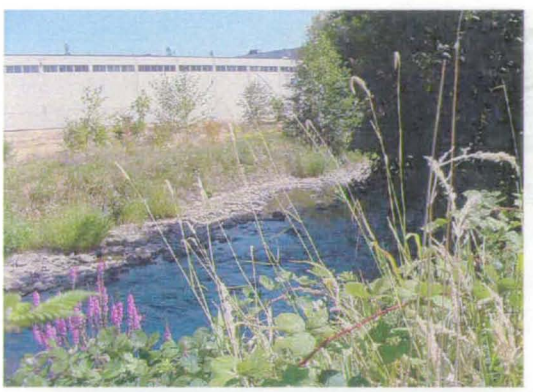


Photo 2-3:

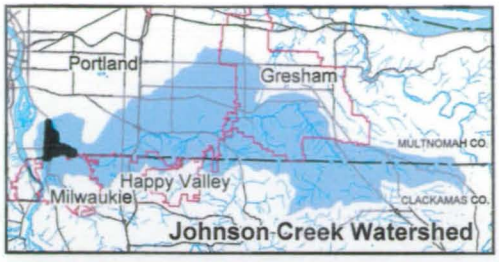
Looking downstream (southeast) at Johnson Creek. The flat nature of the banks at this location present floodplain reconnection opportunities, while the lack of large shade trees and narrow buffer indicate the need for riparian corridor restoration.

Photo 2-4:

Facing south, looking downstream. Little to no riparian corridor exists in this area. Steep banks are due to the presence of the WPA wall, resulting in no connection between Johnson Creek and its original floodplain.

JOHNSON CREEK RESTORATION

REACHES
3, 4, 5



Legend

- Reach Divider
- City Boundary
- County Line

Aerial Images Source:
Spencer Gross, 1998.

Aerial Map

JURISDICTIONS INCLUDED

CITY OF PORTLAND

NORTH

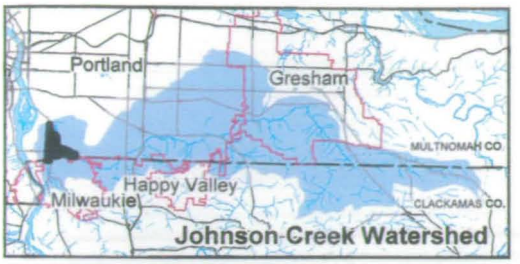
0 250 500 1000 Feet

Produced in MapInfo \\Oberon\GIS2\Projects\6220\Final_Mapping\Phase 3\Maps\Aerials\ARB.Wor (June, 2001) KDR

JOHNSON CREEK RESTORATION

REACHES

3, 4, 5



Legend

- Reach Divider
- Fish Barrier
- Pipe Crossing
- Inundated Properties
- Wildlife Corridors and Habitat Patches
- Floodplain Reconnection
- Impervious Surface

Functions

JURISDICTIONS INCLUDED

CITY OF PORTLAND

NORTH

0 250 500 1000 Feet

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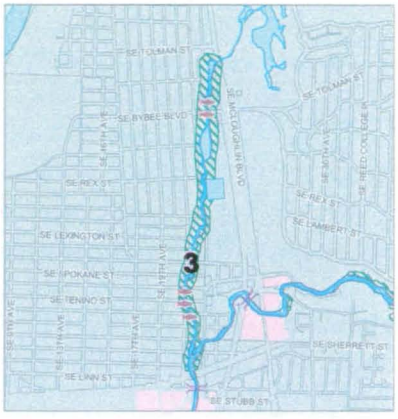
Reach 3



Reach 3 - Description	Target	Units
Floodplain Reconnection	8	acres
Wildlife Corridors and Habitat Patches	61	acres
In-stream Complexity	1,636	feet
Inundated Properties	44	number
Fish Barriers	5	number
Priority Outfalls	1	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Existing Conditions

Reach 3 contains a tributary of Johnson Creek, Crystal Springs, and a small portion of the creek's mainstem. The reach extends from just south of the confluence of Johnson Creek and Crystal Springs to the north along Crystal Springs and east along Johnson Creek to SE McLoughlin Boulevard. It is located in the jurisdiction of the City of Portland. The area consists primarily of single-family homes and includes a large park area (Westmoreland Park). The riparian corridor is narrow and vegetation is limited, mainly due to land use (residential and active recreation). Vegetation consists primarily of native red alder, bigleaf maple, Oregon ash, and willow, with an invasive understory of Himalayan blackberry, hedge bindweed, and clematis. Many areas of the reach contain steep banks covered with invasive plant species and little to no buffer between the creek and homes. Current conditions in this reach are rated as 2 at the confluence of Johnson Creek and Crystal Springs (Johnson Creek Park), and as 3+/3- from Johnson Creek Park up through Crystal Springs.

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Stabilize stream banks exhibiting excessive erosion
- Protect tributaries and tributary confluences
- Increase in-stream complexity of the creek
- Mitigate outfalls
- Remove fish barriers
- Protect areas of cool/cold water seeps and springs
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $5,020,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by scour pools, dammed pools, and glides.

- Average pool depth is 28 cm.
- Stream substrate is dominated by fine sediments and gravel.
- Wood volume is extremely low.
- Riparian vegetation is scarce; this reach is heavily urbanized.
- The reach consists of one confined channel.
- The banks and creek bed are armored with concrete throughout much of the reach.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, and erosion and sediment control.
- Place wood in stream to provide in-channel habitat diversity and hydraulic "roughness" for cover, pool formation, and channel bed stability.
- Provide off-channel habitat.
- Reduce the rate and magnitude of stormwater runoff by working with adjacent property owners to decrease impervious surfaces and by identifying areas where stormwater outfalls can be treated before entering the creek.

Recommended Actions

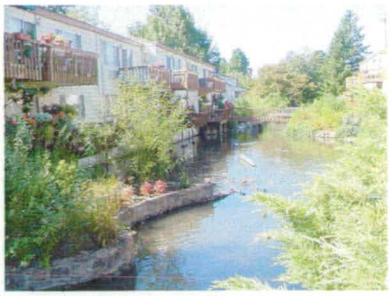
1. Work toward acquiring frequently flooded properties along Crystal Springs tributary through the Willing Seller Program as opportunities arise. On acquired properties, structures will be removed (see Photo 3-1), creek banks will be terraced back as appropriate to reconnect the floodplain and replanted with native vegetation, and the riparian corridor will be protected and enhanced to the maximum extent possible.
2. Work with property owners adjacent to Johnson Creek to reconnect the floodplain with the creek. Where appropriate, the banks will be terraced back as much as possible and then both the banks and the riparian corridor will be replanted with native riparian vegetation (see Photos 3-2 and 3-3). Also work with willing property owners adjacent to the creek to enhance and restore the riparian corridor, as well as stabilize creek banks exhibiting excessive erosion. On properties where it is not feasible to terrace the banks and promote reconnection of the floodplain with Crystal Springs, the emphasis will be on enhancing the riparian corridor and stabilizing the creek banks. Removing invasive vegetation and replacing it with native species will create healthier stretches of riparian corridor along the creek and help stabilize banks.
3. Work with property owners at the confluence of Johnson Creek and Crystal Springs to protect both the tributary and the

Photo 3-1:

Properties such as this one along Crystal Springs flood frequently. If acquired through the Willing Seller Program, the opportunity exists to terrace banks, restore the riparian corridor, reduce stream bank erosion, and reconnect the original floodplain.

Photo 3-2:

Facing east on SE Tenino Street looking at Crystal Springs Creek, a tributary of Johnson Creek. Currently, the creek has no access to its original floodplain. An opportunity exists to work with owners of properties such as this one to naturally terrace the banks and restore the riparian corridor with native vegetation. Outfall pipes, such as the one shown here, will be addressed on a site-specific basis.



Modern building practices and urban infill have led to the degradation of urban streams and the creation of unsafe housing situations for many people.

confluence through floodplain reconnection and riparian enhancement actions. At the confluence, terrace banks as far as possible, then replant them with native riparian vegetation (see Photo 3-4).

4. Increase in-stream complexity throughout the length of the creek and tributary running through this reach. This action, which will be done in conjunction with other projects in the reach, will consist of creating areas with large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase (see Photos 3-2 and 3-3).

Photo 3-3:

Facing north at Westmoreland Park, looking at an impounded area of Crystal Springs Creek. Removal of the concrete that lines the creek and pond area will create opportunities to increase in-stream complexity, improve wildlife habitat, and reconnect Crystal Springs Creek to its floodplain. Another opportunity in this area is to expand the riparian corridor through native plantings.

Photo 3-4:

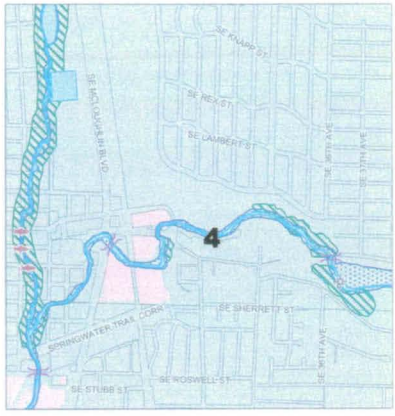
Looking southeast from west bank of Crystal Springs at Johnson Creek Park. Opportunities exist at the confluence of Johnson Creek and a tributary, Crystal Springs, to reconnect the floodplain, protect and enhance the riparian corridor, and increase in-stream complexity.

5. Address outfalls that directly impact Johnson Creek (see Photo 3-2). Outfalls may be removed or diverted through some sort of mitigation measure, such as a bio-filtration swale.
6. Remove or modify culverts along Crystal Springs that impede the movement of salmonids. Determination of whether the culverts will require improvement or removal will be determined on a site-by-site basis in the project design phase.
7. Identify areas of seeps and springs along or near the creek. Work with property owners in these areas to protect the natural resource and replant the riparian corridor with native vegetation.
8. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Reach 4

Existing Conditions

Reach 4 is located between SE McLoughlin Boulevard and SE 37th Avenue in the jurisdiction of the City of Portland. The reach includes single-family residences, industrial properties, commercial properties, and Eastmoreland Golf Course. The width of the riparian corridor is narrow, with moderate shade cover provided for the creek. Vegetation consists primarily of bigleaf maple, Oregon ash, red alder, and black cottonwood. Some of the larger trees are being topped by English ivy and clematis, and Himalayan blackberry is present along the banks. Many invasive plant species are present through the reach, and there are large areas of impervious surface and substantial amounts of debris in the creek. Current conditions in this reach are rated as 3/3- at the western end, 2+ through the middle, and 2/2- near the eastern end.



Reach 4 - Description	Target	Units
Floodplain Reconnection	8	acres
Wildlife Corridors and Habitat Patches	7	acres
In-stream Complexity	4,222	feet
Inundated Properties	1	number
Fish Barriers	0	number
Priority Outfalls	4	number
Pipe Crossings	0	number
Impervious Surface	20	acres

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Stabilize streambanks exhibiting excessive erosion
- Protect and restore riparian vegetation
- Increase in-stream complexity of creek
- Mitigate outfalls
- Reduce adverse effects of impervious surface
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $2,210,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by scour pools and riffles.
- Average pool depth is 93 cm.
- Stream substrate is dominated by cobble and gravel.
- Wood volume is extremely low.
- Riparian vegetation is dominated by small bigleaf maple, cottonwood, willow, and alder, with some medium-sized and large trees. Shade cover is moderate.

- The reach consists of multiple channels in some areas.
- Banks are dominated by earth slopes showing significant erosion, as well as incision.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, and erosion and sediment control.
- Place wood in stream to provide in-channel habitat diversity and hydraulic "roughness" for cover, pool formation, and channel bed stability.
- Provide off-channel habitat.

Recommended Actions

1. Work toward acquiring frequently flooded properties near the creek through the Willing Seller Program as opportunities arise. On acquired properties, structures will be removed, creek banks will be terraced back as appropriate to reconnect the floodplain, and replanted with native vegetation, and the riparian corridor will be protected and enhanced to the maximum extent possible.
2. Work with owners of the Eastmoreland Golf Course located on the north side of Johnson Creek) and the apartment complex (located on the south side of the creek bank) to expand the floodplain and enhance the riparian corridor. On the south side of the creek, only about 10 to 20 feet of space is available. The north side of the creek along the golf course has more room in which to work, but the banks are steeper and require removal of more invasive plants. Terracing and revegetating the banks of the creek with native species will help stabilize eroding banks throughout this reach (see Photo 4-1).

Photo 4-1:

Looking at Eastmoreland Golf Course on the north bank of Johnson Creek. Opportunities exist to work with willing owners to reconnect properties to the Johnson Creek floodplain and increase and enhance the riparian corridor

3. Work with property owners on the north side and the south side (Racquet Club) of Johnson Creek to reconnect the floodplain, stabilize the banks of the creek, and enhance the riparian corridor. The opportunity exists to terrace the banks back 20 to 50 feet. Terracing will include removing all invasive species and replanting with native riparian vegetation. Removal of fences will facilitate wildlife passage and access to the creek (see Photo 4-2).

Photo 4-2:

Facing south, looking across the creek from the banks of the Racquet Club. Working with property owners to remove barriers such as fences, planting the banks with native vegetation, and reconnecting the creek with its floodplain will significantly enhance the riparian corridor and wildlife habitat.

4. Increase in-stream stream complexity throughout this reach. This action, which will be undertaken in conjunction with other actions in the reach, will consist of inserting large wood in the creek, creating pool/riffle sequences, and deepening pools in the creek channel, as well as adding sinuosity where appropriate. Activities will be site-specific and will be determined in the project design phase.
5. Address outfalls that directly impact Johnson Creek. Outfalls may be removed or diverted through some sort of mitigation measure, such as a bio-filtration swale.
6. Work with property owners along Johnson Creek whose properties contain large areas of impervious surface. Mitigating the effects of impervious surface by applying current technology, such as drainage swales, green rooftops, and infiltration basins, will reduce surface runoff, improve water quality, and contribute to groundwater recharge (see Photos 4-3 and 4-4).
7. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

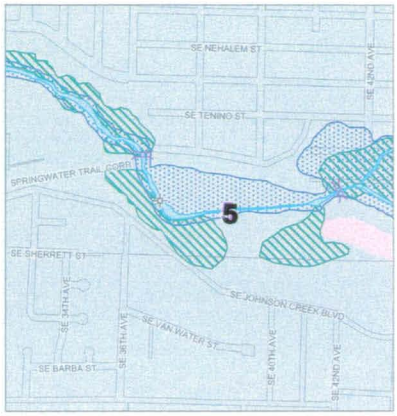
Photo: 4-3:

Facing south, looking at an apartment complex located on the south side of Johnson Creek. Residences, such as these near the creek, present an opportunity to mitigate for impervious surface through innovative techniques like eco-roofs and bio-swales.

Photo 4-4:

Facing east, showing the area just north of Johnson Creek with its large areas of impervious surface. Such areas contribute to increased surface runoff and degradation of in-stream water quality. Mitigation for these effects can often be achieved through an increased and enhanced riparian corridor.

Reach 5



Reach 5 - Description	Target	Units
Floodplain Reconnection	8	acres
Wildlife Corridors and Habitat Patches	5	acres
In-stream Complexity	1,751	feet
Inundated Properties	0	number
Fish Barriers	0	number
Priority Outfalls	5	number
Pipe Crossings	1	number
Impervious Surface	0	acres

Existing Conditions

Reach 5 is located between SE 32nd and 42nd Avenues in the jurisdiction of the City of Portland. The area consists mainly of single-family residences, with some industrial property in the eastern portion of the reach. Tideman Johnson Park is located within this reach, and there are some additional vegetated areas near the park. The width of the riparian corridor ranges from moderate to narrow. Vegetation consists primarily of red alder, bigleaf maple, willow, Oregon ash, and black cottonwood, with occasional native conifers interspersed throughout. These existing native species provide moderate shade to the creek. Some invasive plant species are also present, with English ivy topping some of the larger shade trees along the corridor. Current conditions in this reach are rated as 2.

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Protect and restore riparian vegetation
- Increase in-stream complexity of creek
- Mitigate outfalls
- Mitigate pipe crossing
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $760,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by scour pools, glides, and riffles.
- Average pool depth is 88 cm.
- Stream substrate is dominated by cobble and gravel, with significant amounts of fine sediments, as well as boulders.
- Wood volume is extremely low.
- Riparian vegetation is dominated by multi-aged deciduous trees, such as bigleaf maple, cottonwood, alder, and willow, as well as some conifers. Shade cover is good.

- The reach consists of one confined channel.
- Incision and channel erosion occur throughout the reach.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, and erosion and sediment control.
- Place wood in stream to provide in-channel habitat diversity and hydraulic "roughness" for cover, pool formation, and channel bed stability.
- Provide off-channel habitat.

Recommended Actions

1. Reconnect Johnson Creek with its original floodplain by recreating a braided channel with limited associated wetlands through the Tideman Johnson Park area. The process will require lowering the stream banks so that the creek gains access to identified property areas. Most large trees and native vegetation throughout this reach should be retained as much as possible in the design of the constructed wetland or reused as appropriate. Design should take into account existing upland species (beginning about 100 feet from the north bank of the creek), and new riparian/wetland areas should be planned in such a way that they are retained. After the banks of the creek are lowered, allowing increased access by the creek, the area will be planted with native wetland and riparian vegetation. Existing native vegetation that must be removed during this action will be replanted on the site to the maximum extent possible. The banks of the creek will be planted with vegetation able to provide shade to the creek (see Photo 5-1).

   During the process of regrading and lowering the banks, 300-foot channels will be created to provide off-channel fish habitat. In addition, the banks of the creek will be reshaped, developing greater sinuosity in the creek by adding meanders throughout this stretch. Upland areas adjacent to newly created meanders will be revegetated with native upland understory species. Large upland trees, such as Douglas-fir and western redcedar, should be retained and used as a basis for determining the appropriate planting scheme. Dense upland plantings will create a wildlife habitat corridor adjacent to the creek and allow for increased wildlife access to the riparian area.

Photo 5-1:

Facing southeast, looking at Johnson Creek in Tideman Johnson Park. This area has been identified for recreating a braided channel and associated wetlands.

2. Work with property owners along the south side of the creek to enhance the riparian corridor and increase the connection of Johnson Creek with its floodplain. This action would entail terracing the banks of the creek where appropriate, removing

non-native invasive plants, and then replanting the banks with native riparian vegetation (see Photo 5-2). The amount of terracing completed will be based on the willingness of the property owners to participate and the amount of area available adjacent to the creek.

Photo 5-2:

Looking at south bank of Johnson Creek. Work with property owner to terrace banks and revegetate with native species.

3. Increase in-stream complexity throughout this reach. This work will be done in conjunction with other actions in the reach and will consist of inserting large wood in the creek, creating pool/riffle sequences, and deepening pools in the creek channel, as well as adding sinuosity in areas where it is deemed appropriate. Activities will be site-specific and will be determined in the project design phase (see Photo 5-3).

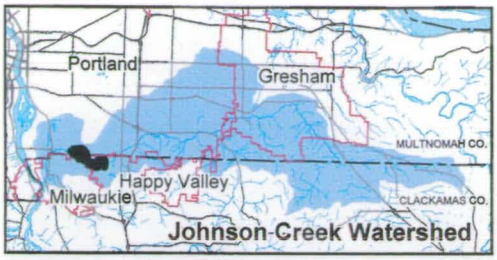
Photo 5-3:

Facing west, looking at the south bank of Johnson Creek. Work in stream to add complexity to the straight channelized areas of the creek will improve habitat conditions.

4. Address outfalls that directly impact Johnson Creek. Outfalls may be removed or diverted through some sort of mitigation measure, such as a bio-filtration swale.
5. Mitigate the effect of the uncovered pipe that crosses Johnson Creek in this reach. Erosion has undercut the pipe on the downstream side. Specific mitigation actions will be determined during the project design phase.
6. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

JOHNSON CREEK RESTORATION

REACHES
6, 7, 8, 9, 10



Aerial Map

Legend

- Reach Divider
- City Boundary
- County Line

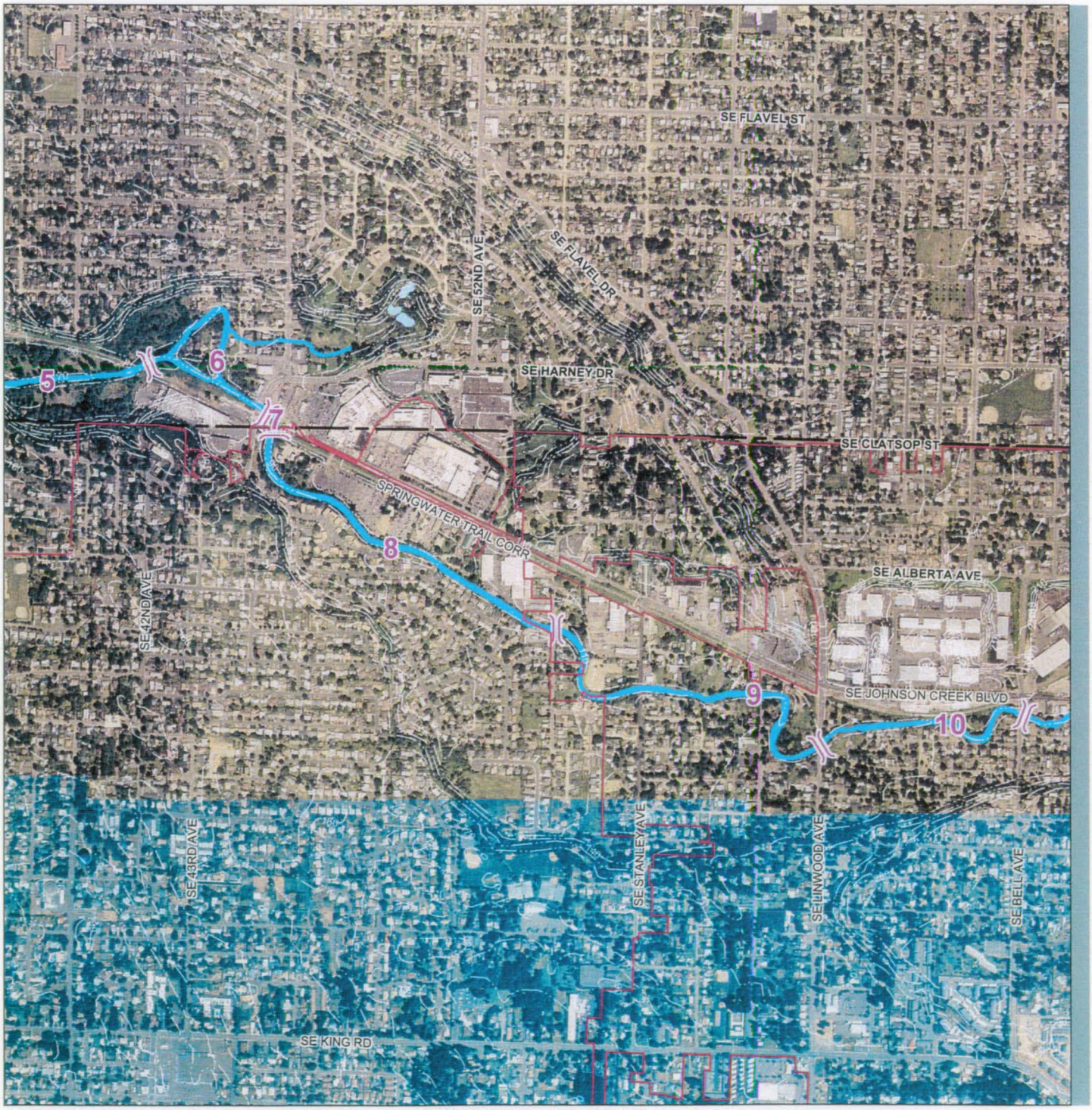
Aerial Images Source:
Spencer Gross, 1998.

JURISDICTIONS INCLUDED

CITY OF PORTLAND
CITY OF MILWAUKIE
CLACKAMAS COUNTY

NORTH

0 250 500 1000 Feet



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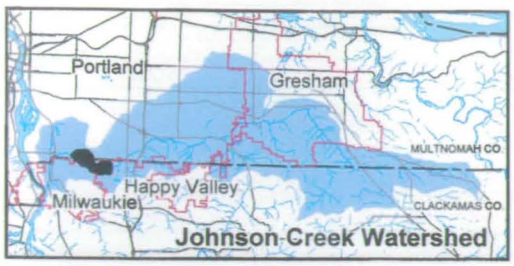
JOHNSON CREEK RESTORATION

REACHES 6, 7, 8, 9, 10



Legend

- Reach Divider
- Fish Barrier
- Pipe Crossing
- Inundated Properties
- Wildlife Corridors and Habitat Patches
- Floodplain Reconnection
- Impervious Surface

Functions

JURISDICTIONS INCLUDED

CITY OF PORTLAND
CITY OF MILWAUKIE
CLACKAMAS COUNTY

NORTH

0 250 500 1000 Feet

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Reach 6

Reach 6 - Description	Target	Units
Floodplain Reconnection	29	acres
Wildlife Corridors and Habitat Patches	27	acres
In-stream Complexity	973	feet
Inundated Properties	16	number
Fish Barriers	2	number
Priority Outfalls	3	number
Pipe Crossings	0	number
Impervious Surface	4	acres

Existing Conditions

Reach 6 is located between SE 39th Avenue and 52nd Avenue, north of the Springwater Corridor and Johnson Creek Boulevard. It is in the jurisdiction of the City of Portland. The area consists predominantly of single-family homes, with a few industrial properties. Errol Heights, a spring-fed wetland habitat, and Thomas Park are located in this reach. The springs originating in Errol Heights feed a tributary of Johnson Creek that has good fish habitat potential. The riparian corridor is moderate to narrow in width and primarily vegetated with Oregon ash, red alder, common hawthorn, beaked hazelnut, willow, and black cottonwood. Himalayan blackberry covers many of the stream banks in this area, and English ivy is topping a number of the trees. Wetland invasive species, such as reed canarygrass, purple loosestrife, watercress, European bittersweet, and clematis, are abundant in the Errol Heights area. Invasive plants grow near the creek, and impervious surfaces frequently extend to the edge of the creek, thereby limiting the riparian corridor. The eastern section of the reach contains some relatively healthy wildlife habitat and some areas of seeps and springs. Current conditions in this reach are rated as 2-/3 near the creek area, 3 through the center of the project, and 1- near the eastern portion of the reach (Errol Heights).

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Protect tributaries and tributary confluences
- Create or enhance wildlife corridors
- Increase in-stream complexity of creek
- Mitigate outfalls
- Reduce adverse effects of impervious surface
- Remove fish barriers
- Protect areas of cool/cold water seeps and springs
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $4,940,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by scour pools, glides, and riffles.
- Average pool depth is 88 cm.
- Stream substrate is dominated by cobble and gravel.
- Wood volume is extremely low.
- Riparian vegetation is dominated by multi-aged deciduous trees, such as bigleaf maple, cottonwood, alder, and willow, as well as some conifers. Shade cover is good.
- The reach consists of two confined channels.
- The straight channel above the waterfall is completely lined, both streambed and banks, with WPA tiles. The materials composing the oxbow banks vary.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, and erosion and sediment control.
- Place wood in stream to provide in-channel habitat diversity and hydraulic "roughness" for cover, pool formation, and channel bed stability.
- Provide off-channel habitat.
- Daylight Errol Heights Creek. The Johnson Creek Watershed Council has recommended this action, which would require land acquisition and restoration of approximately one-half mile of channel. This would create some off-channel refuge and possible opportunities for steelhead spawning and rearing at the mouth of the creek.

Recommended Actions

1. Work toward acquiring frequently flooded properties near the creek through the Willing Seller Program as opportunities arise. On acquired properties, structures will be removed, creek banks will be terraced back as appropriate to reconnect the floodplain and replanted with native vegetation, and the riparian corridor will be protected and enhanced to the maximum extent possible.
2. Work toward acquiring additional properties on the north side of Johnson Creek through the Willing Seller Program as opportunities arise for the purpose of reconnecting Johnson Creek with its natural floodplain by developing an enhanced wetland area. This action will entail removing purchased homes; terracing back the banks of the creek, its tributary, and oxbow as far as appropriate; and allowing the creek additional area to

Photo 6-1:

Facing north, showing property on SE 44th Avenue near the oxbow north of Johnson Creek. This area already exhibits wetland conditions and provides opportunity to create enhanced wetlands.

Photo 6-2:

Facing north, showing property near SE 44th Avenue on the oxbow of Johnson Creek. This area provides opportunity for floodplain reconnection through working with property owners or Willing Seller Program land acquisition.

Photo 6-3:

Looking at property just below Errol Heights within proposed wildlife corridor.

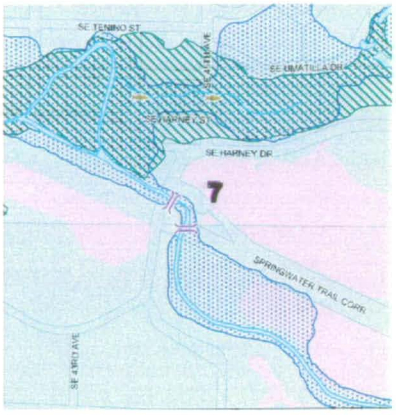
access during flood events. During terracing, the WPA wall will be removed so that the creek is not restricted. The banks will then be planted with native species to increase the size and enhance the value of the riparian corridor and also provide shade for the creek. Property exhibiting wetland conditions already exists in this reach. The purpose of the work is to expand and enhance this area with additional native wetland vegetation and in the process remove such non-native invasive species as reed canarygrass and Himalayan blackberry. Existing native wetland vegetation will be maintained in the design (see Photos 6-1 and 6-2).

3. Work with property owners to the northeast of the enhanced wetland area for the purpose of creating a wildlife corridor and protecting the tributary that extends through this section of the reach. Property owners will be encouraged to allow planting of native riparian vegetation to improve wildlife habitat and provide access to the creek from the surrounding upland areas (see Photo 6-3). Areas along the tributary have been identified as key areas for restoration opportunities.
4. Increase in-stream complexity throughout the length of the creek running through this reach. This action will be done in conjunction with other projects in the reach and will consist of creating areas with large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase.
5. Address outfalls that directly impact Johnson Creek. Outfalls may be removed or diverted through some sort of mitigation measure, such as a bio-filtration swale.
6. Work with property owners along Johnson Creek whose properties contain large areas of impervious surface. Mitigating the effects of impervious surface by applying current technology, such as drainage swales, green rooftops, and infiltration basins, will reduce surface runoff, improve water quality, and contribute to groundwater recharge.
7. Remove or modify culverts that impede salmonid movement. Determination of whether the culvert will require improvement or removal will be decided on a site-by-site basis during the project design phase.
8. Identify areas of seeps and springs along or near the creek and work with property owners in these areas to protect this natural resource. On identified properties, non-native invasive species will be removed and native riparian vegetation will be planted. This action will also help to stabilize steep slopes and slow erosive processes occurring in the watershed.
9. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Reach 7

Existing Conditions

Reach 7 extends from the intersection of Johnson Creek Boulevard with the Springwater Corridor to just west of SE 55th Avenue, and is bounded on the north by SE Harney Drive and on the south by the county line. It is in the jurisdiction of the City of Portland. This project area contains part of a large industrial complex (Precision Castparts) on the north side of Johnson Creek, creating large areas of impervious surfaces and open lots. The width of the riparian corridor is narrow to nonexistent in many locations and lacks significant vegetation. Existing vegetation consists primarily of red alder, bigleaf maple, and black cottonwood. Current conditions in this reach are rated as 3.



Reach 7 - Description	Target	Units
Floodplain Reconnection	.3	acres
Wildlife Corridors and Habitat Patches	0	acres
In-stream Complexity	250	feet
Inundated Properties	4	number
Fish Barriers	0	number
Priority Outfalls	0	number
Pipe Crossings	0	number
Impervious Surface	17	acres

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Increase in-stream complexity of creek
- Reduce adverse effects of impervious surface
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $690,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by riffles, glides, and scour pools.
- Average pool depth is 47 cm.
- Stream substrate is dominated by cobble and gravel.
- Wood volume is extremely low.
- Riparian vegetation is dominated by large deciduous trees , such as black cottonwood. Shade cover is good, but the width of riparian buffer is restricted by parking lots and residences.
- Banks are constrained by WPA tiles.
- Numerous stormwater outfalls are present.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place wood in stream to provide in-channel habitat diversity and hydraulic "roughness" for cover, pool formation, and channel bed stability.

Recommended Actions

1. Work toward acquiring frequently flooded properties near the creek through the Willing Seller Program as opportunities arise. On acquired properties, structures will be removed, creek banks will be terraced back as appropriate to reconnect the floodplain and replanted with native vegetation, and the riparian corridor will be protected and enhanced to the maximum extent possible.
2. Work with willing landowners to maximize floodplain reconnection and restoration and enhancement of the riparian corridor. The banks of the creek will be terraced as much as practicable and appropriate, based on the willingness of the property owner to participate. As with any acquired properties, all invasive species will be removed and the area replanted with native riparian vegetation. Available areas will be maximized for restoration activities (see Photo 7-1).
3. Increase in-stream complexity throughout the length of the creek running through this reach. This action will be done in conjunction with other projects in the reach and will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase.
4. Work with landowners along Johnson Creek whose properties contain large areas of impervious surface. Mitigating the effects of impervious surface by applying current technology, such as drainage swales, green rooftops, and infiltration basins, will reduce surface runoff, improve water quality, and contribute to groundwater recharge.
5. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

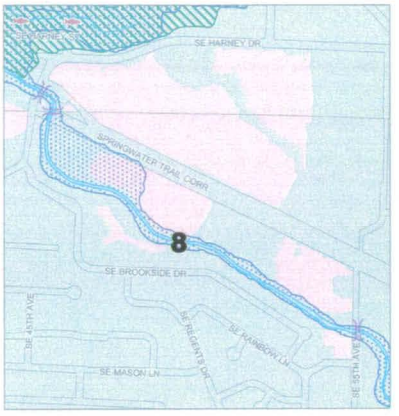
Photo 7-1:

Facing east, looking at a Precision Castparts parking lot. Opportunity exists to work with the property owner to mitigate for impervious surface, increase the riparian corridor, and reconnect the floodplain where feasible.

Reach 8

Existing Conditions

Reach 8 is located between SE Johnson Creek Boulevard and SE 55th Avenue in Clackamas County. Johnson Creek runs through the middle of the area, as does the Springwater Corridor. The reach is in the jurisdiction of the City of Milwaukie. It contains a portion of a large industrial complex (Precision Castparts) on the north side of Johnson Creek, and consequently there are large areas of impervious surface and open parking lots. Single-family homes predominate south of Johnson Creek. The riparian corridor in this area is narrow to nonexistent in many locations, with steep eroding banks that lack significant vegetation. Many private homes are situated adjacent to the creek with little or no buffer in between. Vegetation consists primarily of red alder, bigleaf maple, Oregon ash, and black cottonwood. Current conditions in this reach are rated as 3+.



Reach 8 - Description	Target	Units
Floodplain Reconnection	10	acres
Wildlife Corridors and Habitat Patches	0	acres
In-stream Complexity	3,061	feet
Inundated Properties	17	number
Fish Barriers	0	number
Priority Outfalls	0	number
Pipe Crossings	0	number
Impervious Surface	26	acres

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Increase in-stream complexity of creek
- Reduce adverse effects of impervious surface
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $3,830,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by riffles, glides, and scour pools.
- Average pool depth is 47 cm.
- Stream substrate is dominated by cobble and gravel.
- Wood volume is extremely low.
- Riparian vegetation is dominated by large deciduous trees, such as black cottonwood. Shade cover is good, but the width of riparian buffer is restricted by parking lots and residences.
- The reach consists of multiple channels.
- Patches of potential spawning gravels occur just southeast of Johnson Creek Boulevard.

- Banks are constrained by WPA tiles.
- Numerous stormwater outfalls are present.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place wood in stream to provide in-channel habitat diversity and hydraulic "roughness" for cover, pool formation, and channel bed stability. Creation of additional pool habitat in this area is important.

Recommended Actions

1. Work toward acquiring frequently flooded properties near the creek through the Willing Seller Program as opportunities arise. On acquired properties, structures will be removed, creek banks will be terraced back as appropriate to reconnect the floodplain and replanted with native vegetation, and the riparian corridor will be protected and enhanced to the maximum extent possible.
2. Work toward acquiring additional property along the north bank of Johnson Creek through the Willing Seller Program and design a constructed wetland area for the purpose of reconnecting Johnson Creek with its original floodplain. This action will entail regrading the banks of the creek and the properties as necessary to open them up for access by the creek. Many of the banks in this reach are not significantly steep, which will reduce the regrading effort required. Once regrading is completed, the property will be planted with native wetland vegetation. The banks will be planted with appropriate native riparian vegetation to create additional shade for the creek (see Photo 8-1).

   Other actions to be completed during the construction of wetlands include creating off-channel fish habitat and increasing sinuosity along the creek. During the process of regrading and lowering the banks, 300-foot channels will be created to provide

Photo 8-1:

Facing west (downstream), looking at north bank property along Johnson Creek. Opportunity exists in this area for the banks to be terraced back and the riparian corridor enhanced.

off-channel fish habitat. At the same time, the creek banks will be reshaped by adding meanders throughout this stretch. The creek can be accessed fairly easily from Johnson Creek Boulevard.

3. Work with willing property owners along the south side of the creek to reconnect the floodplain, where appropriate, and enhance and restore the riparian corridor. This process will require terracing the creek banks to increase the area available for the creek to access. The banks will then be revegetated with native plants to the extent permitted by the property owner to assist in restoring the riparian corridor through this reach. Some bank areas along the south side of the creek are potentially able to accommodate 25 to 50 feet of revegetation, though the actual size of buffer zones created will depend on the specific site and the willingness of the property owner to participate (see Photo 8-2).
4. Increase in-stream throughout the length of the creek running through this reach. This action will be done in conjunction with other projects in the reach and will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the design phase.
5. Work with property owners along Johnson Creek whose properties contain large areas of impervious surface. Mitigating the effects of impervious surface by applying current technology, such as drainage swales, green rooftops, and infiltration basins, will reduce surface runoff, improve water quality, and contribute to groundwater recharge (see Photo 8-3).
6. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

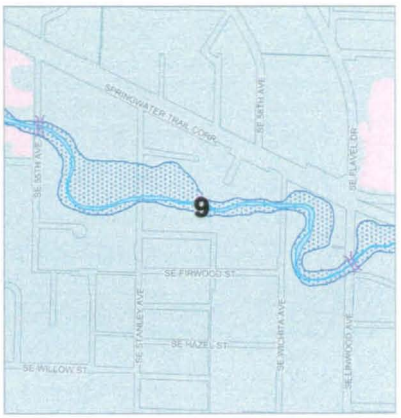
Photo 8-2:

Looking at private property on the south bank of the creek. The opportunity exists to work with landowners to reconnect the floodplain and restore the riparian corridor.

Photo 8-3:

Facing south, looking at impervious surface on the north side of Johnson Creek. Opportunity exists to mitigate for impervious surface through such techniques as bio-swales and infiltration basins

Reach 9



Reach 9 - Description	Target	Units
Floodplain Reconnection	12	acres
Wildlife Corridors and Habitat Patches	0	acres
In-stream Complexity	3,076	feet
Inundated Properties	11	number
Fish Barriers	0	number
Priority Outfalls	1	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Existing Conditions

Reach 9 extends from SE 55th Avenue to SE Linwood Avenue. Johnson Creek runs through the middle of the area. It is in the jurisdiction of Clackamas County. The reach consists primarily of single-family residences and some large industrial areas. The riparian corridor is very narrow, ranging from 5 to 15 feet. Vegetation consists of a combination of native species, such as red alder, bigleaf maple, and willow, and non-native invasive species, such as Himalayan blackberry, hedge bindweed, reed canarygrass, purple loosestrife, European bittersweet, and English ivy. Many trees are topped by English ivy, and large amounts of debris are in the creek bed. The WPA wall is prevalent through this reach. Current conditions in this reach are rated from 2- at the western end to 3+ near the eastern end.

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Increase in-stream complexity of creek
- Mitigate outfalls
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $3,540,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by riffles, glides, and scour pools.
- Average pool depth is 47 cm.
- Stream substrate is dominated by cobble and gravel.
- Wood volume is extremely low.
- Riparian vegetation is dominated by large deciduous trees, such as black cottonwood. Shade cover is good, but the width of riparian buffer is restricted by parking lots and residences.
- The reach consists of multiple channels.
- Patches of potential spawning gravels occur just southeast of Johnson Creek Boulevard.

- Banks are constrained by WPA tiles.
- Numerous stormwater outfalls are present.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place wood in stream to provide in-channel habitat diversity and hydraulic "roughness" for cover, pool formation, and channel bed stability. Creation of additional pool habitat in this area is important.
- Provide off-channel habitat.
- Reduce the rate and magnitude of stormwater runoff by working with adjacent property owners to decrease impervious surfaces and by identifying areas where stormwater outfalls can be treated before entering the creek.

Recommended Actions

1. Work toward acquiring frequently flooded properties near the creek through the Willing Seller Program as opportunities arise. On acquired properties, structures will be removed, creek banks will be terraced back as appropriate to reconnect the floodplain and replanted with native vegetation, and the riparian corridor will be protected and enhanced to the maximum extent possible.
2. Design a constructed wetland on properties acquired through the Willing Seller Program, predominantly along the north side of Johnson Creek in the western portion of the reach. The purpose of this action is to reconnect Johnson Creek with its original floodplain. The action will require removing the WPA wall from the creek, then regrading the banks as necessary to open up identified properties for access by the creek (see Photo 9-1). After regrading, the property will be replanted with native wetland vegetation. The banks will be planted with appropriate native riparian vegetation to provide shade for the creek (see Photo 9-2). Additional actions to be completed include creating off-channel fish habitat and increasing sinuosity in the creek. During the process of regrading and lowering the banks, 300-foot channels will be created to provide off-channel fish habitat. At the same time, the creek banks will be reshaped and meanders added throughout this stretch.
3. Work with property owners along the north and south sides of Johnson Creek to reconnect floodplain areas and restore the riparian corridor. This action entails removing the WPA wall where appropriate. Creek banks can be terraced from 10 to 100 feet where appropriate. The amount of terracing will be based on site conditions and the willingness of the property owner to

Photo 9-1:

Looking west (downstream) at the prominent WPA wall lining the creek bank in this area.

Photo 9-2:

Facing west at the Stanley Street bridge over Johnson Creek. Opportunity exists to terrace the banks here, creating a constructed wetland and restoring the riparian corridor.

participate. Once banks have been terraced, they will be revegetated with native species (see Photos 9-2 and 9-3).

4. Increase in-stream complexity throughout the length of the creek running through this reach. This action will be done in conjunction with other projects in the reach and will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase (see photo 9-3).
5. Mitigate the effects of the high priority outfall located near the intersection of Johnson Creek Boulevard and SE Wichita Street. Address additional outfalls that directly impact Johnson Creek. Outfalls may be removed or diverted through some sort of mitigation measure, such as a bio-filtration swale.
6. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek (see Photo 9-4).

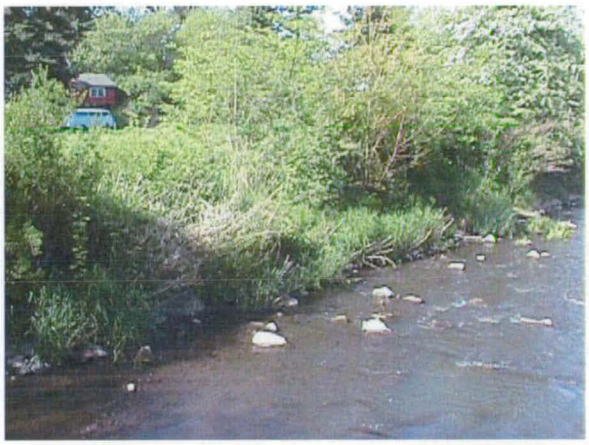


Photo 9-3:

Facing west, looking downstream at the south bank of the creek. Areas such as this one provide opportunity to increase in-stream complexity and restore the riparian corridor.

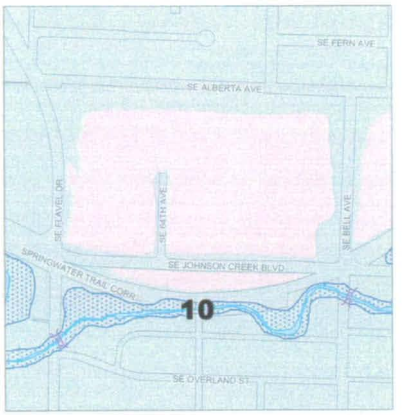
Photo 9-4:

Facing west, looking at north bank of Johnson Creek. Through educating and working with willing property owners, Johnson Creek can be reconnected to its original floodplain and the banks revegetated to shade the creek.

Reach 10

Existing Conditions

Reach 10 extends from SE Linwood Avenue to SE Bell Avenue and is in the jurisdiction of Clackamas County. The area consists primarily of single-family residences with some large industrial areas located on the south side of the creek. The riparian corridor is very narrow, and sometimes nonexistent. The limited vegetation consists of non-native horse chestnut, cherry, and laurel, as well as some native willow. In addition, many invasive species are present, such as Himalayan blackberry, reed canarygrass, purple loosestrife, and hedge bindweed. Many of the banks are steep, and the sparse riparian buffer provides little or no shade for the creek. Current conditions in this reach are rated as 3.



Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Increase in-stream complexity of creek
- Reduce adverse effects of impervious surface
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $2,840,000

Reach 10 - Description	Target	Units
Floodplain Reconnection	5	acres
Wildlife Corridors and Habitat Patches	0	acres
In-stream Complexity	1,779	feet
Inundated Properties	14	number
Fish Barriers	0	number
Priority Outfalls	0	number
Pipe Crossings	0	number
Impervious Surface	34	acres

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by riffles, glides, and scour pools.
- Average pool depth is 84 cm.
- Stream substrate is dominated by cobble, gravel, and boulders.
- Wood volume is extremely low, and its size is small.
- Riparian vegetation is dominated by small deciduous trees, such as willow, ash, alder and maple, interspersed with shrubs and annual grasses. The width of the riparian zone is generally confined on both sides by land use.
- The reach consists primarily of one constrained channel.
- Incision is evident throughout the reach
- Banks are constrained by WPA tiles or other forms of reinforcement.

- Channel complexity is found in association with gravel bars in some areas.
- Few outfalls are evident, but two had small oil/gas slicks associated with them at the time of the survey.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place wood in stream to provide in-channel habitat diversity and hydraulic "roughness" for cover, pool formation, and channel bed stability. Creation of additional pool habitat in this area is important.

Recommended Actions

1. Work toward acquiring frequently flooded properties near the creek through the Willing Seller Program as opportunities arise. On acquired properties, structures will be removed, creek banks will be terraced back as appropriate to reconnect the floodplain and replanted with native vegetation, and the riparian corridor will be protected and enhanced to the maximum extent possible.
2. Work toward acquiring additional properties along the north side of Johnson Creek through the Willing Seller Program and design a constructed wetland area for the purpose of reconnecting Johnson Creek with its original floodplain (see Photo 10-1). The action will require regrading the banks of the creek and the properties as necessary to open them up for access by the creek. After regrading is completed and all non-native invasive species are removed, the property will be planted with native wetland vegetation. As many of the existing native species as possible will be maintained in the design of the constructed wetland area. The banks will be planted with appropriate native riparian vegetation to shade the creek.

   Additional actions to be completed during wetlands construction include the creation of off-channel fish habitat and increasing sinuosity along the creek. During the process of regrading and lowering the banks, 300-foot channels will be created to provide off-channel fish habitat. At the same time, the creek banks will be reshaped by adding meanders throughout this stretch.
3. Work with other landowners adjacent to the creek to achieve the same functions as on the acquired properties. There will likely be less reconnection and riparian corridor enhancement on these properties because there is limited area to work with. The extent of the work will depend on each owner's willingness to participate (see Photos 10-2 and 10-3).

Photo 10-1:

Looking east (upstream) off SE Linwood Avenue. Opportunity exists to terrace the banks and design a constructed wetland.

Photo 10-2:

Looking east (upstream) from SE Bell Avenue at the south bank of Johnson Creek. Opportunity exists to work with property owners to reconnect the original floodplain and restore the riparian corridor.

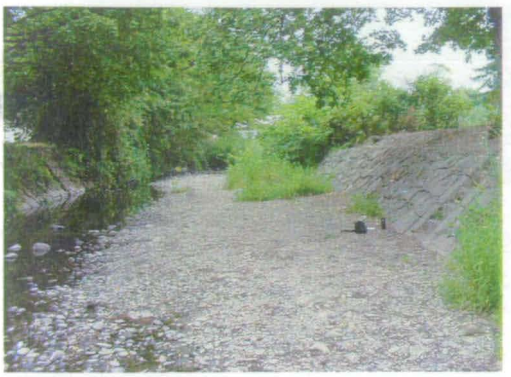


Photo 10-3:

Looking upstream near Mill Park. Note that there is little to no complexity in the stream, a limited riparian corridor, and steep WPA wall banks. Opportunity exists to restore the riparian corridor, add complexity to the creek, and reconnect the floodplain.

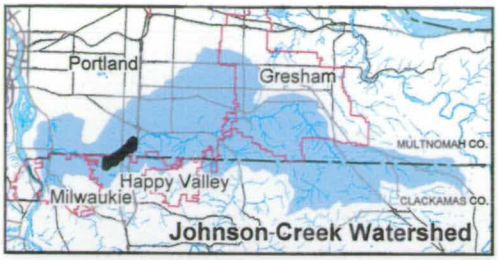
4. Increase in-stream complexity throughout the length of the creek running through this reach. This action will be done in conjunction with other projects in the reach and will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase (see Photo 10-3).
5. Work with landowners along Johnson Creek whose properties contain large areas of impervious surface. Mitigating the effects of impervious surface by applying current technology, such as drainage swales, green rooftops, and infiltration basins, will reduce surface runoff, improve water quality, and contribute to groundwater recharge (see Photo 10-4).
6. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Photo 10-4:

Facing west from SE Bell Avenue, looking at impervious surface near the creek. Opportunities exist to work with property owners in reducing impacts of impervious surface through techniques such as eco-roofs and swales.

JOHNSON CREEK RESTORATION

REACHES
11, 12



Legend

- Reach Divider
- City Boundary
- County Line

Aerial Images Source:
Spencer Gross, 1998.

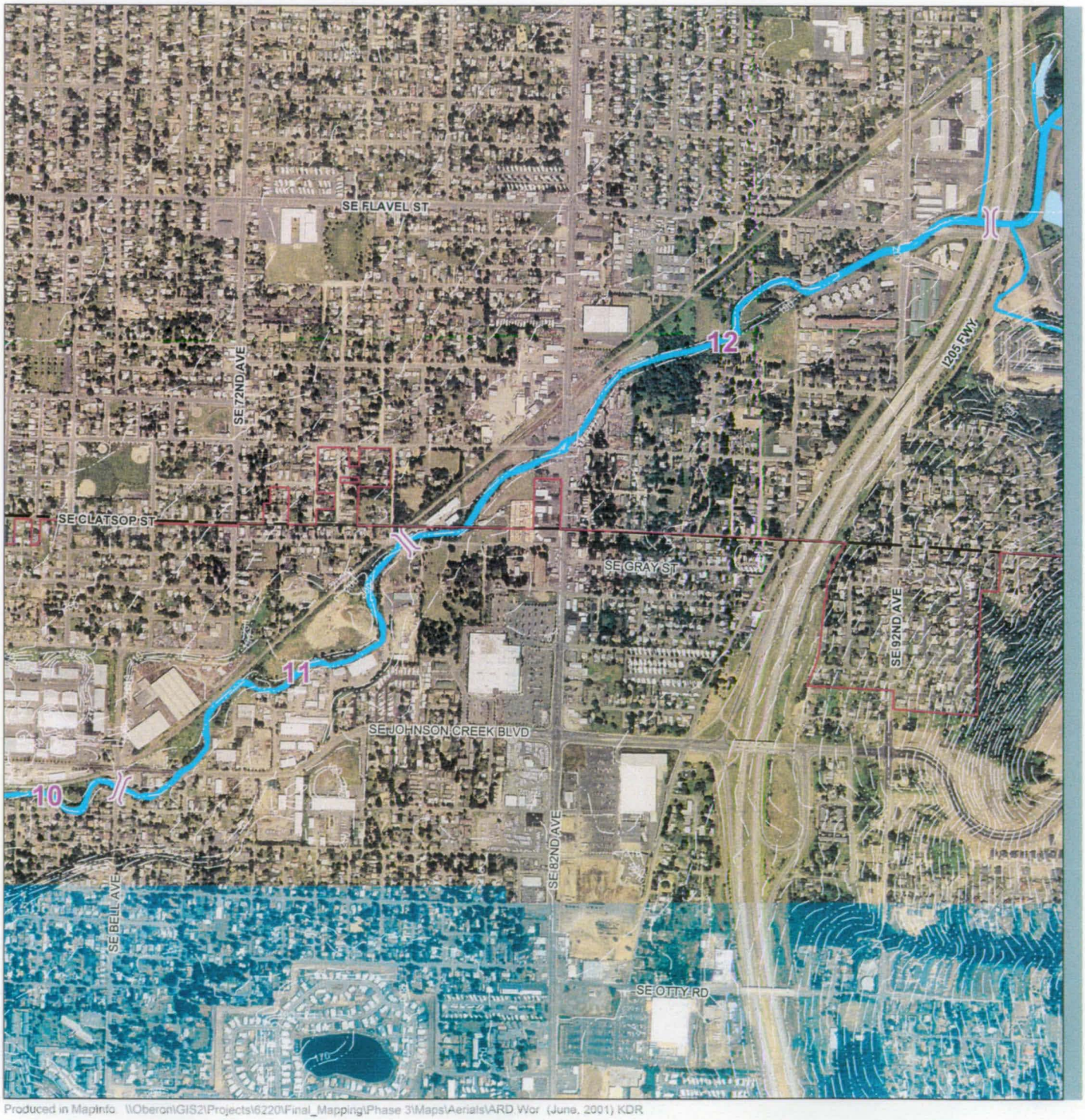
Aerial Map

JURISDICTIONS INCLUDED

CITY OF PORTLAND
CLACKAMAS COUNTY

NORTH

0 250 500 1000 Feet



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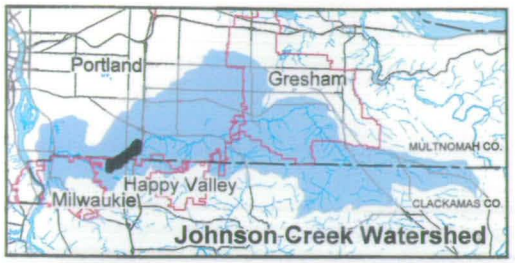
JOHNSON CREEK RESTORATION

REACHES
11, 12



Legend

- Reach Divider
- Fish Barrier
- Pipe Crossing
- Inundated Properties
- Wildlife Corridors and Habitat Patches
- Floodplain Reconnection
- Impervious Surface

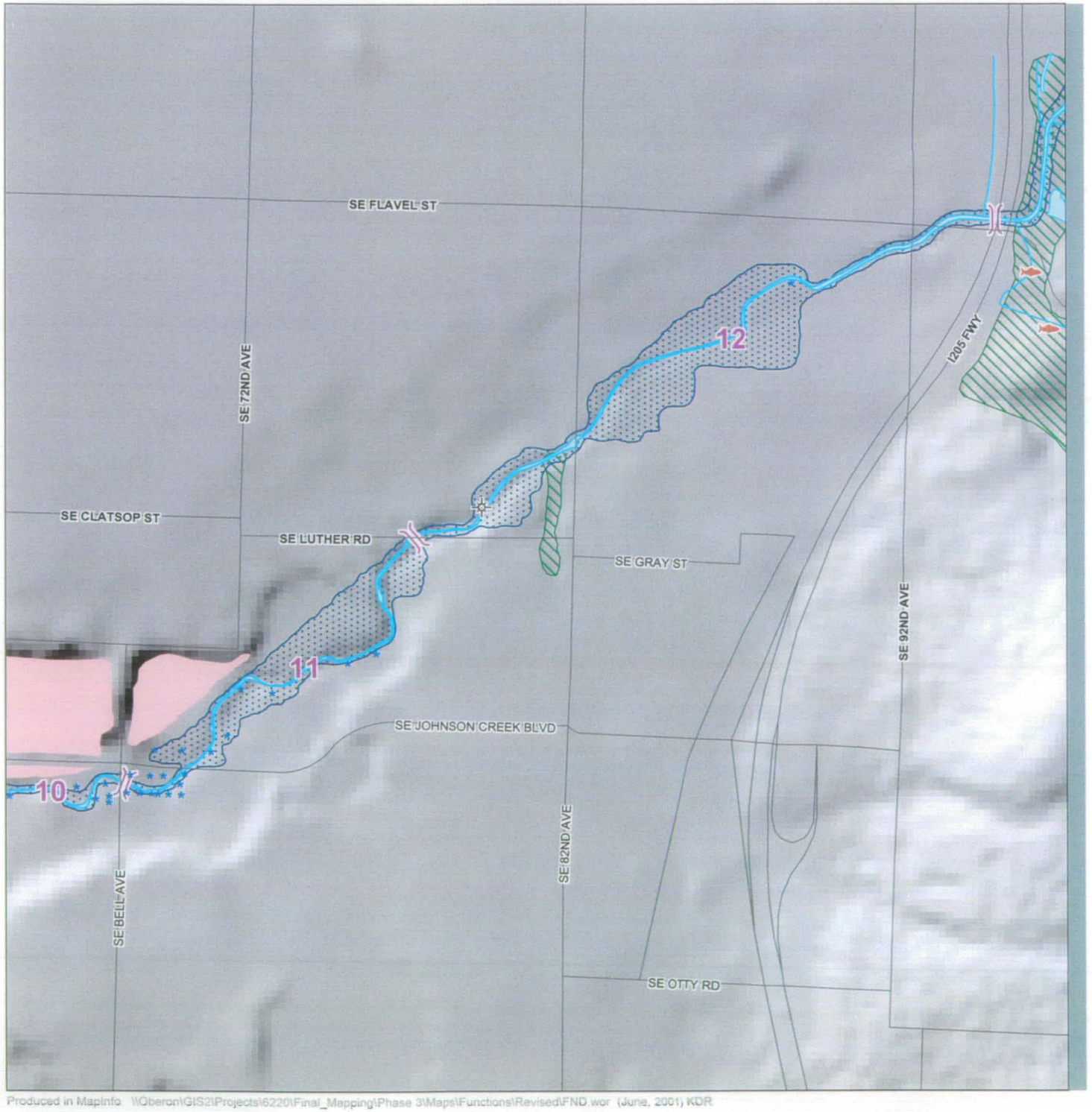
Functions

JURISDICTIONS INCLUDED

CITY OF PORTLAND
CLACKAMAS COUNTY

NORTH

0 250 500 1000 Feet



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Reach 11

Reach 11 - Description	Target	Units
Floodplain Reconnection	25	acres
Wildlife Corridors and Habitat Patches	0	acres
In-stream Complexity	3,689	feet
Inundated Properties	19	number
Fish Barriers	0	number
Priority Outfalls	5	number
Pipe Crossings	1	number
Impervious Surface	11	acres

Existing Conditions

Reach 11 extends from SE Bell Avenue to SE 78th Avenue near SE Luther Road and is in the jurisdiction of Clackamas County. The area consists primarily of single-family residential housing, along with large industrial areas both north and south of Johnson Creek. The width of the riparian corridor through this reach ranges in size from very narrow to nonexistent. Vegetation consists primarily of a limited amount of Oregon ash, willow, red alder, black cottonwood, oceanspray, and bigleaf maple. Such non-native species as horse chestnut, Himalayan blackberry, reed canarygrass, Scot's broom, hedge bindweed, and purple loosestrife are also present. Current conditions in this reach are rated as 3+ at the western portion of the reach to 2/2- in the middle and eastern portions.

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Stabilize stream banks exhibiting excessive erosion
- Increase in-stream complexity of creek
- Mitigate outfalls
- Reduce adverse effects of impervious surface
- Mitigate pipe crossing
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $7,750,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by riffles, glides and scour pools.
- Average pool depth is 84 cm.
- Stream substrate is dominated by cobble, gravel, and boulders.
- Wood volume is extremely low, and its size is small.
- Riparian vegetation is dominated by small deciduous trees such as willow, ash, alder, and maple, interspersed with shrubs and annual grasses. The width of the riparian zone is generally confined on both sides by land use.

- The reach consists primarily of one constrained channel.
- Incision in this reach is creating eroding cliffs along the creek bank.
- Channel complexity is found in association with gravel bars in some areas.
- Few outfalls are evident, but two showed signs of small oil/gas slicks at the time of the survey.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place wood in stream to provide in-channel habitat diversity and hydraulic "roughness" for cover, pool formation, and channel bed stability.
- Create off-channel habitat that provides refuges for salmonids, as well as flood retention opportunities. Specifically, evaluate a potential area of interest for both flood retention and off-channel habitat just downstream of SE Luther Avenue, on the left side of the channel, near a cleared, open high terrace.

Recommended Actions

1. Work toward acquiring frequently flooded properties near the creek through the Willing Seller Program as opportunities arise. On acquired properties, structures will be removed, creek banks will be terraced back as appropriate to reconnect the floodplain and replanted with native vegetation, and the riparian corridor will be protected and enhanced to the maximum extent possible.
2. Acquire property through the Willing Seller Program along the north side of Johnson Creek. Maximize available area through design of a constructed wetland area for the purpose of reconnecting Johnson Creek with its original floodplain. This action will require terracing and regrading the creek banks as necessary to allow access by the creek. After removal of all non-native invasive species, the property will be replanted with native wetland vegetation. Existing native species will be maintained where appropriate in the design. Creek banks will be planted with appropriate native riparian vegetation that will provide shade for the creek. Revegetation of the banks will help stabilize them and decrease the effects of excessive erosion throughout the reach (see Photo 11-1). Additional actions to be completed during design are the creation of off-channel fish habitat and an increase of sinuosity along the creek.
3. Work with willing property owners adjacent to Johnson Creek for the purpose of floodplain reconnection. Restoration activities will be property-specific and to the degree deemed appropriate by

Photo 11-1:

Looking at area on north side of Johnson Creek. Opportunity exists here to reconnect the floodplain through design of a constructed wetland.

Photo 11-2:

Looking downstream on Johnson Creek near Luther Road. Opportunities exist to remove invasive species, terrace the banks, and replant the area with native riparian vegetation.

the property owners. The action of floodplain reconnection will entail removal of invasive species from creek banks, as well as removal of the WPA wall where appropriate. Creek banks will be terraced and replanted with native riparian vegetation (see Photo 11-2).

4. Increase in-stream complexity throughout the length of the creek running through this reach. This action will be done in conjunction with other projects in the reach and will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase.

Photo 11-3:

Looking east from SE Bell Avenue. Opportunities exist to work with property owner to incorporate impervious surface improvements.

5. Mitigate the effects of the outfall located off Johnson Creek Boulevard east of Bell Station. Address additional outfalls that directly impact Johnson Creek. Outfalls may be removed or diverted through some sort of mitigation measure, such as a bio-filtration swale.
6. Work with landowners along the north side of Johnson Creek whose properties contain large areas of impervious surface. Mitigating the effects of impervious surface by applying current technology, such as drainage swales, green rooftops, and infiltration basins, will reduce surface runoff, improve water quality, and contribute to groundwater recharge (see Photo 11-3).
7. Mitigate the effects of the pipe that crosses Johnson Creek in this reach. This pipe has been uncovered through erosion caused by the creek and is undercut on the downstream side. Specifics of this action will be determined in the project design phase.
8. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Reach 12

Existing Conditions

Reach 12 is located between SE 77th Avenue and Interstate 205 in the jurisdiction of the City of Portland. It consists primarily of single-family residences, commercial properties, and large industrial areas on both sides of the creek. Land use on many creekside properties has severely limited the vegetation buffer along the creek. Consequently, the width of the riparian corridor is often narrow to nonexistent; however, there are a few scattered pockets of native vegetation. Vegetation in these areas consists primarily of Oregon ash, red alder, black cottonwood, western redcedar, willow, bigleaf maple, and Douglas' spiraea. Non-native invasive species, such as Himalayan blackberry, reed canarygrass, English ivy, and clematis, are also present. Current conditions in this reach range from 2 to 3.

Reach 12 - Description	Target	Units
Floodplain Reconnection	38	acres
Wildlife Corridors and Habitat Patches	5	acres
In-stream Complexity	4,974	feet
Inundated Properties	1	number
Fish Barriers	0	number
Priority Outfalls	4	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Protect tributaries and tributary confluences
- Increase in-stream complexity of creek
- Mitigate outfalls
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $11,050,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by glides and scour pools.
- Average pool depth is 48 cm.
- Stream substrate is dominated by cobble, gravel, and fine sediments.
- Wood volume is extremely low.
- Riparian vegetation is dominated by small deciduous trees, such as willow, ash, alder, and maple, interspersed with shrubs and annual grasses. The width of the riparian zone is generally confined on both sides by land use.
- The reach consists primarily of one channel, constrained by remnants of WPA tile and concrete.

- A secondary channel, lined by the WPA, is located near a private drive at the end of SE Lambert Street. At low flows the channel is dry.
- Areas of extensive erosion exist. An exposed vertical wall approximately 4 meters high is located just upstream of SE Luther Avenue. Incision is also evident.
- Stormwater outfalls are associated with the five bridges that cross the creek in this reach. Two are located at the SE 82nd Avenue bridge crossing. Some of the culverts are only partially enclosed and resemble "drainage ditches."
- The area from SE Flavel Street to the end of the reach is completely lined with concrete. According to residents in this area, winter flows are sufficient to remove all deposits of woody debris and beaver dams in the channel.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place wood in stream to provide in-channel habitat diversity and hydraulic "roughness" for cover, pool formation, and channel bed stability. Because of the high velocities in this reach, wood structures should be well anchored.
- Provide off-channel habitat for refuge opportunities during high flows.

Photo 12-1:

Looking southwest toward Johnson Creek. Through regrading of the property, the original floodplain can be reconnected with the creek.

Photo 12-2:

Looking west from footbridge on SE Lambert Avenue, north bank. Opportunity exists to terrace the banks and reconnect areas of original floodplain while enhancing the riparian corridor.

Recommended Actions

1. Work toward acquiring frequently flooded properties near the creek through the Willing Seller Program as opportunities arise. On acquired properties, structures will be removed, creek banks will be terraced back as appropriate to reconnect the floodplain and replanted with native vegetation, and the riparian corridor will be protected and enhanced to the maximum extent possible.
2. Maximize floodplain reconnection opportunities through the design of a constructed wetland on acquired property near SE Lambert Avenue. This action will require terracing and regrading of the creek banks and adjacent property. After regrading and removal of non-native invasive species, the area will be planted with native wetland vegetation. Creek banks will be planted with appropriate native riparian vegetation that provides shade (see Photos 12-1 and 12-2). Existing native species will be maintained where appropriate in the project design. Additional actions to be completed during design include creating off-channel fish habitat and increasing sinuosity along the creek.

3. Work with willing property owners adjacent to Johnson Creek for the purpose of floodplain reconnection. Restoration activities will be property-specific and to the degree deemed appropriate by the property owner. The action of floodplain reconnection will entail removal of invasive species from creek banks, as well as removal of the WPA wall where appropriate. Creek banks will be terraced and replanted with native riparian vegetation (see Photo 12-3).

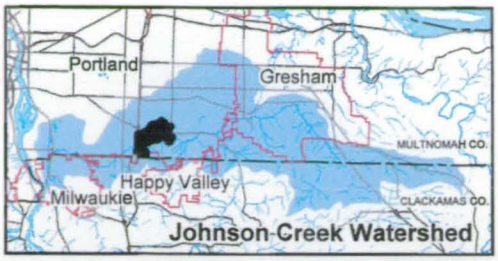
Photo 12-3:
Looking southwest from the footbridge on SE Lambert Avenue. Opportunity exists to terrace the banks, remove invasive species, and undertake floodplain reconnection actions.

4. Work with property owners adjacent to Johnson Creek tributaries for the purpose of protecting and enhancing the resource. Where appropriate, assist landowners along the tributary to enhance the riparian corridor by removing invasive vegetation and replanting with native species.
5. Increase in-stream complexity throughout this reach. This action, which will be undertaken in conjunction with other projects in the reach, will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase.
6. Address outfalls that directly impact Johnson Creek. Three high priority outfalls are located in this reach: at SE Flavel Street and SE 92nd Avenue; at SE Harney Street and SE 82nd Avenue; and at Harney Street and SE 80th Avenue. Outfalls may be removed or diverted through some sort of mitigation measure, such as a bio-filtration swale.
7. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on Johnson Creek. Assist them in altering these practices to better protect and enhance Johnson Creek.
8. Increase the number of large trees, especially near SE 82nd Avenue, to buffer the creek and riparian area from the busy road. Also work to create some swales and larger riparian corridors between the major streets and the creek to filter pollution and protect the wildlife habitat.

Note: Reaches 14, 16, 17, 18, and 19 are not located adjacent to Johnson Creek, but have been identified as restoration areas within the Johnson Creek Watershed.

JOHNSON CREEK RESTORATION

REACHES
13, 14, 15, 16, 17, 18, 19, 20



Legend

- Reach Divider
- City Boundary
- County Line

Aerial Images Source: Spencer Gross, 1998.

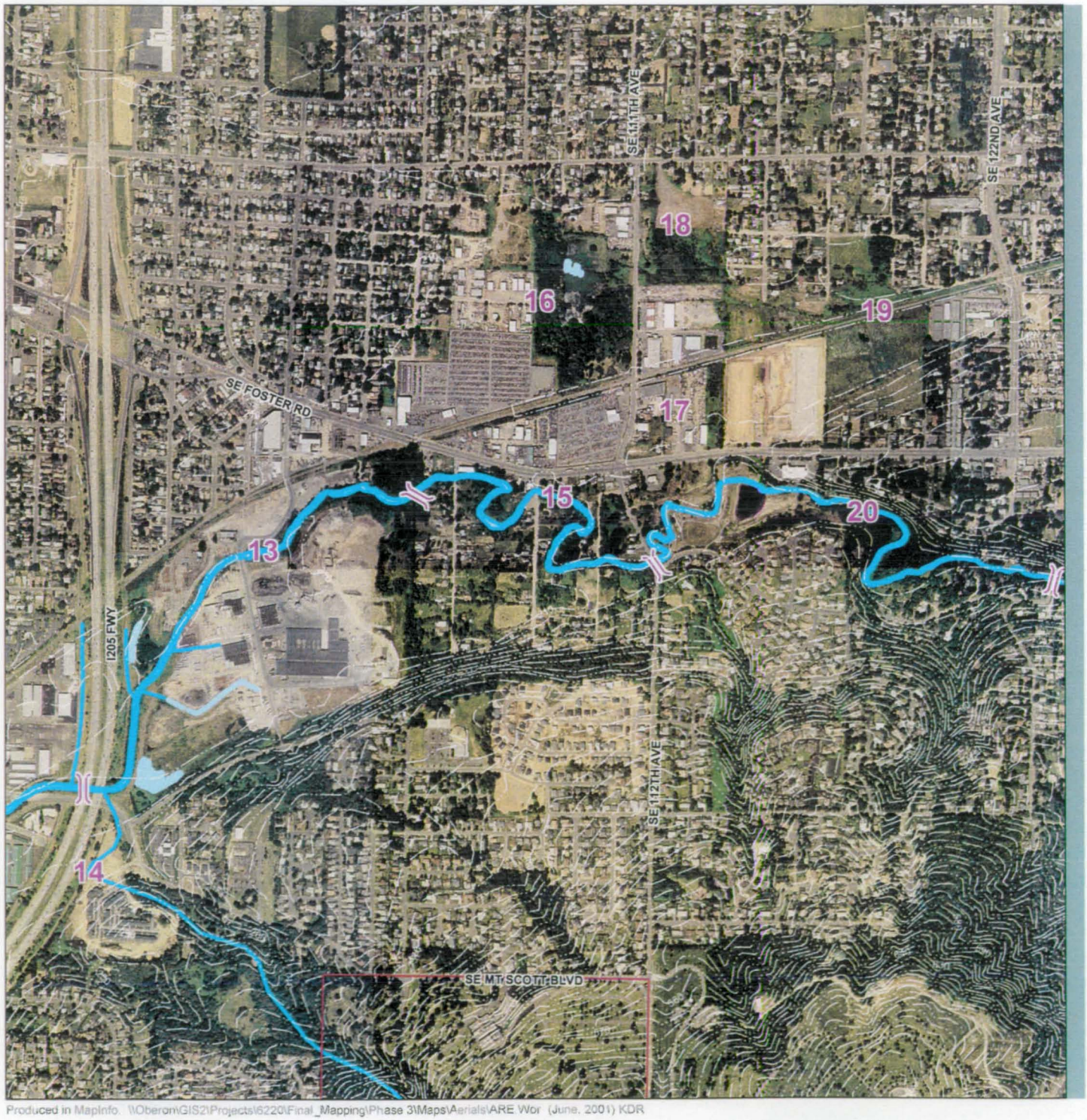
Aerial Map

JURISDICTIONS INCLUDED

CITY OF PORTLAND

NORTH

0 250 500 1000 Feet



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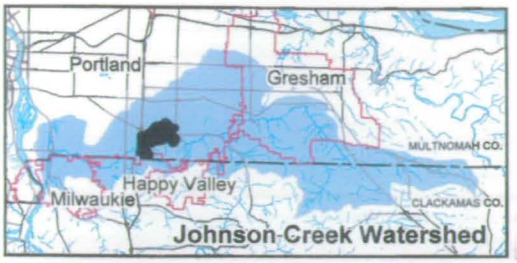
Note: Reaches 14, 16, 17, 18, and 19 are not located adjacent to Johnson Creek, but have been identified as restoration areas within the Johnson Creek Watershed.



Legend

- Reach Divider
- Fish Barrier
- Pipe Crossing
- Inundated Properties
- Wildlife Corridors and Habitat Patches
- Floodplain Reconnection
- Impervious Surface

JOHNSON CREEK RESTORATION

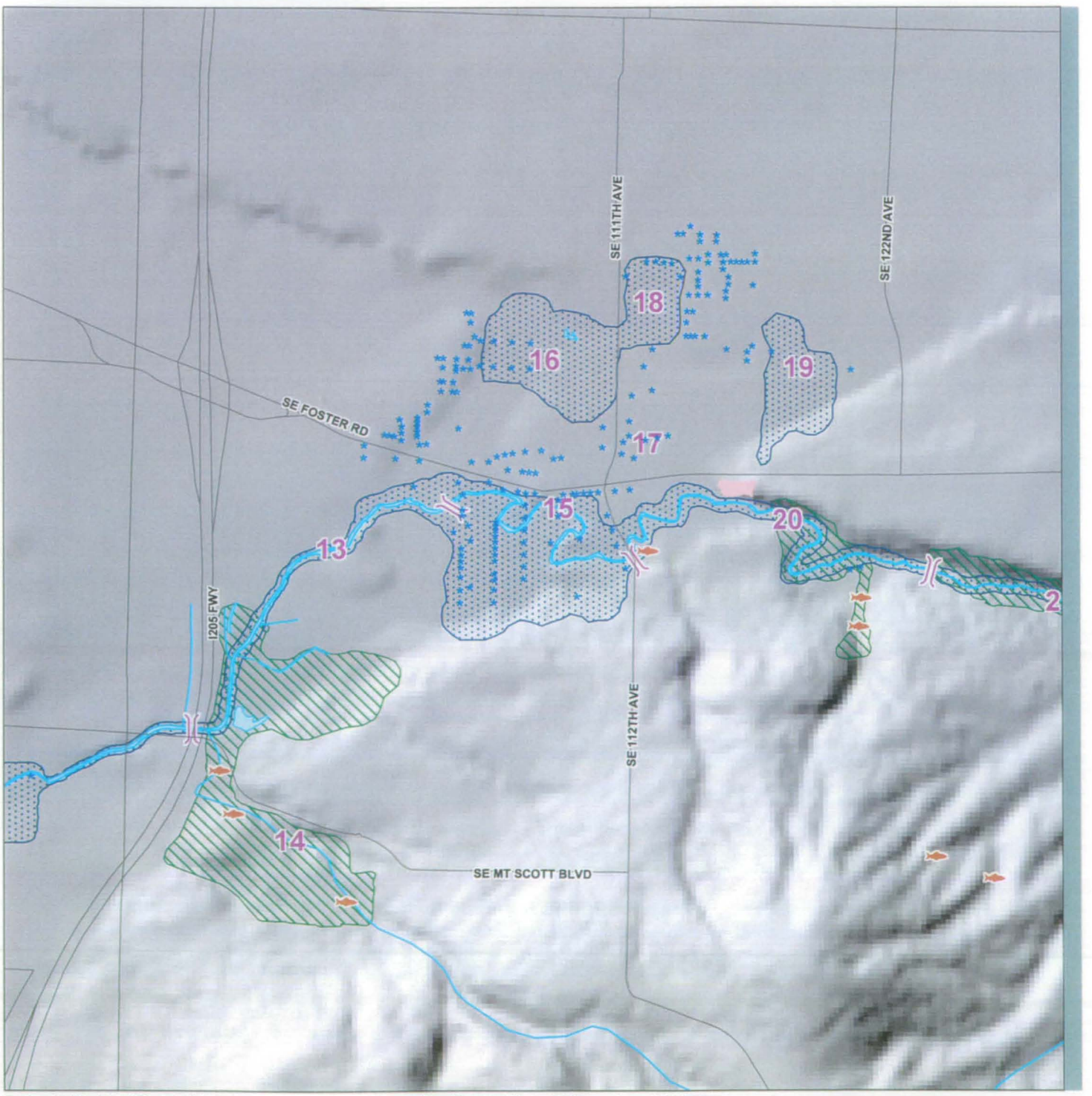
REACHES
13, 14, 15, 16, 17, 18, 19, 20

Functions

JURISDICTIONS INCLUDED
CITY OF PORTLAND

NORTH

0 250 500 1000 Feet



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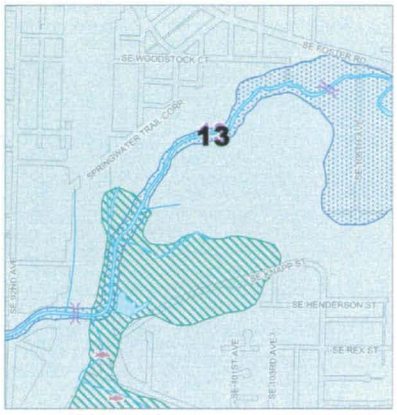
Reach 13



Reach 13 - Description	Target	Units
Floodplain Reconnection	8	acres
Wildlife Corridors and Habitat Patches	195	acres
In-stream Complexity	3,561	feet
Inundated Properties	2	number
Fish Barriers	0	number
Priority Outfalls	3	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Existing Conditions

Reach 13 extends from Interstate 205 to SE 105th Avenue and is in the jurisdiction of the City of Portland. The area consists primarily of a single industrial property (Freeway Land Company) that contains a combination of impervious surface and open space. There is little shading of the creek because the width of the riparian corridor is narrow to nonexistent. Vegetation consists primarily of red alder, black cottonwood, and willow, as well as non-native invasive Himalayan blackberry, reed canarygrass, clematis, and English ivy. The creek contains much debris, and the banks are steep and eroding. Current conditions in this reach range from 3/3+ at the west end, to 3- through Freeway Land Company, to 2-/3+ along the southern edge.

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Protect tributaries and tributary confluences
- Create or enhance wildlife corridors
- Increase in-stream complexity of creek
- Mitigate outfalls
- Protect areas of cool/cold water seeps and springs
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $2,260,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by glides and scour pools.
- Average pool depth is 41 cm.
- Stream substrate is dominated by fine sediments.
- Wood volume is extremely low, and its size is small.
- Riparian vegetation is dominated by small deciduous trees, primarily willow, with a few areas of excellent overhanging vegetation. The width of the riparian zone is generally confined by the Freeway Land Company.

- The reach exhibits possible multiple channels at high flows, with backwater pools at the entrances and exits of these dry channel units.
- Banks have eroded and have not been modified by artificial material.
- Three pools have been created by beaver dams.
- Few culvert outfalls are present.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place wood in stream to provide in-channel habitat diversity and hydraulic "roughness" for cover, pool formation, and channel bed stability.

Recommended Actions

1. Work with Freeway Land Company and other property owners to maximize floodplain reconnection opportunities. This process will require removing invasive species and terracing the banks of the creek. Once terraced, the banks will be revegetated with native plant species to the extent deemed feasible by the property owner to assist in restoring the riparian corridor (see Photos 13-1 and 13-2).

Photo 13-1:

Looking downstream just south of Freeway Land Company near Interstate 205. Opportunities exist to terrace the creek banks and revegetate them with native plants to provide additional shade cover.

2. Work with Freeway Land Company and other property owners to protect tributaries that extend from the southern portion of the reach and to create a wildlife corridor. Property owners will be encouraged to allow planting of native riparian vegetation and to remove invasive species, thus helping to improve wildlife habitat conditions and provide access to the creek from surrounding upland areas (e.g., Mt. Scott). Areas along the tributary have been identified as key areas for restoration opportunities (see Photo 13-3).

Photo 13-2:

Johnson Creek runs through this Freeway Land Company property. The riparian buffer along the creek is in very poor condition. Opportunities exist to enhance the riparian corridor and limit the effects of surface runoff to the creek.

Photo 13-3:

Looking east on a tributary just outside of the Freeway Land Company site that flows onto company property. Opportunities exist to protect and enhance this area as a wildlife corridor.

3. Increase in-stream complexity throughout the length of the creek running through this reach. This action will be done in conjunction with other projects in the reach and will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase.
4. Address outfalls that directly impact Johnson Creek. Outfalls may be removed or diverted through some sort of mitigation measure, such as a bio-filtration swale.
5. Identify areas of seeps and springs along or near the creek and work with Freeway Land Company to protect this natural resource. Non-native invasive species will be removed and replaced with native riparian vegetation.
6. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Reach 14

Existing Conditions

Reach 14 is located east of Interstate 205 and south of Johnson Creek along SE Mt. Scott Boulevard. It is in the jurisdiction of the City of Portland. The area, which consists mainly of forested tributaries leading into an upland area of Mt. Scott, is situated between single-family housing developments to the south and north. Vegetation along this reach consists primarily of western redcedar, bigleaf maple, red alder, vine maple, bracken fern, lady fern, thimbleberry, and sword fern, as well as non-native invasive Himalayan blackberry and English Ivy. Ivy is a problem in the reach, and it is topping many of the native trees. Some dense canopy and a fairly diverse collection of native vegetation still exist. Current conditions in this reach are rated as 2+/1-.

Reach 14 - Description	Target	Units
Floodplain Reconnection	0	acres
Wildlife Corridors and Habitat Patches	100	acres
In-stream Complexity	0	feet
Inundated Properties	0	number
Fish Barriers	3	number
Priority Outfalls	0	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Identified Opportunities

Opportunities exist within this reach to:

- Protect and restore riparian vegetation
- Protect tributaries and tributary confluences
- Create or enhance wildlife corridors
- Remove fish barriers
- Protect areas of cool/cold water seeps and springs
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $1,370,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by dammed pools, scour pools, riffles, and cascades.
- Average pool depth is 31 cm.
- Stream substrate is dominated by silt, sand, gravel, and cobble.
- Wood volume is low.
- The riparian zone varies from being dramatically altered in the lower portion of the reach (culvert crossings, concrete structures, and buildings on the banks) to decent in the upper

portion of the reach (the housing development and cemetery retained good buffers in the riparian zone).

- The beginning of this creek has been completely resectioned and altered by I-205, Mt. Scott Boulevard, and various concrete structures. Landowners have heavily influenced this portion of the reach.
- The upper portion of the reach is largely intact, though the flow has been adjusted by cemetery irrigation practices.
- A potential artificial fish passage barrier exists at the confluence of the tributary with Johnson Creek, along with a series of step-pool sequences in the lower portion of the reach. The pools were stocked with an exotic fish species (Koi).

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place wood in stream to provide in-channel habitat diversity and hydraulic "roughness" for cover, pool formation, and channel bed stability.
- Create off-channel habitat.
- Remove potential fish passage barrier near the confluence with Johnson Creek to allow salmonid access to this tributary.

Recommended Actions

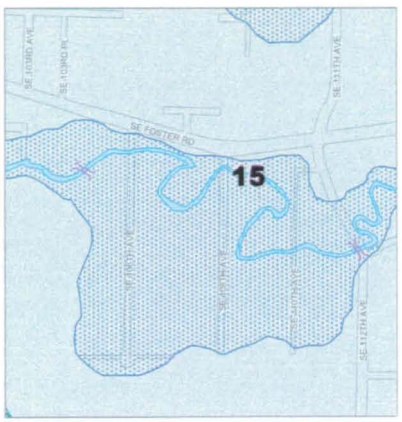
1. Work with willing property owners adjacent to tributaries running south of Johnson Creek to restore and enhance vegetation. Along these tributaries, remove invasive species, such as Himalayan blackberry and English ivy, and replant with native riparian vegetation (see Photo 14-1).

Photo 14-1:
Looking northwest (downstream) at a tributary of Johnson Creek. Opportunity exists to protect and enhance this area.

Photo 14-2:
Looking southeast at a newly developed site in a wildlife corridor area. Working with the property owner could protect and enhance the remaining corridor vegetation.

2. Work with willing property owners to realize the potential of this area as a wildlife corridor. As development continues in this area, opportunities exist to work with property owners to help maintain a wildlife corridor between Johnson Creek and nearby uplands (Mt. Scott) to the southwest. Areas of riparian vegetation can be protected while open space can be planted with native riparian vegetation (see Photo 14-2).
3. Remove or modify culverts that impede salmonid movement. Determination of whether the culverts will require improvement or removal will be on a site-by-site basis during the project design phase.
4. Identify areas of seeps and springs along or near the creek and work with property owners in these areas to protect this natural resource. Non-native invasive species will be removed and native riparian vegetation will be planted.
5. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Reach 15



Reach 15 - Description	Target	Units
Floodplain Reconnection	63	acres
Wildlife Corridors and Habitat Patches	0	acres
In-stream Complexity	4,357	feet
Inundated Properties	76	number
Fish Barriers	0	number
Priority Outfalls	1	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Existing Conditions

Reach 15 extends from SE 105th to SE 112th Avenues along the creek, and to SE 100th Avenue along the Springwater Corridor. It is located in the Lents neighborhood and is in the jurisdiction of the City of Portland. The is area situated primarily on the south side of Johnson Creek and consists mainly of single-family homes. The width of the riparian corridor is relatively narrow. Vegetation is dominated by red alder, bigleaf maple, willow, and Oregon ash, as well as non-native invasive Himalayan blackberry, reed canarygrass, European bittersweet, and hedge bindweed. English ivy is topping some of the large native trees. Adjacent upland areas contain some Douglas-fir and western redcedar. Many invasive plant species grow throughout the riparian corridor, and much of the creek has steep banks. Current conditions in this reach are rated from 2+ (based on proximity to open space) to 3.

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Stabilize stream banks exhibiting excessive erosion
- Increase in-stream complexity of creek
- Mitigate outfalls
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $14,020,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by scour pools.
- Average pool depth is 61 cm.
- Stream substrate is dominated by fine sediments.
- Wood volume is extremely low.
- Riparian vegetation is predominantly characterized by small and medium-sized trees, with some larger trees interspersed.
- The reach consists of one channel.

- Incision and erosion are evident throughout the reach, as the banks are composed only of earth.
- Many consecutive deep pools exist, but the reach lacks aeration from riffles.
- A few culvert outfalls occur; a very large flood control culvert, which empties a flood control tunnel originating at the Brookside Wetland, is located approximately 150 meters upstream from the SE 106th Avenue bridge crossing.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place wood in stream to provide in-channel habitat diversity and hydraulic "roughness" for cover, pool formation, and channel bed stability.

Recommended Actions

1. Work toward acquiring frequently flooded properties near the creek through the Willing Seller Program as opportunities arise. On acquired properties, structures will be removed, creek banks will be terraced back as appropriate to reconnect the floodplain and replanted with native vegetation, and the riparian corridor will be protected and enhanced to the maximum extent possible.
2. Acquire property along the north side of Johnson Creek through the Willing Seller Program. Maximize available area through design of a constructed wetland area for the purpose of reconnecting Johnson Creek with its original floodplain. This action will require terracing and regrading the banks of the creek as necessary to allow access by the creek. After removal of all non-native invasive species, the property will be planted with native wetland vegetation. Existing native species will be maintained where appropriate in the design. Creek banks will be planted with appropriate native riparian vegetation that will shade the creek. Revegetation of the banks will help stabilize them and decrease the effects of excessive erosion throughout the reach (see Photos 15-1, 15-2, and 15-3). Additional actions to be completed during project design include the creation of off-channel fish habitat and an increase of sinuosity along the creek (to be determined as part of Lents 2040 process).
3. Increase the in-stream complexity throughout the length of the creek running through this reach. This action, will be done in conjunction with other projects in the reach, will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase.

Photo 15-1:

Looking west toward an area just east of Freeway Land Company. Opportunity exists to remove invasive species, regrade the banks, and undertake floodplain reconnection actions.

Photo 15-2:

Looking south just off SE 106th Avenue at a frequently flooded area. Opportunities exist (through the Willing Seller Program) to acquire property and undertake floodplain reconnection actions, such as constructed wetlands.

Photo 15-3:

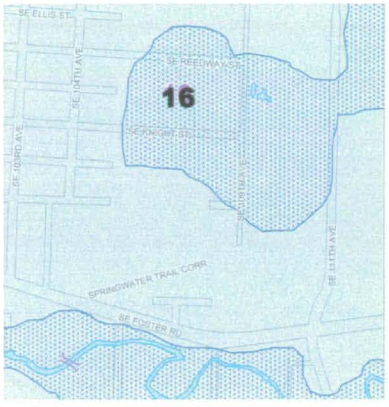
An area near the southern end of Reach 15 along SE 106th Avenue identified as frequently flooded. Opportunities exist to acquire property through the Willing Seller Program and undertake floodplain reconnection activities.

4. Mitigate the effects of the high priority outfall at SE 106th Avenue and Foster Road. In addition, address any other outfalls identified in the reach that directly impact Johnson Creek. Outfalls may be removed or diverted through some sort of mitigation measure, such as a bio-filtration swale.
5. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Reach 16

Existing Conditions

Reach 16 extends from SE 102tnd Avenue to SE 111th Avenue, north of Johnson Creek and the Springwater Corridor, in the Lents neighborhood. It is in the jurisdiction of the City of Portland. The area consists of both open space (Beggars Tick Marsh) and single-family residences. Vegetation consists primarily of willow, black cottonwood, Oregon ash, native rose, and Douglas' spiraea, as well as non-native invasive European bittersweet, reed canarygrass, Himalayan blackberry, Scot's broom, and black locust. Current conditions in this reach are rated as 1/1-.



Identified Opportunities

Opportunities exist within this reach area to:

- Reconnect and restore Johnson Creek floodplain
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $6,380,000

Reach 16 - Description	Target	Units
Floodplain Reconnection	32	acres
Wildlife Corridors and Habitat Patches	0	acres
In-stream Complexity	0	feet
Inundated Properties	46	number
Fish Barriers	0	number
Priority Outfalls	0	number
Pipe Crossings	0	number
Impervious Surface	0	acres

ODFW Survey Results

The ODFW Stream Habitat Survey did not include this reach of the Johnson Creek watershed, as the creek does not run through it.

Recommended Actions

1. Work toward acquiring frequently flooded properties through the Willing Seller Program for the purpose of designing a constructed wetland area (see Photos 16-1 and 16-2). Although this area is not directly adjacent to Johnson Creek, it is flooded during nuisance

Photo 16-1:

Looking south at the intersection of SE 104th Avenue and SE Wright Street at an area identified as flooding frequently. Opportunity exists to acquire properties and undertake floodplain reconnection actions, such as constructed wetlands.

Photo 16-2:

Looking east at intersection of SE 104th Avenue and SE Wright Street, which is an area of frequent flooding. Opportunities exist to acquire properties and undertake constructed wetland actions.

storm events. Actions in this reach will require regrading and replanting with native wetland vegetation. This area will be maintained as a wetland able to receive floodwater from Johnson Creek through a designed drainage path (to be determined as part of the Lents 2040 process).

2. Work with property owners to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Reach 17

Existing Conditions

Reach 17 extends from SE 111th Avenue to SE 117th Avenue, north of Johnson Creek and south of the Springwater Corridor, in the Lents neighborhood. It is in the jurisdiction of the City of Portland. Vegetation in the reach consists primarily of Douglas hawthorn, common hawthorn, black cottonwood, Oregon white oak, native rose, Douglas' spiraea, western redcedar, bigleaf maple, beaked hazelnut, and snowberry, as well as non-native invasive Himalayan blackberry, European bittersweet, and reed canarygrass. Current conditions in this reach are rated as 2/2-.

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $350,000

Reach 17 - Description	Target	Units
Floodplain Reconnection	0	acres
Wildlife Corridors and Habitat Patches	0	acres
In-stream Complexity	0	feet
Inundated Properties	8	number
Fish Barriers	0	number
Priority Outfalls	0	number
Pipe Crossings	0	number
Impervious Surface	0	acres

ODFW Survey Results

The ODFW Stream Habitat Survey did not include this reach in the Johnson Creek watershed, as the creek does not run through it.

Recommended Actions

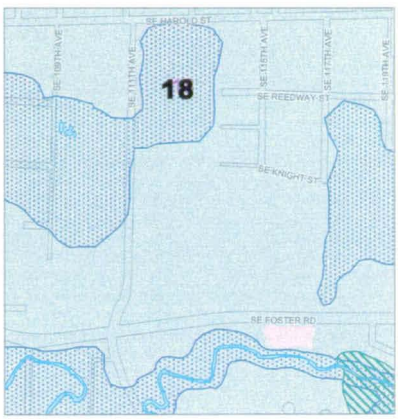
1. Work toward acquiring frequently flooded properties through the Willing Seller Program as opportunities arise for the purpose of reconnecting the floodplain. On acquired properties, structures will be removed, the property may be regraded if appropriate, and native vegetation will be planted. A constructed wetland will be considered if appropriate for the site.
2. Design a potential drainage way for the purpose of directing floodwaters from Johnson Creek to constructed wetland areas for flood storage (see Photo 17-1). The specific drainage path will be determined as part of the Lents 2040 process.
3. Work with property owners to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Photo 17-1:

Looking west down the Springwater Corridor. Reach 17 is on the south side of the corridor. Opportunities exist to construct a drainage way along Springwater Corridor to convey flood-waters to wetland areas.

Reach 18

Existing Conditions



Reach 18 extends from SE 111th Avenue to SE 117th Avenue, north of Johnson Creek and the Springwater Corridor, in the jurisdiction of the City of Portland. The area consists of both open space and single-family residences. A substantial remnant wetland is hydrologically connected to Beggars Tick Marsh and Johnson Creek in this reach. Vegetation consists primarily of willow, Douglas hawthorn, Oregon ash, red alder, native rose, white poplar, black cottonwood, Douglas' spiraea, and bigleaf maple, as well as non-native and invasive Himalayan blackberry, reed canarygrass, European bittersweet, and Scot's broom. Current conditions in this reach are rated as 2.

Reach 18 - Description	Target	Units
Floodplain Reconnection	15	acres
Wildlife Corridors and Habitat Patches	0	acres
In-stream Complexity	0	feet
Inundated Properties	53	number
Fish Barriers	0	number
Priority Outfalls	0	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $4,450,000

ODFW Survey Results

The ODFW Stream Habitat Survey did not include this reach in the Johnson Creek watershed, as the creek does not run through it.

Recommended Actions

1. Work toward acquiring property through the Willing Seller Program for the purpose of constructing a wetland area designed to receive floodwater from Johnson Creek (see Photos 18-1 and 18-2). Although this area is not directly adjacent to Johnson Creek, it is periodically flooded by the creek during nuisance storm events. This action will require regrading acquired properties and planting them with native wetland vegetation. The area will then be maintained as a wetland to provide the functions associated with a wetland environment. Specific projects will be determined as part of the Lents 2040 process.

Photo 18-1:

Looking east from SE 111th Avenue. Opportunities exist to regrade and revegetate area with native wetland vegetation, providing an environment able to receive floodwaters from Johnson Creek.

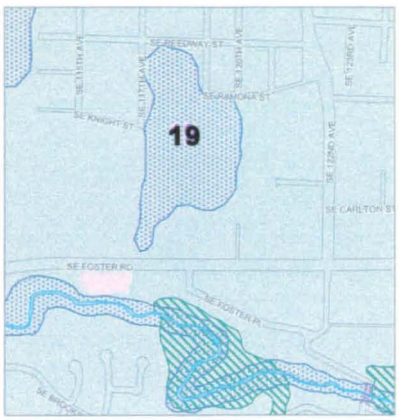
Photo 18-2:

Looking south from SE Harold Street. Opportunities exist to clean up this site and create a constructed wetland area that could mitigate for the nuisance flood.

2. Work with property owners to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Reach 19

Existing Conditions



Reach 19 extends from SE 117th Avenue to SE 120th Avenue, north of Johnson Creek, in the jurisdiction of the City of Portland. The Springwater Corridor bisects this area, running east-west. This reach consists of both open space and single-family residences. A series of existing wetlands provides valuable habitat and water storage. A cold water spring that originates in the Zenger wetlands feeds Beggars Tick Marsh. Vegetation consists primarily of willow, Oregon ash, red alder, native rose, Douglas' spiraea, snowberry, serviceberry, Indian plum, beaked hazelnut, and cattail, as well as non-native and invasive Himalayan blackberry, reed canarygrass, English ivy, and holly. This area has fairly diverse wetland vegetation with good habitat. Current conditions in this reach are rated as 1-.

Reach 19 - Description	Target	Units
Floodplain Reconnection	25	acres
Wildlife Corridors and Habitat Patches	0	acres
In-stream Complexity	0	feet
Inundated Properties	2	number
Fish Barriers	0	number
Priority Outfalls	0	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $3,170,000

The ODFW Stream Habitat Survey did not include this reach in the Johnson Creek watershed, as the creek does not run through it.

Recommended Actions

1. Work toward acquiring property through the Willing Seller Program for the purpose of enhancing wetland areas so that they may receive additional floodwaters from Johnson Creek (see Photo 19-1). Although this area is not directly adjacent to Johnson Creek, it is periodically flooded by the creek during nuisance storm events. This action involves planting the area with native wetland vegetation, and some regrading may be required to create additional wetland areas. The area will then be maintained as a wetland to provide the functions associated with a wetland environment. Specific projects will be determined as part of the Lents 2040 process.
2. Work with property owners to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Photo 19-1:

Looking south from the Springwater Corridor. Opportunity exists to enhance wetland areas so that they have greater capacity to receive Johnson Creek's floodwaters and provide habitat.

Reach 20

Existing Conditions

Reach 20 extends from SE 112th Avenue to SE 122nd Avenue just north of Mt. Scott and is in the jurisdiction of the City of Portland. Single-family homes predominate, with vegetated areas lining both sides of Johnson Creek. The width of the riparian corridor through this reach is narrow to moderate. Vegetation consists primarily of red alder, western redcedar, black cottonwood, beaked hazelnut, common hawthorn, vine maple, bigleaf maple, Oregon grape, red-flowering currant, Indian plum, goat'sbeard, thimbleberry, sword fern, snowberry, and inside-out flower, as well as invasive English ivy, hedge bindweed, and Himalayan blackberry. Much of the diversity in this area is due to the nearby presence of Leach Botanical Garden. Beginning in this reach, the dominant canopy of the riparian corridor begins to shift generally from an Oregon ash, black cottonwood, bigleaf maple, and red alder community to a western redcedar, Douglas-fir, bigleaf maple, and red alder community. Current conditions in this reach range from a rating of 1-/2 in the western portion to a rating of 1 near Leach Botanical Garden.

Reach 20 - Description	Target	Units
Floodplain Reconnection	9	acres
Wildlife Corridors and Habitat Patches	19	acres
In-stream Complexity	4,064	feet
Inundated Properties	2	number
Fish Barriers	3	number
Priority Outfalls	0	number
Pipe Crossings	0	number
Impervious Surface	2	acres

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Stabilize stream banks exhibiting excessive erosion
- Protect and restore riparian vegetation
- Protect tributaries and tributary confluences
- Increase in-stream complexity of creek
- Remove fish barriers
- Reduce adverse effects of impervious surface
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $2,040,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by scour pools and glides.
- Average pool depth is 53 cm.

- Stream substrate is dominated by fine sediments in the lower portion and by gravel and cobble in the upper portion.
- Wood volume is extremely low.
- Riparian vegetation is dominated by grasses and newly planted trees and shrubs in the lower portion. The upper portion is dominated by mature coniferous and deciduous trees.
- The reach consists of multiple channels, with large overflow channels, a "lake," and an alcove.
- A few culvert outfalls are present.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place wood in stream to provide in-channel habitat diversity and hydraulic "roughness" for cover, pool formation, and channel bed stability.
- Include reconnecting floodplains with the stream channel in restoration efforts to provide valuable off-channel habitat.

Recommended Actions

1. Work toward acquiring frequently flooded properties near the creek through the Willing Seller Program as opportunities arise. On acquired properties, structures will be removed, creek banks will be terraced back as appropriate to reconnect the floodplain and replanted with native vegetation, and the riparian corridor will be protected and enhanced to the maximum extent possible (see Photo 20-1).
2. Work with willing property owners adjacent to Johnson Creek for the purpose of reconnecting Johnson Creek with its original floodplain (see Photo 20-2). Activities along the creek will be

Photo 20-1:

Looking north from the Brookside area near the approximate confluence of Johnson Creek and a tributary, at an area identified as flooding frequently. Opportunity exists throughout this reach to undertake floodplain reconnection actions.

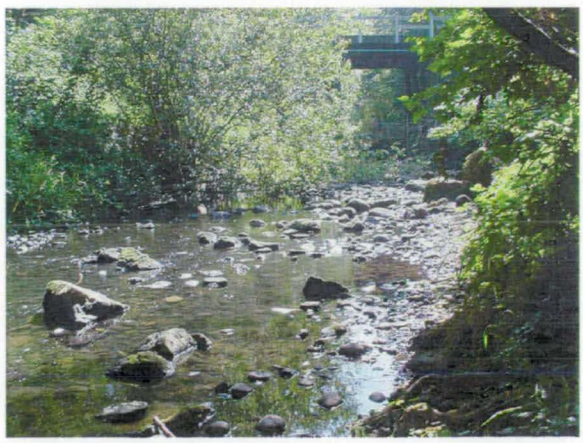


Photo 20-2:

Looking east toward the SE 122nd Avenue bridge. Opportunity exists for floodplain reconnection actions.

property-specific and to the degree deemed appropriate by the property owner. Floodplain reconnection will require the removal of invasive species from the banks of the creek. The banks will then be terraced, regraded, and replanted with native riparian vegetation. Enhancing the riparian corridor and increasing floodplain connection will help to stabilize creek banks and reduce excessive erosion.

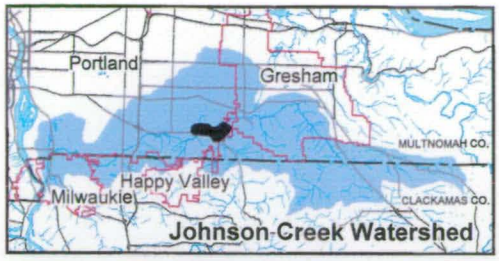
3. Work with property owners along the tributaries of Johnson Creek to protect and enhance the resource. Invasive plant species will be removed and native riparian vegetation will be planted, which will help maintain a healthy connection between the tributary and Johnson Creek. Where appropriate, areas of healthy vegetation will be targeted for protection through the use of conservation easements (see Photo 20-3).

Photo 20-3:
Looking at a tributary on the south side of Johnson Creek. The tributary can be protected and enhanced by removing invasive species and planting native plants.

4. Increase in-stream complexity throughout the length of the creek running through this reach. This action, which will be done in conjunction with other projects in the reach, will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase.
5. Remove or modify culverts that impede salmonid movement. Determination of whether each culvert will require improvement or removal will be decided on a site-by-site basis during the project design phase.
6. Work with property owners along Johnson Creek whose properties contain large areas of impervious surface. Mitigating the effects of impervious surface by applying current technology, such as drainage swales, green rooftops, and infiltration basins, will reduce surface runoff, improve water quality, and contribute to groundwater recharge.
7. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

JOHNSON CREEK RESTORATION

REACHES
21, 22



Legend

- Reach Divider
- City Boundary
- County Line

Aerial Images Source:
Spencer Gross, 1998.

Aerial Map

JURISDICTIONS INCLUDED

CITY OF PORTLAND

NORTH

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JOHNSON CREEK RESTORATION

REACHES
21, 22

Functions

JURISDICTIONS INCLUDED
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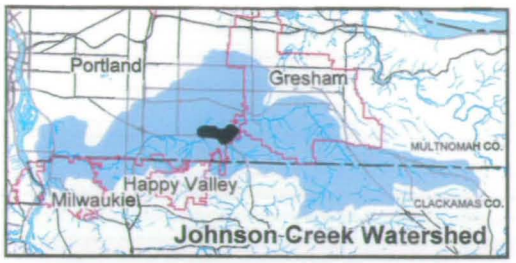

Legend

- Reach Divider
- Fish Barrier
- Pipe Crossing
- Inundated Properties
- Wildlife Corridors and Habitat Patches
- Floodplain Reconnection
- Impervious Surface

NORTH

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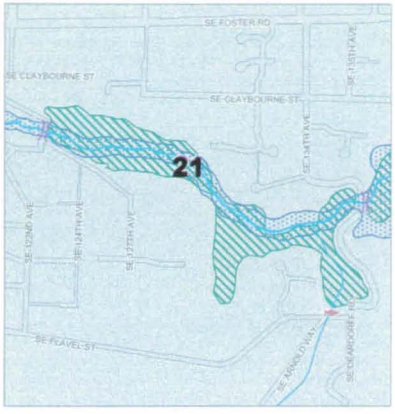
Reach 21



Reach 21 - Description	Target	Units
Floodplain Reconnection	8	acres
Wildlife Corridors and Habitat Patches	64	acres
In-stream Complexity	3,463	feet
Inundated Properties	1	number
Fish Barriers	3	number
Priority Outfalls	8	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Existing Conditions

Reach 21 extends from SE 122nd Avenue to SE Deardorff Road in the jurisdiction of the City of Portland. This area consists primarily of single-family homes, with a larger forested area located south of Johnson Creek. The width of the riparian corridor varies from moderate to very narrow. Some sections contain wide buffer zones and native vegetation, while others contain lawns and structures directly adjacent to the creekside. Vegetation consists primarily of red alder, western redcedar, bigleaf maple, Douglas-fir, Oregon ash, common hawthorn, willow, vine maple, sword fern, Oregon grape, Indian plum, stinging nettle, and jewelweed, as well as invasive Himalayan blackberry, reed canarygrass, and English ivy. Current conditions in this reach are rated from 1 to 3.

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Protect and restore riparian vegetation
- Protect tributaries and tributary confluences
- Increase in-stream complexity of creek
- Mitigate outfalls
- Remove fish barriers
- Provide education to property owners to encourage stream stewardship

Estimated Project Costs: $1,830,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by glides.
- Average pool depth is 53 cm.
- Stream substrate is dominated by gravel and cobble.
- Wood volume is extremely low.
- Riparian vegetation is dominated by mature coniferous and deciduous trees.
- The reach consists of multiple channels.

- Very little WPA work occurs in this reach, but there is significant bank erosion and undercutting.
- Very few culvert outfalls exist, and most are associated with bridges.
- Only three pools with a depth greater than 1.0 meter were identified.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place large wood structures in this reach to create pool habitat.
- Develop off-channel habitat to provide refuge opportunities during high flows.

Recommended Actions

1. Work toward acquiring frequently flooded properties near the creek through the Willing Seller Program as opportunities arise. On acquired properties, structures will be removed, creek banks will be terraced back as appropriate to reconnect the floodplain and replanted with native vegetation, and the riparian corridor will be protected and enhanced to the maximum extent possible.
2. Work with property owners to optimize floodplain reconnection opportunities along this reach. Where appropriate, terrace banks of the creek to expand the available room for the creek. Once banks are terraced and invasive species removed, the banks will be revegetated with native trees and shrubs. Special attention will be given to providing shade for the creek (see Photo 21-1). This process will require terracing the creek banks to open up additional room for the creek to access. The riparian corridor could be enhanced up to 100 feet in some areas.
3. Work with property owners along the tributaries of Johnson Creek to protect and enhance the resource. Invasive plant species will be removed and native riparian vegetation will be planted, helping to maintain a healthy connection between the tributary and Johnson Creek (see Photos 21-2 and 21-3). Where appropriate, areas of healthy vegetation will be targeted for protection through the use of conservation easements.
4. Increase in-stream complexity throughout the length of the creek running through this reach. This action, which will be done in conjunction with other projects in the reach, will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase.

Photo 21-1:

Looking east along Johnson Creek near SE Deardorf Road. Opportunities exist to terrace creek banks and undertake floodplain reconnection actions.

Photo 21-2:

Looking east at a creekside wetland area along a tributary to Johnson Creek. Opportunity exists to work with property owners to protect areas of riparian vegetation and enhance tributaries by removing invasive species and replanting with native riparian plants.

Photo 21-3 :

Looking east at a forested area near Johnson Creek. Opportunities exist to protect riparian vegetation and areas that drain to Johnson Creek.

5. Address outfalls that directly impact Johnson Creek. Outfalls may be removed or diverted through some sort of mitigation measure, such as a bio-filtration swale.
6. Remove or modify culverts that impede salmonid movement. Determination of whether each culvert will require improvement or removal will be decided on a site-by-site basis during the project design phase.
7. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Reach 22

Existing Conditions

Reach 22 extends from SE Deardorf Road to SE Duke Street south of SE Foster Road. It is in the jurisdiction of the City of Portland. The area consists of forested riparian corridors along Johnson Creek interspersed with single-family residential homes. The riparian corridor varies in width from narrow to moderate. Vegetation consists primarily of western redcedar, red alder, bigleaf maple, Oregon ash, and willow, as well as invasive reed canarygrass and Himalayan blackberry. Moving from west to east through the reach, the riparian corridor narrows and erosion increases as the banks become steeper. Current conditions in this reach range from a rating of 1- near the western end to 2+ near the middle and 3/3+ near the eastern end.

Reach 22 - Description	Target	Units
Floodplain Reconnection	22	acres
Wildlife Corridors and Habitat Patches	118	acres
In-stream Complexity	3,899	feet
Inundated Properties	2	number
Fish Barriers	0	number
Priority Outfalls	3	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Protect and restore riparian vegetation
- Protect tributaries and tributary confluences
- Create or enhance wildlife corridors
- Increase in-stream complexity of creek
- Mitigate outfalls
- Provide education to property owners to encourage stream stewardship

Estimated Project Costs: $6,960,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by glides and scour pools.
- Average pool depth is 64 cm.
- Stream substrate is dominated by boulders and cobble, with some parts of the channel bottom composed of exotic rock boulders.
- Wood volume is extremely low.
- Riparian vegetation is dominated by small and medium-sized coniferous and deciduous trees, including maple, fir and alder. Backyards degrade the natural riparian flora.

- The reach consists of a single channel.
- Banks are highly constrained by WPA tiles between Deardorff Road and SE 142nd Avenue. Banks between 142nd Avenue and Foster Road are earthen, with occasional erosion is evident.
- A small restoration project was undertaken just upstream from 142nd Avenue after the 1996 floods. The emphasis was slope stabilization and erosion prevention, but some large boulders were placed in selected areas to create habitat at high flows.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place large wood structures in this reach to create pool habitat, reduce overall erosive velocities, and decrease areas of high bank erosion.
- Develop off-channel habitat to provide refuge opportunities during high flows.

Recommended Actions

1. Work toward acquiring frequently flooded properties near the creek through the Willing Seller Program as opportunities arise. On acquired properties, structures will be removed, creek banks will be terraced back as appropriate to reconnect the floodplain and replanted with native vegetation, and the riparian corridor will be protected and enhanced to the maximum extent possible.
2. Work toward acquiring additional property along the western portion of this reach through the Willing Seller Program and design a constructed wetland area. The purpose of this action is to reconnect Johnson Creek with its original floodplain (see Photo 22-1). The action requires regrading the creek banks and removing non-native invasive species to open up additional area for access by the creek. After regrading, the banks will be planted with appropriate native riparian vegetation to create shade for the creek. Other actions to be completed during the process of regrading and lowering the banks include creating off-channel fish habitat and increasing sinuosity along the creek by adding meanders. Existing native vegetation, especially large trees, will be preserved as much as possible during restoration.
3. Work with willing property owners adjacent to Johnson Creek for the purpose of reconnecting the creek with its original floodplain. Activities will be property-specific and to the extent deemed appropriate by the owner. Floodplain reconnection will entail removal of invasive plant species from the banks of the creek, as

Photo 22-1:

Looking east from SE Deardorf Road at a possible area for creating a constructed wetland near the creek.

well as removal of the WPA wall where appropriate. The banks will be regraded, terraced, and then replanted with native riparian vegetation. Enhancing the riparian corridor and increasing floodplain connection will help stabilize the stream banks (see Photos 22-2, 22-3, and 22-4).

4. Work with property owners along the Johnson Creek tributaries to protect and enhance this resource. At each tributary confluence, floodplain reconnection actions will be undertaken as described earlier. Where appropriate, landowners on other identified properties will be offered assistance in enhancing the riparian corridor by removing invasive vegetation and replanting with native species.
5. Work with property owners throughout this project area to create a wildlife corridor. Owners will be encouraged to plant native riparian vegetation to enhance habitat conditions and provide wildlife access to the creek from the surrounding upland areas (see Photo 22-3).
6. Increase in-stream complexity throughout this reach. This action, which will be done in conjunction with other projects in the reach, will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase (see Photo 22-4).
7. Address outfalls that directly impact Johnson Creek. Outfalls may be removed or diverted through some sort of mitigation measure, such as a bio-filtration swale.
8. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Photo 22-2:

Looking northeast from the south side of Johnson Creek. This area represents an opportunity to work with the property owner in undertaking floodplain reconnection actions.

Photo 22-3:

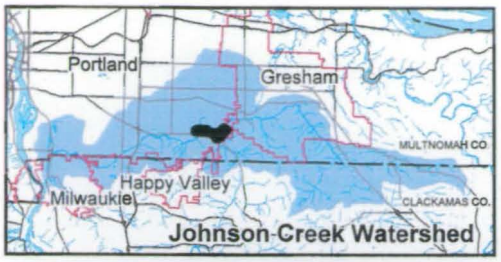
Looking northwest off Barbara Welch Road at a potential area for floodplain reconnection actions. Work with property owners to revegetate creek banks and enhance wildlife corridors.

Photo 22-4:

Looking west off the SE 142nd Avenue bridge crossing. This area offers an opportunity to work with property owners to reconnect the floodplain, increase in-stream complexity, and replace invasive species with native plants.

JOHNSON CREEK RESTORATION

REACHES
23, 24



Legend

- Reach Divider
- City Boundary
- County Line

Aerial Images Source:
Spencer Gross, 1998.

Aerial Map

JURISDICTIONS INCLUDED

CITY OF PORTLAND

NORTH

0 250 500 1000 Feet

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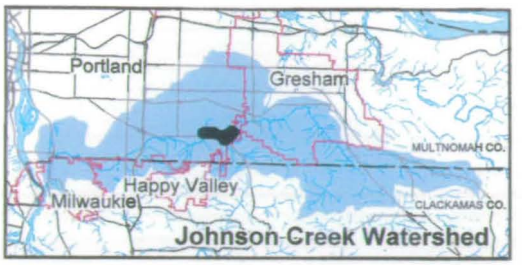
JOHNSON CREEK RESTORATION

REACHES
23, 24

Functions

JURISDICTIONS INCLUDED
CITY OF PORTLAND



Legend

- Reach Divider
- Fish Barrier
- Pipe Crossing
- Inundated Properties
- Wildlife Corridors and Habitat Patches
- Floodplain Reconnection
- Impervious Surface

NORTH

0 250 500 1000 Feet

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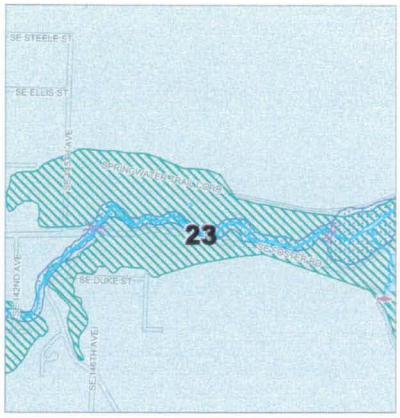
Reach 23

Existing Conditions



Reach 23 - Description	Target	Units
Floodplain Reconnection	8	acres
Wildlife Corridors and Habitat Patches	92	acres
In-stream Complexity	3,684	feet
Inundated Properties	10	number
Fish Barriers	0	number
Priority Outfalls	2	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Reach 23 extends from SE 141st Avenue to SE 158th Avenue north of Foster Road in the Lower Powell Butte area. It is in the jurisdiction of the City of Portland. The area consists of forested property intermingled with single-family residences. The northern portion is dominated by uplands (Powell Butte). The width of the riparian corridor is narrow to nonexistent in some places. Vegetation consists primarily of Douglas-fir, red alder, bigleaf maple, Western redcedar, beaked hazelnut, and common hawthorn, as well as non-native invasive reed canarygrass and Himalayan blackberry. Large native trees occur sporadically along the creek banks. Remnant wetland vegetation is present in the former creek meanders, suggesting that this area is still at least seasonally wet. Current conditions in this reach are rated as 2-/3.

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Stabilize stream banks exhibiting excessive erosion
- Create or enhance wildlife corridors
- Increase in-stream complexity of creek
- Mitigate outfalls
- Protect areas of cool/cold water seeps and springs
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $4,800,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by glides and scour pools.
- Average pool depth is 64 cm.
- Stream substrate is dominated by boulders and cobble, with some parts of the channel bottom composed of exotic rock boulders.
- Wood volume is extremely low.

- Riparian vegetation is dominated by small and medium-sized coniferous and deciduous trees, including maple, fir, and alder. Backyards degrade the natural riparian flora.
- The reach consists of a single channel.
- Many small exposed pipes traverse the creek upstream of the Foster Road bridge crossing.
- Numerous private driveways are bridged across the creek.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place large wood structures in this reach to create pool habitat, reduce overall erosive velocities, and decrease areas of high bank erosion.
- Explore opportunities to open up the channel, allowing access to the floodplain and creating off-channel habitat.

Recommended Actions

1. Work toward acquiring frequently flooded properties near the creek through the Willing Seller Program as opportunities arise. On acquired properties, structures will be removed, creek banks will be terraced back as appropriate to reconnect the floodplain and replanted with native vegetation, and the riparian corridor will be protected and enhanced to the maximum extent possible (see Photo 23-1).

Photo 23-1:
BES-owned property off SE 145th Avenue that would be part of floodplain reconnection actions.

2. Work with willing property owners adjacent to Johnson Creek for the purpose of reconnecting the creek with its original floodplain. Activities will be property-specific and to the extent deemed appropriate by the owner. Floodplain reconnection will entail removal of invasive plant species from the banks of the creek, as well as removal of the WPA wall where appropriate. The banks will be regraded, terraced, and then replanted with native riparian

vegetation. Enhancing the riparian corridor and increasing floodplain connection will help stabilize the stream banks and decrease the effects of excessive erosion on the creek (see Photo 23-2).

Photo 23-2:

Looking west from the SE 158th Avenue bridge over Johnson Creek. Opportunity exists to terrace the banks, reconnect the floodplain, and restore the riparian corridor through revegetation projects and the addition of in-stream complexity.

3. Work with property owners near the creek to encourage planting of native riparian vegetation. This action will enhance habitat conditions and provide wildlife access to the creek from the surrounding upland areas (see Photo 23-3).

Photo 23-3:

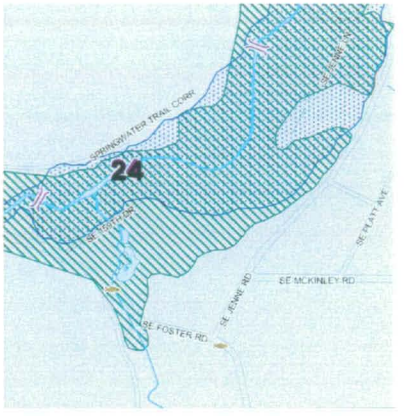
A wetland area in Reach 23 that could be restored to function as both floodplain and habitat after regrading and planting with native vegetation.

4. Increase in-stream complexity throughout the length of the creek running through this reach. This action, which will be done in conjunction with other projects in the reach, will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project's design phase.
5. Address outfalls that directly impact Johnson Creek. Outfalls may be removed or diverted through some sort of mitigation measure, such as a bio-filtration swale.
6. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Reach 24

Existing Conditions

Reach 24 is located between SE 158th Avenue and SE Jenne Lane in the Lower Powell Butte area. It is in the jurisdiction of the City of Portland. The reach consists primarily of forested properties. Powell Butte to the north and Clatsop Butte to the south confine the floodplain area of Johnson Creek. The confluence of Kelley Creek and Johnson Creek is located in the southern portion of this reach. The riparian corridor is fairly wide. Vegetation consists of native rose, bigleaf maple, red alder, Oregon ash, beaked hazelnut, red osier dogwood, willow, salmonberry, Douglas' spiraea, Pacific ninebark, red elderberry, Douglas-fir, grand fir, Douglas hawthorn, and Indian plum, as well as non-native invasive Himalayan blackberry and reed canarygrass. Due to high quality vegetation and available open space, current conditions in this reach are rated as 1/1-.



Reach 24 - Description	Target	Units
Floodplain Reconnection	71	acres
Wildlife Corridors and Habitat Patches	140	acres
In-stream Complexity	3,195	feet
Inundated Properties	3	number
Fish Barriers	4	number
Priority Outfalls	6	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Protect and restore riparian vegetation
- Protect tributaries and tributary confluences
- Create or enhance wildlife corridors
- Increase in-stream complexity of creek
- Mitigate outfalls
- Remove fish barriers
- Protect areas of cool/cold water seeps and springs
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $15,250,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by glides and scour pools.
- Average pool depth is 62 cm.
- Stream substrate is dominated by cobble and fine sediments, with exotic boulders.
- Wood volume is extremely low.

- Riparian vegetation is dominated by small and medium-sized deciduous trees, including alder, dogwood, and willow, which often overhang the water.
- The reach contains few multiple channels and backwaters..
- Summer conditions are typified by slow, deep water.
- Banks are constrained by WPA tiles.
- There is a good variety of deep pools, steps, and riffles.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place large wood structures in this reach to create pool habitat and reduce overall erosive velocities.
- Provide off-channel habitat.
- Evaluate tributary junctions, such as the confluence of Kelley and Johnson Creeks, which are areas of high biological diversity due to the mixing of different flows, temperatures, nutrients and other factors. In-channel and riparian restoration at junctions could offer high returns for fish.

Recommended Actions

1. Work toward acquiring frequently flooded properties near the creek through the Willing Seller Program as opportunities arise. On acquired properties, structures will be removed, creek banks will be terraced back as appropriate to reconnect the floodplain and replanted with native vegetation, and the riparian corridor will be protected and enhanced to the maximum extent possible (see Photo 24-1).
2. Work toward acquiring property along the north and south banks of Johnson Creek through the Willing Seller Program for the purpose of designing a constructed wetland. The constructed wetland may encompass the entire length of the creek through this reach. The intention is to reconnect Johnson Creek with its original floodplain. This action requires regrading the banks of the creek and the properties as necessary to open them up for access by the creek. Following regrading and removal of all invasive plants, the properties will be replanted with native wetland vegetation to shade the creek. Additional actions during construction of wetlands include creating off-channel fish habitat and increasing sinuosity along the creek. During the process of regrading and lowering the banks, 300-foot channels will be created to provide off-channel fish habitat. In addition, the banks of the creek will be reshaped, increasing sinuosity in the creek by

Photo 24-1:

BES-owned property off of SE 159th Avenue, site of the Alsop-Brownwood early action project. There is opportunity here to reconnect the creek to its floodplain and restore fish and wildlife habitat. The project will also create a habitat corridor from Powell Butte to the creek.

adding meanders throughout this reach. Constructed wetland areas in this area will serve as a wildlife corridor as well as protect cool/cold water seeps and springs (see Photo 24-2).

3. Work with willing property owners adjacent to Johnson Creek for the purpose of reconnecting the creek with its original floodplain. Activities will be property-specific and to the extent deemed appropriate by the owner. Floodplain reconnection will entail removal of invasive plant species from the banks of the creek, as well as removal of the WPA wall where appropriate. The banks will be regraded, terraced, and then replanted with native riparian vegetation. Enhancing the riparian corridor and increasing floodplain connection will help stabilize the stream banks and decrease the effects of excessive erosion on the creek (see Photo 24-3).
4. Work with property owners south of Johnson Creek for the dual purpose of creating a wildlife corridor and protecting the Kelley Creek tributary that extends from Johnson Creek to the south. Property owners will be encouraged to allow planting of native riparian vegetation to enhance habitat conditions and to provide wildlife access to the creek from the surrounding upland areas. Properties along the tributary will be identified as key areas for protection and enhancement of native riparian vegetation.
5. Increase in-stream complexity throughout the length of the creek running through this reach. This action, which will be done in conjunction with other projects in the reach, will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase.
6. Address outfalls that directly impact Johnson Creek. Outfalls may be removed or diverted through some sort of mitigation measure, such as a bio-filtration swale.
7. Remove or modify culverts that impede salmonid movement. Determination of whether the culverts will require improvement or removal will be on a site-by-site basis during the project design phase.
8. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Photo 24-2:

A forested wetland near Johnson Creek. Wetlands like this one could be created on appropriate sites to provide habitat and floodplain reconnection.

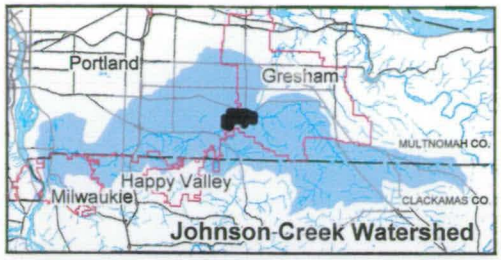
Photo 24-3:

Looking east from the SE 158th Avenue bridge over Johnson Creek. Opportunity exists to work with property owners to terracing the banks, reconnecting the floodplain, and restoring the riparian corridor.

Note: Reach 25 is not located adjacent to Johnson Creek, but has been identified as a restoration area within the Johnson Creek Watershed.

JOHNSON CREEK RESTORATION

REACHES
25, 26, 27, 28, 29



Aerial Map

Legend

- Reach Divider
- City Boundary
- County Line

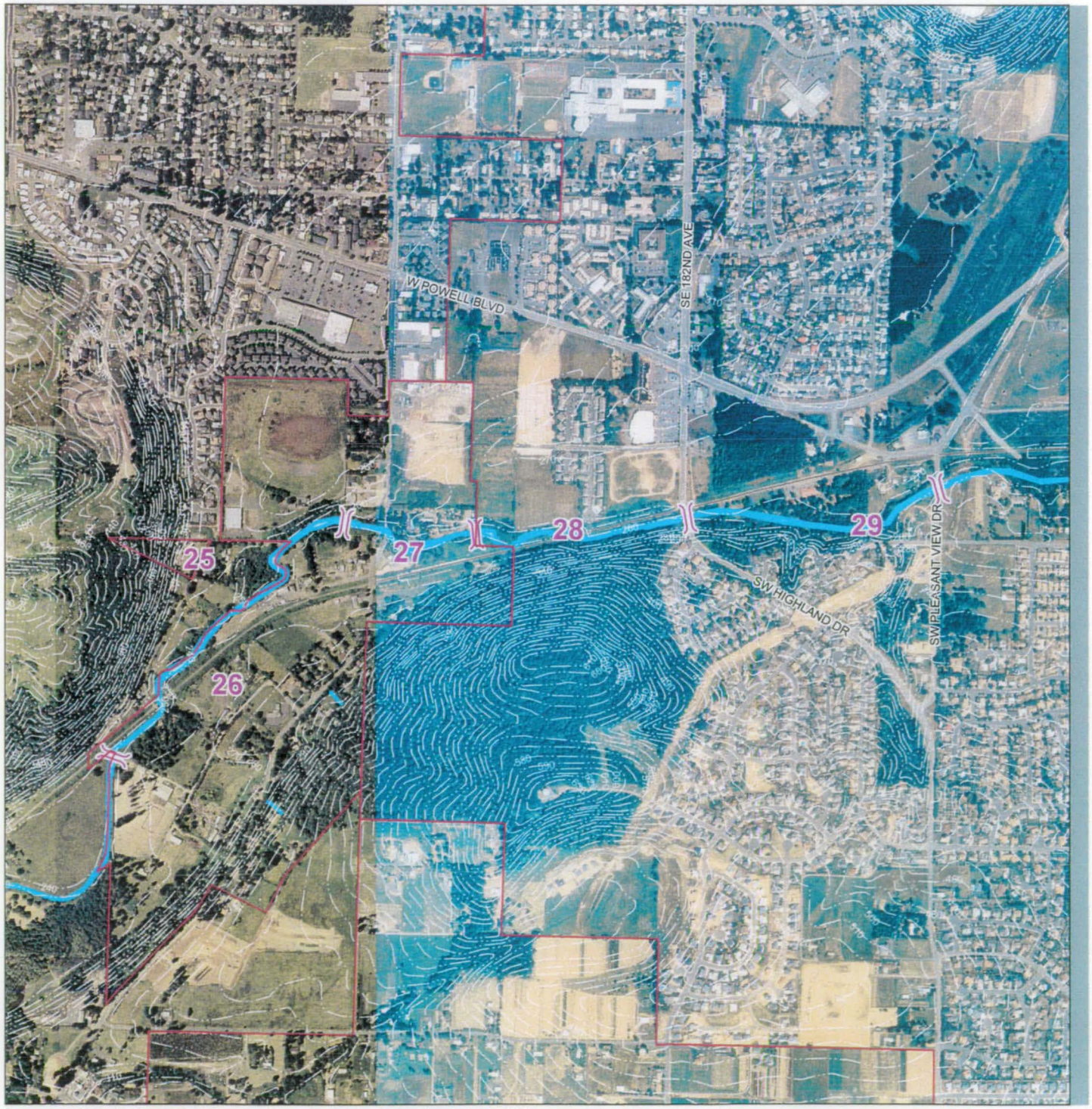
Aerial Images Source: Spencer Gross, 1998.

JURISDICTIONS INCLUDED

CITY OF PORTLAND
CITY OF GRESHAM
MULTNOMAH COUNTY

NORTH

0 250 500 1000 Feet



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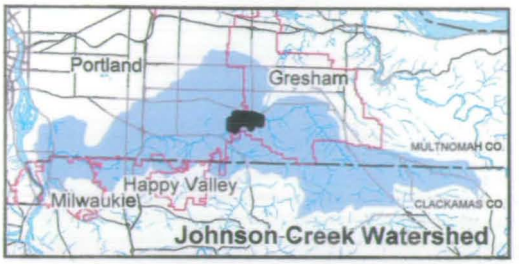
Note: Reach 25 is not located adjacent to Johnson Creek, but has been identified as a restoration area within the Johnson Creek Watershed.



Legend

- Reach Divider
- Fish Barrier
- Pipe Crossing
- Inundated Properties
- Wildlife Corridors and Habitat Patches
- Floodplain Reconnection
- Impervious Surface

JOHNSON CREEK RESTORATION

REACHES 25, 26, 27, 28, 29

Functions

JURISDICTIONS INCLUDED

CITY OF PORTLAND
CITY OF GRESHAM
MULTNOMAH COUNTY

NORTH

0 250 500 1000 Feet

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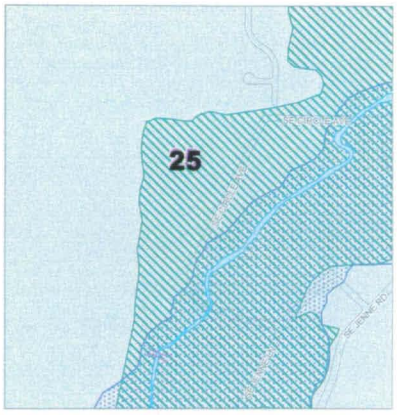
Reach 25



Reach 25 - Description	Target	Units
Floodplain Reconnection	3	acres
Wildlife Corridors and Habitat Patches	33	acres
In-stream Complexity	1,422	feet
Inundated Properties	0	number
Fish Barriers	0	number
Priority Outfalls	0	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Existing Conditions

Reach 25 is located on the north side of Johnson Creek along SE Circle Avenue in the jurisdiction of the City of Portland. The area consists of some single-family homes on the lower slopes of Powell Butte. In general, the width of the riparian corridor is narrow. Vegetation consists primarily of sword fern, cattail, native rose, bigleaf maple, red alder, Oregon ash, beaked hazelnut, bitter cherry, black cottonwood, red osier dogwood, willow, salmonberry, Douglas' spiraea, ninebark, stinging nettle, red elderberry, and lady fern, as well as such non-native invasive plants as Himalayan blackberry and reed canarygrass. Current conditions in this reach are rated as 1-.

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Create or enhance wildlife corridors
- Increase in-stream complexity of creek
- Protect areas of cool/cold water seeps and springs
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $1,010,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by glides and scour pools.
- Average pool depth is 62 cm.
- Stream substrate is dominated by cobble and fine sediments.
- Wood volume is extremely low.
- Riparian vegetation is dominated by small and medium-sized deciduous trees, including alder, dogwood, and willow, which often overhang the water.
- Few multiple channels and backwaters are present.
- Summer conditions are typified by slow, deep water.
- Some banks are constrained by WPA tiles.
- There is a good variety of deep pools, steps, and riffles.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place large wood structures in this reach to create pool habitat and reduce overall erosive velocities.
- Provide off-channel habitat.

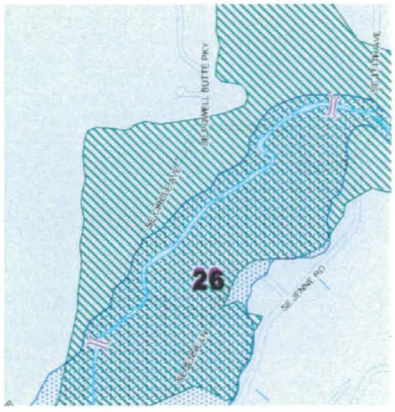
Recommended Actions

1. Work with willing property owners adjacent to Johnson Creek for the purpose of reconnecting the creek with its original floodplain (see Photo 25-1). Activities will be property-specific and to the extent deemed appropriate by the owner. Floodplain reconnection will entail removal of invasive plant species from the banks of the creek, as well as removal of the WPA wall where appropriate. The banks will be regraded, terraced, and then replanted with native riparian vegetation. Enhancing the riparian corridor and increasing floodplain connection will help stabilize the stream banks.
2. Work with property owners throughout this reach to create a wildlife corridor. Owners will be encouraged to plant native riparian vegetation to enhance habitat conditions and provide wildlife access to the creek from the surrounding upland areas.
3. Increase in-stream complexity throughout the length of the creek running through this reach. This work, which will be done in conjunction with other projects in the reach, will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific as determined during the project design phase.
4. Work with owners of properties containing cool/cold water seeps and springs to protect this valuable natural resource through actions, such as revegetation projects, that shade the creek.
5. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Photo 25-1:

Looking east toward Johnson Creek off of SE Circle Avenue. Opportunity exists to work with property owners to enhance floodplain reconnection.

Reach 26



Reach 26 - Description	Target	Units
Floodplain Reconnection	39	acres
Wildlife Corridors and Habitat Patches	77	acres
In-stream Complexity	2,435	feet
Inundated Properties	1	number
Fish Barriers	0	number
Priority Outfalls	2	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Existing Conditions

Reach 26 is located north of SE Jenne Road and extends east to SE 174th Avenue on the southern side of the creek near the Lower Powell Butte area. It is in the jurisdiction of Multnomah County. The area consists primarily of single-family homes and open space areas southeast of Powell Butte. The width of the riparian corridor ranges from moderate to narrow. Vegetation consists primarily of sword fern, cattail, native rose, bigleaf maple, red alder, Oregon ash, beaked hazelnut, bitter cherry, black cottonwood, red osier dogwood, willow, salmonberry, Douglas' spiraea, Pacific ninebark, stinging nettle, red elderberry, and lady fern, as well as non-native invasive Himalayan blackberry and reed canarygrass. Current conditions in this reach are rated as 1-.

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Create or enhance wildlife corridors
- Increase in-stream complexity of creek
- Mitigate outfalls
- Protect areas of cool/cold water seeps and springs
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $7,290,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by glides and scour pools.
- Average pool depth is 62 cm.
- Stream substrate is dominated by cobble and fine sediments.
- Wood volume is extremely low.
- Riparian vegetation is dominated by small and medium-sized deciduous trees, including alder, dogwood, and willow, which often overhang the water.
- There are a few multiple channels and backwaters.
- Summer conditions are typified by slow, deep water.

- Some banks are constrained by WPA tiles.
- There is a good variety of deep pools, steps, and riffles.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place large wood structures in this reach to create pool habitat and reduce overall erosive velocities.
- Provide off-channel habitat.

Recommended Actions

1. Work toward acquiring frequently flooded properties near the creek through the Willing Seller Program as opportunities arise. On acquired properties, structures will be removed, creek banks will be terraced back as appropriate to reconnect the floodplain and replanted with native vegetation, and the riparian corridor will be protected and enhanced to the maximum extent possible.
2. Work toward acquiring additional properties on the south side of Johnson Creek through the Willing Seller Program for the purpose of reconnecting Johnson Creek with its natural floodplain by developing an enhanced wetland area. This action will entail removing acquired homes, terracing back the banks of the creek as far as is appropriate, and allowing the creek to access additional area. During bank terracing, the WPA wall will be removed so that it does not restrict the creek. The banks will then be vegetated with native plants to enhance the quality of the riparian corridor and also provide shade for the creek. Property exhibiting wetland conditions already exists in this area.
3. Work with willing property owners adjacent to Johnson Creek for the purpose of reconnecting the creek with its original floodplain. Activities will be property-specific and to the extent deemed appropriate by the owner. Floodplain reconnection will entail removal of invasive plant species from the banks of the creek, as well as removal of the WPA wall where appropriate. The banks will be regraded, terraced, and then replanted with native riparian vegetation. Enhancing the riparian corridor and increasing floodplain connection will help stabilize the stream banks (see Photos 26-1 and 26-2).
4. Identify areas of cool/cold water seeps and springs along or near the creek and work with property owners in these areas to protect this natural resource. Non-native invasive species will be removed, and native riparian vegetation will be planted. This action will also help stabilize steep slopes and slow erosive processes.

Photo 26-1:

Looking south at a pasture area adjacent to Johnson Creek, near the SE Circle Avenue overpass. It is a potential area for floodplain reconnection actions.

Photo 26-2:

Looking southeast from the south bank of Johnson Creek. This open area provides opportunity to work with landowners to reconnect the floodplain and enhance wetlands on their properties.

5. Work with property owners throughout this reach to create a wildlife corridor. Owners will be encouraged to plant native riparian vegetation to enhance habitat conditions and provide wildlife access to the creek from the surrounding upland areas (see Photo 26-3).

Photo 26-3:

Facing upstream (east) on Johnson Creek. Opportunity exists to terrace the banks and replant them with native riparian vegetation to shade the creek and enhance the wildlife corridor In-stream complexity should also be added.

6. Increase in-stream complexity throughout the length of the creek running through this reach. This action, which will be done in conjunction with other projects in the reach, will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined during the project design phase (see Photo 26-3).
7. Mitigate the effects of the high priority outfall located off SE Jenne Lane and other outfalls in the area that directly affect Johnson Creek. Several different techniques are available, and the specific approach will be determined in the projectdesign phase.
8. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Reach 27

Existing Conditions

Reach 27 extends along Johnson Creek from SE Jenne Road to just east of SE 174th Avenue at the Multnomah County line. It is in the jurisdiction of Multnomah County. The area consists of a combination of single-family homes, vacant lots on both sides of the creek, and forested property to the south. The width of the riparian corridor ranges from narrow to moderate. Vegetation consists primarily of western redcedar, red alder, Oregon ash, Douglas-fir, bigleaf maple, vine maple, willow, beaked hazelnut, and red elderberry, as well as non-native invasive reed canarygrass and Himalayan blackberry. Some healthy native vegetation is present in this reach, but there also are areas characterized by steep eroding banks with lots of trash along the creek banks and in the creek channel. Current conditions in this reach are rated as 2/2+.

Reach 27 - Description	Target	Units
Floodplain Reconnection	5	acres
Wildlife Corridors and Habitat Patches	38	acres
In-stream Complexity	1,178	feet
Inundated Properties	1	number
Fish Barriers	0	number
Priority Outfalls	2	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Stabilize stream banks exhibiting excessive erosion
- Create or enhance wildlife corridors
- Increase in-stream complexity of creek
- Mitigate outfalls
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $1,270,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by glides and scour pools.
- Average pool depth is 62 cm.
- Stream substrate is dominated by cobble and fine sediments.
- Wood volume is extremely low overall, but small woody debris is abundant
- Riparian vegetation is dominated by small and medium-sized deciduous trees, including alder, dogwood, and willow, which often overhang the water.

- There are a few multiple channels and backwaters in this reach.
- Summer conditions are typified by slow, deep water.
- Banks are earthen and often steep and eroding.
- There is a good variety of deep pools, steps, and riffles.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place large wood structures in this reach to create pool habitat and reduce overall erosive velocities, as well as decrease areas of high bank erosion.
- Reconnect the floodplain and provide off-channel habitat.

Recommended Actions

1. Work toward acquiring frequently flooded properties near the creek through the Willing Seller Program as opportunities arise. On acquired properties, structures will be removed, creek banks will be terraced back as appropriate to reconnect the floodplain and replanted with native vegetation, and the riparian corridor will be protected and enhanced to the maximum extent possible.
2. Work toward acquiring properties along Johnson Creek on the western edge of the project area through the Willing Seller Program for the purpose of reconnecting Johnson Creek with its natural floodplain by developing an enhanced wetland area. This action will entail removing acquired homes, terracing back the banks of the creek as far as is appropriate, and allowing the creek additional area to access. The banks will then be vegetated with native plants to increase the size and enhance the value of the riparian corridor and also provide shade for the creek. Property exhibiting wetland characteristics already exists in this area (see Photo 27-1).

   The purpose of the work is to expand and enhance this area by planting additional native wetland vegetation and removing non-native invasive species, such as reed canarygrass and Himalayan blackberry. Existing native wetland vegetation will be maintained in the design. This stretch of creek was identified as exhibiting excessive erosion. Revegetating the banks will increase their stability and decrease the effects of excessive erosion on the creek.

Photo 27-1:

Looking west at Johnson Creek off of the SE 174th Avenue overpass. Opportunities exist to enhance the riparian corridor and wetlands throughout this reach.

3. Work with willing property owners adjacent to Johnson Creek for the purpose of reconnecting the creek with its original floodplain. Activities will be property-specific and to the extent deemed appropriate by the owner. Floodplain reconnection will entail removal of invasive plant species from the banks of the creek. The banks will be regraded , terraced, and then replanted with native riparian vegetation. Enhancing the riparian corridor and increasing floodplain connection will help stabilize the stream banks and decrease the effects of excessive erosion on the creek (see Photo 27-2).
4. Work with property owners south of the Springwater Corridor for the purpose of creating a wildlife corridor from the upland areas to the creek. This corridor would be an extension of the enhanced wetland area. If a property owner is interested and the site is appropriate, a connection may be designed to allow the creek access to the property and open up additional floodplain area. Property owners will be encouraged to allow removal of invasive plant species (e.g., Himalayan blackberries, reed canarygrass) and planting of native riparian vegetation to enhance wildlife habitat conditions, as well as providing access to the creek from the surrounding upland areas (see Photos 27-3 and 27-4).
5. Increase in-stream complexity throughout the length of the creek running through this reach. This action, which will be done in conjunction with other projects in the reach, will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined during the project's design phase.
6. Address outfalls that directly impact Johnson Creek. Outfalls may be removed or diverted through some sort of mitigation measure, such as a bio-filtration swale.
7. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Photo 27-2:

Looking north from the Springwater Corridor on the south side of Johnson Creek. The property is situated in between the corridor and the creek and is a potential area for floodplain reconnection actions.

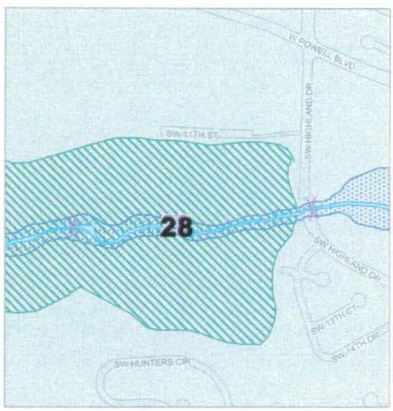
Photo 27-3:

Looking at a property on the south side of the Springwater Corridor. This area offers opportunity to work with the property owner to maintain and enhance the wildlife corridor and upland connection.

Photo 27-4:

Looking southeast from the Springwater Corridor south of Johnson Creek. This area offers an opportunity to work with the property owner to enhance the wildlife corridor and upland connections, and to potentially reconnect the floodplain.

Reach 28



Reach 28 - Description	Target	Units
Floodplain Reconnection	3	acres
Wildlife Corridors and Habitat Patches	77	acres
In-stream Complexity	1,733	feet
Inundated Properties	0	number
Fish Barriers	0	number
Priority Outfalls	2	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Existing Conditions

Reach 28 extends east from the Multnomah County line to SW Highland Drive/SE 182nd Avenue. It is in the jurisdiction of the City of Gresham. This area contains both single-family homes and commercial properties on the north side of the creek, with predominantly vegetated upland areas on the south side. The width of the riparian corridor is moderate to narrow. The vegetation includes red alder, willow, red elderberry, beaked hazelnut, bigleaf maple, cattail, red osier dogwood, Pacific ninebark, Douglas' spiraea, and Indian plum, as well as invasive Himalayan blackberry and purple loosestrife. Current conditions in this reach are rated as 1/1-.

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Stabilize stream banks exhibiting excessive erosion
- Create or enhance wildlife corridors
- Increase in-stream complexity of creek
- Mitigate outfalls
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $1,750,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by glides and scour pools.
- Average pool depth is 62 cm.
- Stream substrate is dominated by cobble and fine sediments.
- Wood volume is extremely low overall, but small woody debris is abundant.
- Riparian vegetation is dominated by small and medium-sized deciduous trees, including alder, dogwood, and willow, which often overhang the water.
- There are a few multiple channels and backwaters in this reach.
- Summer conditions are typified by slow, deep water.

- Banks are earthen and often steep and eroding.
- There is a good variety of deep pools, steps, and riffles.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place large wood structures in this reach to create pool habitat and reduce overall erosive velocities, as well as decrease areas of high bank erosion.
- Explore opportunities to open up the channel, allowing access to the floodplain and creating off-channel habitat.

Recommended Actions

1. Work with willing property owners adjacent to Johnson Creek for the purpose of reconnecting the creek with its original floodplain. Activities will be property-specific and to the extent deemed appropriate by the owner. Floodplain reconnection will entail removal of invasive plant species from the banks of the creek. The banks will be regraded, terraced, and then replanted with native riparian vegetation. Enhancing the riparian corridor and increasing floodplain connection will help stabilize the stream banks and decrease the effects of excessive erosion on the creek (see Photos 28-1, 28-2, and 28-3).

Photo 28-1:

Looking northeast from the Springwater Corridor at a potential area for floodplain reconnection and bank stabilization. The banks are predominantly covered with Himalayan blackberry, which does little to stabilize eroding banks.

Photo 28-2:

Looking northwest from the Springwater Corridor on the north side of Johnson Creek. This is a backwater area that could potentially be reconnected to the creek to expand the floodplain.

Photo 28-3:

Facing west, looking down the Springwater Corridor. Potentially, Johnson Creek, which is on the south side of Springwater Corridor, and its backwaters, which are on the north side, could be reconnected. This would provide increased and improved fish habitat.

2. Work with property owners throughout this reach to create a wildlife corridor. Owners will be encouraged to plant native riparian vegetation to enhance habitat conditions and provide wildlife access to the creek from the surrounding upland areas (see Photos 28-4 and 28-5).
3. Increase in-stream complexity throughout this reach. This action, which will be undertaken in conjunction with other projects in the reach, will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined during the project design phase.
4. Address outfalls that directly impact Johnson Creek. Outfalls may be removed or diverted through some sort of mitigation measure, such as a bio-filtration swale.
5. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Photo 28-4:

Looking southwest above the Springwater Corridor and Johnson Creek. This open area can be replanted with native riparian vegetation to enhance wildlife corridors and the connection to upland areas.

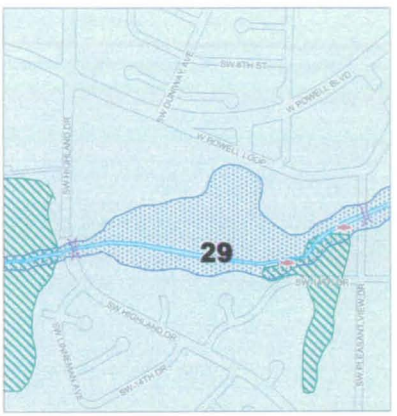
Photo 28-5:

Looking southwest from the Springwater Corridor on the north side of Johnson Creek at upland area vegetation being invaded by non-native Himalayan blackberries. Removal of invasive species and revegetation with native plants will enhance wildlife habitat.

Reach 29

Existing Conditions

Reach 29 extends from SW Highland Drive/SE 182nd Avenue to SW Pleasant View Drive and is in the jurisdiction of the City of Gresham. The area consists of single-family homes, undeveloped parcels of forest, and open land bordering the Springwater Corridor. The riparian corridor is narrow. Vegetation is predominantly red alder, black cottonwood, bigleaf maple, and willow, as well as invasive Himalayan blackberry, reed canarygrass, Japanese knotweed, and hedge bindweed. Some large Douglas-firs and western redcedars grow in the reach, but there are too few and they are set too far back from the creek to provide shade. Current conditions in this reach are rated as 2/3-.



Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Stabilize stream banks exhibiting excessive erosion
- Protect and restore riparian vegetation
- Protect tributaries and tributary confluences
- Increase in-stream complexity of creek
- Mitigate outfalls
- Remove fish barriers
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $3,70,000

Reach 29 - Description	Target	Units
Floodplain Reconnection	18	acres
Wildlife Corridors and Habitat Patches	22	acres
In-stream Complexity	2,263	feet
Inundated Properties	0	number
Fish Barriers	2	number
Priority Outfalls	2	number
Pipe Crossings	0	number
Impervious Surface	0	acres

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by glides and scour pools.
- Average pool depth is 62 cm.
- Stream substrate is dominated by cobble and fine sediments.
- Wood volume is extremely low overall, but small woody debris is abundant.
- Riparian vegetation is dominated by small and medium-sized deciduous trees, including alder, dogwood, and willow, which often overhang the water.

- There are few multiple channels and backwaters in this reach.
- Summer conditions are typified by slow, deep water.
- Banks are earthen and often steep and eroding.
- There is a good variety of deep pools, steps, and riffles.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place large wood structures in this reach to create pool habitat and reduce overall erosive velocities, as well as decrease areas of high bank erosion.
- Explore opportunities to open up the channel, allowing access to the floodplain and creating off-channel habitat.

Recommended Actions

Photo 29-1:

Looking east down the Springwater Corridor. The recommended action is to connect properties on both sides of the corridor and create an enhanced wetland.

1. Work toward acquiring properties on the south side of the Springwater Corridor and some limited property on the north side of the corridor for the purpose of creating an enhanced wetlands area. These properties are mainly on the north side of Johnson Creek. Existing structures and invasive species will be removed, the banks of the creek and the property south of the Springwater Corridor will be regraded, and a channel will be constructed underneath the corridor to connect natural floodplain areas on both sides. The intent of this action is to reconnect Johnson Creek with its original floodplain through the enhancement of existing wetland areas in this reach. Areas will be expanded and enhanced with additional native wetland vegetation. Banks will be terraced and planted with native vegetation to increase the size and enhance the value of the riparian corridor, and also provide shade for the creek (see Photo 29-1).

Photo 29-2:

Looking south from Springwater Corridor at the north bank of Johnson Creek. Opportunity exists here to reconnect the floodplain.

2. Work with willing property owners adjacent to Johnson Creek for the purpose of reconnecting the creek with its original floodplain. Activities will be property-specific and to the extent deemed appropriate by the owner. Floodplain reconnection will entail removal of invasive plant species from the banks of the creek. The banks will be regraded, terraced, and then replanted with native riparian vegetation. Enhancing the riparian corridor and increasing floodplain connection will help stabilize the stream banks and decrease the effects of excessive erosion on the creek (see Photos 29-2, 29-3, and 29-4).
3. Work with property owners along the tributaries of Johnson Creek to protect and enhance the resource. Invasive species will be removed and replaced by native riparian vegetation, thereby

helping to maintain a healthy connection between the tributary and Johnson Creek. Where practicable, areas of healthy vegetation will be targeted for protection through the use of conservation easements.

4. Increase in-stream complexity throughout the length of the creek running through this reach. This action, which will be done in conjunction with other projects in the reach, will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase (see Photo 29-4).

Photo 29-4:

Looking west from SE 190th Avenue along the south bank of Johnson Creek. Opportunity exists in this area to reconnect the creek to its natural floodplain though working with landowners to pull back the banks, revegetate, and increase in-stream complexity.

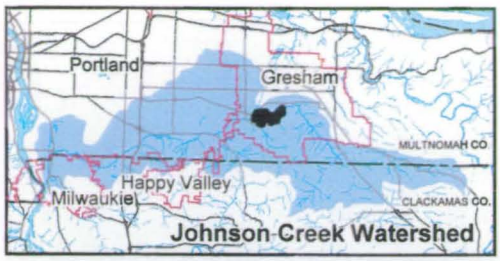
Photo 29-3:

Looking north at a new construction site near the Springwater Corridor. A large forested area was removed for construction of a supermarket. This area presents an opportunity to incorporate property around the developed site into a wetland buffer.

5. Address outfalls that directly impact Johnson Creek. Outfalls may be removed or diverted through some sort of mitigation measure, such as a bio-filtration swale.
6. Remove or modify culverts that impede salmonid movement. Determination of whether the culverts require improvement or removal will be on a site-by-site basis during the project design phase.
7. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

JOHNSON CREEK RESTORATION

REACHES
30, 31, 32



Legend

- Reach Divider
- City Boundary
- County Line

Aerial Images Source:
Spencer Gross, 1998.

Aerial Map

JURISDICTIONS INCLUDED

CITY OF GRESHAM

NORTH

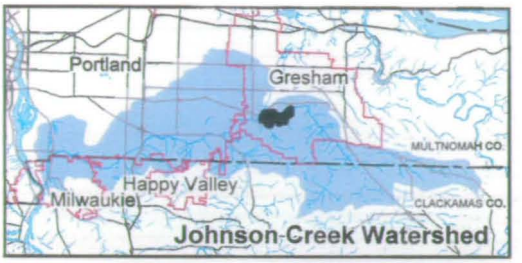
0 250 500 1000 Feet

Produced in MapInfo: \\Oberon\GIS2\Projects\6220\Final_Mapping\Phase 3\Maps\Aerials\ARI Wor (June, 2001) KDR

JOHNSON CREEK RESTORATION

REACHES

30, 31, 32



Legend

- Reach Divider
- Fish Barrier
- Pipe Crossing
- Inundated Properties
- Wildlife Corridors and Habitat Patches
- Floodplain Reconnection
- Impervious Surface

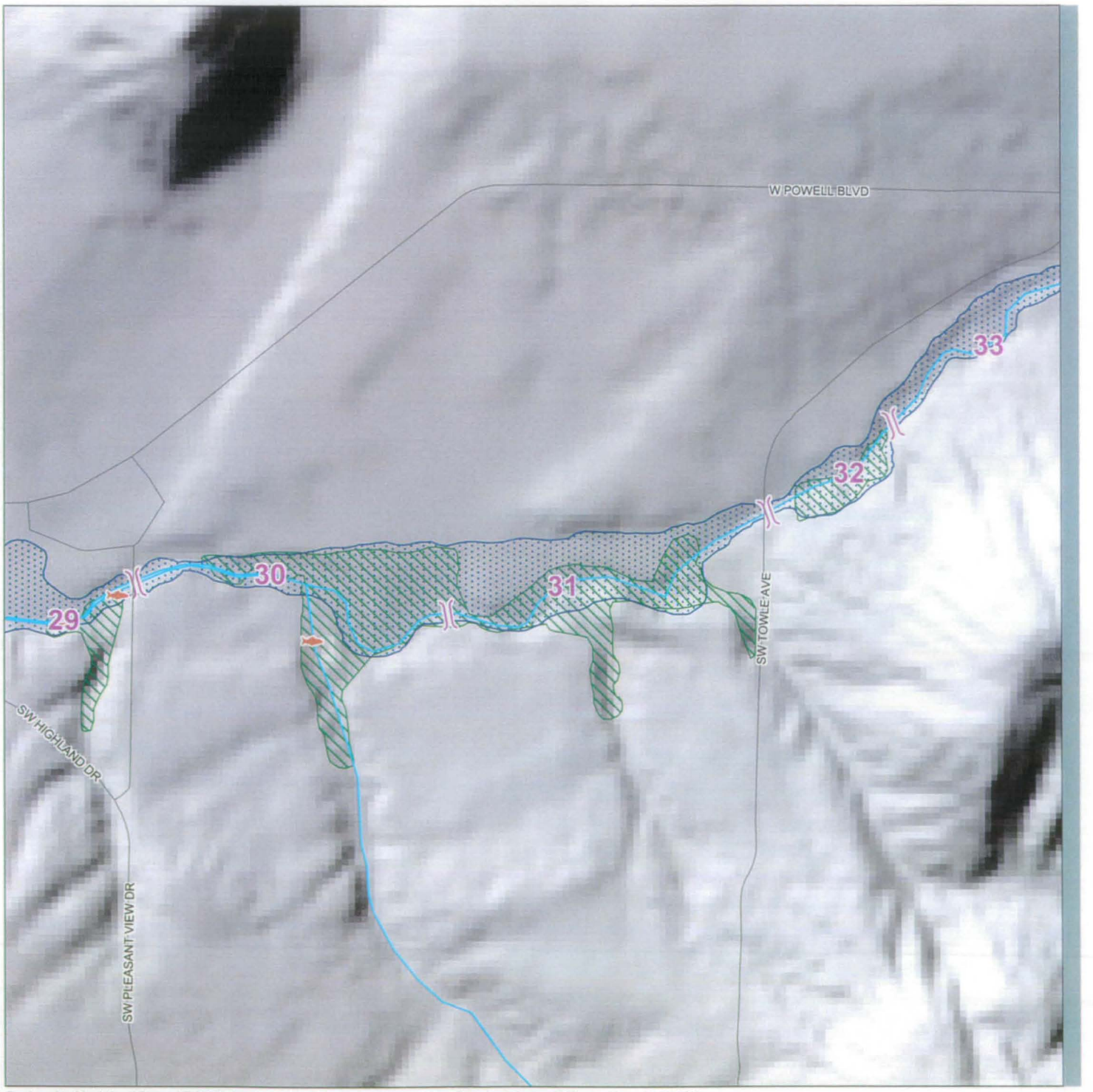
Functions

JURISDICTIONS INCLUDED

CITY OF GRESHAM

NORTH

0 250 500 1000 Feet



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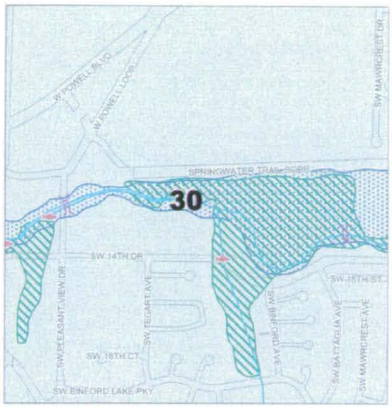
Reach 30



Reach 30 - Description	Target	Units
Floodplain Reconnection	28	acres
Wildlife Corridors and Habitat Patches	68	acres
In-stream Complexity	3,613	feet
Inundated Properties	0	number
Fish Barriers	1	number
Priority Outfalls	2	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Existing Conditions

Reach 30 extends from SW Pleasant View Drive to just east of SW Lillyben Avenue in the jurisdiction of the City of Gresham. This area consists of single-family homes surrounding some small forested areas at the confluence of Johnson Creek and Butler Creek, as well as several paved and open spaces to the north of the Springwater Corridor. The riparian corridor varies from wide to narrow. Vegetation consists primarily of Oregon ash, red alder, red osier dogwood, bigleaf maple, black cottonwood, Douglas-fir, willow, vine maple, thimbleberry, snowberry, Oregon grape, red elderberry, skunk cabbage, and sword fern, as well as such invasive species as Himalayan blackberry, reed canarygrass, English ivy, and Scot's broom. Although many native species are present, the numerous invasive plants may out-compete native vegetation if not removed. Current conditions in this reach range from a rating of 3- in the northern portion to 1 in the southern part on or near the Butler Creek tributary.

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Stabilize stream banks exhibiting excessive erosion
- Protect and restore riparian vegetation
- Protect tributaries and tributary confluences
- Increase in-stream complexity of creek
- Mitigate outfalls
- Remove fish barriers
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $1,950,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by glides and scour pools.
- Average pool depth is 63 cm.
- Stream substrate is dominated by cobble and fine sediments.

- Wood volume is extremely low, but greater than much of downstream.
- Riparian vegetation is a mosaic of areas of large trees with a dense understory and areas dominated by dense Himalayan blackberry and reed canarygrass.
- Areas dominated by blackberry and canarygrass are primarily associated with slow, deep water.
- The reach consists of one channel.
- Incision is widespread in this reach.
- Banks are dominated by eroding earth on both sides of the channel.
- A fair number of outfalls are present.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place large wood structures in this reach to create pool habitat and reduce overall erosive velocities, as well as decrease areas of high bank erosion.
- Explore opportunities to open up the channel, allowing access to the floodplain and creating off-channel habitat.
- Reduce rate and magnitude of stormwater runoff by working with adjacent property owners to decrease impervious surfaces and by identifying areas where stormwater outfalls can be treated before entering the creek.

Recommended Actions

1. Work toward acquiring properties along Johnson Creek through the Willing Seller Program for the purpose of reconnecting Johnson Creek with its natural floodplain by developing an enhanced wetland area. This action will entail removing acquired homes, terracing back the banks of the creek as far as possible, and allowing the creek additional area in which to expand. The banks will then be revegetated with native plants to increase the size and enhance the value of the riparian corridor, and also to provide shade for the creek (see Photo 30-1). Property exhibiting wetland characteristics already exists in this area. The purpose of the work is to expand and enhance this area by planting additional native wetland vegetation and removing non-native invasive species, such as reed canarygrass and Himalayan blackberry. Existing native wetland vegetation will be maintained in the design (see Photo 30-2). Within this project, enhanced wetland areas will also serve as wildlife corridors. Revegetating the banks will help increase their stability and decrease the effects of excessive erosion on the creek.

Photo 30-1:

Looking southeast from the Springwater Corridor, at the south bank of Johnson Creek. Opportunity exists in this area to reconnect the floodplain, create enhanced wetland areas, and restore the riparian corridor.

Photo 30-2:

Looking west on Butler Creek south of SW 14th Place. Opportunity exists to enhance this wetland area.

Photo 30-3:

Looking south from the Springwater Corridor, east of Pleasant View Drive, across the creek at lawn. Only blackberries are growing between the lawn and the creek, intensifying bank erosion and reducing the quality of the riparian corridor. Working with willing property owners, bank terracing and revegetation opportunities exist to restore the riparian corridor and reconnect the floodplain.

2. Work with willing property owners adjacent to Johnson Creek for the purpose of reconnecting the creek with its original floodplain. Activities will be property-specific and to the extent deemed appropriate by the owner. Floodplain reconnection will entail removal of invasive plant species from the banks of the creek. The banks will be regraded, terraced, and then replanted with native riparian vegetation. Enhancing the riparian corridor and increasing floodplain connection will help stabilize the stream banks and decrease the effects of excessive erosion on the creek (see Photos 30-3 and 30-4).

Photo 30-4:

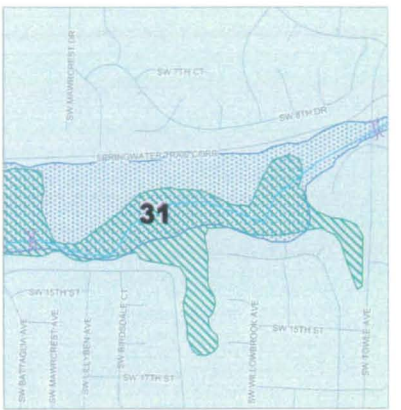
Looking southeast, from the Springwater Corridor, east of Pleasant View Drive. Opportunity exists in areas like this along the creek to restore the riparian corridor and increase in-stream complexity.

3. Work with property owners along the tributaries of Johnson Creek to protect and enhance the resource. Invasive species will be removed and replaced by native riparian vegetation, thereby helping to maintain a healthy connection between the tributary and Johnson Creek. Where practicable, areas of healthy vegetation will be targeted for protection through the use of conservation easements.
4. Increase in-stream complexity throughout the length of this reach. This action, which will be done in conjunction with other projects in the reach, will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase (see Photo 30-4).
5. Mitigate a high-priority outfall located near SW Pleasant View Drive. Address additional outfalls that directly impact Johnson Creek. Outfalls may be removed or diverted through some sort of mitigation measure, such as a bio-filtration swale.
6. Remove or modify culverts that impede salmonid movement. The determination of whether a culvert requires improvement or removal will be on a site-by-site basis during the project design phase.
7. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Reach 31

Existing Conditions

Reach 31 extends from SW Lilyben Avenue to SW Towle Avenue in the jurisdiction of the City of Gresham. The area consists primarily of single-family homes along the southern edge and forested open space along Johnson Creek. The width of the riparian corridor varies from moderate to narrow. Vegetation consists primarily of red alder, bigleaf maple, vine maple, Douglas-fir, willow, black cottonwood, Oregon ash, red osier dogwood, common hawthorn, beaked hazelnut, red elderberry, Douglas' spiraea, and native rose. Non-native invasive species include reed canarygrass, Himalayan blackberry, purple loosestrife, hedge bindweed, and English ivy. Current conditions in this reach are rated as 1- near the western (wetland) side of the reach to 2/2- in the middle and eastern portions.



Reach 31 - Description	Target	Units
Floodplain Reconnection	36	acres
Wildlife Corridors and Habitat Patches	42	acres
In-stream Complexity	3,298	feet
Inundated Properties	0	number
Fish Barriers	0	number
Priority Outfalls	2	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Stabilize stream banks exhibiting excessive erosion
- Protect and restore riparian vegetation
- Protect tributaries and tributary confluences
- Increase in-stream complexity of creek
- Mitigate outfalls
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $3,400,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by glides and scour pools.
- Average pool depth is 63 cm.
- Stream substrate is dominated by cobble and fine sediments.
- Wood volume is extremely low, but greater than much of downstream.

- Riparian vegetation is a mosaic of areas of large trees with a dense understory and areas dominated by dense Himalayan blackberry and reed canarygrass.
- Areas dominated by blackberry and canarygrass are primarily associated with slow, deep water.
- The reach consists of one channel.
- Incision is widespread.
- Banks are dominated by eroding earth on both sides of the channel.
- A fair number of outfalls are present.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place large wood structures in this reach to create pool habitat and reduce overall erosive velocities, as well as decrease areas of high bank erosion.
- Explore opportunities to open up the channel, allowing access to the floodplain and creating off-channel habitat.
- Reduce rate and magnitude of stormwater runoff by working with adjacent property owners to decrease impervious surfaces and by identifying areas where stormwater outfalls can be treated before entering the creek.

Recommended Actions

1. Work toward acquiring property through the Willing Seller Program for the purpose of floodplain reconnection along Johnson Creek. This action will entail development of an enhanced wetland area. On acquired property, creek banks will be terraced and regraded as far as is appropriate, and the banks will be planted with native riparian vegetation to increase the size and enhance the riparian corridor, as well as provide shade for the creek. The purpose of the work is to expand and enhance this area by removing non-native invasive species, such as reed canarygrass and Himalayan blackberry, and planting additional native wetland vegetation. Existing native wetland vegetation will be maintained in the project design. Revegetating the banks will help to increase their stability and decrease the effects of excessive erosion on the creek (see Photo 31-1).
2. Work with willing property owners adjacent to Johnson Creek for the purpose of reconnecting the creek with its original floodplain. Activities will be property-specific and to the extent deemed appropriate by the owner. Floodplain reconnection will entail removal of invasive plant species from the banks of the creek.

Photo 31-1:

Looking northwest from SW 14th Avenue, just east of Battaglia at a field of reed canarygrass in the foreground and Johnson Creek in the background. Opportunity exists to reconnect the floodplain through terracing and regrading the creek banks.

The banks will be regraded, terraced, and then replanted with native riparian vegetation. Enhancing the riparian corridor and increasing floodplain connection will help stabilize the stream banks and decrease the effects of excessive erosion on the creek.

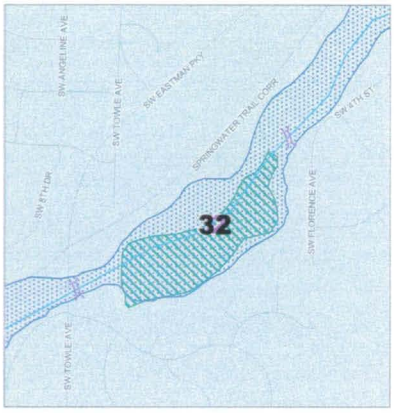
3. Work with property owners along the tributaries of Johnson Creek to protect and enhance the resource (see Photo 31-2).

Photo 31-2:
Looking northeast at the intersection of SW 14th Avenue and SE Heiney Road. Opportunity exists to work with property owners to protect this Johnson Creek tributary (located behind parking area).

Invasive species will be removed and replaced by native riparian vegetation, thereby helping to maintain a healthy connection between the tributary and Johnson Creek. Where practicable, areas of healthy vegetation will be targeted for protection through the use of conservation easements.

4. Increase in-stream complexity throughout the length of the creek running through this reach. This action, which will be done in conjunction with other projects in the reach, will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase.
5. Address outfalls that directly impact Johnson Creek. Outfalls may be removed or diverted through some sort of mitigation measure, such as a bio-filtration swale.
6. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Reach 32



Reach 32 - Description	Target	Units
Floodplain Reconnection	11	acres
Wildlife Corridors and Habitat Patches	8	acres
In-stream Complexity	1,355	feet
Inundated Properties	0	number
Fish Barriers	0	number
Priority Outfalls	4	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Existing Conditions

Reach 32 extends from SW Towle to SW Florence Avenue in the jurisdiction of the City of Gresham. The reach consists primarily of apartments and single-family homes, with a forested area to the south containing a small connection to uplands. The width of the riparian corridor varies from moderate to narrow. Vegetation consists primarily of bigleaf maple, red alder, Douglas-fir, Oregon ash, red osier dogwood, beaked hazelnut, and black cottonwood, as well as invasive Himalayan blackberry, hedge bindweed, and reed canarygrass. Current conditions in this reach are rated as 2/2+.

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Stabilize stream banks exhibiting excessive erosion
- Protect and restore riparian vegetation
- Increase in-stream complexity of creek
- Mitigate outfalls
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $1,960,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by glides and scour pools.
- Average pool depth is 63 cm.
- Stream substrate is dominated by cobble and fine sediments.
- Wood volume is extremely low, but greater than much of downstream.
- Riparian vegetation is a mosaic of areas of large trees with a dense understory and areas dominated by dense Himalayan blackberry and reed canarygrass.
- Areas dominated by blackberry and canarygrass are primarily associated with slow, deep water.
- The reach consists of one deep, meandering channel.
- Incision is widespread.

- Banks are dominated by eroding earth on both sides of the channel.
- The area just upstream from Eastman Parkway serves as a natural water retention area and could possibly be enhanced for this purpose.
- A fair number of outfalls are present.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place large wood structures in this reach to create pool habitat and reduce overall erosive velocities, as well as decrease areas of high bank erosion.
- Explore opportunities to open up the channel, allowing access to the floodplain and creating off-channel habitat.
- Reduce rate and magnitude of stormwater runoff by working with adjacent property owners to decrease impervious surfaces and by identifying areas where stormwater outfalls can be treated before entering the creek.

Recommended Actions

1. Work toward acquiring property through the Willing Seller Program for the purpose of floodplain reconnection along Johnson Creek. This action will entail development of an enhanced wetland area. On acquired property, creek banks will be terraced and regraded as far as is appropriate, and the banks will be replanted with native riparian vegetation to increase and enhance the riparian corridor, as well as provide shade for the creek (see Photo 32-1). The purpose of the work is to expand

Photo 32-1:
Looking southwest from the horse trail off of the Springwater Corridor. Vegetation consists of alder, ash, and holly, with an understory of reed canarygrass and Himalayan blackberry. Opportunity exists to enhance and protect riparian vegetation.

and enhance this area by removing non-native invasive species, such as reed canarygrass and Himalayan blackberry, and planting additional native wetland vegetation. Existing native wetland vegetation will be maintained in the project design. Revegetating the banks will increase their stability and decrease the effects of excessive erosion on the creek.

2. Work with willing property owners adjacent to Johnson Creek for the purpose of reconnecting the creek with its original floodplain. Activities will be property-specific and to the extent deemed appropriate by the owner. Floodplain reconnection will entail removal of invasive plant species from the banks of the creek. The banks will be regraded, terraced, and then replanted with native riparian vegetation. Enhancing the riparian corridor and increasing floodplain connection will help stabilize the stream banks and decrease the effects of excessive erosion on the creek. Willing property owners near, but not adjacent, to the creek will also be assisted to promote riparian plantings and enhancement of wetland areas, as well as to mitigate additional drainage to Johnson Creek (see Photo 32-2).

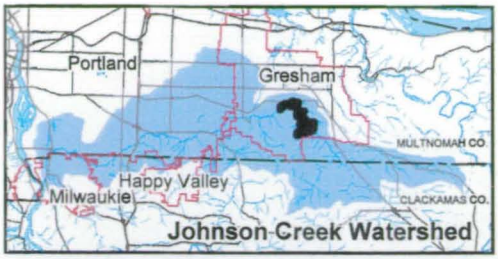
Photo 32-2:
Looking northwest at apartments along Eastman Parkway and the Springwater Corridor. Opportunity exists to develop stormwater swales in this area to mitigate drainage to the creek.

3. Increase in-stream complexity throughout the length of the creek running through this reach. This action, which will be performed in conjunction with other projects in the reach, will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase.
4. Address outfalls that directly impact Johnson Creek. Outfalls may be removed or diverted through some sort of mitigation measure, such as a bio-filtration swale.
5. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Note: Reach 36 is not located adjacent to Johnson Creek, but has been identified as a restoration area within the Johnson Creek Watershed.

JOHNSON CREEK RESTORATION

REACHES
33, 34, 35
36, 37



Legend

- Reach Divider
- City Boundary
- County Line

Aerial Images Source: Spencer Gross, 1998.

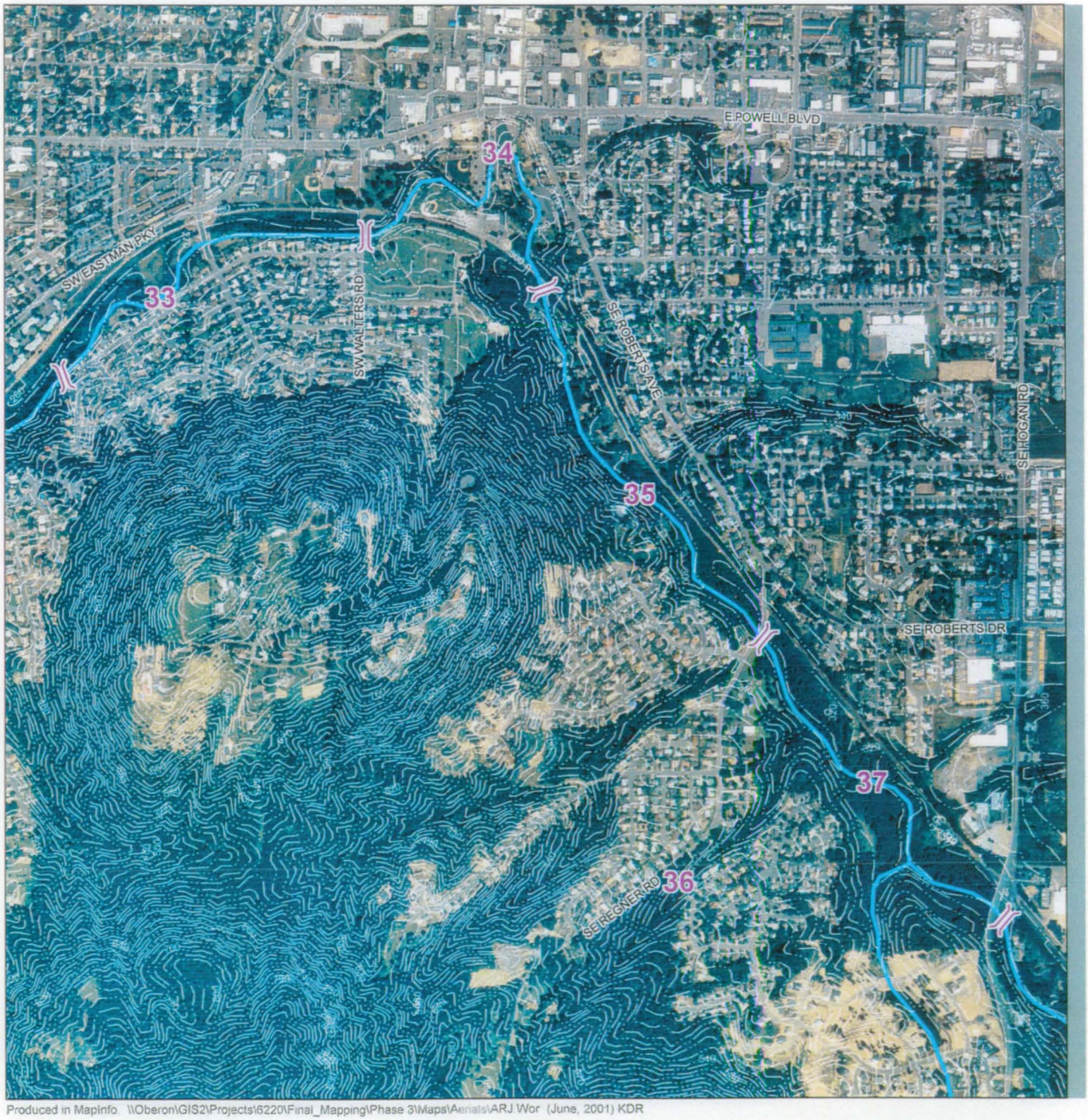
Aerial Map

JURISDICTIONS INCLUDED

CITY OF GRESHAM

NORTH

0 250 500 1000 Feet



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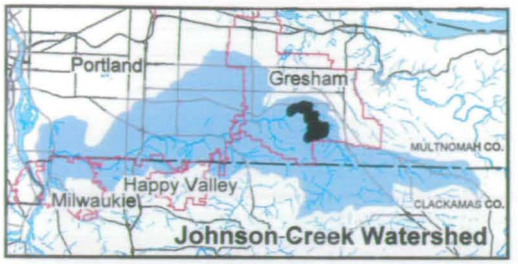
Note: Reach 36 is not located adjacent to Johnson Creek, but has been identified as a restoration area within the Johnson Creek Watershed.



Legend

- Reach Divider
- Fish Barrier
- Pipe Crossing
- Inundated Properties
- Wildlife Corridors and Habitat Patches
- Floodplain Reconnection
- Impervious Surface

JOHNSON CREEK RESTORATION

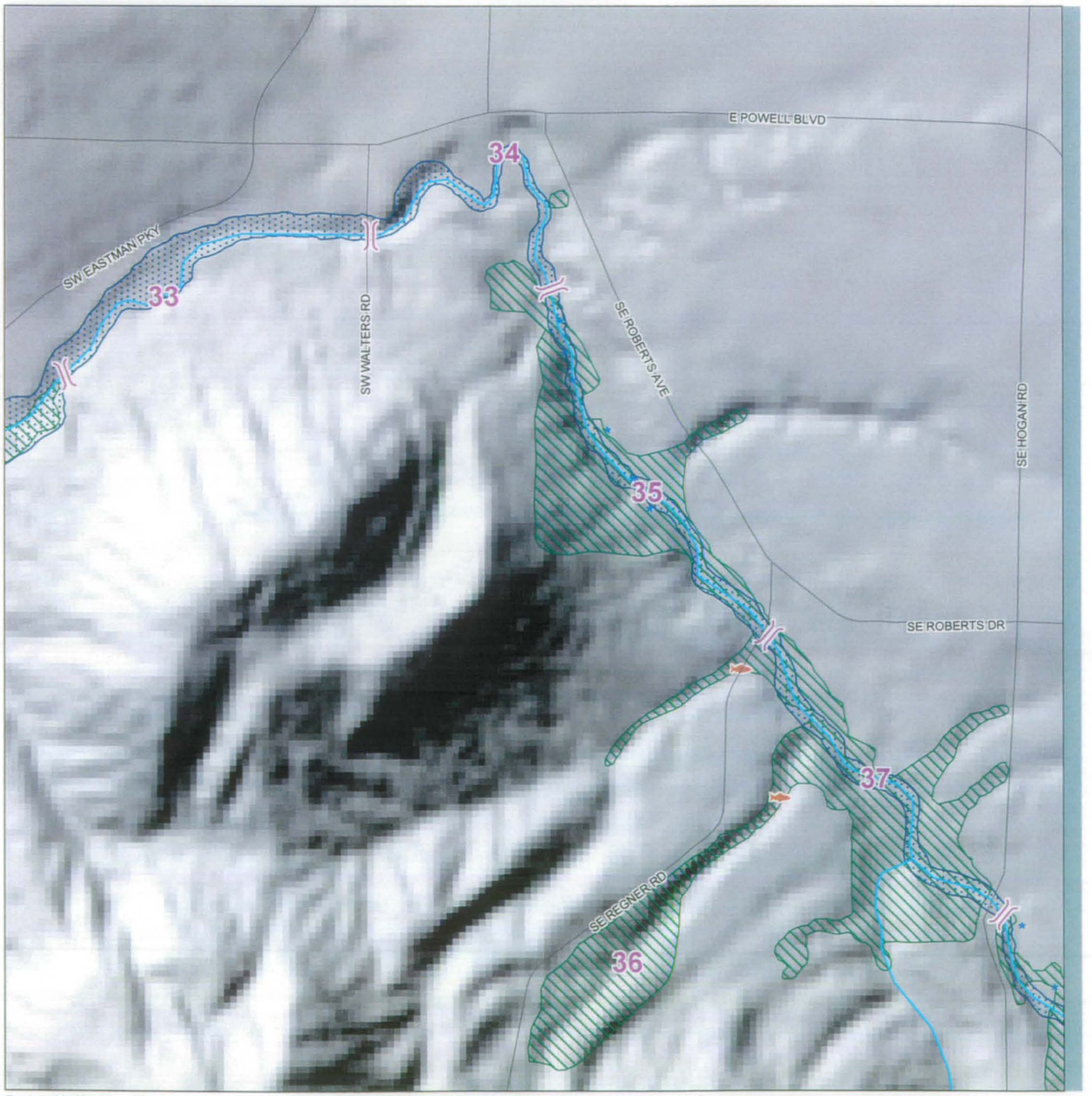
REACHES
33, 34, 35
36, 37

Functions

JURISDICTIONS INCLUDED
CITY OF GRESHAM

NORTH

0 250 500 1000 Feet



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Reach 33

Reach 33 - Description	Target	Units
Floodplain Reconnection	15	acres
Wildlife Corridors and Habitat Patches	0	acres
In-stream Complexity	3,540	feet
Inundated Properties	0	number
Fish Barriers	0	number
Priority Outfalls	7	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Existing Conditions

Reach 33 extends from SW Florence Avenue to SW Walters Road in the jurisdiction of the City of Gresham. This reach contains primarily single-family homes to the south of Johnson creek, while Eastman Parkway and some open space areas are located north of the creek. The width of the riparian corridor varies from moderate to narrow. Vegetation consists primarily of Douglas-fir, western redcedar, red alder, willow, bigleaf maple, and beaked hazelnut, as well as invasive Himalayan blackberry and reed canarygrass. Current conditions in this reach are rated as 2/2+.

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Stabilize stream banks exhibiting excessive erosion
- Increase in-stream complexity of creek
- Mitigate outfalls
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $1,360,000

ODFW Survey Results

ODFW Stream Habitat Survey Results pertaining to this reach include the following observations:

- Stream habitat is dominated by glides and scour pools.
- Average pool depth is 63 cm.
- Stream substrate is dominated by cobble and fine sediments.
- Wood volume is extremely low, but greater than much of downstream.
- Riparian vegetation is a mosaic of areas of large trees with a dense understory and areas dominated by dense Himalayan blackberry and reed canarygrass.
- Areas dominated by blackberry and canarygrass are primarily associated with slow, deep water.
- The reach consists primarily of a single channel.
- Incision is widespread.

- Banks are dominated by eroding earth on both sides of the channel.
- A fair number of outfalls are present.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place large wood structures in this reach to create pool habitat and reduce overall erosive velocities, as well as decrease areas of high bank erosion.
- Explore opportunities to open up the channel, allowing access to the floodplain and creating off-channel habitat.
- Reduce rate and magnitude of stormwater runoff by working with adjacent property owners to decrease impervious surfaces and by identifying areas where stormwater outfalls can be treated before entering the creek.

Recommended Actions

1. Work toward acquiring property through the Willing Seller Program for the purpose of floodplain reconnection along Johnson Creek. This action will entail development of an enhanced wetland area. On acquired property, creek banks will be terraced and regraded as far as is appropriate, and the banks will be replanted with native riparian vegetation to increase and enhance the riparian corridor and also provide shade for the creek (see Photos 33-1, 33-2, and 33-3). The purpose of the work is to expand and enhance this area by removing non-native invasive species, such as reed canarygrass and Himalayan blackberry, and planting additional native wetland vegetation. Existing native wetland vegetation will be maintained in the project design. Revegetating the banks will increase their stability and decrease the effects of excessive erosion on the creek.

Photo 33-1:

Looking west from the 7th Street bridge. Opportunities exist to terrace banks, replant with native riparian vegetation, and reconnect floodplain with Johnson Creek.

Photo 33-2:

Looking west from the 7th Street bridge. Opportunities exist to create a wetland area here by terracing creek banks and reconnecting the floodplain.

Photo 33-3:

Looking east from the 7th Street bridge. Opportunity exists to reconnect the floodplain with Johnson Creek (terrace banks and revegetate with native vegetation).

2. Work with willing property owners adjacent to Johnson Creek for the purpose of reconnecting the creek with its original floodplain. Activities will be property-specific and to the extent deemed appropriate by the owner. Floodplain reconnection will entail removal of invasive plant species from the banks of the creek. The banks will be regraded, terraced, and then replanted with native riparian vegetation. Enhancing the riparian corridor and increasing floodplain connection will help stabilize the stream banks and decrease the effects of excessive erosion on the creek.
3. Increase in-stream complexity throughout the length of the creek running through this reach. This action will be done in conjunction with other projects in the reach and will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase.
4. Mitigate the effects of the high priority outfall located near Eastman Parkway. Address other outfalls that directly impact Johnson Creek. Outfalls may be removed or diverted through some sort of mitigation measure, such as a bio-filtration swale.
5. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Reach 34

Existing Conditions

Reach 34 is the Gresham Main City Park located between SW Walter Road and SE Roberts Avenue and is in the jurisdiction of the City of Gresham. The area consists of open space surrounded by single-family homes. The width of the riparian corridor ranges from moderate to narrow. Vegetation consists primarily of willow, Douglas-fir, western redcedar, bigleaf maple, red alder, and Oregon ash, as well as invasive Himalayan blackberry, reed canarygrass, and hedge bindweed. Current conditions in this reach are rated from 3+ to 3-.

Identified Opportunities

Refer to the Main City Park Master Plan.

Reach 34 - Description	Target	Units
Floodplain Reconnection	4	acres
Wildlife Corridors and Habitat Patches	2	acres
In-stream Complexity	2,099	feet
Inundated Properties	0	number
Fish Barriers	0	number
Priority Outfalls	3	number
Pipe Crossings	0	number
Impervious Surface	0	acres

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by glides and scour pools.
- Average pool depth is 63 cm.
- Stream substrate is dominated by cobble and fine sediments.
- Wood volume is extremely low, but greater than much of downstream.
- Riparian vegetation is a mosaic of areas of large trees with a dense understory and areas dominated by dense Himalayan blackberry and reed canarygrass.
- Areas dominated by blackberry and canarygrass are primarily associated with slow, deep water.
- The reach consists primarily of a single channel.
- Incision is widespread in this reach.
- Banks are dominated by eroding earth on both sides of the channel.
- A fair number of outfalls are present.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place large wood structures in this reach to create pool habitat and reduce overall erosive velocities, as well as decrease areas of high bank erosion.
- Explore opportunities to open up the channel, allowing access to the floodplain and creating off-channel habitat.
- Reduce rate and magnitude of stormwater runoff by working with adjacent property owners to decrease impervious surfaces and by identifying areas where stormwater outfalls can be treated before entering the creek.

Recommended Actions

All actions are linked to the Main City Park Restoration Plan. See Photos 34-1 through 34-4.

Photo 34-1:

Looking north on Johnson Creek just east of SW Walters Road. Opportunities exist to remove invasive species and terrace banks to increase floodplain connection.

Photo 34-2:

Looking downstream from the bridge in Main City Park. Terracing banks, removing invasive species, and replanting with native riparian vegetation will improve habitat conditions and reconnect the creek to its floodplain.

Photo 34-3:

Looking north from Main City Park, at a small oxbow feeding into Johnson Creek. Removing invasive species and revegetating with native plants will increase bank stabilization.

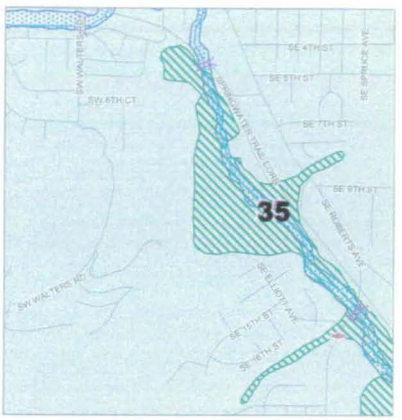
Photo 34-4:

Looking east from Main City Park at Johnson Creek. Terracing banks and revegetating with native trees and shrubs will improve habitat conditions along the creek.

Reach 35

Existing Conditions

Reach 35 extends from Gresham Main City Park to SE Regner Road in the jurisdiction of the City of Gresham. The area consists primarily of single-family homes, with forested uplands in the northern section of the reach. The width of the riparian corridor is moderate. Primary vegetation consists primarily of western redcedar, willow, bigleaf maple, red alder, Oregon ash, red osier dogwood, vine maple, black cottonwood, beaked hazelnut, and sword fern, as well as invasive Himalayan blackberry, English ivy, Japanese knotweed, and reed canarygrass. Current conditions in this reach are rated from 1- to 3.



Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Stabilize stream banks exhibiting excessive erosion
- Protect and restore riparian vegetation
- Protect tributaries and tributary confluences
- Create or enhance wildlife corridors
- Increase in-stream complexity of creek
- Mitigate outfalls
- Remove fish barriers
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $3,690,000

Reach 35 - Description	Target	Units
Floodplain Reconnection	9	acres
Wildlife Corridors and Habitat Patches	108	acres
In-stream Complexity	3,903	feet
Inundated Properties	6	number
Fish Barriers	1	number
Priority Outfalls	3	number
Pipe Crossings	0	number
Impervious Surface	0	acres

ODFW Survey Results

ODFW Stream Habitat Survey Results pertaining to this reach include the following observations:

- Stream habitat is dominated by glides, riffles, and scour pools.
- Average pool depth is 55 cm.
- Stream substrate is dominated by cobble.
- Wood volume is extremely low.
- Riparian vegetation is dominated by mixed medium-sized and large coniferous and deciduous trees. Unlike the previous reaches, these favorable riparian characteristics are continuous throughout the reach.

- The reach consists primarily of a single channel.
- Banks are dominated by earth, either eroding or vegetatively stabilized.
- Very few culvert outfalls are present.
- There are some small, unnamed tributary junctions.
- The reach is a part of the most natural and least disturbed section of the creek surveyed in 1999. Large, rural home sites enhance the undisturbed riparian zones left on the creek, compared to the denser housing areas downstream.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place large wood structures in this reach to create pool habitat and reduce overall erosive velocities, as well as decrease areas of high bank erosion.
- Explore opportunities to open up the channel, allowing access to the floodplain and creating off-channel habitat.

Recommended Actions

1. Work toward acquiring frequently flooded properties near the creek through the Willing Seller Program as opportunities arise. On acquired properties, structures will be removed, creek banks will be terraced back as appropriate to reconnect floodplain and replanted with native vegetation, and the riparian corridor will be protected and enhanced to the maximum extent possible.
2. On acquired properties adjacent to Johnson Creek, complete floodplain reconnection as well as enhancement and restoration of the riparian corridor. This process will require terracing the creek banks as far as possible to maximize use of the entire property. After banks are terraced and invasive species removed, the banks will be replanted with native riparian vegetation to enhance the riparian corridor. Appropriate vegetation will be placed along the creek banks to provide shade to the creek as necessary. Revegetating the stream banks will increase their stability and decrease the effects of excessive erosion on the creek.
3. Work with willing property owners adjacent to Johnson Creek for the purpose of reconnecting the creek with its original floodplain. Activities will be property-specific and to the extent deemed appropriate by the owner. Floodplain reconnection will entail removal of invasive plant species from the banks of the creek. The banks will be regraded, terraced, and then replanted with native riparian vegetation. Enhancing the riparian corridor and

increasing floodplain connection will help stabilize the stream banks and decrease the effects of excessive erosion on the creek (see Photos 35-1, 35-2, and 35-3).

4. Work with property owners along the tributaries of Johnson Creek to protect and enhance the resource. Invasive species will be removed and replaced by native riparian vegetation, thereby helping to maintain a healthy connection between the tributary and Johnson Creek. Where practicable, areas of healthy vegetation will be targeted for protection through the use of conservation easements.
5. Work with property owners throughout this reach to create a wildlife corridor. Owners will be encouraged to plant native riparian vegetation to enhance habitat conditions and provide wildlife access to the creek from the surrounding upland areas. Forested areas in the western portion of this reach are identified for protection and enhancement for the purpose of developing a wildlife corridor. The forested area contains a number of orchard-type and maple trees.
6. Increase in-stream complexity throughout the length of the creek running through this reach. This action, which will be done in conjunction with other projects in the reach, will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase.
7. Mitigate the effects of the high priority outfall located off Johnson Creek Boulevard east of Bell Station. Address additional outfalls that directly impact Johnson Creek. Outfalls may be removed or diverted through some sort of mitigation measure, such as a bio-filtration swale.
8. Remove or modify culverts that impede salmonid movement. Determination of whether a culvert will require improvement or removal will be decided on a site-by-site basis in the project design phase.
9. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Photo 35-1:

Looking southwest near SE Park Drive and SE Roberts Avenue, east of Johnson Creek. Opportunities exist to work with property owners to excavate creek banks, allow reconnection with the floodplain, and replant with native wetland vegetation.

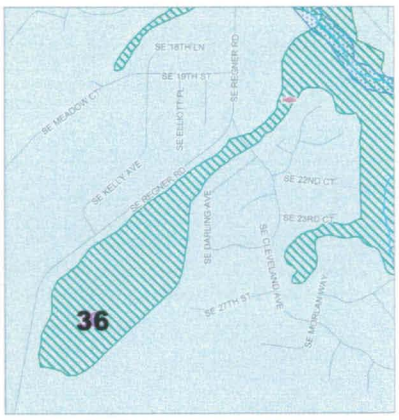
Photo 35-2:

Looking east from Regner Road off of the Springwater Corridor on a bridge (private driveway), showing vine maple, cottonwood, and many exposed cobbles. Opportunities exist to work with property owners to pull back the bank, reconnect the original floodplain in grassy area, and replant with native riparian vegetation.

Photo 35-3:

Looking west from Regner Road off of the Springwater Corridor on a bridge (private driveway), showing salmonberry, maple, alder, blackberry, English ivy, and many exposed cobbles. Opportunity exists to work with property owners to pull back the bank, remove blackberry growth, and replant with native riparian vegetation.

Reach 36



Reach 36 - Description	Target	Units
Floodplain Reconnection	1	acres
Wildlife Corridors and Habitat Patches	86	acres
In-stream Complexity	0	feet
Inundated Properties	0	number
Fish Barriers	1	number
Priority Outfalls	0	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Existing Conditions

Reach 36 extends along SE Regner Road, just southwest of Reach 37, in the jurisdiction of the City of Gresham. It consists of forested upland area along a tributary that feeds into Johnson Creek. The area contains primarily single-family homes. The width of the riparian corridor varies from narrow to wide. The primary vegetation is western redcedar, Douglas-fir, red alder, bigleaf maple, Oregon ash, beaked hazelnut, and vine maple, as well as invasive Himalayan blackberry. Current conditions in this reach range from 1- to 3.

Identified Opportunities

Opportunities exist within this project area to:

- Protect tributaries and tributary confluences
- Create or enhance wildlife corridors
- Increase in-stream complexity of creek
- Remove fish barriers
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $920,000

ODFW Survey Results

The ODFW Stream Habitat Survey did not include this tributary of Johnson Creek.

Recommended Actions

1. Work with property owners along the tributaries of Johnson Creek to protect and enhance the resource. Invasive species will be removed and replaced by native riparian vegetation, thereby helping to maintain a healthy connection between the tributary and Johnson Creek. Where practicable, areas of healthy vegetation will be targeted for protection through the use of conservation easements.
2. Work with property owners throughout the reach to create a wildlife corridor. Owners will be encouraged to plant native riparian vegetation that will enhance habitat conditions and provide wildlife access to the creek from the surrounding upland areas (see Photos 36-1 and 36-2).

3. Increase in-stream complexity throughout the length of the creek running through this reach. This action, which will be done in conjunction with other projects in the reach, will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase.
4. Remove or modify culverts that impede salmonid movement. Determination of whether a culvert will require improvement or removal will be on a site-by-site basis in the project design phase.
5. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

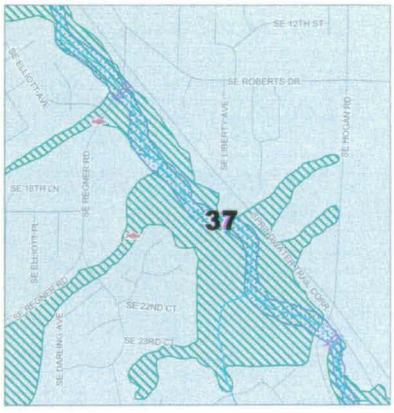
Photo 36-1:

Looking southeast, downstream from a tributary of Johnson Creek. Working with property owners to remove invasive species and revegetate with native plants to protect and enhance the area is recommended.

Photo 36-2:

Looking south at new development near the tributary. Opportunities exist to work with property owners to enhance and protect the wildlife corridor and promote planting of open space with native plants and shrubs.

Reach 37



Reach 37 - Description	Target	Units
Floodplain Reconnection	8	acres
Wildlife Corridors and Habitat Patches	99	acres
In-stream Complexity	3,793	feet
Inundated Properties	0	number
Fish Barriers	0	number
Priority Outfalls	8	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Existing Conditions

Reach 37 extends from SE Regner Road to SE Hogan Road in the jurisdiction of the City of Gresham. This reach consists predominantly of forested areas along Johnson Creek and single-family homes. The width of the riparian corridor reach varies from wide to narrow. Vegetation consists primarily of western redcedar, Oregon ash, red alder, willow, red osier dogwood, beaked hazelnut, bigleaf maple, vine maple, Indian plum, thimbleberry, sword fern, Douglas' spiraea, Douglas-fir, skunk cabbage, and cattail, as well as invasive Himalayan blackberry, reed canarygrass, hedge bindweed, English ivy, and purple loosestrife. Current conditions in this reach are rated 1/1-.

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Stabilize stream banks exhibiting excessive erosion
- Protect and restore riparian vegetation
- Protect tributaries and tributary confluences
- Increase in-stream complexity of creek
- Mitigate outfalls
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $2,070,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by glides, riffles, and scour pools.
- Average pool depth is 55 cm.
- Stream substrate is dominated by cobble.
- Wood volume is extremely low.
- Riparian vegetation is dominated by mixed medium-sized and large coniferous and deciduous trees. Unlike the previous reaches, these favorable riparian characteristics are continuous throughout the reach.
- There are multiple channels with good complexity.

- Complexity is especially diverse near Hogan Road, where many large woody debris jams are associated with deep pools and multiple channels.
- Banks are dominated by earth, either eroding or vegetatively stabilized.
- Very few culvert outfalls are present.
- Some small, unnamed tributary junctions exist.
- The reach is a part of the most natural and least disturbed section of the creek surveyed in 1999. Large, rural home sites enhance the undisturbed riparian zones left on the creek, compared to the denser housing areas downstream.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place large wood structures in this reach to create pool habitat and reduce overall erosive velocities, as well as decrease areas of high bank erosion.
- Explore opportunities to open up the channel, allowing access to the floodplain and creating off-channel habitat.

Recommended Actions

1. Work with willing property owners adjacent to Johnson Creek for the purpose of reconnecting the creek with its original floodplain. Activities will be property-specific and to the extent deemed appropriate by the owner. Floodplain reconnection will entail removal of invasive plant species from the banks of the creek. The banks will be regraded, terraced, and then replanted with native riparian vegetation. Enhancing the riparian corridor and increasing floodplain connection will help stabilize the stream banks and decrease the effects of excessive erosion (see Photos 37-1 and 37-2).
2. Work with property owners along the tributaries of Johnson Creek to protect and enhance the resource. Invasive species will be removed and replaced by native riparian vegetation, thereby helping to maintain a healthy connection between the tributary and Johnson Creek. Where practicable, areas of healthy vegetation will be targeted for protection through the use of conservation easements.
3. Increase in-stream complexity throughout the length of the creek running through this reach. This action, which will be done in conjunction with other projects in the reach, will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase.

Photo 37-1:

Looking east near the intersection of SE Elliot and Regner Roads at a stand of alder and ash trees. Opportunities exist to work with property owners to terrace back the banks, removing grass and blackberry growth, and revegetate with native plants.

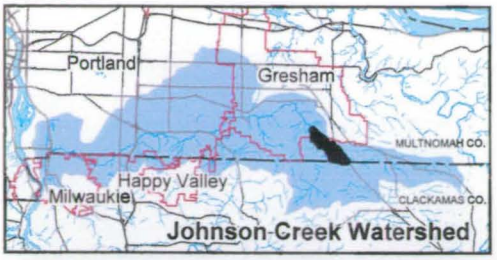
Photo 37-2:

Looking at a creek side area near the intersection of SE Elliot and Regner Roads. Working with the property owner to terrace the banks of the creek and allow this area to flood could improve habitat conditions and reconnect the floodplain.

4. Address outfalls that directly impact Johnson Creek. Outfalls may be removed or diverted through some sort of mitigation measure, such as a bio-filtration swale.
5. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

JOHNSON CREEK RESTORATION

REACHES
38, 39, 40, 41, 42, 43, 44, 45



Aerial Map

JURISDICTIONS INCLUDED

CITY OF GRESHAM
MULTNOMAH COUNTY

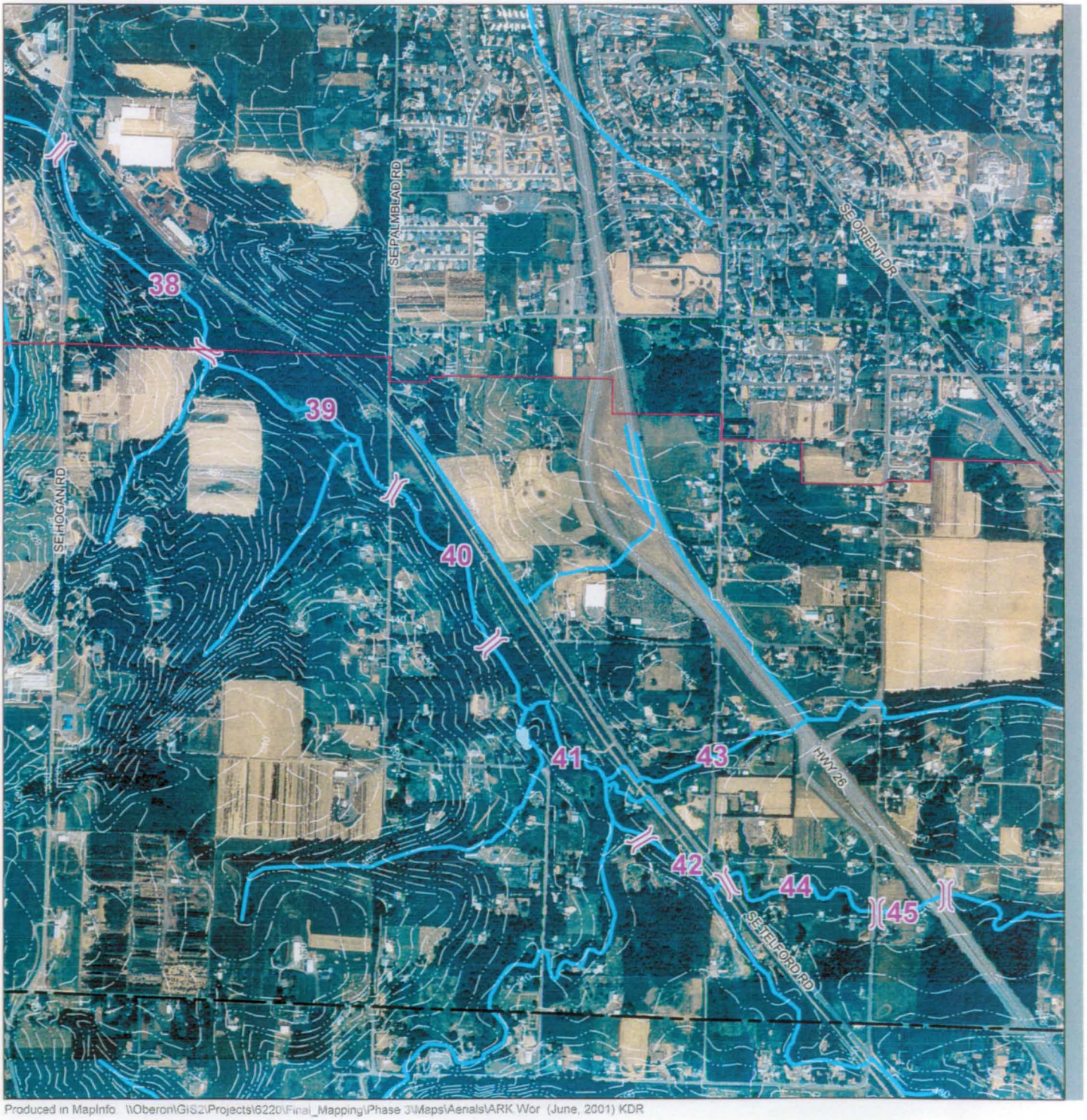
Legend

- Reach Divider
- City Boundary
- County Line

Aerial Images Source:
Spencer Gross, 1998.

NORTH

0 250 500 1000 Feet



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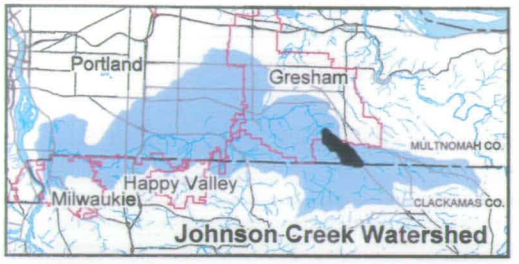
JOHNSON CREEK RESTORATION

REACHES
38, 39, 40, 41, 42, 43, 44, 45

Functions

JURISDICTIONS INCLUDED

CITY OF GRESHAM
MULTNOMAH COUNTY

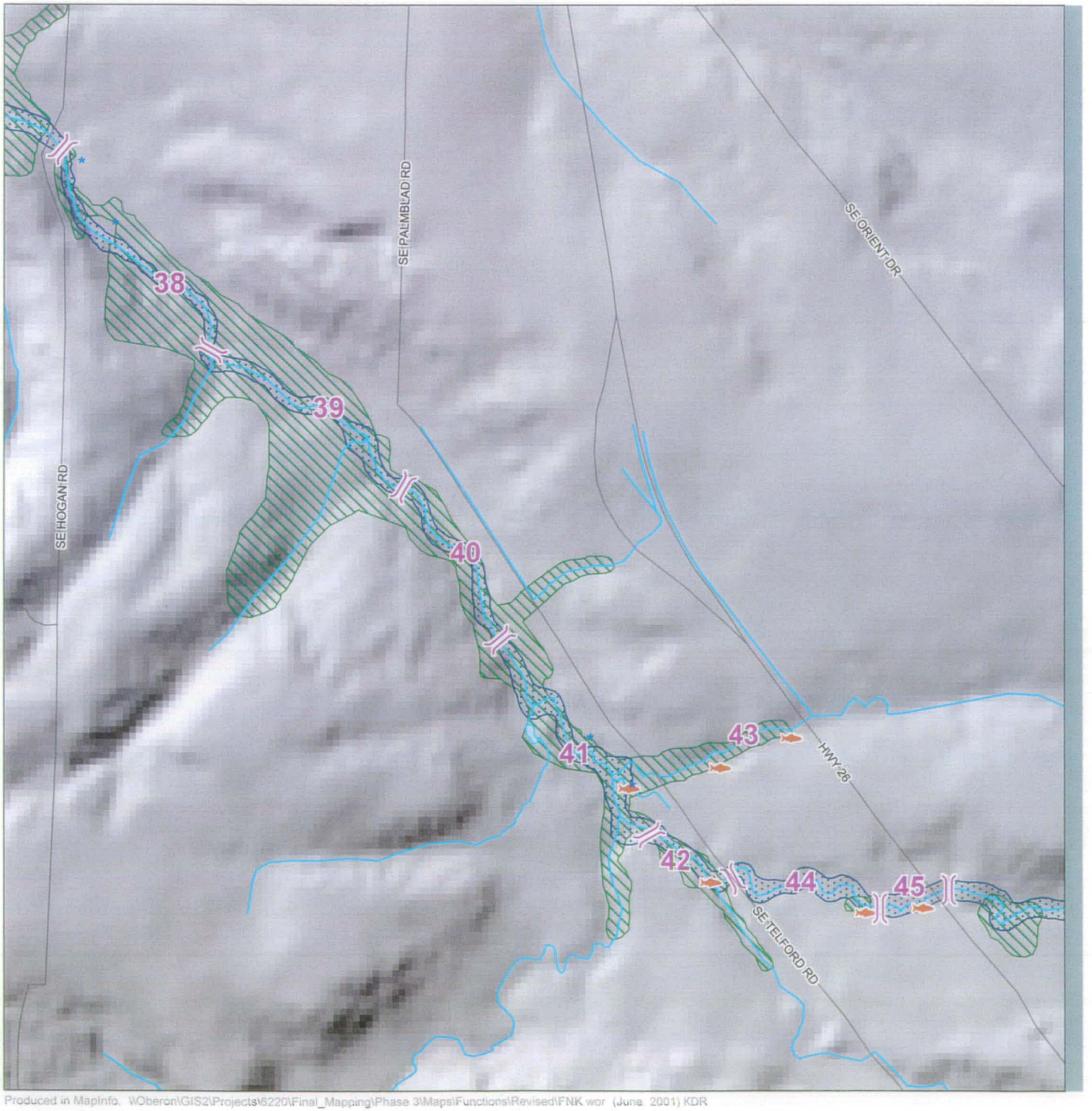


Legend

- Reach Divider
- Fish Barrier
- Pipe Crossing
- Inundated Properties
- Wildlife Corridors and Habitat Patches
- Floodplain Reconnection
- Impervious Surface

NORTH

0 250 500 1000 Feet



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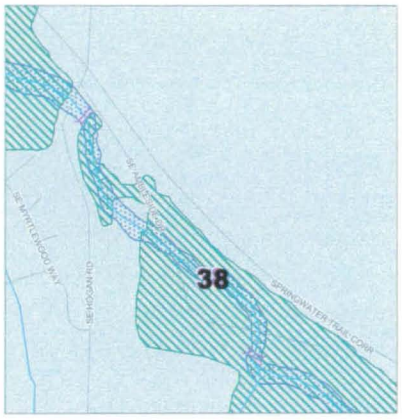
Reach 38



Reach 38 - Description	Target	Units
Floodplain Reconnection	7	acres
Wildlife Corridors and Habitat Patches	26	acres
In-stream Complexity	3,018	feet
Inundated Properties	2	number
Fish Barriers	0	number
Priority Outfalls	10	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Existing Conditions

Reach 38 begins at SE Hogan Road and extends southeast along SE Ambleside Drive, ending at the Gresham City limit, just west of SE 252nd Avenue. It is in the jurisdiction of the City of Gresham. The reach consists of forested areas interspersed with light industrial and light agricultural properties, as well as a scattering of single-family homes. The width of the riparian corridor varies from narrow to wide. Vegetation consists primarily of willow, red alder, western redcedar, Douglas-fir, bigleaf maple, beaked hazelnut, red osier dogwood, vine maple, red elderberry, snowberry, and sword fern, as well as invasive Himalayan blackberry. Current conditions in this reach are rated from 1- to 2+.

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Stabilize stream banks exhibiting excessive erosion
- Protect and restore riparian vegetation
- Protect tributaries and tributary confluences
- Increase in-stream complexity of creek
- Mitigate outfalls
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $1,220,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by glides, riffles, and scour pools.
- Average pool depth is 55 cm.
- Stream substrate is dominated by cobble.
- Wood volume is extremely low.
- Riparian vegetation is dominated by mixed medium-sized and large coniferous and deciduous trees. Unlike previous reaches, these favorable riparian characteristics are continuous throughout the reach.
- There are multiple channels with good complexity.

- Complexity is especially diverse near Hogan Road where many large woody debris jams are associated with deep pools and multiple channels.
- Banks are dominated by earth, either eroding or vegetatively stabilized.
- Very few culvert outfalls are present.
- Some small, unnamed tributary junctions occur.
- The reach is a part of the most natural and least disturbed section of the creek surveyed in 1999. Large, rural home sites enhance the undisturbed riparian zones left on the creek, compared to the denser housing areas downstream.
- A potential fish passage barrier exists just upstream from SE Hogan Road where the creek passes through a set of structures that appear to be a very old waterfall, fish ladder, and swimming pool or pond, none of which has been maintained for quite some time.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place large wood structures in this reach to create pool habitat and reduce overall erosive velocities, as well as decrease areas of high bank erosion.
- Explore opportunities to open up the channel, allowing access to the floodplain and creating off-channel habitat.
- Remove the old dam that is a potential fish barrier. Metro is pursuing a grant to have the dam removed.

Recommended Actions

1. Work toward acquiring frequently flooded properties near the creek through the Willing Seller Program as opportunities arise. On acquired properties, structures will be removed, creek banks will be terraced back as appropriate to reconnect the floodplain and replanted with native vegetation, and the riparian corridor will be protected and enhanced to the maximum extent possible.
2. Work with willing property owners adjacent to Johnson Creek for the purpose of reconnecting the creek with its original floodplain. Activities will be property-specific and to the extent deemed appropriate by the owner. Floodplain reconnection will entail removal of invasive plant species from the banks of the creek. The banks will be regraded, terraced, and then replanted with native riparian vegetation. Enhancing the riparian corridor and increasing floodplain connection will help stabilize the stream banks and decrease the effects of excessive erosion on the creek (see Photos 38-1 and 38-2).

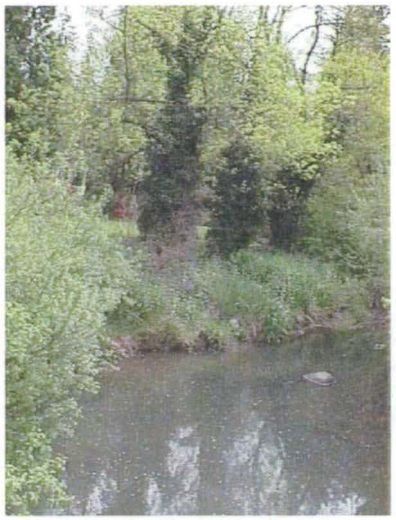


Photo 38-1:

Looking west near SE Hogan Road, south of the Springwater Corridor. Opportunity exists to work with property owners to terrace creek banks and replant them with native vegetation. Stabilization of the creek banks will help to reduce the high levels of suspended sediment in the creek.

3. Work with property owners along the tributaries of Johnson Creek to protect and enhance the resource. Invasive species will be removed and replaced by native riparian vegetation, thereby helping to maintain a healthy connection between the tributary and Johnson Creek. Where practicable, areas of healthy vegetation will be targeted for protection through the use of conservation easements.
4. Increase in-stream complexity throughout the length of the creek running through reach. This action, which will be done in conjunction with other projects in the reach, will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase.
5. Mitigate the effects of the high priority outfall located at the Hogan Road Bridge. Address other outfalls that directly impact Johnson Creek. Outfalls may be removed or diverted through some sort of mitigation measure, such as a bio-filtration swale.
6. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Photo 38-2:

Looking south near the Springwater Corridor and SE Hogan Road. Opportunities exist to work with property owners to terrace and revegetate creek banks, maximize open areas available along the creek, and reconnect the floodplain.

Reach 39

Existing Conditions

Reach 39 extends from the Gresham City limits to SE 252nd Avenue and south along some tributaries of Johnson Creek. It is in the jurisdiction of Multnomah County. The reach consists primarily of forested areas interspersed with light industrial and light agricultural properties and single-family homes. The width of the riparian corridor varies from narrow to wide. Vegetation consists primarily of western redcedar, willow, red alder, Douglas-fir, bigleaf maple), beaked hazelnut, red osier dogwood, snowberry, red elderberry, vine maple, and sword fern, as well as invasive Himalayan blackberry. Current conditions in this reach are rated from 1 to 2+.

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Stabilize stream banks exhibiting excessive erosion
- Protect and restore riparian vegetation
- Protect tributaries and tributary confluences
- Increase in-stream complexity of creek
- Mitigate outfalls
- Provide education to property owners to encourage stream stewardship

Estimated project cost: $1,600,000

Reach 39 - Description	Target	Units
Floodplain Reconnection	4	acres
Wildlife Corridors and Habitat Patches	120	acres
In-stream Complexity	1,837	feet
Inundated Properties	0	number
Fish Barriers	0	number
Priority Outfalls	5	number
Pipe Crossings	0	number
Impervious Surface	0	acres

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by glides, riffles, and scour pools.
- Average pool depth is 55 cm.
- Stream substrate is dominated by cobble.
- Wood volume is extremely low.
- Riparian vegetation is dominated by mixed medium and large coniferous and deciduous trees. Unlike previous reaches, these favorable riparian characteristics are continuous throughout the reach.
- The reach consists primarily of a single channel.

- Banks are dominated by earth, either eroding or vegetatively stabilized.
- Very few culvert outfalls are present.
- Some small, unnamed tributary junctions occur.
- The reach is a part of the most natural and least disturbed section of the creek surveyed in 1999. Large, rural home sites enhance the undisturbed riparian zones left on the creek, compared to the denser housing areas downstream.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place large wood structures in this reach to create pool habitat and reduce overall erosive velocities, as well as decrease areas of high bank erosion.
- Explore opportunities to open up the channel, allowing access to the floodplain and creating off-channel habitat.

Recommended Actions

1. Work with willing property owners adjacent to Johnson Creek for the purpose of reconnecting the creek with its original floodplain. Activities will be property-specific and to the extent deemed appropriate by the owner. Floodplain reconnection will entail removal of invasive plant species from the banks of the creek. The banks will be regraded, terraced, and then replanted with native riparian vegetation. Enhancing the riparian corridor and increasing floodplain connection will help stabilize the stream banks and decrease the effects of excessive erosion on the creek (see Photos 39-1 and 39-2).
2. Work with property owners along the tributaries of Johnson Creek to protect and enhance the resource. Invasive species will be removed and replaced with native riparian vegetation, thereby helping to maintain a healthy connection

Photo 39-1:

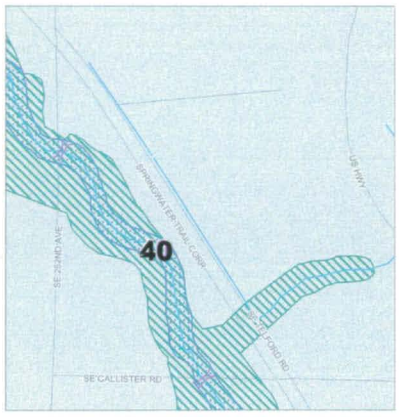
Looking northwest along the bank of Johnson Creek. Alder and blackberry are present, possibly a riparian wetland. Work with property owners to remove blackberry growth, grade back banks, and revegetate with native plants.

Photo 39-2:
Looking upland from the south bank of Johnson Creek. Opportunity exists to work with property owner to replant the area with native riparian vegetation.

between the tributary and Johnson Creek. Where practicable, areas of healthy vegetation will be targeted for protection through the use of conservation easements.

3. Increase in-stream complexity throughout the length of the creek running through this reach. This action, which will be done in conjunction with other projects in the reach, will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase.
4. Address outfalls that directly impact Johnson Creek. Outfalls may be removed or diverted through some sort of mitigation measure, such as a bio-filtration swale.
5. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Reach 40



Reach 40 - Description	Target	Units
Floodplain Reconnection	4	acres
Wildlife Corridors and Habitat Patches	30	acres
In-stream Complexity	1,842	feet
Inundated Properties	0	number
Fish Barriers	0	number
Priority Outfalls	6	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Existing Conditions

Reach 40 extends from SE 252nd Avenue to SE Callister Road along the Springwater Corridor. It is in the jurisdiction of Multnomah County. The reach contains forested areas interspersed with light industrial and light agricultural properties and a few single-family homes. The width of the riparian corridor varies from wide to narrow. Vegetation consists primarily of Oregon ash, willow, western redcedar, vine maple, red alder, red osier dogwood, and native rose, as well as invasive Himalayan blackberry and reed canarygrass. Current conditions through this reach are rated as 2-/3+.

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Stabilize stream banks exhibiting excessive erosion
- Protect tributaries and tributary confluences
- Increase in-stream complexity of creek
- Mitigate outfalls
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $870,000

ODFW Survey Results

ODFW Stream Habitat Survey Results pertaining to this reach include the following observations:

- Stream habitat is dominated by riffles and scour pools.
- Average pool depth is 39 cm.
- Stream substrate is dominated by gravel and cobble.
- There is more large wood in this reach, as well as a couple of debris jams.
- Riparian vegetation is quite diverse, ranging from grassy banks for grazing cattle and little to no riparian vegetation to sections buffered by an adequate, wide riparian zone consisting of alder, western redcedar, Douglas-fir, and willow.
- Earthen banks are eroding heavily in some areas due to cattle and general instability.
- There is very little interaction between the stream and its floodplain.

- The reach has a few areas of good off-channel habitat, including both tributaries and secondary channels, but lacks deep pools.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place large wood structures in this reach to create pool habitat and reduce overall erosive velocities, as well as decrease areas of high bank erosion.
- Explore opportunities to open up the channel, allowing access to the floodplain and creating off-channel habitat.

Recommended Actions

1. Work with willing property owners adjacent to Johnson Creek for the purpose of reconnecting the creek with its original floodplain. Activities will be property-specific and to the extent deemed appropriate by the owner. Floodplain reconnection will entail removal of invasive plant species from the banks of the creek. The banks will be regraded, terraced, and then replanted with native riparian vegetation. Enhancing the riparian corridor and increasing floodplain connection will help stabilize the stream banks and decrease the effects of excessive erosion on the creek (see Photos 40-1 and 40-2).
2. Work with property owners along the tributaries of Johnson Creek to protect and enhance the resource. Invasive species will be removed and replaced by native riparian vegetation, thereby helping to maintain a healthy connection between the tributary and Johnson Creek. Where practicable, areas of healthy vegetation will be targeted for protection through the use of conservation easements.
3. Increase in-stream complexity throughout the length of the creek running through this reach. This action, which will be done in conjunction with other projects in the reach, will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase.
4. Address outfalls that directly impact Johnson Creek. Outfalls may be removed or diverted through some sort of mitigation measure, such as a biofiltration swale.
5. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

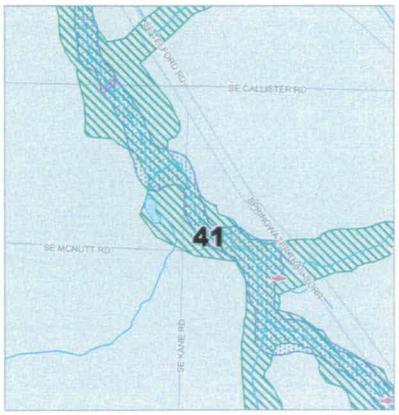
Photo 40-1:

Looking east from the intersection of SE 252nd Avenue and Telford Road. Opportunity exists to work with the property owner to maintain this riparian vegetation up to 200 feet from creek and reconnect the floodplain.

Photo 40-2:

Looking southeast from a point near the middle of the reach on the north side of Johnson Creek just off the Springwater Corridor. This open area presents opportunity to work with landowners on floodplain reconnection actions.

Reach 41



Reach 41 - Description	Target	Units
Floodplain Reconnection	5	acres
Wildlife Corridors and Habitat Patches	22	acres
In-stream Complexity	2,461	feet
Inundated Properties	2	number
Fish Barriers	1	number
Priority Outfalls	5	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Existing Conditions

Reach 41 begins at SE Callister Road and ends just downstream of the junction with MacDonald Creek, a tributary of Johnson Creek, on the south side of the Springwater Corridor. It is in the jurisdiction of Multnomah County. The reach contains forested areas interspersed with light industrial and light agricultural property, as well as a few single-family homes. The width of the riparian corridor varies from wide to narrow. Vegetation consists primarily of Oregon ash, willow, western redcedar, vine maple, red alder, red osier dogwood, and native rose, as well as invasive Himalayan blackberry. Current conditions in this reach are rated as 2/2-.

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Stabilize stream banks exhibiting excessive erosion
- Protect and restore riparian vegetation
- Protect tributaries and tributary confluences
- Increase in-stream complexity of creek
- Mitigate outfalls
- Remove fish barriers
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $920,000

ODFW Survey Results

ODFW Stream Habitat Survey Results pertaining to this reach include the following observations:

- Stream habitat is dominated by riffles and scour pools.
- Average pool depth is 39 cm.
- Stream substrate is dominated by gravel and cobble.
- There is more large wood in this reach, as well as a couple of debris jams.
- Riparian vegetation is quite diverse, ranging from grassy banks for grazing cattle and little to no riparian vegetation to sections buffered by an adequate, wide riparian zone consisting of alder, western redcedar, Douglas-fir, and willow.

- Earthen banks are eroding heavily in some areas due to cattle and general instability.
- There is very little interaction between the stream and its floodplain in this reach.
- The reach has a few areas of good off-channel habitat, including both tributaries and secondary channels, but lacks deep pools.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place large wood structures in this reach to create pool habitat and reduce overall erosive velocities, as well as decrease areas of high bank erosion.
- Explore opportunities to open up the channel, allowing access to the floodplain and creating off-channel habitat.

Recommended Actions

1. Work toward acquiring frequently flooded properties near the creek through the Willing Seller Program as opportunities arise. On acquired properties, structures will be removed, creek banks will be terraced back as appropriate to reconnect the floodplain and replanted with native vegetation, and the riparian corridor will be protected and enhanced to the maximum extent possible.
2. Work with willing property owners adjacent to Johnson Creek for the purpose of reconnecting the creek with its original floodplain. Activities will be property-specific and to the extent deemed appropriate by the owner. Floodplain reconnection will entail removal of invasive plant species from the banks of the creek. The banks will be regraded, terraced, and then replanted with native riparian vegetation. Enhancing the riparian corridor and increasing

Photo 41-1:

Looking south near the intersection of the Springwater Corridor and SE McNutt Road. Johnson Creek is on the left in the background. The north bank is very grassy; the south bank contains a narrow tree buffer. Opportunity exists to work with the property owner in reconnecting the floodplain and restoring the riparian corridor.

Photo 41-2:
Looking north of the intersection of SE Kane and McNutt Road. Opportunity exists to work with the property owner to revegetate this grassy area up to 200 feet from creek.

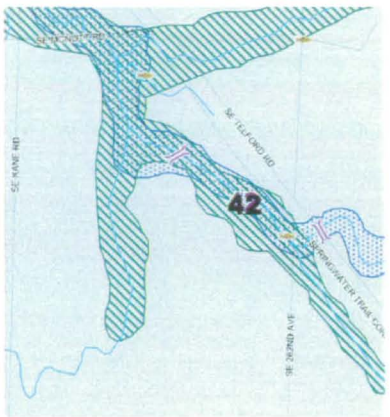
floodplain connection will help stabilize the stream banks and decrease the effects of excessive erosion on the creek (see Photos 41-1 and 41-2).

3. Work with property owners along the tributaries of Johnson Creek to protect and enhance the resource. Invasive species will be removed and replaced with native riparian vegetation, thereby helping to maintain a healthy connection between the tributary and Johnson Creek. Where practicable, areas of healthy vegetation will be targeted for protection through the use of conservation easements.
4. Increase in-stream complexity throughout the length of the creek running through this reach. This action, which will be done in conjunction with other projects in the reach, will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase.
5. Address outfalls that directly impact Johnson Creek. Outfalls may be removed or diverted through some sort of mitigation measure, such as a bio-filtration swale.
6. Remove or modify culverts that impede salmonid movement. Determination of whether a culvert will require improvement or removal will be decided on a site-by-site basis during the project design phase.
7. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Reach 42

Existing Conditions

Reach 42 begins just downstream from the junction of MacDonald Creek (a tributary of Johnson Creek) and extends east to SE Telford Road. The reach also extends west along the tributary a short way and is on the south side of the Springwater Corridor. It is in the jurisdiction of Multnomah County. The reach contains forested areas interspersed with light industrial and light agricultural property a few single-family homes. The width of the riparian corridor varies from wide to narrow. Vegetation consists primarily of willow, red alder, bigleaf maple, and Douglas-fir, as well as invasive Himalayan blackberry and reed canarygrass. Current conditions in this reach are rated as 2.



Reach 42 - Description	Target	Units
Floodplain Reconnection	1	acres
Wildlife Corridors and Habitat Patches	19	acres
In-stream Complexity	500	feet
Inundated Properties	0	number
Fish Barriers	1	number
Priority Outfalls	2	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Stabilize stream banks exhibiting excessive erosion
- Protect tributaries and tributary confluences
- Increase in-stream complexity of creek
- Mitigate outfalls
- Remove fish barriers
- Provide education to property owners to encourage stream stewardship

Estimated project cost: $530,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by riffles and scour pools.
- Average pool depth is 39 cm.
- Stream substrate is dominated by gravel and cobble.
- There is more large wood in this reach, as well as a couple of debris jams.
- Riparian vegetation is quite diverse, ranging from grassy banks for grazing cattle and little to no riparian vegetation to sections buffered by an adequate, wide riparian zone consisting of alder, western redcedar, Douglas-fir, and willow.

- Earthen banks are eroding heavily in some areas due to cattle and general instability.
- There is very little interaction between the stream and its floodplain in this reach.
- Thie reach has a few areas of good off-channel habitat, including both tributaries and secondary channels, but lacks deep pools.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place large wood structures in this reach to create pool habitat and reduce overall erosive velocities, as well as decrease areas of high bank erosion.
- Explore opportunities to open up the channel, allowing access to the floodplain and creating off-channel habitat.

Recommended Actions

1. Work with willing property owners adjacent to Johnson Creek for the purpose of reconnecting the creek with its original floodplain. Activities will be property-specific and to the extent deemed appropriate by the owner. Floodplain reconnection will entail removal of invasive plant species from the banks of the creek. The banks will be regraded, terraced, and then replanted with native riparian vegetation. Enhancing the riparian corridor and increasing floodplain connection will help stabilize the stream banks and decrease the effects of excessive erosion on the creek (see Photos 42-1 and 42-2).

Photo 42-1:

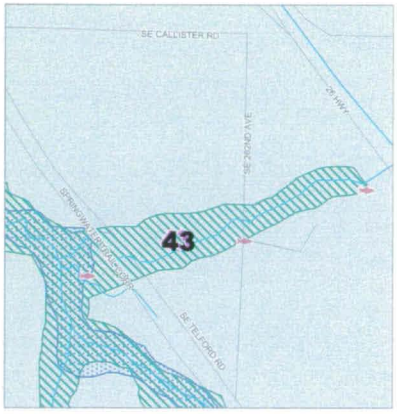
Looking south from the intersection of the Springwater Corridor and SE 262nd Avenue at the north bank of Johnson Creek. Opportunity exists to work with willing landowners to reconnect the floodplain, increase in-stream complexity, and restore the riparian corridor.

Photo 42-2:

Near the intersection of the Springwater Corridor and SE 262nd Avenue, facing south, looking at the north bank of Johnson Creek. Opportunity exists to work with willing landowners to reconnect the floodplain, increase in-stream complexity, and restore the riparian corridor.

2. Work with property owners along the tributaries of Johnson Creek to protect and enhance the resource. Invasive species will be removed and replaced by native riparian vegetation, thereby helping to maintain a healthy connection between the tributary and Johnson Creek. Where practicable, areas of healthy vegetation will be targeted for protection through the use of conservation easements.
3. Increase in-stream complexity throughout the length of the creek running through this reach. This action, which will be done in conjunction with other projects in the reach, will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase.
4. Address outfalls that directly impact Johnson Creek. Outfalls may be removed or diverted through some sort of mitigation measure, such as a bio-filtration swale.
5. Remove or modify culverts that impede salmonid movement. Determination of whether a culvert will require improvement or removal will be decided on a site-by-site basis in the project design phase.
6. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Reach 43



Reach 43 - Description	Target	Units
Floodplain Reconnection	0	acres
Wildlife Corridors and Habitat Patches	21	acres
In-stream Complexity	0	feet
Inundated Properties	0	number
Fish Barriers	2	number
Priority Outfalls	0	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Existing Conditions

Reach 43 extends from SE Teleford Road to U.S. Highway 26 on the north side of the Springwater Corridor, in the jurisdiction of Multnomah County. This area contains agricultural land situated along a tributary of Johnson Creek that is bisected by Highway 26. The width of the riparian corridor is thick in some areas and narrow to nonexistent in other areas. Vegetation consists primarily of red alder, willow, bigleaf maple, vine maple, beaked hazelnut, and snowberry, as well as invasive Himalayan blackberry and reed canarygrass. Current conditions in this reach range from a rating of 2+/1- to 3/3-.

Identified Opportunities

Opportunities exist within this reach to:

- Protect and restore riparian vegetation
- Protect tributaries and tributary confluences
- Remove fish barriers
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $460,000

ODFW Survey Results

The ODFW Stream Habitat Survey did not include this reach in the Johnson Creek watershed.

Recommended Actions

1. Work with property owners along the tributaries of Johnson Creek to protect and enhance the resource (Photo 43-1). At each tributary confluence, undertake floodplain reconnection actions. Where appropriate, assist landowners of other identified properties to enhance the riparian corridor by removing invasive vegetation and replanting with native species.
2. Remove or modify culverts that impede salmonid movement. Determination of whether a culvert will require improvement or removal will be decided on a site-by-site basis in the project design phase.
3. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

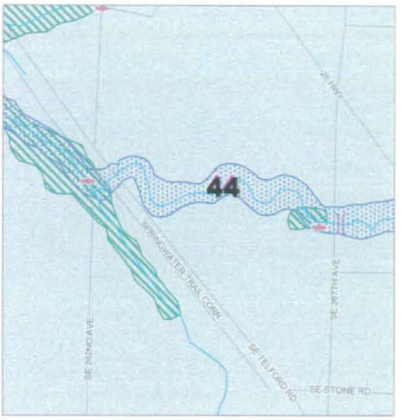
Photo 43-1:

Looking east toward a tributary of Johnson Creek. Opportunity exists for possible floodplain reconnection actions, working with willing property owners.

Reach 44

Existing Conditions

Reach 44 extends from SE Telford Road to SE 267th Avenue in the jurisdiction of Multnomah County. The reachr, contains forested areas interspersed with light industrial and light agricultural properties, as well as a few single-family homes. The width of the riparian corridor varies from wide to narrow. Vegetation consists primarily of red alder and Oregon ash, as well as invasive Himalayan blackberry and reed canarygrass. Current conditions in the reach range from a rating of 2/2- to 3.



Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Stabilize streambanks exhibiting excessive erosion
- Protect and restore riparian vegetation
- Increase in-stream complexity of creek
- Mitigate outfalls
- Remove fish barriers
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $430,000

Reach 44 - Description	Target	Units
Floodplain Reconnection	3	acres
Wildlife Corridors and Habitat Patches	7	acres
In-stream Complexity	1,248	feet
Inundated Properties	0	number
Fish Barriers	1	number
Priority Outfalls	3	number
Pipe Crossings	0	number
Impervious Surface	0	acres

ODFW Survey Results

ODFW Stream Habitat Survey Results pertaining to this reach include the following observations:

- Stream habitat is dominated by riffles and scour pools.
- Average pool depth is 38 cm.
- Stream substrate is dominated by silt/organics, sand, gravel and cobble.
- Wood volume is extremely low.
- The riparian zone is quite narrow, often consisting of back-yard lawns adjacent to the creek. Houses are often built very close to the stream channel.
- Earthen banks are eroding heavily in some areas due to grazing.
- There is very little interaction between the stream and its floodplain in this reach.

- The reach contains quite a bit of off-channel habitat.
- There are a few very long, slow sections of water, but very few strong riffle-pool sequences in this reach.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place large wood structures in this reach to create pool habitat and reduce overall erosive velocities, as well as decrease areas of high bank erosion.
- Explore opportunities to open up the channel, allowing access to the floodplain and creating off-channel habitat.

Recommended Actions

1. Work with willing property owners adjacent to Johnson Creek for the purpose of reconnecting the creek with its original floodplain. Activities will be property-specific and to the extent deemed appropriate by the owner. Floodplain reconnection will entail removal of invasive plant species from the banks of the creek. The banks will be regraded, terraced, and then replanted with native riparian vegetation. Enhancing the riparian corridor and increasing floodplain connection will help stabilize the stream banks and decrease the effects of excessive erosion on the creek (see Photos 44-1 and 44-2).
2. Increase in-stream complexity throughout the length of the creek running through this reach. This action will be done in conjunction with other projects in the reach and will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase (see Photo 44-2).
3. Address outfalls that directly impact Johnson Creek. Outfalls may be removed or diverted through some sort of mitigation measure, such as a bio-filtration swale.
4. Remove or modify culverts that impede salmonid movement. Determination of whether a culvert will require improvement or removal will be decided on a site-by-site basis during the project design phase.
5. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Photo 44-1:

Looking at a property on the east side of SE 262nd Avenue near SE Telford Road, facing east. There is a cottonwood forest in background. Opportunity exists to work with property owner to replant this area with native vegetation and reconnect floodplain.

Photo 44-2:

Looking west, upstream on Johnson Creek near SE 267th Avenue. Opportunity exists to work with landowners on possible floodplain reconnection and riparian restorative actions, and to increase in-stream complexity

Reach 45

Existing Conditions

Reach 45 extends from SE 267th Avenue to U.S. Highway 26, north of Stone Road and east of Reach 44. It is in the jurisdiction of Multnomah County. Wetland conditions predominate. About half of the area is forested and half is open agricultural land. The width of the riparian corridor varies from narrow to nonexistent. Vegetation consists primarily of willow, red alder, native rose, and non-native birch, as well as invasive reed canarygrass. Current conditions in this reach are rated 3/3-.

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Increase in-stream complexity of creek
- Remove fish barriers

Estimated Project Cost: $160,000

Reach 45 - Description	Target	Units
Floodplain Reconnection	1	acres
Wildlife Corridors and Habitat Patches	0	acres
In-stream Complexity	399	feet
Inundated Properties	0	number
Fish Barriers	1	number
Priority Outfalls	0	number
Pipe Crossings	0	number
Impervious Surface	0	acres

ODFW Survey Results

ODFW Stream Habitat Survey Results pertaining to this reach include the following observations:

- Stream habitat is dominated by riffles and scour pools.
- Average pool depth is 38 cm.
- Stream substrate is dominated by silt/organics, sand, gravel, and cobble.
- Wood volume is extremely low.
- The riparian zone is quite narrow, often consisting of back-yard lawns adjacent to the creek. Houses are often built very close to the stream channel.
- Earthen banks are eroding heavily in some areas due to grazing.
- There is very little interaction between the stream and its floodplain in this reach.
- The reach has quite a bit of off-channel habitat.
- There are a few very long, slow sections of water, but very few strong riffle/pool sequences.,

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place large wood structures in this reach to create pool habitat and reduce overall erosive velocities, as well as decrease areas of high bank erosion.
- Explore opportunities to open up the channel, allowing access to the floodplain and creating off-channel habitat.

Photo 45-1:

Looking east from SE 267th Avenue, upstream on Johnson Creek. Opportunities exist in this area to work with willing landowners to reconnect the floodplain, restore the riparian corridor, and increase in-stream complexity.

Photo 45-2:

Looking northwest at the property bounded by SE 267th Avenue, Stone Road, and Highway 26. Work with landowners to reconnect this area with the original floodplain of Johnson Creek.

Photo 45-3:

Looking north on the property bounded by SE 267th Avenue, Stone Road, and Highway 26. Work with the landowner to enhance this riparian wetland and reconnect it to the creek.

Recommended Actions

1. Work with willing property owners adjacent to Johnson Creek for the purpose of reconnecting the creek with its original floodplain. Activities will be property-specific and to the extent deemed appropriate by the owner. Floodplain reconnection will entail removal of invasive plant species from the banks of the creek. The banks will be regraded, terraced, and then replanted with native riparian vegetation. Enhancing the riparian corridor and increasing floodplain connection will help stabilize the stream banks (see Photos 45-1, 45-2, and 45-3).
2. Increase in-stream complexity throughout the length of the creek running through this reach. This action, which will be done in conjunction with other projects in the reach, will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase.
3. Remove or modify culverts that impede salmonid movement. Determination of whether a culvert will require improvement or removal will be on a site-by-site basis during the project design phase.
4. Plant a large native tree buffer along Highway 26 to filter stormwater and buffer the area from noise pollution for habitat purposes.
5. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

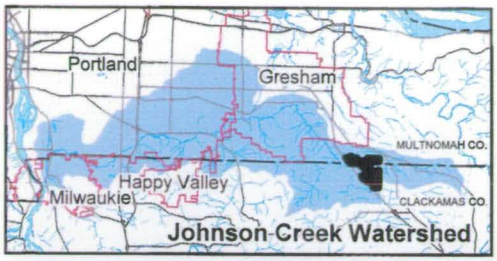
JOHNSON CREEK RESTORATION

REACHES
46, 47, 48

Aerial Map

JURISDICTIONS INCLUDED

MULTNOMAH COUNTY
CLACKAMAS COUNTY



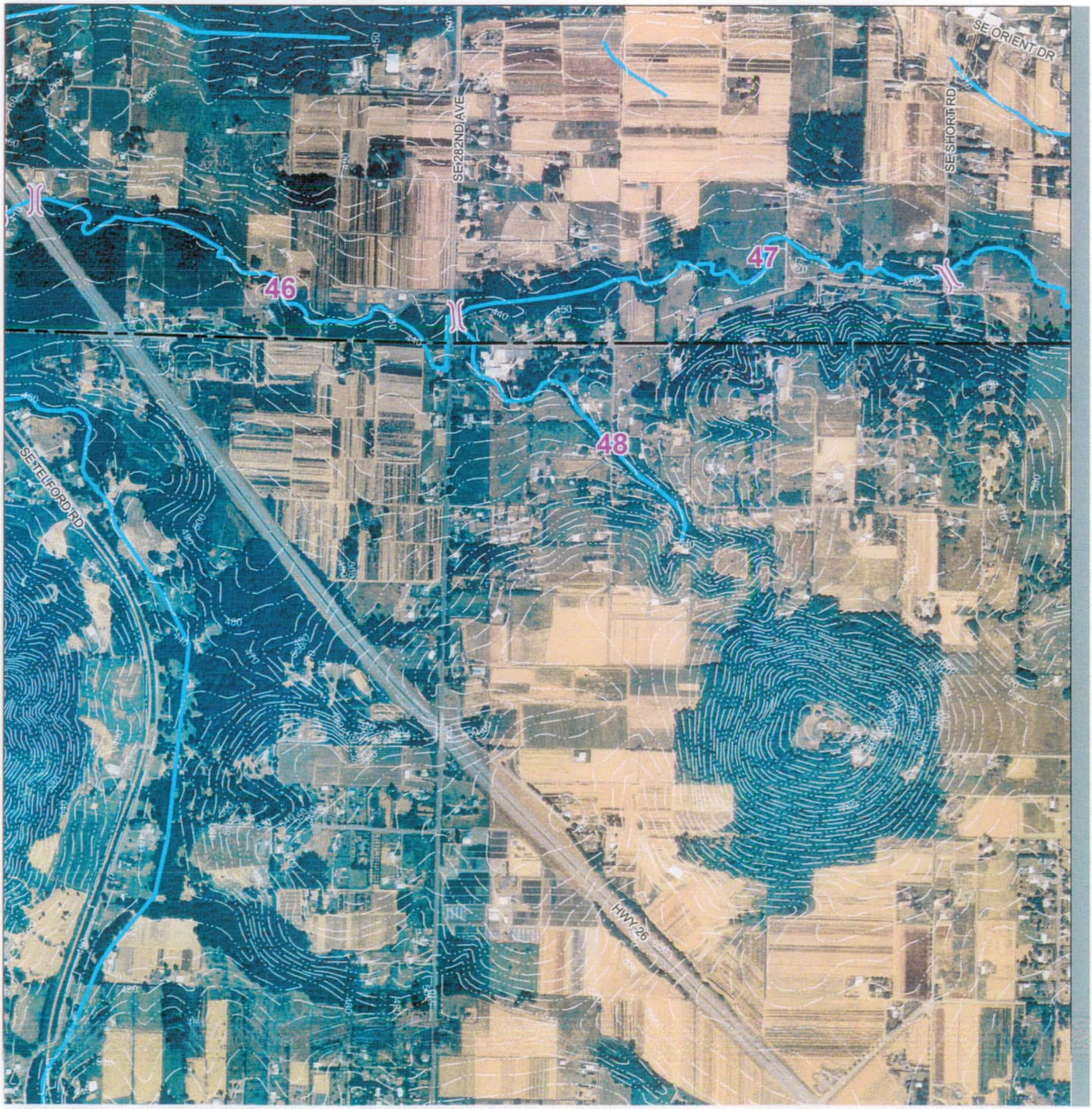
Legend

- Reach Divider
- City Boundary
- County Line

Aerial Images Source:
Spencer Gross, 1998.

NORTH

0 250 500 1000 Feet



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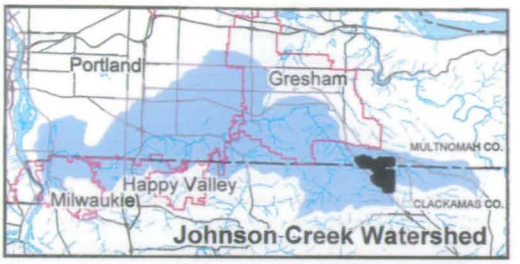
JOHNSON CREEK RESTORATION

REACHES
46, 47, 48



Legend

- Reach Divider
- Fish Barrier
- Pipe Crossing
- Inundated Properties
- Wildlife Corridors and Habitat Patches
- Floodplain Reconnection
- Impervious Surface

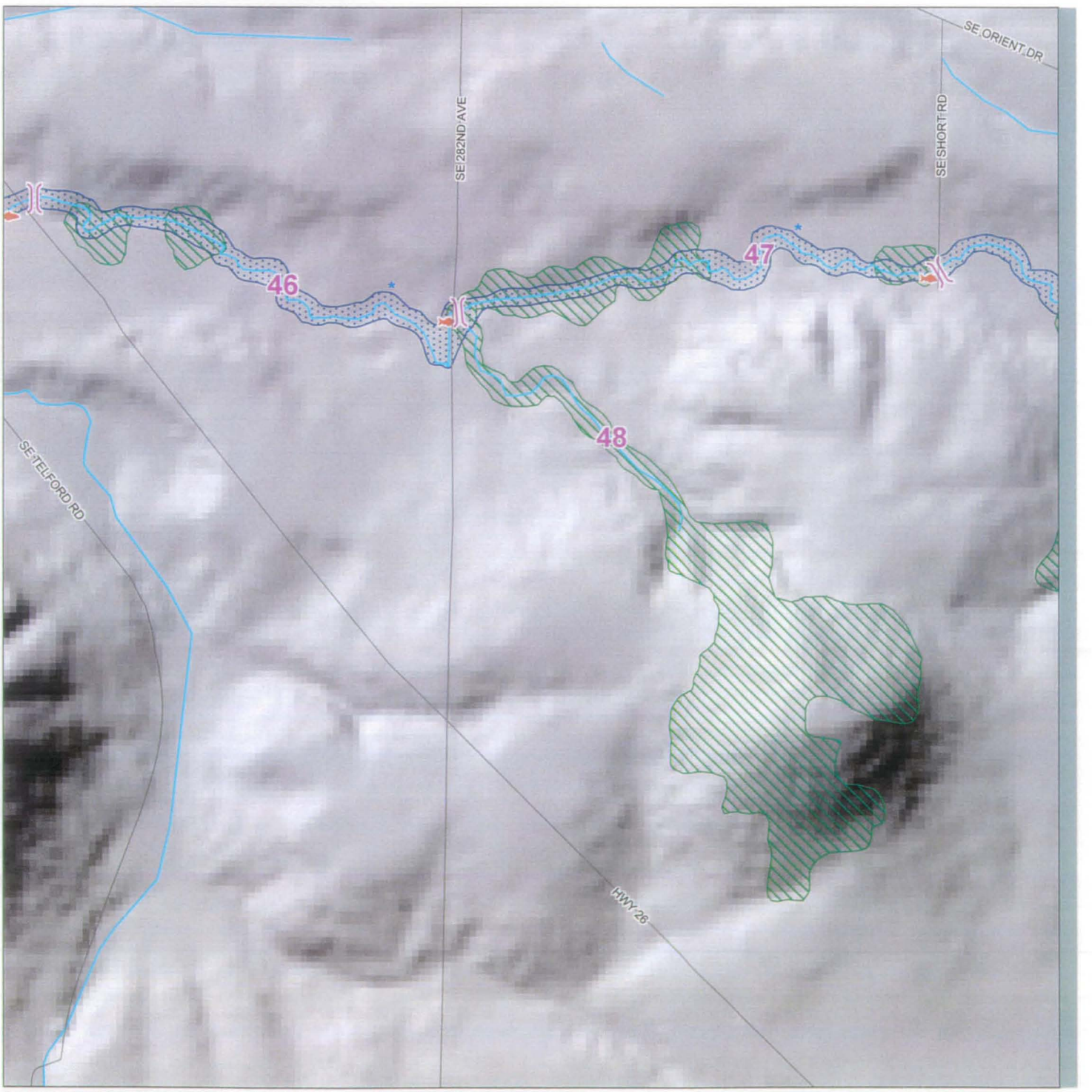
Functions

JURISDICTIONS INCLUDED

MULTNOMAH COUNTY
CLACKAMAS COUNTY

NORTH

0 250 500 1000 Feet



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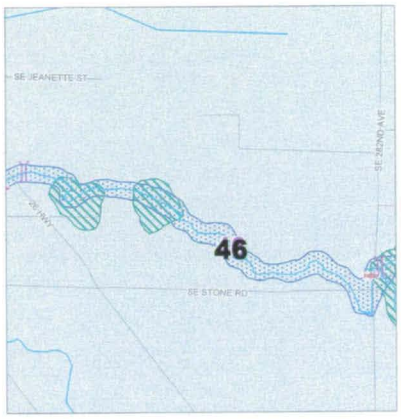
Reach 46

Existing Conditions



Reach 46 - Description	Target	Units
Floodplain Reconnection	8	acres
Wildlife Corridors and Habitat Patches	14	acres
In-stream Complexity	3,604	feet
Inundated Properties	1	number
Fish Barriers	1	number
Priority Outfalls	0	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Reach 46 extends from U.S. Highway 26 to SE 282nd Avenue in the jurisdiction of Multnomah County. This area contains some wetlands, but agricultural land is predominant. The width of the riparian corridor along the north bank of the creek is very narrow; it is thicker along the southern bank between the creek and SE Stone Road. Vegetation consists primarily of western redcedar, red alder, vine maple, bigleaf maple, beaked hazelnut, common hawthorn, thimbleberry, willow, native rose, Douglas' spiraea, red osier dogwood, and Oregon ash, as well as invasive Himalayan blackberry, reed canarygrass, and Scot's broom. Wetland conditions appear to be present in the eastern portion of the reach. Current conditions in this reach range from a rating of 1 at the western end to 3 from the middle to the eastern area.

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Protect and restore riparian vegetation
- Increase in-stream complexity of creek
- Remove fish barriers
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $1,610,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by riffles and scour pools.
- Average pool depth is 33 cm.
- Stream substrate is dominated by silt/organics, sand, gravel, and cobble.
- The riparian zone is quite poor. There are some patches of a narrow but decent riparian buffer consisting of willow and alder trees. Considerable clearing has been done right up to the creek, leaving no shade for the channel.
- The reach has heavy beaver activity, intensive grazing, willow overgrowth across the channel, and backyards abutting the creek.

- There are many long, back-to-back pools and beaver ponds, which have slowed the water and are increasing sediment.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Explore opportunities to open up the channel, allowing access to the floodplain and creating off-channel habitat.

Recommended Actions

1. Work toward acquiring frequently flooded properties near the creek through the Willing Seller Program as opportunities arise. On acquired properties, structures will be removed, creek banks will be terraced back as appropriate to reconnect the floodplain and replanted with native vegetation, and the riparian corridor will be protected and enhanced to the maximum extent possible.
2. Work with willing property owners adjacent to Johnson Creek for the purpose of reconnecting the creek with its original floodplain. Activities will be property-specific and to the extent deemed appropriate by the owner. Floodplain reconnection will entail removal of invasive plant species from the banks of the creek. The banks will be regraded, terraced, and then replanted with native riparian vegetation. Enhancing the riparian corridor and increasing floodplain connection will help stabilize the stream banks (see Photos 46-1, 46-2, and 46-3).
3. Increase in-stream complexity throughout the length of the creek running through this reach. This action, which will be done in conjunction with other projects in the reach, will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase.
4. Remove or modify culverts that impede salmonid movement. Determination of whether the culverts will require improvement or removal will be on a site-by-site basis during the project design phase.
5. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Photo 46-1:

Looking west from SE 282nd Avenue. The potential exists to work with property owners on the north bank to implement floodplain reconnection actions.

Photo 46-2:

Looking north from SE Stone Road just east of intersection with Highway 26. The creek is in the distance, with a narrow riparian corridor. Opportunity exists to terrace the banks and revegetate the corridor with native plants.

Photo 46-3:

Looking north from a property on SE Stone Road just east of intersection with Highway 26. Opportunity exists to work with landowners to protect and enhance this riparian wetland.

Reach 47

Reach 47 - Description	Target	Units
Floodplain Reconnection	10	acres
Wildlife Corridors and Habitat Patches	33	acres
In-stream Complexity	4,382	feet
Inundated Properties	1	number
Fish Barriers	1	number
Priority Outfalls	0	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Existing Conditions

Reach 47 extends from SE 282nd Avenue to SE Short Road in the jurisdiction of Multnomah County. The area is dominated by agricultural land. The width of the riparian corridor in this reach ranges from moderate to narrow. Vegetation consists primarily of red alder, western redcedar, Douglas-fir, Oregon ash, red elderberry, willow, and sword fern, as well as invasive Himalayan blackberry and reed canarygrass. Current conditions in this reach are rated 2+/1- in the eastern portion, 3+/2- in the middle, and 3+ in the western portion.

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Protect and restore riparian vegetation
- Protect tributaries and tributary confluences
- Increase in-stream complexity of creek
- Remove fish barriers
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $1,370,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by riffles and scour pools.
- Average pool depth is 33 cm.
- Stream substrate is dominated by silt/organics, sand, gravel and cobble.
- The riparian zone is quite poor. There are some patches of a narrow but decent riparian buffer consisting of willow and alder trees. Considerable clearing has been done right up to the creek, leaving no shade for the channel.
- The reach has heavy beaver activity, intensive grazing, willow overgrowth across the channel, and backyards abutting the creek.
- There are many long, back-to-back pools and beaver ponds, which have slowed the water and are increasing sediment.

The banks of the properties will be terraced back as far as possible to maximize use of the entire property. After the creek banks are terraced and invasive species removed, the banks will be re-vegetated with native species to enhance the riparian corridor, including trees that will shade the creek.

3. Work with willing property owners adjacent to Johnson Creek for the purpose of reconnecting the creek with its original floodplain. Activities will be property-specific and to the extent deemed appropriate by the owner. Floodplain reconnection will entail removal of invasive plant species from the banks of the creek, as well as removal of the WPA wall where necessary. The banks will be regraded and terraced and then replanted with native riparian vegetation. Enhancing the riparian corridor and increasing floodplain connection will help stabilize the stream banks (see Photos 47-1 through 47-3).
4. Work with property owners along the tributaries of Johnson Creek to protect and enhance the resource. Invasive species will be removed and replaced by native riparian vegetation, thereby helping to maintain a healthy connection between the tributary and Johnson Creek. Where practicable, areas of healthy vegetation will be targeted for protection through the use of conservation easements.
5. Increase in-stream complexity throughout the length of the creek running through this reach. This action will be done in conjunction with other projects in the reach and will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the design phase (see Photo 47-4).
6. Remove or modify culverts that impede salmonid movement. Determination of whether a culvert will require improvement or removal will be on a site-by-site basis during the design phase.
7. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Photo 47-4:

Looking east just off SE Short Road at open area along Johnson Creek. Work with property owners to reconnect the floodplain, restore the riparian corridor, and add in-stream complexity to the creek.

Photo 47-1:

Looking east from SE Stone Road near the intersection with SE Short Road. Work with the landowner to revegetate a 200-foot corridor and reconnect the floodplain.

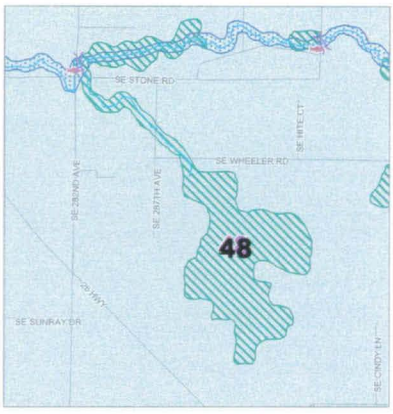
Photo 47-2:

Looking northeast toward Johnson Creek just north of SE Stone Road. Work with property owners to undertake floodplain reconnection actions.

Photo 47-3:

Looking north on SE Stone Road between SE 282nd and SE 287th Avenues. Opportunity exists to work with landowners to expand the riparian corridor 200 feet, enhance the forest, revegetate the grassy area with native plants, and reconnect the floodplain.

Reach 48



Reach 48 - Description	Target	Units
Floodplain Reconnection	0	acres
Wildlife Corridors and Habitat Patches	241	acres
In-stream Complexity	0	feet
nundated Properties	0	number
Fish Barriers	0	number
Priority Outfalls	0	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Existing Conditions

Reach 48 extends south of SE Stone Road along a tributary of Johnson Creek in the jurisdiction of Clackamas County. The area consists of a forested butte where the tributary's headwaters originate, as well as agricultural land with some single-family residential use. The width of the riparian corridor varies from moderate to narrow through most of the reach, but it is wide in some areas. Vegetation includes western hemlock, Douglas-fir, western redcedar, bigleaf maple, vine maple, red alder, beaked hazelnut, red elderberry, sword fern, bracken fern, Oregon grape, thimbleberry, and inside-out flower, as well as invasive Himalayan blackberry, English ivy, and Japanese knotweed. Current conditions in this reach are rated 1/1+ through most of the forested area, though the agricultural lands are rated lower.

Identified Opportunities

Opportunities exist within this reach to:

- Protect and restore riparian vegetation
- Protect tributaries and tributary confluences
- Create or enhance wildlife corridors
- Provide education to property owners to encourage stream stewardship

Estimated Project Costs: $3,420,000

ODFW Survey Results

The ODFW Stream Habitat Survey did not include this reach in the Johnson Creek watershed.

Recommended Actions

1. Work with property owners along the tributaries of Johnson Creek to protect and enhance the resource. Invasive species will be removed and replaced by native riparian vegetation, thereby helping to maintain a healthy connection between the tributary and Johnson Creek. Where practicable, areas of healthy vegetation will be targeted for protection through the use of conservation easements (see Photos 48-1, 48-2, and 48-3).

Photo 48-1:

Looking south near SE 282nd Avenue along a tributary on the south side of Johnson Creek. Work with property owners to revegetate the tributary's banks.

Photo 48-2:

Looking west from SE 287th Avenue at a tributary of Johnson Creek. Mature cedars and maples are present, but the creek bed is filling in with blackberry growth. Work with the property owner to remove blackberries and revegetate with native riparian plants.

2. Work with property owners throughout the reach to create a wildlife corridor. Owners will be encouraged to plant native riparian vegetation to enhance habitat conditions and provide wildlife access to the creek from the surrounding upland areas (see Photo 48-4).
3. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Photo 48-3:

Looking east from SE 287th Avenue toward the tributary. Mature cedars and maples are present, but the creek bed is filling in with grass. Work with the property owner to remove grass and replant native vegetation.

Photo 48-4:

Looking south from SE Wheeler Road at the tributary crossing. This is a very dense, mature riparian corridor, with large cedars. Work with the property owner to protect the riparian/ wildlife corridor area up to 200 feet from creek.

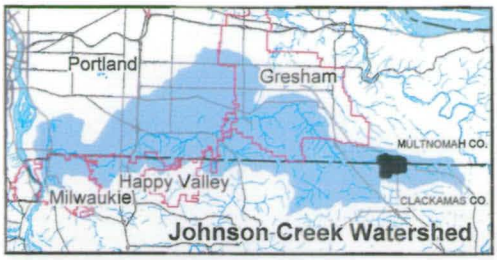
JOHNSON CREEK RESTORATION

REACHES
49, 50, 51, 52

Aerial Map

JURISDICTIONS INCLUDED

MULTNOMAH COUNTY
CLACKAMAS COUNTY



Legend

- Reach Divider
- City Boundary
- County Line

Aerial Images Source:
Spencer Gross, 1998.

NORTH

0 250 500 1000 Feet

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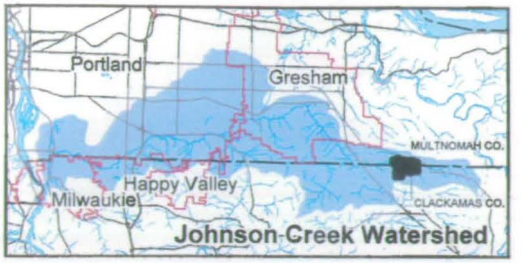
JOHNSON CREEK RESTORATION

REACHES
49, 50, 51, 52



Legend

- Reach Divider
- Fish Barrier
- Pipe Crossing
- Inundated Properties
- Wildlife Corridors and Habitat Patches
- Floodplain Reconnection
- Impervious Surface

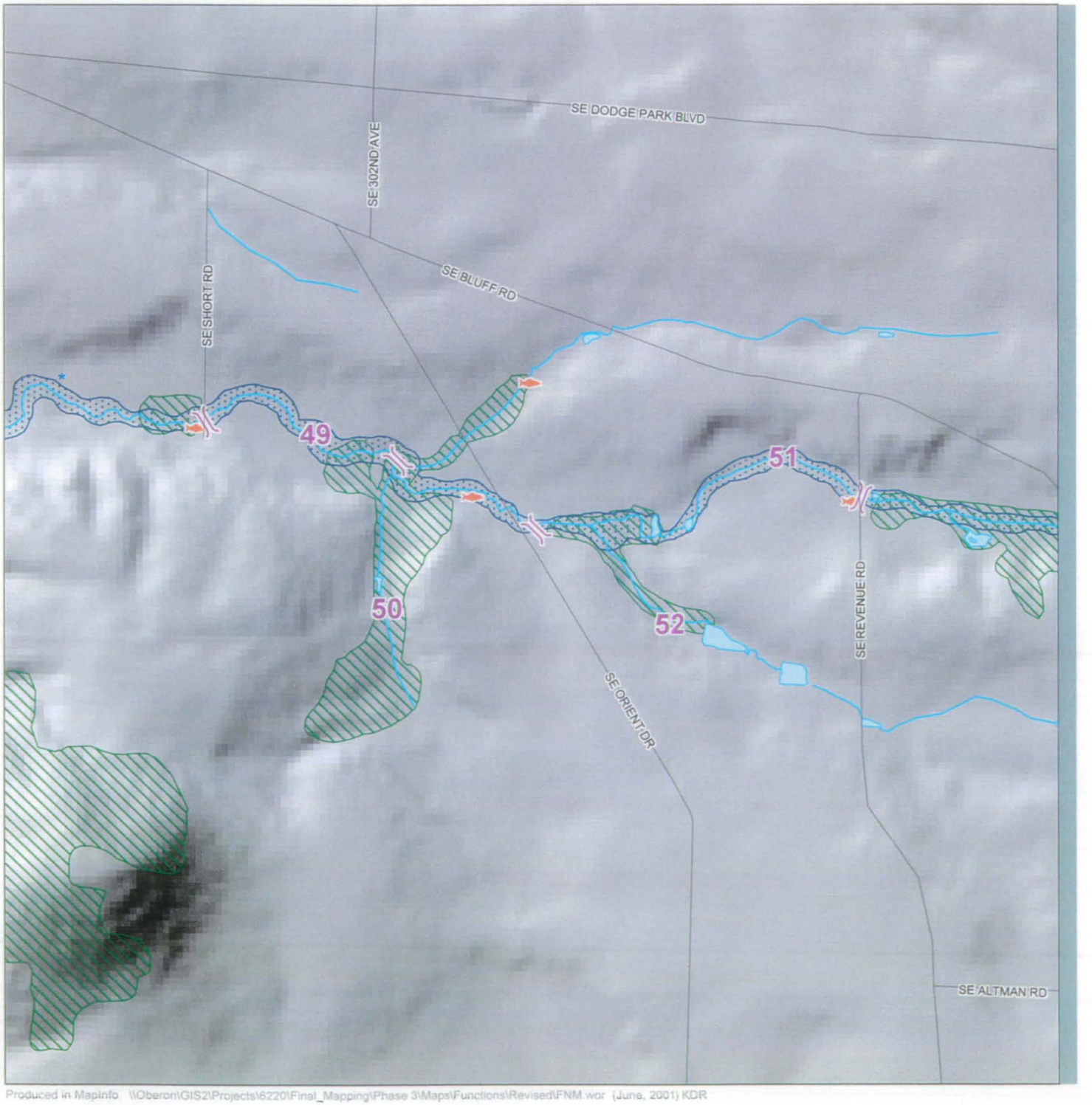
Functions

JURISDICTIONS INCLUDED

MULTNOMAH COUNTY
CLACKAMAS COUNTY

NORTH

0 250 500 1000 Feet



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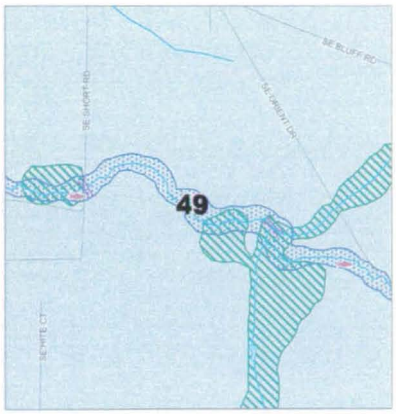
Reach 49



Reach 49 - Description	Target	Units
Floodplain Reconnection	6	acres
Wildlife Corridors and Habitat Patches	28	acres
In-stream Complexity	2,693	feet
Inundated Properties	0	number
Fish Barriers	2	number
Priority Outfalls	0	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Existing Conditions

Reach 49 extends from SE Short Road to SE 307th Avenue in the jurisdiction of Multnomah County. This area is predominantly agricultural land used by nurseries, with a few single-family homes. The width of the riparian corridor is narrow; however, intermittent forested areas surround the tributary in this reach. Vegetation consists primarily of western redcedar, red alder, snowberry, willow, red osier dogwood, beaked hazelnut, stinging nettle, and Oregon ash, as well as invasive Himalayan blackberry, European bittersweet, English ivy, and reed canarygrass. Wetland conditions appear to exist in the eastern portion of this reach. Current conditions in the reach are rated 3/3-.

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Protect and restore riparian vegetation
- Protect tributaries and tributary confluences
- Increase in-stream complexity of creek
- Remove fish barriers
- Provide education to property owners to encourage stream stewardship

Estimated Project Costs: $1,180,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by riffles, scour pools, and dammed pools.
- Average pool depth is 32 cm.
- Stream substrate is dominated by silt/organics, sand, gravel and cobble.
- Wood volume is extremely low.
- Most of this reach is actively grazed up to the creek. If the banks are not eroding and/or grazed upon, then Himalayan blackberry covers the channel.
- There is considerable beaver activity, and there are long sections of beaver dam-beaver pond sequences.

- The channel is U-shaped, and erosion is extensive.
- There are no secondary channels, very few riffle/pool sequences occur, shade is poor, and there is extensive collection of fine sediments due to the slow water flow.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Explore opportunities to open up the channel, allowing access to the floodplain and creating off-channel habitat.

Recommended Actions

1. Work with willing property owners adjacent to Johnson Creek for the purpose of reconnecting the creek with its original floodplain. Activities will be property-specific and to the extent deemed appropriate by the owner. Floodplain reconnection will entail removal of invasive plant species from the banks of the creek. The banks will be regraded, terraced, and then replanted with native riparian vegetation. Enhancing the riparian corridor and increasing floodplain connection will help stabilize the stream banks (see Photos 49-1 and 49-2).
2. Work with property owners along the tributaries of Johnson Creek to protect and enhance the resource. Invasive species will be removed and replaced by native riparian vegetation, thereby helping to maintain a healthy connection between the tributary and Johnson Creek. Where practicable, areas of healthy vegetation will be targeted for protection through the use of conservation easements.
3. Increase in-stream complexity throughout the length of the creek running through this reach. This action, which will be done in conjunction with other projects in the reach, will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase (see Photo 49-2).
4. Remove or modify culverts that impede salmonid movement. Determination of whether a culvert will require improvements or removal will be on a site-by-site basis during the project design phase.
5. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

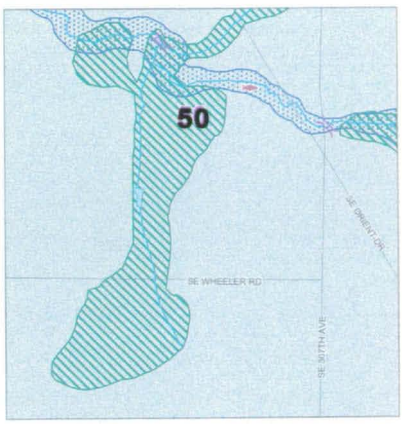
Photo 49-1:

Looking west toward the property at the intersection of SE 307th Avenue and SE Orient Drive. Young but thick riparian vegetation is present; red osier dogwood, alder, and reed canarygrass predominate. Work with the property owner to protect riparian corridor to greatest possible extent, remove reed canarygrass, and enhance with native vegetation.

Photo 49-2:

Looking west from SE Orient Drive at the edge of Reaches 49 and 50. Opportunity exists to work with property owners to complete floodplain reconnection actions, restore riparian vegetation to shade the creek, and increase in-stream complexity.

Reach 50



Reach 50 - Description	Target	Units
Floodplain Reconnection	1	acres
Wildlife Corridors and Habitat Patches	110	acres
In-stream Complexity	320	feet
Inundated Properties	0	number
Fish Barriers	0	number
Priority Outfalls	0	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Existing Conditions

Reach 50 extends south of Reach 49 and west of SE 307th Avenue, along a tributary of Johnson Creek. It is in the jurisdiction of Clackamas County. The area consists of a forested tributary feeding into Johnson Creek and the area where Johnson Creek crosses SE Orient Drive. The width of the riparian corridor along the tributary of Johnson Creek varies from narrow to moderate. The riparian corridor along Johnson Creek near the Orient Drive crossing is narrow to nonexistent. Vegetation consists primarily of western redcedar, bigleaf maple, beaked hazelnut, Oregon ash, Douglas-fir, red alder, and sword fern, as well as invasive Himalayan blackberry and English ivy. In this reach, the tributary riparian corridor and related upland habitat is rated 1+ to 1-; Johnson Creek is rated as 3/3-.

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Protect and restore riparian vegetation
- Protect tributaries and tributary confluences
- Increase in-stream complexity of creek
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $1,020,000

ODFW Survey Results

The ODFW Stream Habitat Survey did not survey this reach in the Johnson Creek watershed.

Recommended Actions

1. Work with willing property owners adjacent to Johnson Creek for the purpose of reconnecting the creek with its original floodplain. Activities will be property-specific and to the extent deemed appropriate by the owner. Floodplain reconnection will entail removal of invasive plant species from the banks of the creek. The banks will be regraded, terraced, and then replanted with native riparian vegetation. Enhancing the riparian corridor and increasing floodplain connection will help stabilize the stream banks (see Photos 50-1 and 50-2).

Photo 50-1:

Looking southeast from SE Orient Drive. Opportunity exists to implement floodplain reconnection actions.

Photo 50-2:

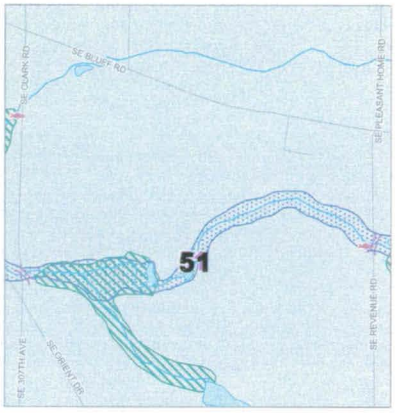
Looking west from SE 307th Avenue just north of SE Orient Drive. Work with property owners to undertake floodplain reconnection actions and restore the riparian corridor.

2. Work with property owners along the tributaries of Johnson Creek to protect and enhance the resource. Invasive species will be removed and replaced by native riparian vegetation, thereby helping to maintain a healthy connection between the tributary and Johnson Creek. Where practicable, areas of healthy vegetation will be targeted for protection through the use of conservation easements (see Photo 50-3).
3. Increase in-stream complexity throughout the length of the creek running through this reach. This action, which will be done in conjunction with other projects in the reach, will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase.
4. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Photo 50-3:

Looking north from SE Wheeler Road at a tributary of Johnson Creek. Work with property owners to enhance and protect this resource.

Reach 51



Reach 51 - Description	Target	Units
Floodplain Reconnection	3	acres
Wildlife Corridors and Habitat Patches	0	acres
In-stream Complexity	1,523	feet
Inundated Properties	0	number
Fish Barriers	1	number
Priority Outfalls	0	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Existing Condition

Reach 51 extends from SE Clark Road to SE Revenue Road, and is bordered by SE Bluff Road to the north and the Multnomah County line to the south. It is in the jurisdiction of Multnomah County. This area is predominantly agricultural land used by nurseries and containing a few single-family residences. The width of the riparian corridor is narrow to nonexistent, with a few interspersed thick patches of forest. Vegetation in the forested areas consists primarily of bigleaf maple, Douglas-fir, red elderberry, beaked hazelnut, Oregon ash, willow, and Indian plum, as well as invasive English ivy and Himalayan blackberry. Current conditions in this reach are rated 2/2+.

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Increase in-stream complexity of creek
- Remove fish barriers
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $460,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by riffles, scour pools, and dammed pools.
- Average pool depth is 35 cm.
- Stream substrate is dominated by silt/organics and sand.
- The riparian zone in this reach improves markedly from immediately downstream. Riparian vegetation is dominated by western redcedar, Douglas-fir, alder and willow. Where grazing occurs, livestock have been fenced off from the creek.
- Quite a bit of room is available for the creek to interact with its floodplain.
- The stream has been resectioned in some places due to redirecting, damming, and/or armoring of banks.
- There is little off-channel habitat and some erosion.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place large wood structures in this reach to create pool habitat and reduce overall erosive velocities, as well as decrease areas of high bank erosion.
- Explore opportunities to open up the channel, allowing access to the floodplain and creating off-channel habitat.

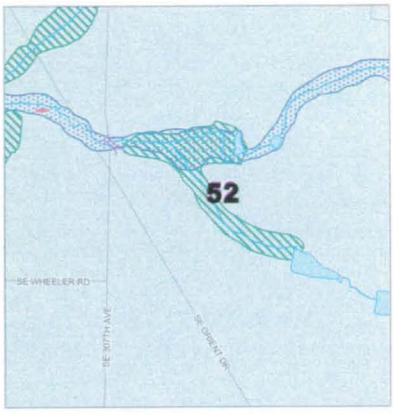
Recommended Actions

1. Work with willing property owners adjacent to Johnson Creek for the purpose of reconnecting the creek with its original floodplain. Activities will be property-specific and to the extent deemed appropriate by the owner. Floodplain reconnection will entail removal of invasive plant species from the banks of the creek. The banks will be regraded, terraced, and then replanted with native riparian vegetation. Enhancing the riparian corridor and increasing floodplain connection will help stabilize the stream banks (see Photo 51-1).

Photo 51-1:
Looking west from SE Revenue Road at vegetation along Johnson Creek mainstem. Opportunities exist to work with landowners to remove invasive species, revegetate riparian corridors with native plants, improve in-stream conditions, and reconnect the floodplain.

2. Increase in-stream complexity throughout the length of the creek running through this reach. This action, which will be done in conjunction with other projects in the reach, will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase.
3. Remove or modify culverts that impede salmonid movement. Determination of whether a culvert will require improvement or removal will be decided on a site-by-site basis during the project design phase.
4. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Reach 52



Reach 52 - Description	Target	Units
Floodplain Reconnection	3	acres
Wildlife Corridors and Habitat Patches	90	acres
In-stream Complexity	1,290	feet
Inundated Properties	0	number
Fish Barriers	0	number
Priority Outfalls	0	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Existing Conditions

Reach 52 extends from SE Orient Drive to SE Revenue road, south of the Clackamas County line. It is in the jurisdiction of Clackamas County. This area is predominantly agricultural land used by nurseries, with a few single-family residences. The width of the riparian corridor is narrow to non-existent, with a few thick patches of forest and a series of large ponds, most likely used for irrigation. Existing vegetation includes of Oregon ash and cattail, with invasive Himalayan blackberry, reed canarygrass, and Japanese knotweed. Current conditions in this reach are rated as 3-.

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Protect and restore riparian vegetation
- Protect tributaries and tributary confluences
- Increase in-stream complexity of creek
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $1,480,000

ODFW Survey Results

The ODFW Stream Habitat Survey did not include this reach in the Johnson Creek watershed.

Recommended Actions

1. Work with willing property owners adjacent to Johnson Creek for the purpose of reconnecting the creek with its original floodplain. Activities will be property-specific and to the extent deemed appropriate by the owner. Floodplain reconnection will entail removal of invasive plant species from the banks of the creek. The banks will be regraded, terraced, and then replanted with native riparian vegetation. Enhancing the riparian corridor and increasing floodplain connection will help stabilize the stream banks (see Photos 52-1 and 52-2).

Photo 52-1:

Looking east from SE 307th Avenue just north of SE Orient Drive at Johnson Creek. Opportunity exists to work with landowners to implement floodplain reconnection and riparian restoration.

Photo 52-2:

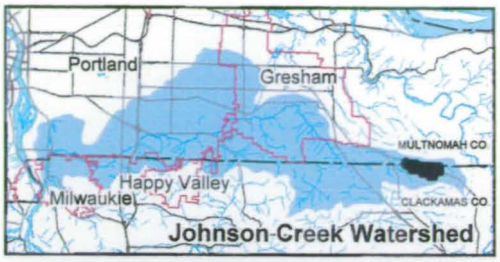
Looking west from SE Revenue Road at a dam in foreground. The area is located just southeast of Reach 52 but is an example of practices employed in this area. This drainage way leads to Johnson Creek. Work with land owners to restore native riparian vegetation.

2. Work with property owners along the tributaries of Johnson Creek to protect and enhance the resource. Invasive species will be removed and replaced by native riparian vegetation, thereby helping to maintain a healthy connection between the tributary and Johnson Creek. Where practicable, areas of healthy vegetation will be targeted for protection through the use of conservation easements.
3. Increase in-stream complexity throughout the length of the creek running through this reach. This action, which will be done in conjunction with other projects in the reach, will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase.
4. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Note: Reach 53 is located on the North side of Johnson Creek adjacent to the western end of Reach 54. Refer to reach descriptions for more detail.

JOHNSON CREEK RESTORATION

REACHES
53, 54, 55



Legend

- Reach Divider
- City Boundary
- County Line

Aerial Images Source: Spencer Gross, 1998.

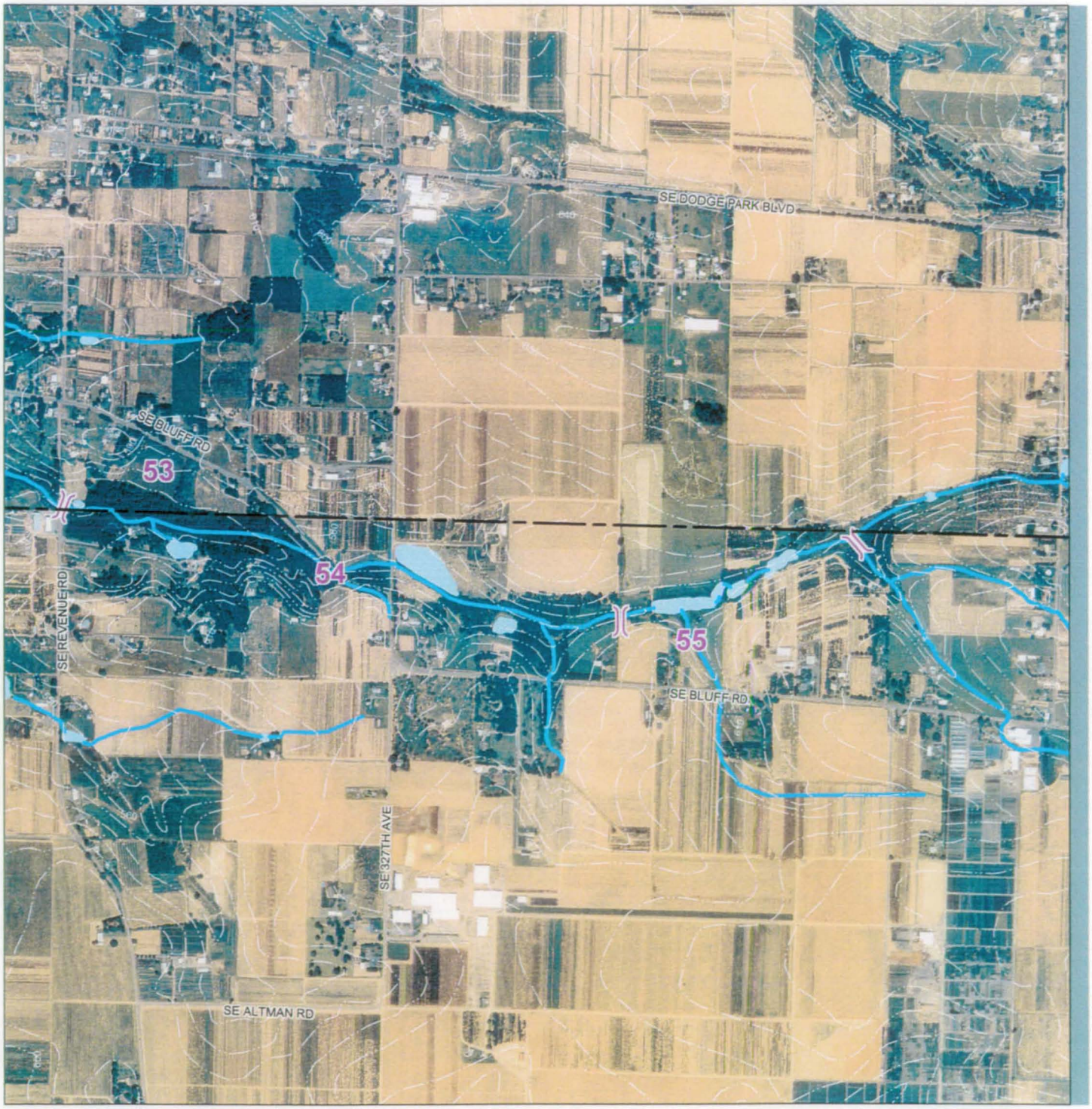
Aerial Map

JURISDICTIONS INCLUDED

MULTNOMAH COUNTY
CLACKAMAS COUNTY

NORTH

0 250 500 1000 Feet



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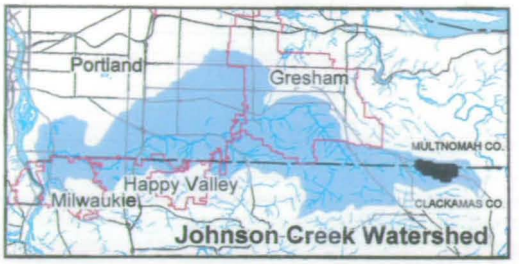
Note: Reach 53 is located on the North side of Johnson Creek adjacent to the western end of Reach 54. Refer to reach descriptions for more detail.



Legend

- Reach Divider
- Fish Barrier
- Pipe Crossing
- Inundated Properties
- Wildlife Corridors and Habitat Patches
- Floodplain Reconnection
- Impervious Surface

JOHNSON CREEK RESTORATION

REACHES

53, 54, 55

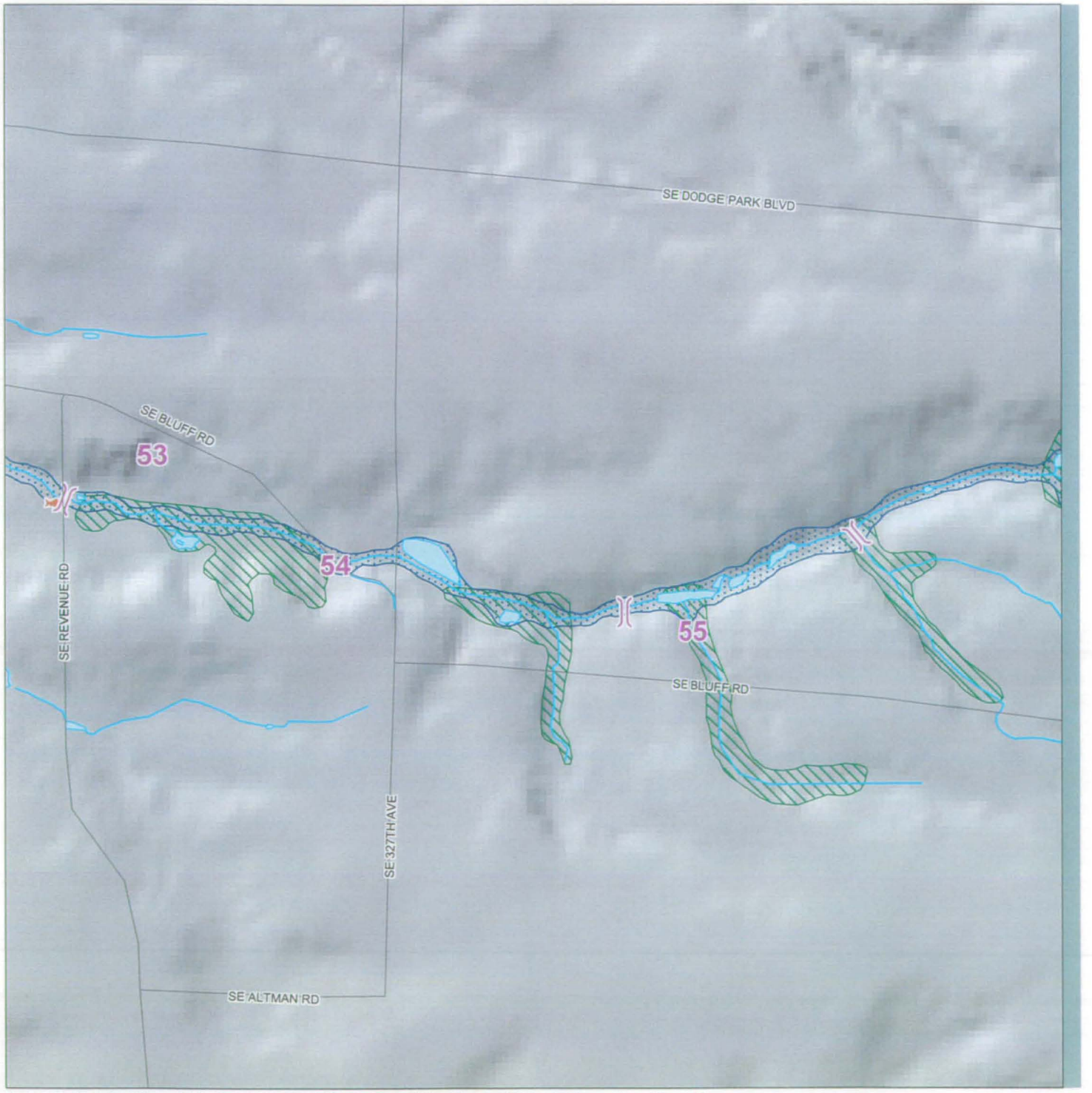
Functions

JURISDICTIONS INCLUDED

MULTNOMAH COUNTY
CLACKAMAS COUNTY

NORTH

0 250 500 1000 Feet



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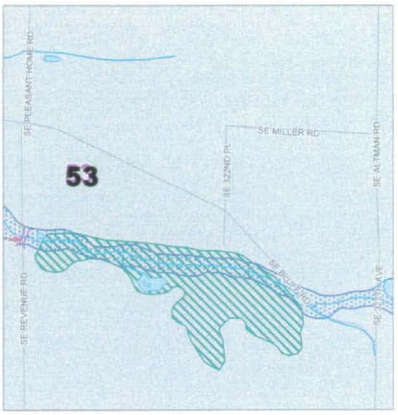
Reach 53



Reach 53 - Description	Target	Units
Floodplain Reconnection	2	acres
Wildlife Corridors and Habitat Patches	3	acres
In-stream Complexity	1,127	feet
Inundated Properties	0	number
Fish Barriers	0	number
Priority Outfalls	0	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Existing Conditions

Reach 53 extends from SE Revenue Road to SE 327th Avenue, just north of Reach 54 and the Multnomah County line. It is in the jurisdiction of Multnomah County. The area consists primarily of agricultural land and nurseries, with some single-family residences. The width of the riparian corridor is narrow to nonexistent. Existing vegetation includes western redcedar, bigleaf maple, red alder, vine maple, and beaked hazelnut, as well as invasive Himalayan blackberry. Current conditions in this reach are rated 2.

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Protect and restore riparian vegetation
- Increase in-stream complexity of creek
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $300,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by riffles, scour pools, and dammed pools.
- Average pool depth is 35 cm.
- Stream substrate is dominated by silt/organics and sand.
- The riparian zone improves markedly from that immediately downstream. Riparian vegetation is dominated by western redcedar, Douglas-fir, alder, and willow. Where grazing occurs, livestock have been fenced off from the creek.
- Quite a bit of room is available for the creek to interact with its floodplain in this reach.
- In some areas, the stream has been resectioned due to redirecting, damming, and/or armoring of banks.
- There is little off-channel habitat and some erosion.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place large wood structures in this reach to create pool habitat and reduce overall erosive velocities, as well as decrease areas of high bank erosion.
- Explore opportunities to open up the channel, allowing access to the floodplain and creating off-channel habitat.

Recommended Actions

1. Work with willing property owners adjacent to Johnson Creek for the purpose of reconnecting the creek with its original floodplain. Activities will be property-specific and to the extent deemed appropriate by the owner. Floodplain reconnection will entail removal of invasive plant species from the banks of the creek. The banks will be regraded, terraced, and then replanted with native riparian vegetation. Enhancing the riparian corridor and increasing floodplain connection will help stabilize the stream banks (see Photos 53-1 and 53-2).

Photo 53-1:

Looking east from SE Revenue Road at Johnson Creek. Work with property owner to terrace the creek banks and revegetate them to enhance and restore the riparian corridor.

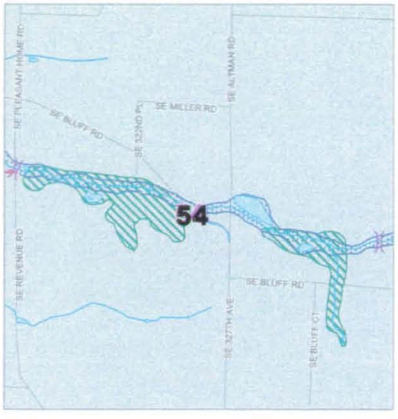
Photo 53-2:

Looking west from SE 327th Avenue north of Johnson Creek. Work with property owners to revegetate this open space and reconnect the floodplain.

2. Increase in-stream complexity throughout the length of the creek running through this reach. This action, which will be done in conjunction with other projects in the reach, will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase.
3. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Reach 54

Existing Conditions



Reach 54 begins at SE Revenue Road south of the creek and ends east of SE 327th Avenue. The reach is just south of Reach 53, and its northern boundary is the county line. It is in the jurisdiction of Clackamas County. This area is made up primarily of agricultural land and nurseries, with some single-family residences. The width of the riparian corridor in this reach ranges from moderate to narrow. Vegetation, where it exists, consists primarily of western redcedar, bigleaf maple, red alder, vine maple, Douglas-fir, red elderberry, beaked hazelnut, sword fern, skunk cabbage, and lady fern, as well as invasive Himalayan blackberry. Current conditions in this reach are rated from 1/1+ along the western end to 3+ near the eastern end.

Reach 54 - Description	Target	Units
Floodplain Reconnection	8	acres
Wildlife Corridors and Habitat Patches	53	acres
In-stream Complexity	3,592	feet
Inundated Properties	0	number
Fish Barriers	0	number
Priority Outfalls	0	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Protect and restore riparian vegetation
- Increase in-stream complexity of creek
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $930,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by riffles, scour pools, and dammed pools.
- Average pool depth is 35 cm.
- Stream substrate is dominated by silt/organics and sand.
- The riparian zone improves markedly from that immediately downstream. Riparian vegetation is dominated by western redcedar, Douglas-fir, alder, and willow. Where grazing occurs, livestock have been fenced off from the creek.
- Quite a bit of room is available for the creek to interact with its floodplain.
- In some areas, the stream has been resectioned due to redirecting, damming, and/or armoring of banks.

- There is little off-channel habitat and some erosion.
- There are two wooden dams just east of SE Altman Road associated with an off-stream settling pond (Crystal Springs Reservoir). These dams could be converted to "fish-friendly" passages with minimal work.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place large wood structures in this reach to create pool habitat and reduce overall erosive velocities, as well as decrease areas of high bank erosion.
- Explore opportunities to open up the channel, allowing access to the floodplain and creating off-channel habitat.
- Alter two wooden dams associated with Crystal Springs Reservoir to make passable for fish.

Recommended Actions

1. Work with willing property owners adjacent to Johnson Creek for the purpose of reconnecting the creek with its original floodplain. Activities will be property-specific and to the extent deemed appropriate by the owner. Floodplain reconnection will entail removal of invasive plant species from the banks of the creek. The banks will be regraded, terraced, and then replanted with native riparian vegetation. Enhancing the riparian corridor and increasing floodplain connection will help stabilize the stream banks (see Photos 54-1 and 54-2).
2. Increase in-stream complexity throughout the length of the creek running through this reach. This action, which will be done in conjunction with other projects in the reach, will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase.
3. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Photo 54-1:

Looking at a riparian/wetland area just off of Bluff Road. Work with property owners to protect and enhance the riparian corridor, removing invasives and planting additional native species.

Photo 54-2:

Looking west near SE 322nd Place toward a pond on Johnson Creek. Work with property owners to terrace banks and enhance the stream and riparian corridor.

Reach 55

Reach 55 - Description	Target	Units
Floodplain Reconnection	5	acres
Wildlife Corridors and Habitat Patches	142	acres
In-stream Complexity	2,028	feet
Inundated Properties	0	number
Fish Barriers	0	number
Priority Outfalls	0	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Existing Conditions

Reach 55 begins east of SE 327th Avenue and extends to SE 347th Avenue south of the county line. It is in the jurisdiction of Clackamas County. The area is made up predominantly of agricultural lands used by tree farms and nurseries, with a few single-family residences. The riparian corridor is intermittent and very narrow. Existing vegetation includes sparse red alder, western redcedar, and Douglas-fir, as well as invasive Himalayan blackberry. Current conditions in this reach range from a rating of 2- to 3/3-.

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Protect and restore riparian vegetation
- Protect tributaries and tributary confluences
- Increase in-stream complexity of creek
- Provide education to property owners to encourage stream stewardship

Estimated Project Costs: $2,030,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by dammed pools and glides.
- Average pool depth is 45 cm.
- Stream substrate is dominated by silt/organics.
- Although there are still a couple of small patches of undisturbed riparian areas where private landowners have left the creek and riparian zone intact, much of the reach is heavily affected by adjacent grazing and nursery activities. As a result, there is reduced shade and reduced bank stability.
- There are some areas of interaction between the creek and its floodplain.
- There is considerable beaver activity, and some boggy areas where it is difficult to discern the main channel.
- The creek has been rearranged and rerouted through part of this reach to create an off-channel dammed pool.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place large wood structures in this reach to create pool habitat and reduce overall erosive velocities, as well as decrease areas of high bank erosion.
- Explore opportunities to open up the channel, allowing access to the floodplain and creating off-channel habitat.

Recommended Actions

1. Work with willing property owners adjacent to Johnson Creek for the purpose of reconnecting the creek with its original floodplain. Activities will be property-specific and to the extent deemed appropriate by the owner. Floodplain reconnection will entail removal of invasive plant species from the banks of the creek. The banks will be regraded, terraced, and then replanted with native riparian vegetation. Enhancing the riparian corridor and increasing floodplain connection will help stabilize the stream banks (see Photos 55-1 and 55-2).

Photo 55-1:

Looking northwest from SE Bluff Road at a tributary drainage of Johnson Creek. Work with property owners to restore and protect the resource.

Photo 55-2:

Looking southeast from SE Bluff Road toward a tributary drainage of Johnson Creek. Work with property owners to restore and protect this resource.

2. Work with property owners along the tributaries of Johnson Creek to protect and enhance the resource. Invasive species will be removed and replaced by native riparian vegetation, thereby helping to maintain a healthy connection between the tributary and Johnson Creek. Where practicable, areas of healthy vegetation will be targeted for protection through the use of conservation easements (see Photos 55-1 through 55-4).

Photo 55-3:

Looking northwest from SE Bluff Road. Work with property owners to restore and protect this tributary drainage of Johnson Creek.

Photo 55-4:

Looking north from SE Bluff Road along Johnson Creek at a wetland drainage on the south side of the creek in winter. Work with landowners to protect and enhance this riparian wetland.

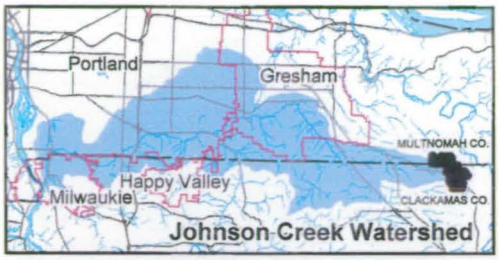
3. Increase in-stream complexity throughout the length of the creek running through this reach. This action, which will be done in conjunction with other projects in the reach, and will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase.
4. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

JOHNSON CREEK RESTORATION

REACHES
56, 57, 58

Aerial Map

JURISDICTIONS INCLUDED
MULTNOMAH COUNTY
CLACKAMAS COUNTY



Legend

- Reach Divider
- City Boundary
- County Line

Aerial Images Source:
Spencer Gross, 1998.

NORTH

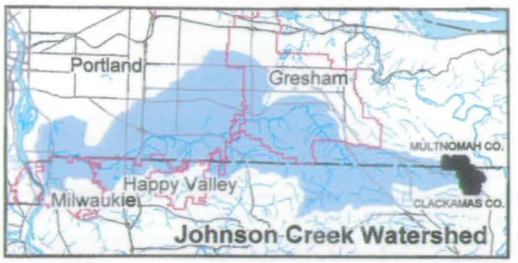
0 250 500 1000 Feet

Produced in MapInfo. \\Oberon\GIS2\Projects\6220\Final_Mapping\Phase 3\Maps\Aerials\ARO.Wor (June, 2001) KDR

JOHNSON CREEK RESTORATION

REACHES

56, 57, 58



Legend

- Reach Divider
- Fish Barrier
- Pipe Crossing
- Inundated Properties
- Wildlife Corridors and Habitat Patches
- Floodplain Reconnection
- Impervious Surface

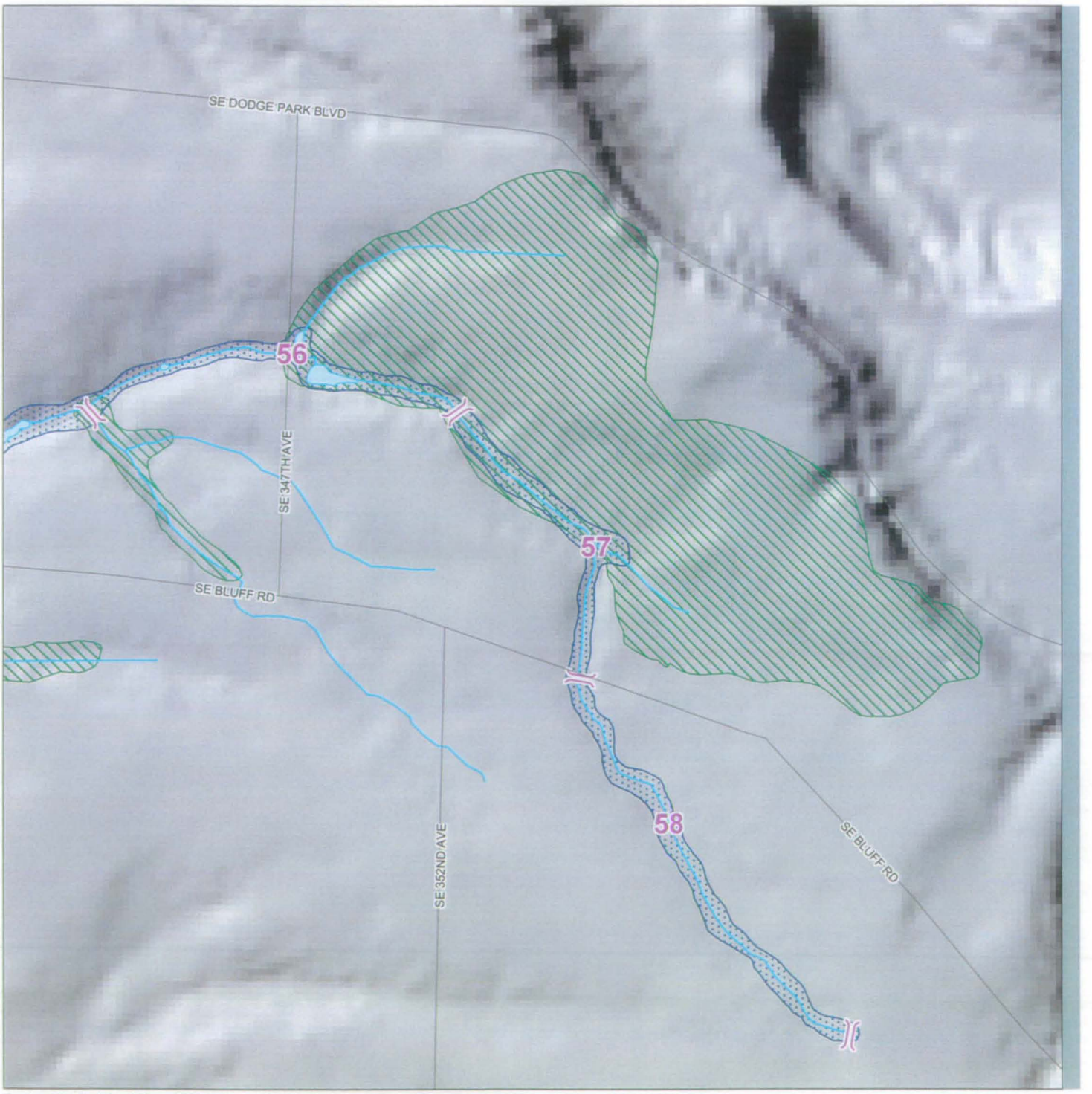
Functions

JURISDICTIONS INCLUDED

MULTNOMAH COUNTY
CLACKAMAS COUNTY

NORTH

0 250 500 1000 Feet



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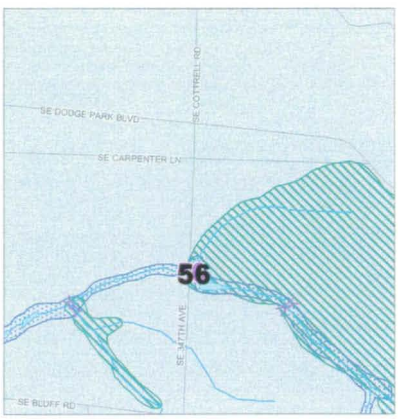
Reach 56

Existing Condition



Reach 56 begins east of SE 327th Avenue and extends west of SE 352nd Avenue north of the county line in the jurisdiction of Multnomah County. The area is predominantly agricultural land used by nurseries, with a few single-family residences. The riparian corridor in this reach is intermittent and sometimes very narrow, though a few forested wetland areas exist. Existing vegetation includes sparse red alder, western redcedar, Douglas-fir, sword fern, oceanspray, and skunk cabbage, as well as invasive reed canarygrass. A few large ponds are present along Johnson Creek, presumably for irrigation purposes. Current conditions in this reach are rated 2- to 3.

Reach 56 - Description	Target	Units
Floodplain Reconnection	7	acres
Wildlife Corridors and Habitat Patches	93	acres
In-stream Complexity	3,252	feet
Inundated Properties	0	number
Fish Barriers	0	number
Priority Outfalls	0	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Protect and restore riparian vegetation
- Create or enhance wildlife corridors
- Increase in-stream complexity of creek
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $1,620,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by dammed pools and glides.
- Average pool depth is 36 cm.
- Stream substrate is dominated by silt/organics.
- The riparian zone alternates from fields (primarily nursery-related) directly adjacent to the creek to being unattended and natural.
- The creek runs through many boggy areas in this reach.
- There is some erosion and unstable banks.
- There is very little refuge habitat in this portion of the creek.
- There is some confusion among landowners and residents in this area as to which body of water is actually Johnson Creek mainstem.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place large wood structures in this reach to create pool habitat and reduce overall erosive velocities, as well as decrease areas of high bank erosion.
- Explore opportunities to open up the channel, allowing access to the floodplain and creating off-channel habitat.

Recommended Actions

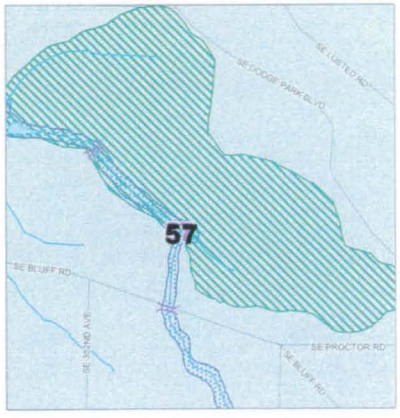
1. Work with willing property owners adjacent to Johnson Creek for the purpose of reconnecting the creek with its original floodplain. Activities will be property-specific and to the extent deemed appropriate by the owner. Floodplain reconnection will entail removal of invasive plant species from the banks of the creek. The banks will be regraded, terraced, and then replanted with native riparian vegetation. Enhancing the riparian corridor and increasing floodplain connection will help stabilize the stream banks (see Photos 56-1 and 56-2).

Photo 56-1:
Looking east from SE 347th Avenue at a large pond adjacent to Johnson Creek. Work with property owners to restore the riparian corridor.

2. Work with property owners throughout this reach to create a wildlife corridor. Owners will be encouraged to plant native riparian vegetation to enhance habitat conditions and provide wildlife access to the creek from the surrounding upland areas.
3. Increase in-stream complexity throughout the length of the creek running through this reach. This action will be done in conjunction with other projects in the reach and will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase (see Photo 56-2).
4. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Photo 56-2:
Looking east from SE 347th Avenue along Johnson Creek. Work with property owners to restore and enhance the riparian corridor and add in-stream complexity.

Reach 57



Reach 57 - Description	Target	Units
Floodplain Reconnection	6	acres
Wildlife Corridors and Habitat Patches	149	acres
In-stream Complexity	2,601	feet
Inundated Properties	0	number
Fish Barriers	0	number
Priority Outfalls	0	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Existing Conditions

Reach 57 extends east from SE 352nd Avenue to SE Dodge Park Boulevard south of the county line. It is in the jurisdiction of Clackamas County. This area is predominantly agricultural land used by tree farms and nurseries, with a few single-family residences. There is no riparian corridor through this reach; Johnson Creek is piped at some locations and plowed over in others. The existing vegetation is sparse. A few small stands of Douglas-fir run along the creek in this reach. Current conditions in this reach are rated as 3-.

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Protect and restore riparian vegetation
- Create or enhance wildlife corridors
- Increase in-stream complexity of creek
- Provide education to property owners to encourage stream stewardship

Estimated Project Costs: $2,590,000

ODFW Survey Results

ODFW Stream Habitat Survey results pertaining to this reach include the following observations:

- Stream habitat is dominated by dammed pools and glides.
- Average pool depth is 36 cm.
- Stream substrate is dominated by silt/organics.
- The riparian zone alternates from fields (primarily nursery-related) directly adjacent to the creek to being unattended and natural.
- The creek runs through many boggy areas in this reach.
- There is some erosion and unstable banks.
- There is very little refuge habitat in this portion of the creek.
- There is some confusion among landowners and residents in this area as to which body of water is actually Johnson Creek mainstem.

Based on ODFW results and recognized opportunities, recommendations for fish habitat protection and restoration include the following:

- Restore riparian corridor to increase the following functions: stream shading, large wood recruitment, bank stabilization, and erosion and sediment control.
- Place large wood structures in this reach to create pool habitat and reduce overall erosive velocities, as well as decrease areas of high bank erosion.
- Explore opportunities to open up the channel, allowing access to the floodplain and creating off-channel habitat.

Recommended Actions

1. Work with willing property owners adjacent to Johnson Creek for the purpose of reconnecting the creek with its original floodplain. Activities will be property-specific and to the extent deemed appropriate by the owner. Floodplain reconnection will entail removal of invasive plant species from the banks of the creek. The banks will be regraded, terraced, and then replanted with native riparian vegetation. Enhancing the riparian corridor and increasing floodplain connection will help stabilize the stream banks (see Photos 57-1 and 57-2).

Photo 57-2:

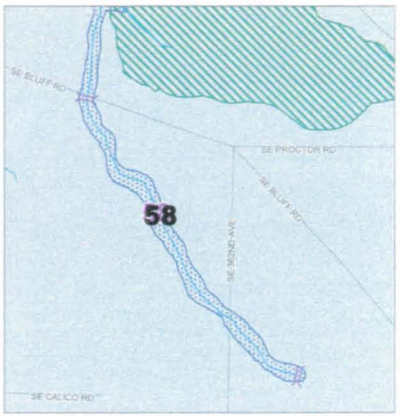
Looking west from SE Bluff Road at an area where Johnson Creek appears to be piped. Opportunity exists to work with landowners to daylight Johnson Creek, restore its riparian corridor, and improve in-stream conditions.

Photo 57-1:

Looking northwest from SE Bluff Road. Opportunity exists to work with landowners in this area to restore the riparian corridor, reconnect the floodplain, and create a wildlife corridor.

2. Work with property owners throughout this reach to create a wildlife corridor reconnecting upper reaches of the Johnson Creek watershed with the Sandy River by replanting open lands with riparian vegetation (see Photo 57-1).
3. Increase in-stream complexity throughout the length of the creek running through this reach. This action , which will be done in conjunction with other projects in the reach, will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase (see Photo 57-2).
3. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Reach 58



Reach 58 - Description	Target	Units
Floodplain Reconnection	8	acres
Wildlife Corridors and Habitat Patches	0	acres
In-stream Complexity	3,485	feet
Inundated Properties	0	number
Fish Barriers	0	number
Priority Outfalls	0	number
Pipe Crossings	0	number
Impervious Surface	0	acres

Existing Conditions

Reach 58 extends south and east from SE Bluff Road and encompasses the headwaters of Johnson Creek. It is in the jurisdiction of Clackamas County. The area consists primarily of agricultural lands used by nurseries, with a few single-family residences. The riparian corridor is almost nonexistent. Drainage ways through this headwaters area are often piped, with only small unmaintained drainage ditches visible. Vegetation is sparse. Current conditions in this reach are rated 3-.

Identified Opportunities

Opportunities exist within this reach to:

- Reconnect and restore Johnson Creek floodplain
- Increase in-stream complexity of creek
- Provide education to property owners to encourage stream stewardship

Estimated Project Cost: $970,000

ODFW Survey Results

The ODFW Stream Habitat Survey did not include this reach of the Johnson Creek watershed.

Recommended Projects

1. Work with willing property owners adjacent to Johnson Creek for the purpose of floodplain reconnection, enhancement and restoration of the riparian corridor, and protection of drainage areas in the watershed. This process will require terracing creek banks and drainage areas. The extent of terracing will be property-specific and will depend on the owner's directive. After the banks are terraced and non-native species are removed, the banks will be revegetated with native species to restore and enhance the riparian corridor (see Photos 58-1, 58-2, and 58-3).
2. Increase in-stream complexity throughout the length of the creek running through this reach. This action, which will be done in conjunction with other projects in the reach, will consist of creating areas of large wood, pool/riffle sequences, and deep pools in the creek channel. Activities will be site-specific and will be determined in the project design phase.

Photo 58-1:

Looking south from SE Bluff Road at Johnson Creek near the headwaters of the creek. Work with property owners to restore and protect drainages.

Photo 58-2:

Looking northeast from SE 362nd Avenue near the headwaters to Johnson Creek. Work with property owners to restore the riparian corridor.

Photo 58-3:

Looking west from SE 362nd Avenue at what most likely is Johnson Creek running through this plowed field. Work with the property owner to restore and protect the creek in headwaters of the Johnson Creek watershed.

3. Work with property owners near the creek to educate them about stream stewardship and the impacts of their actions on the creek. Assist them in altering their habits and practices to better protect and enhance Johnson Creek.

Glossary of Selected Terms

Adapted from StreamNet: http://www.streamnet.org/ff/Glossary/

Canopy - A layer of foliage in a forest stand. Generally, this refers to the uppermost layer of foliage, but it can be used to describe lower layers in a multistoried stand. This term may also include leaves, branches, and vegetation that are above water and provide shade and cover for fish and wildlife.

Cobble - Substrate particles that are smaller than boulders and are generally 64-256 mm in diameter. It can be further classified as small and large cobble.

Confluence - The stream or body of water formed by the junction of two or more streams or rivers.

Corridor - A defined tract of land, usually linear, through which a species must travel to reach habitat suitable for reproduction and other life-sustaining needs.

Cover - Vegetation used by wildlife for protection from predators, or to mitigate weather conditions, or to reproduce. The term may also refer to protective shading provided by vegetation.

Enhancement - Emphasis on improving the value of particular aspects of water and related land resources.

Erosion - Wearing away of rock or soil by the gradual detachment of soil or rock fragments by water, wind, ice, and other mechanical, chemical, or biological forces.

Floodplain - Land that gets covered with water as a result of the flooding of a nearby stream. Similarly, level lowland bordering a stream or river onto which the flow spreads at flood stage.

Floodplain (100-year) - The area adjacent to a stream or river that is on average inundated once a century.

Flow - The amount of water passing a particular point in a stream or river, usually expressed in cubic feet per second.

Habitat - The local environment in which an organism normally lives and grows.

Habitat diversity - The number of different types of habitat within a given area.

Impact - A spatial or temporal change in the environment caused by human activity.

Large woody debris - The principal channel of a drainage system into which other smaller streams or rivers flows.

Outfall - The mouth of a drain or sewer.

Passage - The movement of migratory fish through, around, or over dams, reservoirs, or other obstructions in a stream or river.

Pollutant - Something that pollutes, especially a waste material that contaminates air, soil, or water. Similarly, any solute or cause of change in physical properties that renders water unfit for a given use.

Pool - A reach of stream that is characterized by deep, low-velocity water and a smooth surface.

Pool/riffle ratio - The ratio of surface area or length of pools to the surface area or length of riffles in a given stream reach, frequently expressed as the relative percentage of each category. Used to describe fish habitat rearing quality.

Reach - An individual stream segment that has beginning and ending points. Reach end points are normally designated where a tributary confluence changes the channel character. [The second sentence probably doesn't apply to this report.]

Restoration - The renewal or repair of a natural system so that its functions and qualities are comparable to its original, unaltered state.

Riffle - A reach of stream characterized by shallow, fast-moving water broken by the presence of rocks and boulders.

Riparian habitat - The aquatic and terrestrial habitat adjacent to streams, lakes, estuaries, or other waterways.

Riparian vegetation - The plants that grow rooted in the water table of a nearby wetland area, such as a river, stream, reservoir, pond, spring, marsh, bog, or meadow.

Riprap - Rocks or concrete structures used to stabilize stream banks and protect them from erosion.

Runoff - Water that flows over the ground as a result of rainfall or snowmelt and reaches a stream.

Sediment - The organic material that is transported and deposited by wind and water.

Stream - A general term for a body of flowing water. A natural water course containing water at least part of the year.

Stream channel - The bed where a natural stream of water runs or may run; the long narrow depression shaped by the concentrated flow of a stream and covered continuously or periodically by water.

Stream bank erosion - The wearing away of steam banks by flowing water.

Stream bank stabilization - The natural geological tendency for a stream to mold its banks to conform with the channel of least resistance to flow. Also refers to the lining of stream banks with rock or riprap to control erosion

Streambed - The channel through which a natural stream of water runs or used to run (e.g., a dry streambed).

Substrate - The composition of a streambed, including either mineral or organic materials.

Tributary - A stream that flows into another stream, river, or lake.

Urban runoff - Stormwater from city streets and gutters, or other impervious surfaces, that usually contains pollutants and organic wastes and flows into sewer systems and receiving waters.

Watershed - An area of land that drains to a specific stream.

Watershed restoration - Improvement of current watershed conditions to restore degraded fish habitat and provide long-term protection to aquatic and riparian resources.

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