TESTIMONY SIGN-UP
FOR

#1026

JOHNSON CREEK WATERSHED

IF YOU WISH TO SPEAK TO THE CITY COUNCIL, PLEASE [redacted] YOUR NAME AND ADDRESS BELOW

	NAME	ADDRESS & ZIP CODE
✓	JEROME K. FOLTON	1812 NE 45TH AV. 97213
already testified ✓	Steve Johnson	3707 SE Johnson Cr Blvd 97222
✓	Cathy Mahle	1325 SE Sherrett PTLD 97202
✓	Walt Mintkeski	6815 SE 31st 97202 Mintkeski
✓	Jeff Uebel	581 SW 4th St Gresham 97080
✓	Michael Carlson	5151 NW Cornell Rd 97210
✓	Ennic Francisco	11727 SE Brookside Dr 97266

Date: 6-28-95 Page 1 of ___

Johnson Creek Plan Revision Needed

The Proposed Plan

Is Too Expensive

Will not cut Flood Damage Significantly

Did not inform or involve Sewer & Water Ratepayers

Left no choices for Policymakers by omitting key alternatives

What is the Problem with the proposed Flood Control Plan?

1. Only 5% of the money is left for all other purposes such as fish & wildlife, water quality, and open space.

2. Flood Control does not work to lower flood damage.

3. Costs are underestimated while benefits are overestimated.

4. Full development costs and environmental impact of the retention basins are underestimated.

5. Costs of acquiring key properties in the floodplain are overestimated, while the benefits of such an approach are underestimated.

What are Problems with Flood Control Retention Basins?

1. **environmental impact** such as vegetation removal, soil erosion, fish & wildlife habitat destruction.

2. **landscaping and appearance** of the site both after construction and in later years

3. **public safety** such as possible drownings of toddlers, unauthorized use, and law enforcement on the site.

4. **maintenance** of the site including debris and trash removal, fencing, landscape maintenance.

5. **land use** adjacent to the site.

6. **function** do they work overall and who pays?

What is Plan B?

1. It is $15 Million **cheaper**.

2. Uses **Flood Insurance** and **Flood Plain Acquisition** to deal with flood damage.

3. Requires future development to **pay its own way** without unreasonable public subsidies.

4. **Puts people to work** revegetating and cleaning the creek.

5. Develops a **cooperative process involving land owners** in the watershed as well as local, state, and federal agencies.

Southeast Uplift Neighborhood Program
3534 SE Main Street • Portland, Oregon • 97214 • Phone 232-0010
A non-profit coalition supporting citizen participation and community development in Southeast Portland

June 27, 1995

Mayor Vera Katz
Commissioners of the City Council
City Hall
1220 SW Fifth Ave
Portland, OR 97204

Dear Mayor Katz and Commissioners Blumenauer, Hales, Kafoury, and Lindberg

I am writing on behalf of the Southeast Uplift Land Use and Transportation Committee, which has not had time to comment recently on Council's review of the *Johnson Creek Management Plan* The Committee submitted a letter on November 28, 1994 to Eric Machorro of the Bureau of Environmental Services stating our general support of the *Plan* while also providing constructive critique This letter is attached for your information

I would like to reiterate our support for the *Plan* which I believe is consistent with the Committee's earlier comments and I strongly encourage the Council to approve it I am sure we would all agree that this long and diligent effort on the part of the Johnson Creek Corridor Committee will go a long way towards rectifying the water quality, wildlife habitat, flooding and other problems which have plagued the stream since its conversion from a pristine state

Thank you for the opportunity to comment

Sincerely,

Timothy Baker
Neighborhood Planner

cc Linda Bauer, Pleasant Valley

Attachment

Southeast Uplift Neighborhood Program
3534 SE Main Street • Portland, Oregon • 97214 • Phone 232-0010
A non-profit coalition supporting citizen participation and community development in Southeast Portland

November 28, 1994

Mr. Eric Machorro
Bureau of Environmental Services
1120 SW Fifth Ave., Room 400
Portland, OR 97204

Dear Mr. Machorro:

At its October 17th meeting, the Southeast Uplift Land Use and Transportation Committee voted to respond with this letter to the July, 1994 Draft *Johnson Creek Resources Management Plan*. We realize the lateness of this letter, but hope that some of our concerns might still be reflected in your current revisions of the Plan. Linda Bauer, as a representative to the Johnson Creek Corridor Committee from the Pleasant Valley Neighborhood Association, has kept this Committee informed about this planning process from its inception.

We support unequivocally the establishment of the Watershed Management Organization as soon as possible. The many and widespread requirements for specific plans and physical improvements mandate that a single organization be responsible for coordination and implementation efforts. We are extremely reluctant, however, to endorse the establishment of such a critically important organization, which must act with no statutory authority, using only its persuasive abilities with jurisdictions. We believe a stronger mechanism than an essentially voluntary organization must be established if Johnson Creek is going to be successfully cleaned up within a reasonable timeframe and the mechanisms put into place to keep it cleaned up in future years.

In our April 19, 1994 letter to the Portland City Council on the Combined Sewer Overflow (CSO) program, we strongly advocated that "a special Willamette Watershed Task Force be established to assess implementation strategies for point and non-point source cleanup of the entire river, including methods of cost disbursement for all uses of/contributors to the Willamette River and watershed system outside of the cities. In that same letter we requested the City "to request Metro to determine the ramifications of cleaning up the waters of the region, including the Willamette River, on a regional basis and with a regional fee basis being established." We continue to feel strongly that the clean-up and on-going condition of Johnson Creek's water quality is not just of interest to those who live, work and play in its watershed, but, rather, is - and should be - of interest to all who live in the metropolitan area and, in the wider sense, all who benefit from the Willamette river.

It is even more imperative now, with the anticipated increase in density within the Urban Growth Boundary, and noting that increases in land supply within the UGB will come primarily with the Johnson Creek watershed, that the WMO be given statutory authority to mandate implementation of the RMP.

<u>**We, therefore, request that Metro be designated as the WMO.**</u>
Our reasons include the following

1 Metro is already charged with Open Space acquisition and management
2. Metro is the only agency with authority to cross county and city jurisdictional boundaries to compel implementation
3 We as a region don't have the money to establish another agency when an existing agency already has the authority and resources to assure implementation of the RMP.
4 Johnson Creek and all other water bodies in the Portland metropolitan region need to be handled in a coordinated manner to assure an overall watershed management plan for the urban area.

<u>**Specific Concerns**</u>

<u>Action PP3-1</u> *Prepare water quality management plans for non-urban areas* We note that this plan, once prepared, would encourage voluntary implementation of Best Management Practices (BMP) While we realize that, at this time, there is no legal ability to require - at least through present state and federal Water Quality laws - implementation of BMPs, nevertheless, it would not be inappropriate for local jurisdictions to recognize the need for such a mandate through supporting a change to state or federal law

<u>Objective FM-1</u>. *Minimize Post-Development Peak Flows* We are highly supportive of both Action FM-1-1 and FM-1-2 However, we are somewhat concerned that there is no real inducement for jurisdictions to actually prepare and implement development regulations.

We have participated at length in the effort by Portland and Metro to prepare regulations to implement the State's Transportation Planning Rule and have been discouraged at the inability to bridge the gap between the competing interests. In this case there is a State threat of introducing non-local regulations into the equation; there is not even that mandate in this Objective.

We believe, therefore, that the RMP must clarify by when these new regulations need to be completed and what process might be undertaken to complete them. Again, this might be the appropriate time to consider Metro as the responsible agency for the development of these regulations.

<u>Action WS-3-1</u>: *Coordinate community general plans, zoning and development standards to provide similar protection to all reaches of creek*
The concerns raised above reflect our concerns about this action as well.

<u>Quick Question: p</u> 23: How far into the future does future refer to? 2040?

Thank you very much for giving us this opportunity to respond We would appreciate it if you and one of your consultants would be willing to attend one of our Environmental Subcommittee meetings in the near future to explain in greater detail the various proposals being considered in the Resource Management Plan If so, please contact our new planner, Timothy Baker, at 232-0010 to arrange such a time

Sincerely,

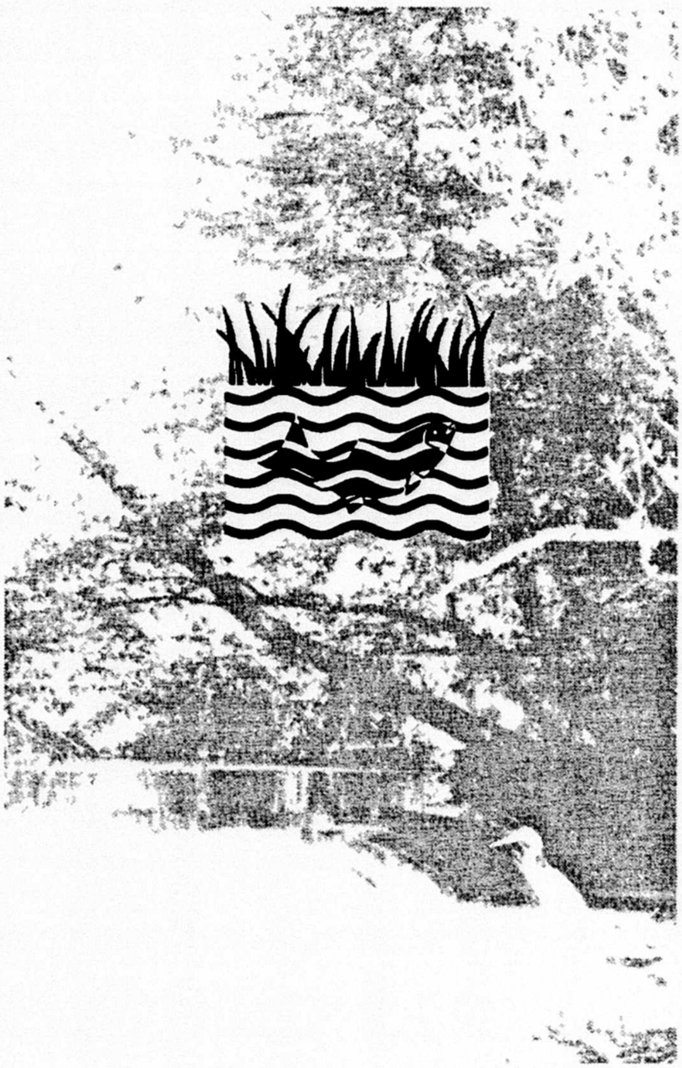
Bill Boyd (cr)　　　　Linda Bauer (cr)

Bill Boyd
Co-Chair

Linda Bauer
Co-Chair

cc　Rena Cusma, Metro
　　Judy Wyers, Metro

Johnson Creek Resources Management Plan



Prepared for
JOHNSON CREEK CORRIDOR COMMITTEE

Prepared by
WOODWARD-CLYDE CONSULTANTS
111 SW Columbia, Suite 990
Portland, Oregon 97201

MAY • 1995

Johnson Creek Corridor Committee[1]

Linda Bauer	Pleasant Valley Neighborhood Association/Reach representative[2]
Bill Bradfield	Reach representative
Jim Carlson	Oregon Association of Nurserymen
Michael Carlson	Portland Audubon Society
Mary Anne Cassin, Co-Chairperson	City of Portland Bureau of Parks and Recreation
Nancy Chase	Metro Regional Parks and Greenspaces
Maggie Collins	City of Milwaukie Department of Planning
Howard Dietrich	Oregon Worsted Company/Reach Representative
Mohammad Fattahi	Clackamas County Department of Transportation and Development
Ed Fitzgerald, Alternate	Land Owners and Friends of Johnson Creek (L O A.F)
Ernie Francisco	Reach representative
Rosemary Furfey	METRO
Ray Hites	Lents Neighborhood Association
Richard Holoch	Clackamas County Department of Utilities
Mart Hughes	Wetlands Conservancy
Steve Johnson, Co-Chairperson	Reach representative
Rob Kappa	City of Milwaukie City Council
Eric Machorro, Co-Chairperson	City of Portland Bureau of Environmental Services
Merrie and Barry Miller	L O A F /Reach representative
Walt Mintkeski	Friends of Johnson Creek
Mel Miracle	City of Gresham Department of Public Works
Nadine Morris	Reach representative
Randy Nicolay	City of Happy Valley Department of Planning
Michael Nixon	Oregon Department of Environmental Quality
Arlene Palshikar	Reach representative
Clifton Lee Powell	Friends of Johnson Creek
Emily Roth	Oregon Division of State Lands

Bonnie Scheeland	Multnomah County Transportation Division, Department of Environmental Services
Molly Sullivan	Reach representative
Jeff Uebel	Reach representative
Laurie Wall, Alternate	City of Portland Bureau of Planning
Doug Warren	City of Portland Bureau of Planning
Ty Weisdorfer	Clackamas County Soil and Water Conservation District
Ela Whelan, Alternate	Clackamas County Department of Utilities
Dennis Wise	Oregon Department of Fish and Game

Notes

1 Current members are listed Former members include Jim Soli, Jean Ochsner, Barbara Walker, Carol and Michael Grant, and Linda Robinson

2 Certain members represent citizen interests in particular reaches of the creek

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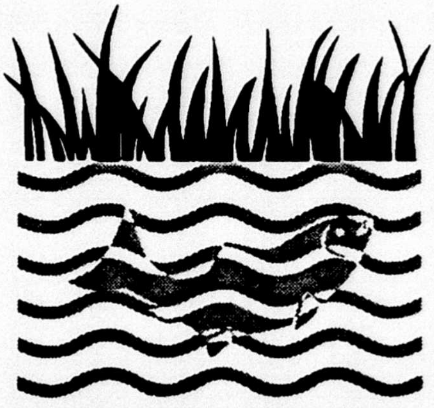


SUMMARY

This plan describes how the natural resources of the Johnson Creek watershed can be protected and restored   The plan was prepared by a committee of stakeholders, that is, a group of individuals with a stake in the future of the watershed   The Johnson Creek Corridor Committee includes residents, business owners, farmers, and representatives of government agencies

WHY THE PLAN IS NEEDED

Johnson Creek is one of the last free-flowing streams in the Portland metropolitan area From its origins in the Cascade foothills to its confluence with the Willamette River, Johnson Creek flows westward 25 miles, through the cities of Gresham, Portland, and Milwaukie   The creek drains a 54-square mile, partially-urbanized watershed with a population of about 130,000

In common with many urban creeks, Johnson Creek has not fared well in the face of development   Much of its watershed has been converted from forest to farms, cities, and suburbs   Urban land uses and agriculture have encroached on the stream corridor, narrowing it and converting a natural, meandering stream into an often-polluted drainage channel   The natural resource values of the stream are much reduced   A few salmon and steelhead still return to the creek, but they are just remnants of former runs, only a few small islands of the original riparian forest continue to provide habitat for wildlife   In addition, flooding plagues creekside neighborhoods, frequently causing extensive damage – on February 24, 1994, a small flood caused damage valued at $375,000 A large flood similar to the one that occurred in 1964 can be expected to cause damage valued at $12,000,000 or more

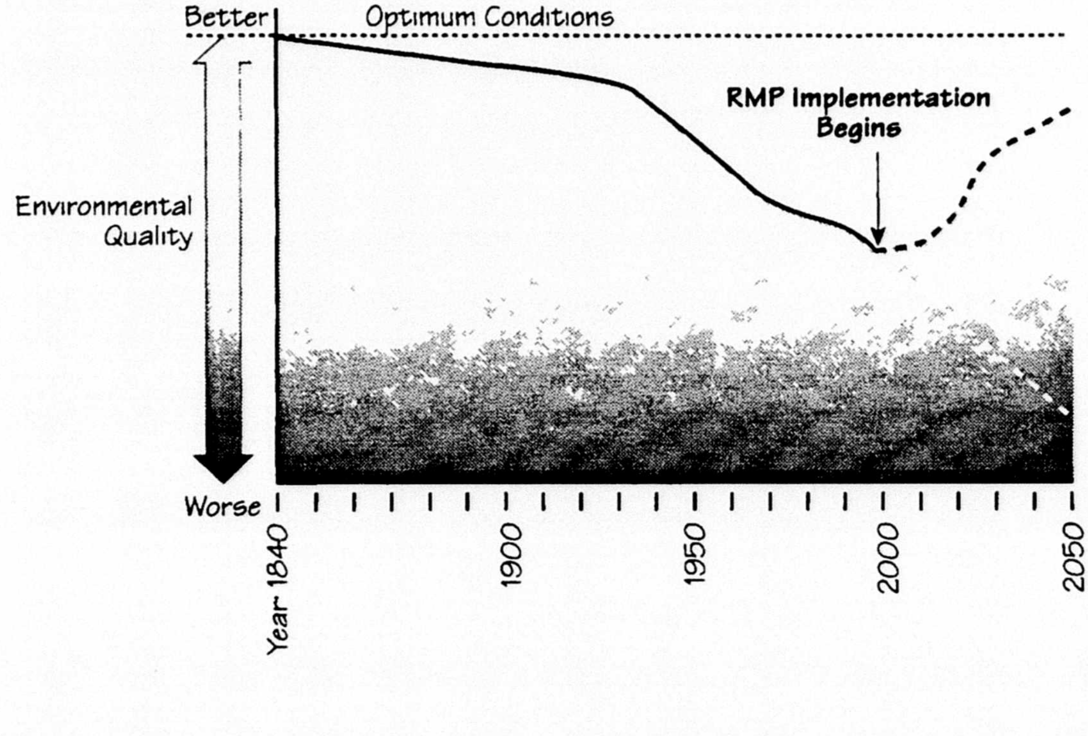
It is clear that, without intervention, Johnson Creek will continue to deteriorate   Metro estimates that the population of the four-county Portland metropolitan area will increase by 1 1 million in the next 50 years   Some of these newcomers are expected to make their homes in the Johnson Creek watershed As the watershed urbanizes, runoff volumes and pollutant loads discharged to the creek will increase Flooding will become more severe and the quality of water and wildlife habitat will decline

Many are now recognizing that allowing urban streams to deteriorate squanders a valuable community asset Wildlife use the waterways as a refuge and safe corridor for movement City dwellers value the tranquillity of running water and birdsong in contrast to the noise and bustle of urban life The presence of natural streams makes the city a better and more attractive place. And because attractive surroundings are such an important part of the quality of life, the value of homes and businesses within easy reach of preserved natural areas often increases Thus, contrary to conventional thought, protecting natural resources can spark economic development

Restoration of a stream, however, is no simple matter It involves complex technical and political challenges From a technical point of view, we need to understand the stream and be able to predict how it will respond to various management alternatives Because stream restoration will not occur overnight, we need to establish institutions capable of implementing and financing a long-term improvement program A number of sometimes conflicting goals (flood control, and preservation of natural areas, for example) will have to be reconciled To deal effectively with these complexities, a comprehensive plan is

FIG 1

Alternative Futures for Johnson Creek



needed that takes into account all present and expected future activities in the watershed that can influence environmental quality The RMP is such a comprehensive plan It provides a framework for action that will halt deterioration of natural resources while simultaneously improving the quality of life Figure 1 shows diagrammatically how the RMP could reverse the decline of Johnson Creek

How the Plan Was Prepared

In 1990, a group of concerned residents and business owners joined with representatives of government agencies to begin seeking solutions to Johnson Creek's problems The Johnson Creek Corridor Committee (JCCC), as the group was known, met monthly to reach consensus on a vision of the watershed's future and to establish a series of goals for a comprehensive plan. The Johnson Creek Vision was published by the committee in late 1992

Based on the JCCC's vision, planning commenced in earnest in the summer of 1993 Technical consultants gathered and analyzed environmental data and began developing drafts of plan elements in concert with four task groups, or sub-committees, of the JCCC The plan elements were reviewed and approved by the JCCC and integrated to form the draft RMP The draft RMP was released for public review in the summer of 1994 After considering all comments received from the public the JCCC modified the draft and approved release of this final RMP

The City of Portland, Bureau of Environmental Services, provided the primary funding and management assistance to the RMP planning process The City of Milwaukie and Clackamas County also provided financial support Many individuals gave their time to the program voluntarily

The Johnson Creek Resources Management Plan

As its name suggests, the Johnson Creek Resources Management Plan is a comprehensive plan for managing resources in the Johnson Creek watershed The plan comprises a series of actions which would result in the gradual environmental enhancement of Johnson Creek and its watershed, while solving the pressing flooding problem It is organized in four integrated elements Together the elements make up a comprehensive plan for management of the watershed The plan elements are entitled flood management, pollution prevention, fish and wildlife habitat enhancement, and watershed stewardship

The plan calls for both administrative and regulatory changes and for the construction of new facilities The new facilities include flood detention basins, stormwater treatment facilities, and fish and wildlife habitat enhancement projects The locations of the facilities called for in the plan are shown in Figure 2 Details of the plan, including all recommended actions, the party responsible for the actions, and estimated costs are contained in Chapter 4

POLLUTION PREVENTION PLAN ELEMENT

In the 1940s, 1950s, and 1960s, the condition of many urban rivers in the United States became so objectionable that many local communities felt they had to act Gross pollution of the Willamette River in Portland, for example, led to the construction of a sewer interceptor system and a treatment plant that discharges effluent to the Columbia River, where more dilution is available Nationally, concern about environmental problems grew, culminating in the passage of much federal and state environmental legislation, including the federal Water Pollution Control Act Amendments of 1972, the nation's first comprehensive water pollution control legislation. A number of government programs stemming from the act have been in progress for twenty years The pollution prevention element of the RMP builds on, and supplements, the existing programs

Point sources of pollution in the Johnson Creek watershed (that is, easily identifiable discharges of sewage or industrial waste) are few in number and have little influence on creek water quality They have been regulated for more than twenty years The most important remaining pollutant sources are urban and rural runoff and illicit connections to the stormwater drainage system The goal of this element of the RMP is to control these remaining pollutant sources The following actions are included in the plan element

- Fully implement urban stormwater management plans recently prepared by Portland, Gresham, and North Clackamas County, and in particular, the requirement to eliminate illicit industrial discharges to the municipal stormwater systems

- Require stormwater pollution reduction facilities be built into all new development and significant re-development

- Construct fifteen stormwater pollution reduction facilities in drainage subbasins that discharge, or have the potential to discharge, relatively-heavy pollutant loads to the creek An example of a treatment system is shown in Figure 3 The on-stream flood detention basins, referred to in the following plan element, will also remove pollutants from creek water

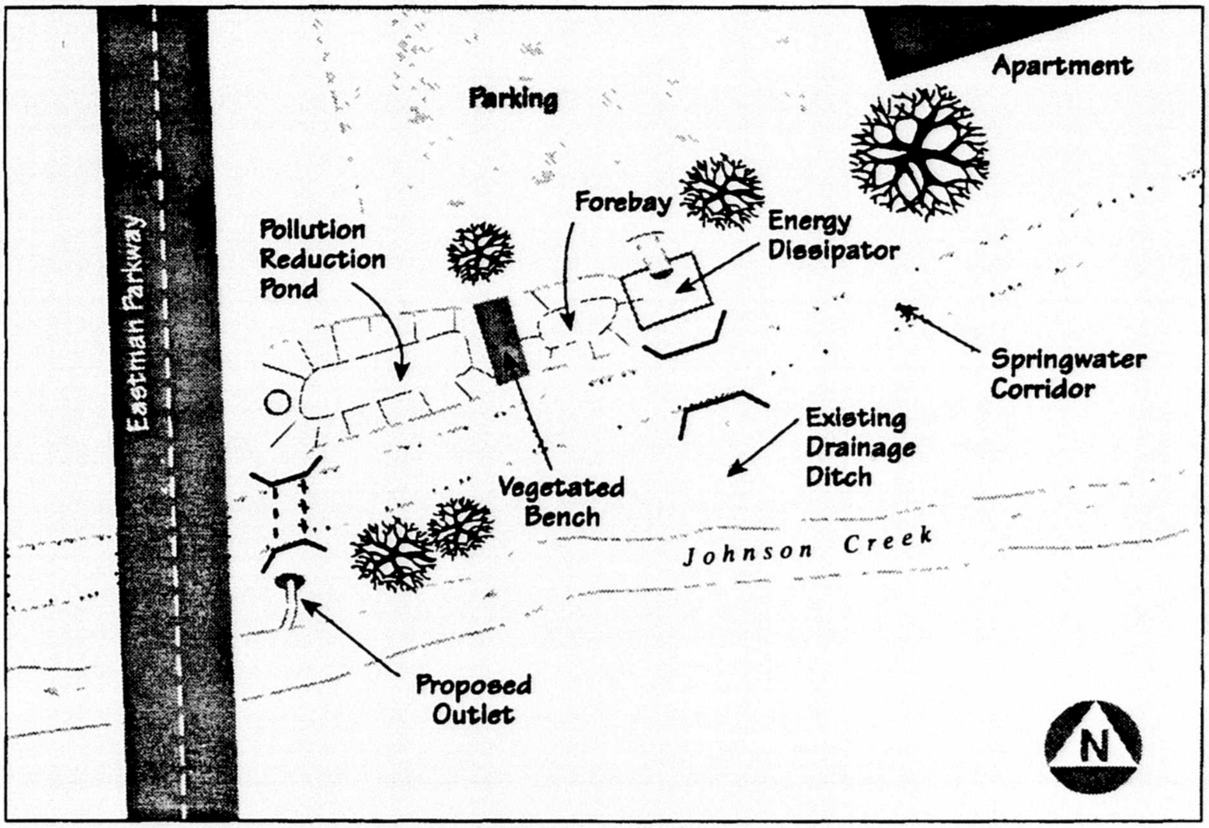
Currently, the discharge of stormwater from farms and managed forests is unregulated The plan includes the recommendation that stormwater management plans be prepared for the rural portions of the watershed and implemented through voluntary agreements with landowners

FLOOD MANAGEMENT PLAN ELEMENT

Early in the planning process it became apparent that providing existing structures with full protection from very large floods was practically impossible Furthermore, residents of flood-vulnerable neighborhoods indicated that their highest priority was avoiding the cost and inconvenience associated with frequent small floods Thus, the objective of the flood management plan element is to provide a reasonable level of flood protection to existing

FIG 3

Water Quality Improvement Facilities at Eastman Parkway Site



structures, while preventing new development from making flooding worse The plan element includes the following actions

- Construct on-stream detention basins with a combined capacity of 400 acre-feet in the upper watershed The detention basins (see Figure 4) will be substantially dry except during severe storms 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 will have multiple purposes, they will also improve water quality, expand wildlife habitat in the vicinity of Beggars-tick marsh and create opportunities for recreation Once sufficient storage has been built, a flood relief channel could be constructed around the Lents area.

- Restrict filling in the 100-year flood plain to prevent loss of flood water storage and consequent increases in flood water levels

- Maintain stream channels regularly so that their capacity to convey flood waters does not decline unacceptably

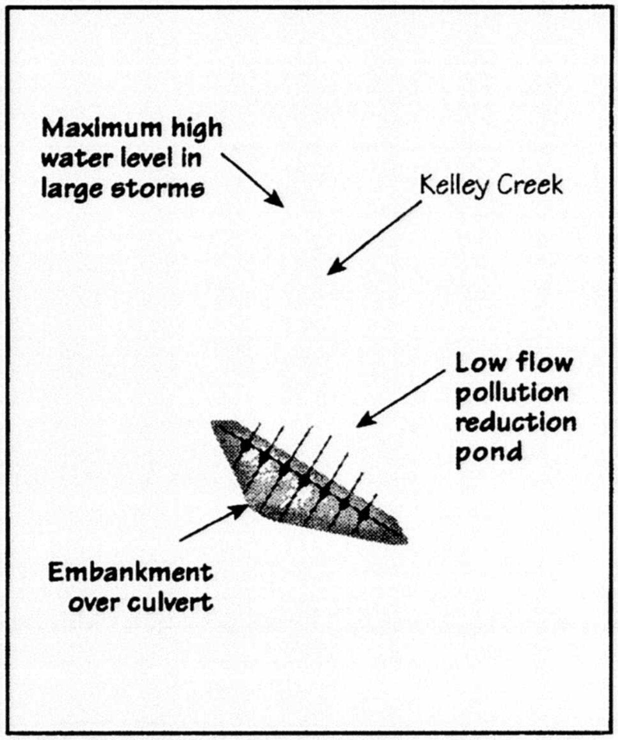
- Establish emergency response procedures to minimize damage during floods

- Limit future increases in peak flow by requiring that new developments include flood water storage facilities

- Acquire the most vulnerable structures in the flood plain as they become available from willing sellers

FIG 4

Detention Site on Kelley Creek at 190th Avenue



All the provisions in this plan element would allow the creek to be managed as a natural waterway in an urban area, rather than as a flood control channel

■ FISH AND WILDLIFE HABITAT ENHANCEMENT PLAN ELEMENT

Waterways play a key role in the natural environment The number of species found in and around rivers and streams far exceeds those found in the neighboring uplands The river corridor contains a diversity of micro-environments that provide habitat for birds, mammals, reptiles, amphibians, and fish Some of these species live permanently in the stream corridor, while others visit it periodically for food and cover Because of the stream corridor's importance to wildlife, its pollution and degradation can have a severe and disproportionate effect on the ecology of an entire watershed

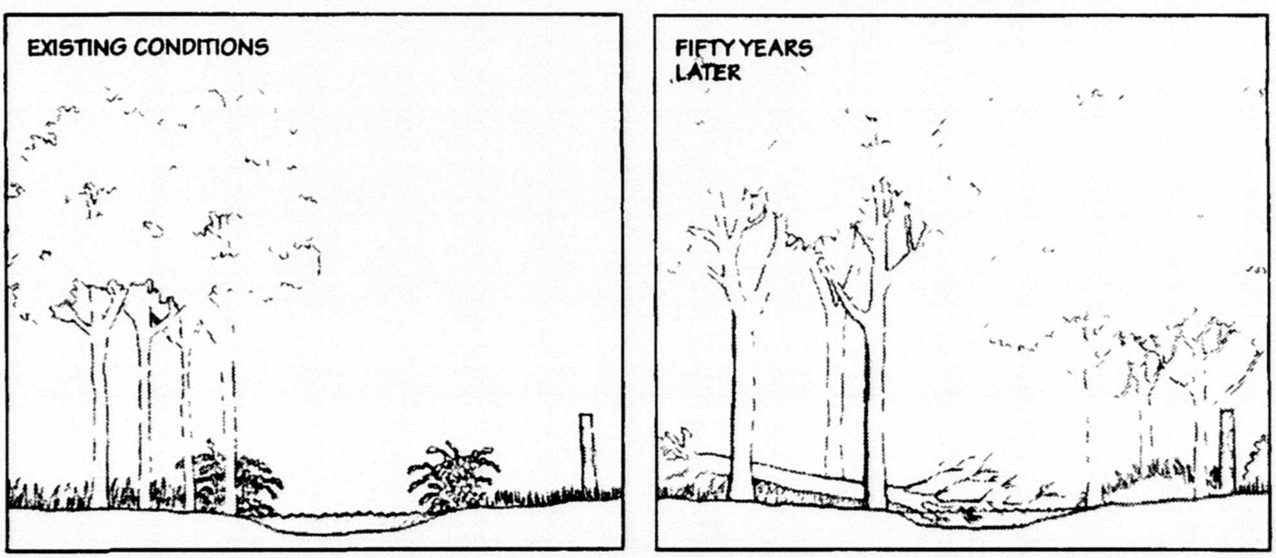
Development of the Johnson Creek watershed has had a profoundly adverse effect on the creek corridor Almost all of the old-growth streamside vegetation has been cleared The downstream reaches of the channel were rock-lined in the 1930s to reduce flooding The rock-lining project not only destroyed any remaining old-growth streamside vegetation but also confined the stream within a channel and eliminated its ability to meander within its flood plain Summertime streamflow has been reduced by development-related hydrologic changes and diversions for irrigation Despite these great changes, the Johnson Creek corridor remains important for wildlife. Enough streamside vegetation exists to provide a corridor for wildlife movement, a remnant salmonid fishery still persists, beaver flourish and a few mink inhabit the least developed tributaries

The goal of this element of the RMP is to restore high quality wildlife habitat throughout the creek corridor The plan is based on the conclusion that fish and wildlife can best be helped by restoration of a close-to-natural riparian corridor This will be done by revegetating the creek corridor with native trees and shrubs to the maximum extent possible in an urban, suburban, or agricultural setting The revegetated riparian corridor will provide a diversity of habitats for terrestrial wildlife and provide shaded waters for fish and other aquatic life It will also filter out sediments and reduce pollutant concentrations in stormwater runoff entering the stream Although development of a mature riparian forest will take 50 years or more, significant improvements in wildlife habitat can be expected in 5 to 10 years A number of interim measures will be taken to accelerate the recovery of salmon and steelhead stocks The plan element includes the following actions to improve wildlife habitat.

- Remove non-native plants from public lands and replaced them with native trees and shrubs. Similar revegetation activities should be encouraged on private lands Approximately 17 percent of the creek is currently owned by the public The effect of revegetation on a stream cross-section is shown in Figure 5

FIG 5

Typical Revegetated Creek Reach

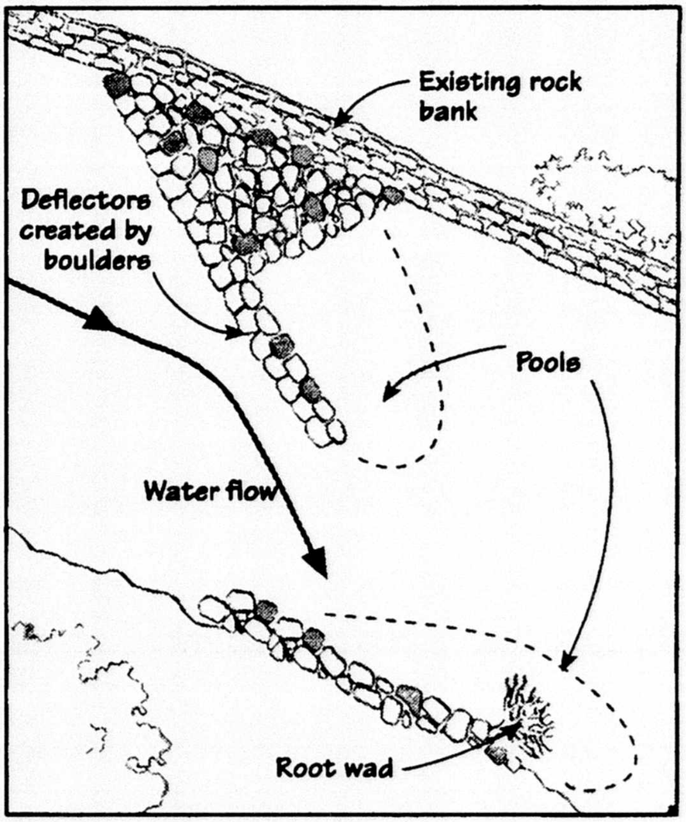


- Acquire ecologically-sensitive or high value wildlife habitats from willing sellers as they become available.

- Construction of off-stream ponds and channels to provide refugia for fish and to encourage future development of a self-sustaining run of coho salmon

FIG 6

Typical In-stream Fish Habitat Enhancement Project



- Modify the stream channel in the lower reaches of Johnson Creek, Crystal Springs Creek, and several tributaries in the upper watershed to improve cover and spawning habitat for steelhead and chinook salmon A typical in-stream modification is shown in Figure 6

Critical to the success of the salmonid fishery will be the restoration of adequate summertime streamflow The plan element recommends that this be accomplished by eliminating illegal diversions and by acquiring instream flow water rights

■ WATERSHED STEWARDSHIP PLAN ELEMENT

Responsibility for maintaining environmental quality in the Johnson Creek watershed is shared by numerous agencies and individuals No single agency focuses its exclusive attention on the watershed Six municipalities lie partially within the basin, but their boundaries do not coincide with watershed boundaries Environmental regulatory agencies, such as the Oregon Department of Environmental Quality, are organized in divisions or regions, which again do not follow watershed boundaries The division of responsibilities tends to breed confusion and inhibit action A key to the successful implementation of the RMP is the creation of an institution that has the well-being of the Johnson Creek as its first and only priority The new institution will seek to obtain the benefits of a watershed perspective while working within the existing institutional structure

Another critical factor determining the outcome of the RMP will be the engagement of citizens in plan implementation Unlike many plans where the sole responsibility for implementation lies with government agencies, implementation of the RMP will rely on a combination of agency and citizen action The plan involves a few large scale construction projects and a myriad of small corrective actions It will fail if citizens and private property owners do not actively participate The key element of the stewardship plan element is

- Establish a Johnson Creek watershed management organization with broad stakeholder representation. It will have no statutory powers and will achieve its objectives by influencing existing decision-making bodies The organization would likely evolve from the Johnson Creek Corridor Committee and should have at least one full-time staff-person who would act as the watershed steward It will be financed by grants from private and public sources The watershed management organization will foster a watershed stewardship ethic by acting as an educator, a disseminator of information and an organizer of volunteers It will also serve as a forum for discussion of development proposals in the watershed and assist existing agencies in monitoring compliance with environmental laws and regulations

The watershed stewardship plan element includes a number of other actions that will improve the quality of life and the environment in the Johnson Creek watershed

- Coordinate plans for creek improvements with improvements to the Springwater Corridor Trail to maximize collective benefits

- Protect historic structures, including the best examples of the Great Depression-era rockwork that lines the creek, and Native American artifacts

- Modify land use regulations to protect natural resources from insensitive development

In addition, the plan element recommends that various aspects of environmental quality, water temperature, numbers of returning fish, for example, be monitored to evaluate the success of the actions in the RMP and to determine whether course corrections are needed

Paying for the Plan

COSTS AND BENEFITS

The purpose of the RMP is to make the Johnson Creek watershed a better place to live By protecting the environment, while allowing development to continue, the watershed will attract new residents and visitors This will in turn increase the value of property and the patronage of local businesses New jobs may be created and, as property tax receipts increase, cities and counties will have more funds to spend on local services and capital investments Thus, the RMP will act as a catalyst for economic growth, producing widespread monetary benefits, as well as the more obvious non-monetary benefits of a pleasant environment

A number of near-term monetary and non-monetary benefits will also result from the RMP Diminution of flood risk for hundreds of homes and businesses will result in reduced flood insurance premiums, lowered damage costs, and improved public safety The flood reduction components of the RMP would prevent damages estimated at, at least, $28 million over a fifty-year period Actions in the RMP designed to improve water quality and fish and wildlife habitat are likely to bear fruit within a few years of implementation, providing recreational opportunities, and other non-monetary benefits

TABLE 1
Estimated Public Sector Costs of RMP

	Initial Costs[b]		
PP-1	Capital	Program	Annual Costs
Pollution Prevention[a]	$300,000	$273,000	$15,000
Flood Reduction	14,000,000	165,000	158,000
Fish and Wildlife Habitat Enhancement	650,000	95,000	–
Watershed Stewardship	–	90,000	100,000
TOTAL	**$14,950,000**	**$623,000**	**$273,000**

Notes

a Initial costs are non-recurring costs, that is they are costs which are only incurred once Initial costs are sub-divided into capital costs and program costs An example of an initial capital cost is the construction cost of a flood detention basin An example of an initial program cost is the cost of drafting and adopting a non-point source pollution control ordinance

b An estimated $800,000 per annum is already being expended by the cities of Gresham and Portland and Clackamas County to control pollution from urban stormwater in the Johnson Creek watershed

In order to obtain these benefits, investments must be made Most of the direct investment cost will be borne by the public sector Private parties may make direct investments in improving the watershed's environment (for example revegetating privately-owned creekside lands with native trees and shrubs) but the investments will be entirely voluntary Some secondary costs will be borne by private parties who are affected by environmental regulation stemming from the RMP. An example might be the loss of value of a privately-owned lot in the flood plain that becomes more difficult to build on as a result of environmental regulations in the RMP

The estimated public sector cost of implementing the RMP is summarized by element in Table 1 The cost estimates should be regarded as planning level estimates They are based on conceptual, rather than detailed, plans and programs

The initial public sector cost of implementing the RMP is $15.6 million All but about $650,000 will be construction cost The remainder will be the cost to begin a variety of environmental improvement programs including forming the WMO Continuing costs of about $300,000 per annum will be incurred to implement the RMP One-third of the cost will be to run the WMO, while the remainder will be used to maintain facilities The private sector cost of the RMP is estimated to be $1 4 million, primarily for revegetation of the mainstem Johnson Creek riparian corridor on private lands.

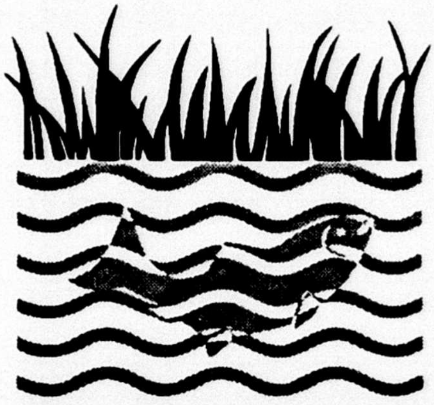
■ FUNDING

The RMP calls for actions by cities and counties, other government agencies, the yet-to-be created watershed management organization, and private individuals and corporations Three actions in the RMP involve significant capital costs for cities and counties They are the construction of flood reduction facilities, construction of stormwater pollution reduction facilities, and revegetation of the riparian corridor on public lands By far the largest capital cost will be $14 million for construction of flood reduction facilities.

Each jurisdiction would obtain its share of capital costs in the manner it chooses Several jurisdictions in the watershed charge property owners a fee for stormwater management Stormwater management fees would be a logical choice as a funding source because flood reduction is a major component of stormwater management

A large number of actions in the RMP will be undertaken by the newly-created watershed management organization (WMO) Obtaining a stable funding source for the WMO will be crucial to the success of the RMP The WMO will seek grant funds or in-kind service contributions from local, state and federal governments and from private foundations

The public sector costs of the RMP will be shared by the jurisdictions in accordance with a yet-to-be-developed formula The formula will take account of benefits received and responsibility for the problems that the RMP addresses



CHAPTER 1

WHY THE RESOURCES MANAGEMENT PLAN IS NEEDED

Watersheds and the Quality of Life

Most people consider pleasant surroundings an important part of what makes life enjoyable For some it's an apartment in the heart of the city, for others it's a neighborly suburb of well-tended homes and lawns, still others choose a cabin in the woods where the only sounds are birdsong and the wind in the trees The choice is personal, but whatever it is, a common theme is evident – surroundings matter

But what do our surroundings consist of? The region in which we live is an important part of our surroundings Residents of the Pacific Northwest are fortunate to live in a region of great natural beauty with easy access to both the outdoors and the city Then there is our home itself, where we are free to create the environment of our choice Finally, somewhere in between is another geographic unit, a neighborhood or community or perhaps even a watershed It is this third element of our surroundings, between the region and the home, that is the subject of this plan

Social and economic life is organized around the community or neighborhood, but neither unit has much meaning from an environmental point of view A more satisfactory defining unit for the natural environment is the watershed The movement of water links all parts of the natural environment together The amount of rainfall that falls on the watershed and remains in the soil determines the types of trees and shrubs that will grow there The availability of year-round flow determines the types of fish that inhabit the watershed's streams The amount and speed of runoff determine the characteristics of the stream channels The natural linkages within an area are associated with the movement of water, thus the watershed becomes an important defining unit This does not mean that the watershed is the only important ecological unit, it is, of course, part of a network of watersheds that form a regional ecosystem The watershed is, however, the most logical unit to understand and manage

THE JOHNSON CREEK WATERSHED

Johnson Creek drains a 55-square-mile, partially-urbanized watershed It is one of the last free-flowing streams in the Portland metropolitan area From its origins in the Cascade foothills to its confluence with the Willamette River, Johnson Creek flows westward 25 miles, through the cities of Gresham, Portland, and Milwaukie Its watershed was first settled by people of European ancestry in the mid-nineteenth century and now has a population of about 130,000

In common with many urban creeks, Johnson Creek has not fared well in the face of development Much of its watershed has been converted from forest to farms, cities, and suburbs Urban land uses and agriculture have encroached on the stream corridor, narrowing it and converting a natural, meandering stream into an often-polluted drainage channel The natural resource values of the stream are much reduced A few salmon and steelhead still return to the creek, but they are just remnants of former runs, only a few small islands of the original riparian forest continue to provide habitat for wildlife In addition, flooding plagues creekside neighborhoods causing damage valued at several hundred thousand dollars each year

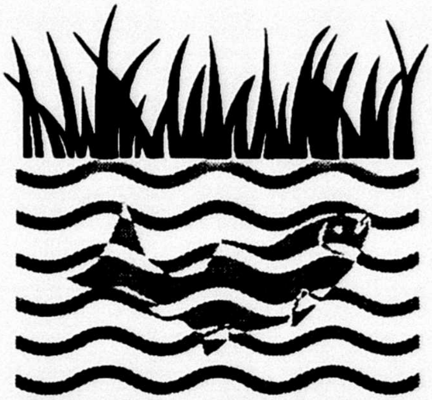
Despite the adverse effects of development on environmental quality, the watershed still contains valuable natural resources Enough streamside vegetation exists to provide a corridor for wildlife movement, beaver flourish, together with a few mink, remnant runs of salmon and steelhead persist, and fragments of the original forest can still be found But the remaining natural resources are under pressure, it is clear that without decisive action they are likely to slip away, bit by bit, as homes and businesses displace field and forest Flooding will become more severe, water quality will decline, and the opportunity to restore the creek as a community asset will be lost

ECONOMICS AND THE ENVIRONMENT

Protecting natural resources in an urbanizing area is difficult It involves reconciling what some see as irreconcilable desires for economic development and environmental protection Striking a balance between the human need for jobs, land for homes and businesses, and the needs of the environment is the basic purpose of the Johnson Creek Resources Management Plan But it is not inevitable that economic development and environmental protection must pull in opposite directions Sometimes they go in tandem Protected and well-cared for natural areas like Beggars Tick Marsh and Powell Butte make the Johnson Creek watershed a better place to live Studies have shown that proximity to natural areas raises property values New residents and visitors, drawn to the watershed by its natural areas and recreational opportunities, patronize and strengthen local businesses Thus a cycle of economic and community revitalization begins, sparked by wise environmental stewardship

THE JOHNSON CREEK RESOURCES MANAGEMENT PLAN

Protecting the watershed involves complex technical and political challenges From a technical point of view we need to understand the natural processes occurring in a stream and be able to predict how they will respond to management Because stream restoration will not occur overnight, we need to establish institutions capable of implementing and financing a long-term improvement program Sometimes, conflicting goals, flood control, and preservation of natural areas, for example, will have to be reconciled To deal effectively with these complexities, a comprehensive plan is needed The plan must take account of all activities in the watershed that adversely affect environmental quality and determine how they can be eliminated or changed It must identify the actions individuals and units of government can take to first halt, and then reverse, the trend toward environmental degradation Finally, it must set a course of action that will protect natural resources and improve the quality of life in the watershed over the next 50 years. The Johnson Creek Resources Management Plan (RMP) is such a comprehensive plan Without the RMP, actions to protect the watershed's environment are likely to be uncoordinated and ineffective



CHAPTER 2

HOW THE PLAN WAS PREPARED

Past Plans

Johnson Creek has suffered from water pollution and flooding for many years. As early as 1950 Congress authorized the U S Army Corps of Engineers to devise ways to relieve flooding on the creek Between 1950 and 1990, a number of flood reduction plans were developed, but none were implemented In 1949 a Johnson Creek Water Control District was formed Aided by the Corps of Engineers, the district attempted to build flood reduction facilities until 1964, when it was disbanded In the 1970s, the newly-formed Metropolitan Services Agency (METRO), again with Corps of Engineers assistance, developed a flood control plan Like the earlier Johnson Creek Water Control Agency plan, METRO's plan failed to obtain voter approval

Efforts to improve water quality have been more effective than the efforts to achieve flood control The discharges of industrial waste that heavily polluted the creek in the past were eliminated or controlled in the 1960s and 1970s Discharge of untreated domestic waste to the creek has been largely eliminated by the provision of public sewers and the private installation of properly-engineered septic tank systems Still, water quality in the creek fails to meet many of the applicable stream water quality standards, and salmon and steelhead runs continue to hang by a thread

By the 1980s, many residents of the Johnson Creek watershed were frustrated and disillusioned by the repeated failure of government to solve the watershed's problems The situation was exacerbated by the lack of agreement among residents on how flooding should be controlled and how to pay for any needed facilities Many watershed residents did not see how they would benefit from a single-purpose flood control project and, consequently, were unwilling to pay for one

A Fresh Approach

By the late 1980s, the city of Portland had concluded it would have to play a more active role in solving the problems of the Johnson Creek watershed In 1987, the Portland Bureau of Environmental Services prepared a drainage master plan for the city, including recently annexed neighborhoods in the Johnson Creek watershed The plan indicated that more than 1,200 acres of the city lay within Johnson Creek's 100-year flood plain In the same year Congress amended the Clean Water Act, making cities responsible for controlling pollution from stormwater

Although Portland realized that it would have to deal with the so far intractable problems of the Johnson Creek watershed, it needed to avoid the pitfalls that destroyed earlier initiatives It was clear that a new, fresh approach to planning was needed To this end, city staff gathered information on other similarly-afflicted watersheds elsewhere in the nation and consulted with a number of experts. Case histories of other projects were examined to determine if there were common denominators for technical and political success The city concluded that its Johnson Creek planning process would have the following features which have contributed to success elsewhere

- Involvement of all who may be affected by the plan or otherwise have an interest in it (stakeholders)
- Multiple objectives and benefits – the plan will address all of the watershed's environmental problems rather than focusing solely on the flooding problem
- Implementation of demonstration creek improvement projects while planning is proceeding

The Johnson Creek Corridor Committee

The keystone of the new approach to planning was the formation of the Johnson Creek Corridor Committee (JCCC) In early 1990, the City of Portland began to identify stakeholders in the Johnson Creek watershed and to invite them to form a committee that would direct the new planning effort Portland would provide the funds for the planning study and would be a member of the committee Development of the Johnson Creek Resources Management Plan (RMP) would, however, be the responsibility of the committee as a whole The first meeting of the corridor committee was held in May 1990 Subsequently, the committee has met at least bi-monthly

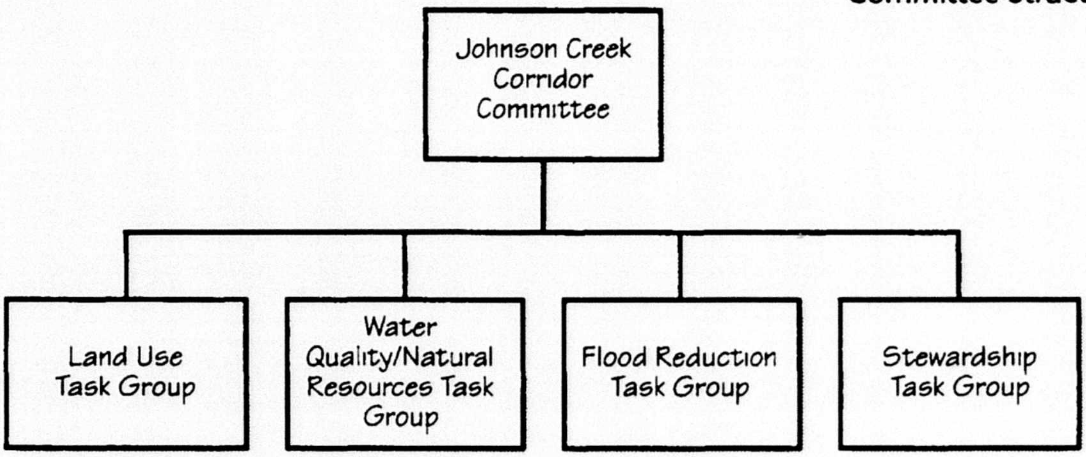
Membership of the JCCC has changed somewhat over the four-year planning period, but it has always included representatives of neighborhood groups, cities and counties, business, agriculture, and several state and federal agencies Past and present committee members and their affiliations are listed in the frontispiece

Preparing the Plan

The planning process was divided into three phases The first phase of the work included the establishment of goals for the plan and review of all existing relevant background information The focus of the second phase was preparation of the draft RMP The third phase of work involved public review of the draft RMP and preparation of the final plan

FIG 7

Committee Structure



One of the JCCC's first tasks was to develop a vision of the future of Johnson Creek After considering comments and suggestions from watershed residents at a series of public meetings and workshops, the committee published a document entitled "Johnson Creek Vision – A Look at the Future of the Johnson Creek Watershed " The JCCC also established 10 goals for the planning process The goals are shown in Table 2 At the same time, consultants working for the committee reviewed all background technical information on the watershed and developed a work plan for Phase 2

When Phase 2 commenced in July 1993, work on the RMP intensified Consultants conducted a variety of field studies and analyses, and developed an overall framework for the RMP based on the JCCC's ten goals The JCCC reviewed and approved the plan framework and directed the consultants to begin preparing drafts of plan elements, working closely with four task groups, or sub-committees, established by the JCCC The committee structure is shown in Figure 7 The task groups consisted of JCCC members and others with expertise or a special interest in the subjects addressed by different plan elements Once preliminary drafts of each plan element were completed, they were submitted to the full JCCC for discussion Each individual proposed action in the RMP was reviewed and approved by the JCCC. The consultants then prepared a complete draft of the RMP incorporating the JCCC's comments and suggestions The JCCC released the draft for public review in July, 1994

Phase 3 began in September 1994 with a series of public meetings and open houses in different parts of the watershed Written comments on the draft were accepted through the Fall. In January 1995, the JCCC considered all comments received on the draft and instructed the consultants to prepare a preliminary final RMP, incorporating those comments that the JCCC found to have merit After thorough review of the revisions, the JCCC approved release of this final RMP

Technical Studies

A number of technical studies form the foundation of the RMP The studies were documented in a series of technical memoranda Their titles are listed in Table 3. Bound copies of the technical memoranda are available for review at the offices of the City of Portland, Bureau of Environmental Services, Woodward-Clyde Consultants and at libraries within the watershed.

TABLE 2
Goals for the Johnson Creek Resources Management Plan
Developed by Johnson Creek Corridor Committee

	GOALS
1	The water in Johnson Creek and its tributaries should meet water quality standards and allow for safe human and wildlife contact
2	Good quality aquatic habitat for creek fauna, including resident and migratory fishes, should be restored and maintained
3	Flood impacts should be minimized
4	Natural areas should be preserved and restored
5	Recreational opportunities should be available in the Corridor
6	Economic Development, sensitive to the community, to the neighborhood, and to resource values should be supported
7	Heritage value of Johnson Creek should be preserved and recognized
8	The role of stewardship of natural resources should be taken on by landowners, special interest groups, and the general populace
9	People should be aware of and educated about the resource values of the Johnson Creek basin
10	The Johnson Creek basin should be a safe, clean, and aesthetically pleasing area that is appreciated by residents and visitors
11	Both private and public values should be considered and respected
12	Urban forestry objectives should be met in the Corridor

TABLE 3
List of Technical Memoranda

No	Author(s)	Title	Description
1	Davis	*Johnson Creek and Its Watershed – A Profile*	Provides a summary description of Johnson Creek and its watershed
2	Kinsella, Anderson	*Summary of Land Use Regulations for Minimizing Hydrologic Impacts*	Provides a summary of research which describes the land use development standards set by agencies in other parts of the country to minimize flooding problems and/or address water quality concerns
3	Reininga	*Water Quality in Johnson Creek – A Summary of Existing Studies and Data*	Provides a compilation of the available data from numerous water quality studies conducted in the Johnson Creek basin Provides a basis for identifying major sources of pollutants in the creek and for selecting control measures to improve water quality
4	Fowler, Kinsella	*Land Use Trends in the Johnson Creek Watershed*	Provides a summary of historical, existing and future land uses within the Johnson Creek watershed
5	Reininga	*Potential Sources of Water Quality Pollutants in the Johnson Creek Watershed*	Provides information on sources of water pollutants and their importance in the watershed Also describes the regulatory background to water pollution control
6	Ellis	*Johnson Creek Benthic Macroinvertebrate Survey*	Provides a comprehensive survey of the macroinvertebrate community (aquatic insects and other aquatic invertebrates) of Johnson Creek These aquatic insects are the food source for fish
7	Smyth	*Johnson Creek Natural Resources Field Surveys and Existing Conditions Summary*	Analyzes data gathered in field surveys in 1993 and updates data gathered earlier
8	Ellis	*A Summary of Existing Fish Population and Fish Habitat Data for Johnson Creek*	Summarizes most recent (1992-1993) salmonid population and habitat data collected by Beak Consultants, Oregon Department of Fish and Wildlife, citizen volunteers, and the author
9	Harper	*Potential Institutional Arrangements for Long-Term Watershed Management in Johnson Creek*	Describes watershed management arrangements in different parts of the western United States, and how their organizational structures might be applied in the Johnson Creek watershed

TABLE 3
List of Technical Memoranda (continued)

No	Author(s)	Title	Description
10	Harper	*Summary of Land Use Regulations Designed to Protect Johnson Creek*	Describes the measures taken by governments in the watershed to protect streamside natural resources
11	Sutherland	*Hydraulic Analysis of Early-Action Flood Reduction Projects*	Discusses of the role of bridges in impeding flow in Johnson Creek
12	Reininga	*Temperature Modeling Results from Johnson Creek*	Discusses of water temperature and how it might be lowered by vegetative cover
13	Bayh	*Program Support for Johnson Creek RMP Elements – A Survey of Public and Private Sector Possibilities*	Lists and discusses potential funding sources
14	Demuth	*Cultural Resources Analysis for Johnson Creek Waterfall, Harney Street Fish Ladder, and Rock-lined Creek Bed*	Describes the current status of the Works Progress Administration rock work
15	Sutherland	*Hydrologic Model for Flood Reduction Element*	Provides data on stream flow and water levels under a variety of conditions
16	Ellis	*A Limiting Factor Analysis for Anadromous Salmonids in Johnson Creek with a Discussion of Habitat Rehabilitation Opportunities and Constraints*	Discusses the major limiting factors for salmonid populations in Johnson Creek, and opportunities for fisheries enhancement
17	Smyth	*Wildlife Habitat Limiting Factors and Recommendations for Restoration, Enhancement and Protection*	Summarizes limiting factors for wildlife, recommendations for habitat improvement, and criteria to measure the success of habitat improvement projects
18	Reininga	*Water Quality Monitoring in Johnson Creek to Detect Trends and Measure the Effectiveness of the Resources Management Plan*	Describes recommendations for a water quality monitoring program including volunteer programs, compilation of data collected as part of other studies, temperature data collection, and development of a long-term monitoring plan

CHAPTER 3

THE JOHNSON CREEK WATERSHED

Johnson Creek originates in the hills near Cotrell and flows westward approximately 25 miles to its confluence with the Willamette River The Johnson Creek watershed, the area draining to Johnson Creek, is a roughly rectangular area of about 54 square miles The watershed and its regional location are shown in Figure 8 The topography of the watershed is varied with a high point of 1,129 feet in the Boring Hills, near the creek's source, and a low point of sea level at the confluence with the Willamette The western half of the watershed is developed, primarily as a low density residential area, but with pockets of commercial, industrial, and high-density residential land use The eastern half is mostly open space and farms The watershed lies within six political subdivisions the cities of Portland, Milwaukie, Gresham, and Happy Valley, and the counties of Multnomah and Clackamas The area of land within the watershed and within each political subdivision is shown in Table 4 The miles of mainstem of Johnson Creek that lie in each jurisdiction are also shown in the table The current population of the watershed is estimated to be about 130,000

LAND USE

Land is used for many different purposes in the Johnson Creek watershed The western third of the watershed, primarily within Portland and Milwaukie, is the most heavily developed The eastern third is mostly open space and agricultural land The middle third, which includes the City of Gresham, is a mixture of low-density residential suburbs and open space

Existing and predicted future land use in the Johnson Creek watershed is shown diagrammatically in Figure 9. Existing land use is about 54 percent farm, park and vacant lands, and 35 percent low density residential High-density residential areas and commercial and industrial areas occupy 4 and 7 percent of the watershed respectively If the watershed develops as envisioned in current city and county comprehensive land use plans, then the proportion of residential land use will expand at the expense of farms and open space. Future land use is expected to be 63 percent low-density residential, 22 percent farmland and open space, 9 percent commercial and industrial, and 6 percent high-density residential

The urban growth boundary for the Portland metropolitan area passes through the watershed Current city and county comprehensive land use plans established the urban growth boundary as it is today METRO, the regional planning agency for the four-county Portland metropolitan area, recently approved a plan to accommodate an expected population increase of 1 1 million by the year 2040 The 2040 plan does not envisage any immediate changes to the urban growth boundary in the Johnson Creek watershed Instead new residents would be accommodated by denser development of lands within the present urban growth boundary However, the 2040 plan does identify lands south and east of Gresham as "urban reserve" or lands that could be included in the urban growth boundary at some future time If this occurs, the proportion of open space and agricultural land in the watershed will decline even further

TABLE 4
Land Area and Stream Miles By Jurisdiction

	LAND AREA		STREAM MILES	
JURISDICTION	Acre	%	Miles	%
Portland	13,393	39 5	7 8	30
Milwaukie	1,235	3 6	1 7	6
Gresham	7,610	22 4	5 0	19
Happy Valley	45	0 1	-	-
Multnomah	3,694	10 9	7 0	27
Clackamas	7,927	23 4	4 7	18
TOTAL	**33,854**	**100 0**	**26 2**	**100**

Population and Community Characteristics

The presence of prehistoric relics along Johnson Creek and its tributaries indicates that Native Americans inhabited or periodically used the watershed in the nineteenth century and before In the mid-1800s, the abundant timber and game, fertile farmland, and the navigable Willamette River attracted settlers of European descent to the Willamette Valley By 1900, Portland's population had reached nearly 100,000, and was served by an extensive railroad network In 1903, the railroad was expanded through the Johnson

FIG 8

Johnson Creek Watershed

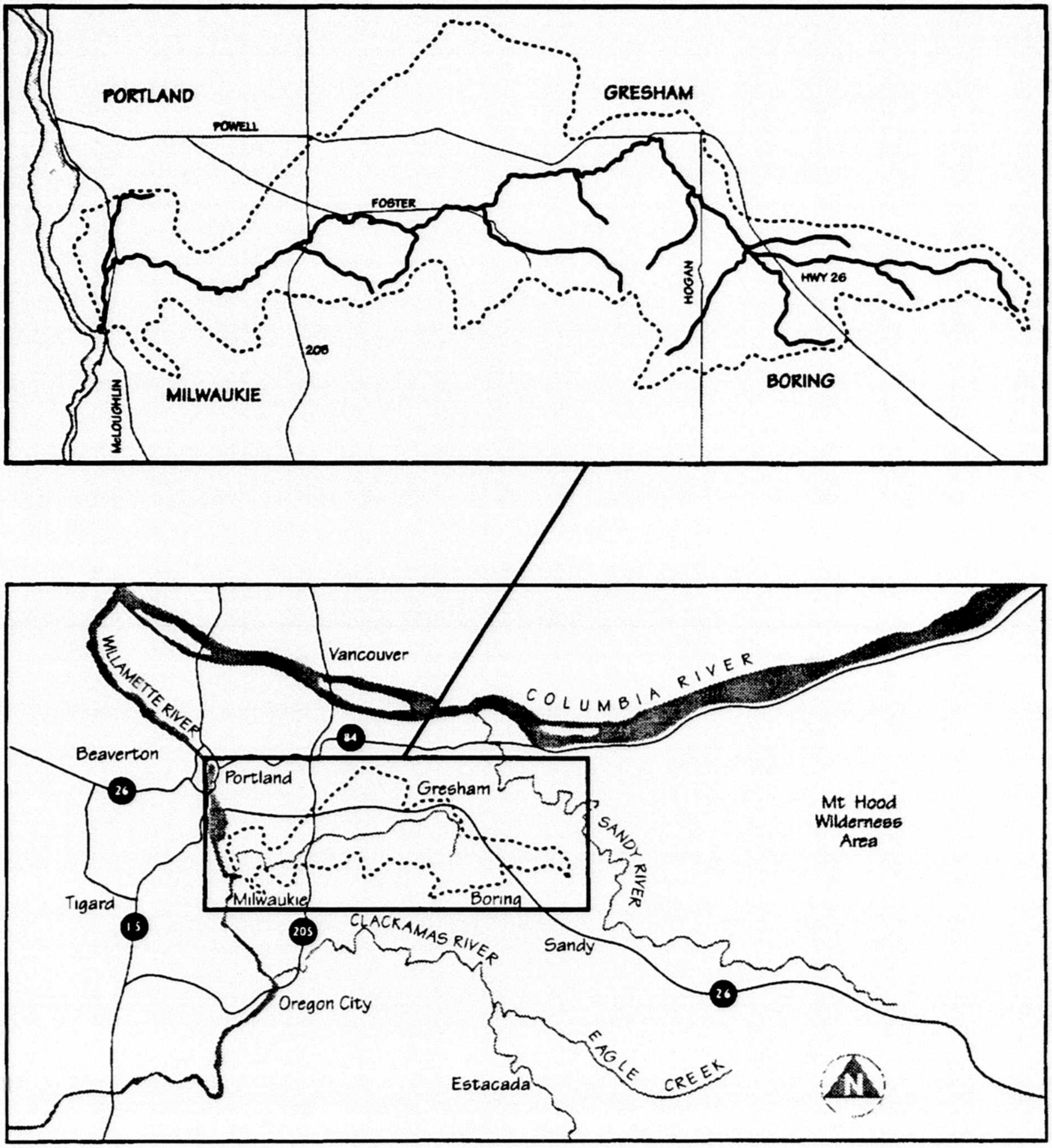
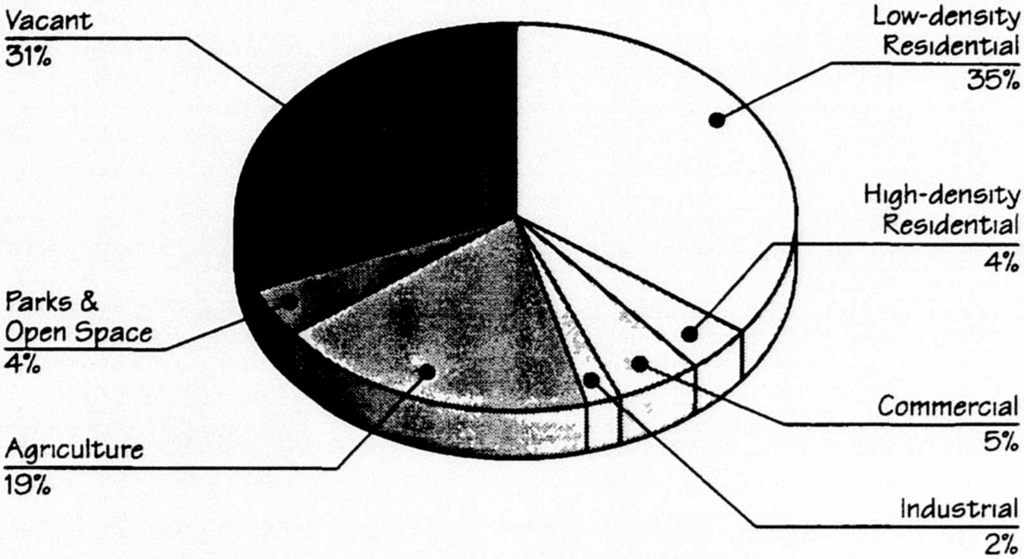


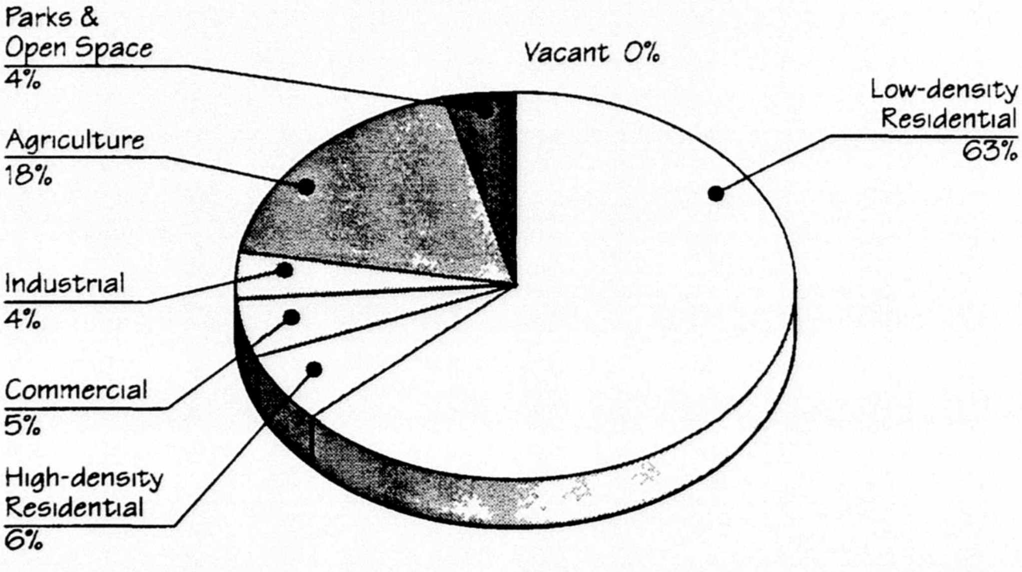
FIG 9

Land Use Percentages in Johnson Creek Watershed

EXISTING



PROJECTED FUTURE



Creek watershed to Gresham and on to Cazadero where a dam on the Clackamas River was under construction Communities grew up all along the railway The line had 54 stops, including stations at Sellwood, Milwaukie, Eastmoreland, Woodstock, Lents, Powellhurst-Gilbert, and Gresham Although the Springwater Line discontinued service in the 1930s due to the effects of the Great Depression and the advent of the automobile age, the communities along the railway continued to thrive

Population in the Johnson Creek watershed is growing rapidly The estimated watershed population at the time of the 1980 census was 96,000 By 1990, it was approximately 120,000 Today, it is probably close to 130,000

The socio-economic characteristics of the communities in the watershed are varied At the western end of the watershed, Johnson Creek passes through Eastmoreland, one of Portland's most prosperous neighborhoods with household income almost twice the city's average To the east, household income declines to less than the city's average in the Brentwood-Darlington and Lents neighborhoods of the Outer Southeast District

Further upstream, Johnson Creek passes through Gresham, a rapidly-growing suburban community that is home to many Portland commuters Household incomes in Gresham are higher than those for the Outer Southeast District of Portland.

Hydrology and Flooding

Rainfall in the Johnson Creek watershed averages 53 inches per year About 20 inches per year drain from the watershed to the Willamette River via Johnson Creek The remainder evaporates, is used by plants, or percolates deeply into the ground Soils to the north of the stream are generally very permeable, while soils to the south are impermeable As a result, most of Johnson Creek's tributaries originate from the south

Johnson Creek is a "flashy" stream, that is, it responds rapidly to precipitation over its watershed Water levels in the downstream reaches can rise and overflow stream banks within a few hours of the onset of rain Damaging floods have often been associated with rainfall on accumulated snow That was the case last year when a serious flood occurred on February 24, 1994, and also in 1964 when the largest recorded flood occurred

A number of neighborhoods along the creek are subject to frequent flooding The most severely affected area is in the Lents neighborhood near the intersection of S E Foster Road and S E 108th Avenue Other flood vulnerable areas are at S.E 158th Avenue and Foster, Bell Station, S E Johnson Creek Boulevard and S E 45th Avenue, and S E Milport Street

Water Quality

Water quality in Johnson Creek is generally consistent with what might be expected in an urban creek Water quality has probably improved considerably since 1935 when a surveyor noted that the creek was heavily polluted by domestic and sawmill wastes Since that time domestic wastes have been diverted to the municipal sewer or engineered septic tank systems Sawmill and other industrial waste discharges have either been discontinued or rerouted to the municipal sewer Despite these improvements, water quality still does not meet federal and state standards for "fishable, swimmable" waters

The principal source of pollutants entering the creek is stormwater runoff from urban and agricultural lands Rain falling on streets, parking lots, homes and businesses, carries the detritus of city life into the storm drains and on to rivers and streams. Oil and grease, metals, and street litter are all washed into urban creeks without treatment In agricultural areas, runoff carries eroded soil and pesticides into natural waterways Water quality is also degraded by periodic chemical spills Although spills do not occur often, they can have a devastating effect on water quality and aquatic life

Biological Resources

Vegetation in the Johnson Creek watershed has been greatly altered since the beginning of European settlement in the mid-nineteenth century Extensive old-growth coniferous forests were cut for timber and the fertile lowlands cleared for agriculture Later, small residential communities were established, ultimately growing to form the current urban and suburban communities. Today, the watershed is a mosaic of vegetation types, including agricultural lands, urban and suburban landscapes, upland forest, riparian woodland, and wetlands. Remnants of pre-development vegetation are rare.

Wildlife within the more urbanized portions of the watershed is limited to those species capable of co-existing with humans and able to exploit small patches of suitable habitat within an urban or suburban landscape They include American crow, American robin, European starling, song sparrow, Bewick's wren, house finch, cedar waxwing, violet-green swallow, belted kingfisher, great blue heron, mallard, wood duck, bushtit, black-capped chickadee, raccoon, opossum, nutria, and moles The less developed areas in the upper watershed probably support a greater diversity of wildlife species that are characteristic of forest and farm land They are likely to include many of the species common in the suburban areas but also western flycatcher, black-headed grosbeak, orange-crowned warbler, woodpeckers, black-tailed deer, coyote, deer mouse, voles, and bats

Nothing is known about fish populations in Johnson Creek before European settlement It seems likely, however, based on comparisons with less-disturbed streams in the lower Willamette watershed, that Johnson Creek supported runs of steelhead trout, coho, and chinook salmon Conditions for these fish declined after the watershed was settled, logged, and converted to agricultural and urban uses Channelization of much of the creek by the Works Progress Administration in the 1930s and the use of the creek for wastewater disposal further exacerbated already-deteriorated conditions Water quality in the creek has probably improved somewhat in recent years Currently, Johnson Creek contains many small non-game fish, but only a remnant of the historic salmonid runs

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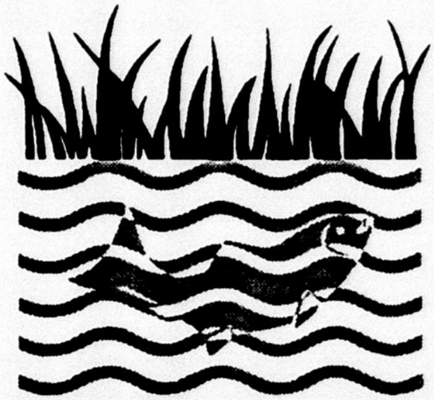


CHAPTER 4

THE JOHNSON CREEK RESOURCES MANAGEMENT PLAN

The Johnson Creek Resources Management Plan is a comprehensive plan for managing the natural resources of the Johnson Creek watershed   The plan is organized in four elements

- Pollution prevention
- Flood management
- Fish and wildlife habitat improvement
- Watershed stewardship

The four elements are fully integrated with each other and, together, they comprise the comprehensive plan

Each plan element begins with a description of the environmental problems afflicting the watershed and goes on to develop a strategy for their solution   The heart of the plan is a list of objectives and related actions   The objectives are general statements of intent based on the goals established by the JCCC and listed in Table 2   Under each objective are listed a series of actions that, if taken collectively, will result in the progressive enhancement of Johnson Creek and its watershed. In some cases, the party responsible for an action is a yet-to-be-formed watershed management organization (WMO)   The WMO will be the successor to the JCCC as discussed in the Watershed Stewardship Plan Element

POLLUTION PREVENTION PLAN ELEMENT

Water Pollution and Its Control

A BRIEF HISTORY OF WATER POLLUTION

The quality of water in Johnson Creek is influenced by a large number of natural and cultural factors Before settlement or use by man, natural factors alone (topography, soils and vegetation) influenced creek water quality Precipitation falling on plants, soils and leaf litter would dissolve salts and complex organic chemicals and carry them to the water course. Decaying vegetation would also contribute dissolved substances to the stream Now these natural processes continue, but they are radically altered by the hand of man Logging, agriculture, and urban development have changed the face of the watershed and with it the nature of the substances entering the creek

The history of Johnson Creek parallels that of many streams and rivers in the United States Relatively pristine in the days before European settlement, water quality deteriorated as the forests were cut and agriculture expanded Further deterioration occurred as the industrial revolution transformed the economy and the cities grew The quality of North American rivers and streams probably reached its low point in the 1940s and 1950s. Until that time government regulation of water pollution was limited to cases where public health was directly threatened Little or no effort was made to protect water quality, aquatic life or the scenic quality of streams

In the 1940s, 1950s, and 1960s the condition of many urban rivers became so objectionable that local communities were often forced to act Gross pollution of the Willamette River in Portland, for example, led to the construction of a sewer interceptor system that conveyed sewage to a treatment plant which discharges to the Columbia River Nationally, concern about environmental problems grew, culminating in the passage of much federal and state environmental legislation, including the Federal Water Pollution Act Amendments of 1972, the nation's first comprehensive water pollution control legislation

FEDERAL WATER POLLUTION CONTROL LEGISLATION

The goal of the Water Pollution Control Act Amendments of 1972 was to restore all of the nation's waters to a "fishable and swimmable" condition This goal was to be met by the establishment of a nationwide regulatory program called the National Pollutant Discharge

Elimination System (NPDES). Every wastewater discharge to the nation's waters was required to have a permit issued under the NPDES The NPDES is administered by the U S Environmental Protection Agency (EPA) In Oregon, the EPA has delegated administration of the program to the Oregon Department of Environmental Quality (DEQ)

The amendments delineated two different sources of water pollutants, point sources and non-point sources Point sources of pollutants are those that enter the nation's waters at a single, easily-identifiable point A city wastewater treatment plant is an example of a point source because it discharges at a single location. Non-point pollutants are those that emanate from a dispersed source and enter waterways at many locations Urban and agricultural areas are sources of non-point pollutants. They enter streams and rivers from numerous urban storm drains and rural drainage ditches

Although it was always understood that a substantial proportion of the pollutants reaching the nation's waters were from non-point sources, little was done to control them in the two decades after passage of the amendments Instead, control of point sources was emphasized because point sources produced the most severe and noticeable cases of pollution In 1987, the Congress, dissatisfied with progress in controlling non-point sources of water pollutants, strengthened federal water pollution control legislation with the passage of the Clean Water Act. The act required the extension of the NPDES to cover urban runoff, a major non-point source of pollutants Currently regulations written to implement the act require that large and medium-sized communities with separate municipal storm sewer systems obtain NPDES permits to discharge stormwater

REGULATION OF WATER QUALITY IN JOHNSON CREEK

Control of water pollution is usually accomplished in four steps which are generally outlined in the Clean Water Act First, the beneficial uses that a water body must support are identified Second, instream water quality standards are set which will allow the desired beneficial uses Third, limitations are set for pollutant discharges into the water body that are consistent with the instream water quality standards These discharge limitations are often referred to as effluent limits Finally, action is taken to ensure that pollutant discharges are controlled to the degree necessary to meet effluent limits Each of these steps has been taken, fully or partially, in the Johnson Creek watershed

The DEQ has prepared, and periodically updates, a statewide water quality plan It was prepared pursuant to the Clean Water Act and is contained in Section 41 of the Oregon Administrative Rules The plan establishes the designated beneficial uses of all water bodies in Oregon The designated beneficial uses of Johnson Creek are public and private domestic water supply, industrial water supply, irrigation, livestock watering, anadromous fish passage, salmonid fish rearing, salmonid fish spawning, resident fish and aquatic life, wildlife and hunting, fishing, boating, water contact recreation, aesthetic quality, and hydropower This means that the waters of Johnson Creek must be managed to support the designated beneficial uses

The DEQ has established instream water quality standards for Johnson Creek that are consistent with the beneficial uses The standards are summarized in Table 5 The DEQ has also issued NPDES permits to several wastewater dischargers in the Johnson Creek watershed The NPDES permits are consistent with the instream standards and are discussed later in this plan element Despite the DEQ's actions to control point sources of water pollutants, water quality in Johnson Creek does not meet DEQ's instream standards

Streams, or portions of streams, that remain out of compliance with instream standards after application of conventional controls to point sources are referred to as "water quality-limited " The Clean Water Act requires that water quality-limited stream segments be subject to further analysis to determine the level of control necessary to achieve

TABLE 5
In-stream Water Quality Standards for Johnson Creek

Dissolved Oxygen	Shall not be less than 90% of saturation at seasonal low or less than 95% of saturation in spawning areas during spawning, incubation, hatching and fry stages of salmonid fishes
Temperature	No measurable increases shall be allowed outside of the assigned mixing zone, as measured relative to a control point immediately upstream from a discharge when stream temperatures are 58o F or greater, or more than 0 5o F increase due to a single-source discharge when receiving water temperatures are 57 5o F or less, or more than 2o F increase due to all sources combined when stream temperatures are 56o F or less
Turbidity	No more than a 10 percent cumulative increase in natural stream turbidities shall be allowed, as measured relative to a control point immediately upstream of the turbidity causing activity
pH	Shall not be lower than 6 5 or greater than 8 5
Fecal Coliform	Shall not exceed a log mean of 200 fecal coliform per 100 milliliters based on a minimum of 5 samples in a 30-day period with no more than 10 percent of the samples in the 30-day period exceeding 400 per 100 ml
Total Dissolved Solids	Shall not exceed 100 mg/L
Toxic Substances	Shall not be introduced above natural background levels in the waters of the state in amounts, concentrations, or combinations which may be harmful, may chemically change to harmful forms in the environment, or may bioaccumulate to levels that adversely affect public health, safety, or welfare, aquatic life, or other designated beneficial uses And, toxic substances shall not exceed the most recent criteria values for organic and inorganic pollutants established by EPA and published in Quality Criteria for Water (1986)

compliance with instream standards   Mathematical models are used to establish a "loading capacity", that is, the greatest amount of pollutant loading the stream can receive without violating water quality standards   Total maximum daily loads (TMDLs) are then established for each pollutant of concern and allocated among the various point and non-point sources of pollutants

Although the requirement for waste load allocations in water quality-limited streams has been in effect for more than 15 years, it has been widely disregarded   Oregon, in common with most states, had not implemented the waste load allocation provision of the Clean Water Act by the late 1980s   At that time, Oregon's failure to perform waste load allocations was challenged in the courts   The court found in favor of the plaintiffs and directed the state to perform a waste load allocation for water quality-limited streams   The DEQ is currently analyzing two water quality-limited streams each year and establishing TMDLs   In the Portland area TMDLs have been established for the Tualatin River

Pursuant to the Clean Water Act, the DEQ conducts a biennial review of water quality data from water bodies in Oregon and determines whether the water bodies meet ambient standards   It also identifies those water bodies judged to be water quality-limited Johnson Creek is judged to be water-quality limited because it fails to comply with standards for bacteria and pH   The latter is a measure of the acidity or alkalinity of creek waters   A possible reason for summertime non-compliance with pH standards is excessive growth of algae which then affects water chemistry   The DEQ expects to establish TMDLs for Johnson Creek at some time in the future, but probably not for several years   Other water quality-limited stream segments in the state have been given a higher priority

The pollution prevention element of the RMP will build on the foundation of water pollution abatement actions taken over the last 20 years   As a preface to the pollution prevention plan element, the following paragraphs describe water quality problems in Johnson Creek and the pollutant sources that cause them

WATER QUALITY PROBLEMS IN JOHNSON CREEK

Water quality in Johnson Creek is generally consistent with what might be expected in an urban creek   Water quality has improved considerably since 1935 when a surveyor noted that the creek was heavily polluted by domestic and sawmill wastes   Since that time domestic wastes have been diverted to the municipal sanitary sewer system or engineered septic tank systems   The sawmills have gone out of business and most other industrial waste discharges have been rerouted to the municipal sanitary sewer system

The quality of water in Johnson Creek has been tested by a number of different agencies over the last twenty years   The most recent water quality studies were made by the U S. Geological Survey, by the City of Portland, and by teams of volunteers organized by the City of Portland   Other information has been gathered by the DEQ and Portland State University. All available data on water quality in Johnson Creek has been compiled and analyzed for the RMP   The results of the work can be found in Technical Memorandum

No 3 – *Water Quality in Johnson Creek – A Summary of Existing Studies and Data* Various aspects of stream water quality are discussed below

WATER TEMPERATURE

Water temperature depends on the source of stream water, the volume of flow, weather conditions, and the extent of shading by vegetation It is important because certain fish species usually regarded as the most desirable, coho salmon for example, have a preferred temperature range and cannot survive when temperatures rise above the range The EPA estimates that the maximum weekly average summer water temperature conducive to growth of coho salmon is 18°C The maximum temperature coho salmon can survive for short periods of time is 24°C

Water temperature in Johnson Creek in the summer is elevated above predicted temperatures for undevelopment conditions because flow and shading have been reduced. Continuous recording thermographs (temperature-measuring devices) were installed at several locations on Johnson Creek between June, 1992 and February, 1993 The highest temperatures were recorded in June, July, and August Maximum average weekly water temperatures exceeded 18°C in all sections of the creek below Gresham The maximum temperature recorded was 24°C

DISSOLVED OXYGEN CONTENT

Almost all aquatic life needs dissolved oxygen to survive In natural streams, oxygen is gradually consumed as leaves, algae, and other vegetation decay It is replaced by oxygen dissolved from the atmosphere above the stream In deep, warm, and slow moving streams oxygen can often become depleted Oxygen depletion does not usually occur in fast moving, turbulent streams For much of the year, dissolved oxygen levels in Johnson Creek are high The highest and lowest dissolved oxygen values occur during summer when creek flow is low The low values were recorded in the middle reaches of the creek and were attributed by the DEQ to decomposition of organic matter in stagnant pools The high values occur during the daytime as a result of algal photosynthesis. The EPA average monthly dissolved oxygen criterion for most life stages of salmonids and other cold water fish species is 6 5 mg/l In a recent survey conducted during summer low flows (August/September 1992), 18 of 112 samples (or 16 percent) had oxygen levels less than 6 5 mg/l All of the low oxygen levels were measured between river miles 7 and 14 where the creek is relatively flat and flow rates are low compared to other reaches

PLANT NUTRIENTS

In common with terrestrial plants, aquatic plants need nutrients (e g , nitrogen and phosphorus) to grow Aquatic plants obtain their nutrients from flowing water If high concentrations of nutrients are available during the warm summer months, then excessive aquatic plant growth can choke a stream Large crops of algae cause wide diurnal swings in dissolved oxygen content as the plants produce oxygen during daytime photosynthesis and consume oxygen during nighttime respiration When the plants die, the mass of decaying vegetation can severely deplete oxygen content.

Although concentrations of nitrogen and phosphorus currently found in Johnson Creek are sufficient to cause it, excessive algal growth does not appear to be a major problem in Johnson Creek Total phosphorus concentrations measured in the last four years in Johnson Creek have been in the range of 0 04 to 0 26 mg/l While no instream standards exist for total phosphorus in Johnson Creek, similar standards set by the DEQ for summer time flows in portions of the Tualatin River are no more than 0 07 mg/l.

BACTERIA AND OTHER MICROBES

Bacterial contamination of stream water does not appear to have a harmful effect on aquatic life, however, it can adversely affect swimmers and consumers of fish or shellfish taken from bacterially-contaminated waters Most studies of Johnson Creek waters have shown bacteria levels considerably in excess of the fecal coliform standards shown in Table 5 The fecal coliform standards are designed to protect the health of swimmers and others who use the stream for recreation

SEDIMENT

All streams carry a certain amount of sediment as stream flow erodes banks and creates bars Suspended sediment is not regarded as a pollutant unless it is present in excess High levels of suspended sediment can directly injure fish and blanket the gravel beds needed for successful salmonid spawning Salmonid eggs must be laid in well-aerated gravel, if they are to hatch successfully In common with most streams, suspended sediment concentrations in Johnson Creek increase during storm events

Sources of sediment in the watershed include bank erosion as the stream channel widens and deepens in response to increased post-development peak flows and runoff from construction sites, agricultural fields, logged areas and other areas where the ground surface is disturbed Because of the increased availability of sediment compared to pre-development conditions, siltation of the stream channel during the periods between large storms has become more severe

TOXIC MATERIALS

Toxic materials affect Johnson Creek in two ways Certain toxic substances, heavy metals such as mercury, and synthetic organic chemicals like the pesticide DDT may be washed into the stream with storm runoff from agricultural fields and industrial sites These substances, which are usually attached to particles of soil, sink to the bottom of the stream and are incorporated into the stream sediments Depending on circumstances, the toxic substances may remain bound up in the sediments or they may be consumed by microorganisms and enter the food web If they enter the food web, the substances can have adverse effects on aquatic life in unpredictable ways For example, the reproductive failure of many fish-eating birds as a result of DDT-induced eggshell thinning was not foreseen

Concentrations of copper, lead, and zinc in Johnson Creek sediments are higher than would be expected in an unpolluted environment. Concentrations of the pesticide DDT and the industrial chemical PCB in Johnson Creek sediments exceed (suggested) applicable EPA sediment criteria

The other way toxic materials reach Johnson Creek is as a result of spills Sudden discharges of industrial chemicals into the stream as a result of mishaps are quite common For example, a chemical spill near SE 52nd Avenue on August 4, 1993, killed between 500 and 1,000 fish, including 15 steelhead Less noticeably, spills of chemicals far from the creek may percolate into the groundwater and eventually migrate toward streams While the effects of individual spills may dissipate within a few hundred feet, the cumulative effect of multiple spills is an important factor in reducing the value of Johnson Creek as fish habitat

Sources of Pollutants

Potential sources of water pollutants can be conveniently divided into five categories as follows

- Municipal wastewaters
- Industrial wastewaters
- Urban stormwater runoff
- Stormwater runoff and other wastewaters from rural areas
- Spills to ground and surface waters

Each of these pollutant sources is discussed below, together with an assessment of their effect on Johnson Creek water quality NPDES pollutant discharge permits, on file at the DEQ for the Johnson Creek watershed, are discussed where applicable in the following description of pollutant sources

MUNICIPAL WASTEWATERS

Municipal wastewater is a mixture of domestic sewage and commercial and industrial wastewater generated within an urban area Municipal wastewaters are usually collected in underground sanitary sewers and conveyed to a treatment plant After treatment, effluent is typically discharged to a large river or the ocean Some low-density residential areas within a city may dispose of wastewater to individual septic tank and drain field systems Septic tank systems are effective in urban settings only if lots are large, soils are ideal and the systems are well-maintained As an urban area expands and population densities increase on the urban fringes, municipal sanitary sewer systems are usually built to replace septic systems This process is proceeding in the Johnson Creek watershed The following paragraphs describe the existing municipal sanitary sewer systems and septic systems in the watershed and describe their relationship to Johnson Creek

■ LARGE COLLECTION SYSTEMS

The Johnson Creek watershed covers approximately 33,000 acres Thirty-eight percent of the developed portion of the watershed is served by municipal sanitary sewers The remainder is served by septic tanks, cesspools or very small packaged wastewater treatment plants Major sanitary sewer systems are operated by the cities of Portland, Milwaukie, Gresham, Happy Valley, and Clackamas County Table 6 shows the acreage of sewered area within each jurisdiction and within the watershed

TABLE 6
Sewered Areas Within the Johnson Creek Watershed

Jurisdiction	Developed Area Within the Watershed (acres)	Sewered Area: Present Area	Present %	Future Area	Future %
Portland	11,264	3,267	72	9,427	85
Milwaukie	1,235	1,235	100	1,235	100
Gresham	3,143	2,699	85	3,143	100
Happy Valley	45	0	0	0	0
Unincorporated Multnomah County	80	0	0	0	0
Unincorporated Clackamas County	4,984	554	11	554	11
TOTAL	**20,751**	**7,825**	**38**	**14,357**	**69**

In general, the older, more densely developed neighborhoods in Portland, Milwaukie, and Gresham are sewered, while the fringes of the cities and the unincorporated areas are unsewered By the year 2000 relatively large areas in the Brookwild, Lents Junction, and Powellhurst neighborhoods of Portland will be sewered The Gresham sanitary sewer system is also expected to expand by 2000 or shortly thereafter

Portland's municipal sanitary sewer system differs from those of the other cities and counties within the watershed Much of Portland's collection system is a combined system, that is, it collects both sanitary wastewater and urban stormwater All other systems in the watershed collect only sanitary wastewater, while urban stormwater runoff is routed to a separate system of pipes and drainage ditches

Combined sewer systems are an obsolete technology only found in the nation's older cities They were built at a time when wastewater was not generally treated – it was simply piped to the nearest convenient water body and discharged at multiple locations referred to as outfalls In Portland the water bodies were the Willamette River and Columbia Slough After pollution of the Willamette became unacceptable in the 1940s, large interceptor sewers were built to convey wastewater from the city to a new treatment plant which discharged treated wastewater to the Columbia River However, the capacity of the interceptor sewers is only about three times greater than the dry-weather wastewater flow During anything other than light rain, the capacity of the interceptor sewers is exceeded, and combined sewage overflows to the Willamette River and the Columbia Slough at multiple locations The City of Portland's on-going combined sewer overflow (CSO) control program is designed to correct, or at least minimize, the adverse effects of the overflows No overflows occur in the Johnson Creek watershed

Within the Johnson Creek watershed, about 2,100 acres of Portland are served by combined sewers Another 1,100 acres are served by separate sanitary sewers that drain to the combined system As Portland expands its wastewater collection system, it will only build separate sanitary sewers to avoid adding still more stormwater to an already overloaded combined system

■ LARGE TREATMENT AND DISPOSAL SYSTEMS

Municipal wastewaters from the watershed are routed to one of three major treatment plants Municipal wastewater from sewered areas of Portland is piped to the City of Portland's Columbia Boulevard Treatment Plant After treatment, it is discharged to the Columbia River. Municipal wastewaters from sewered areas of Milwaukie, Happy Valley, and Clackamas County are piped to the Kellog Creek Treatment Plant operated by the Clackamas County Service District. Treated effluent is disposed of to the Willamette River Municipal wastewater from Gresham is piped to that city's treatment plant at Sandy Boulevard and 201st Street where treated wastewaters are discharged to the Columbia River

■ SMALL COLLECTION, TREATMENT AND DISPOSAL SYSTEMS

Two NPDES permits for discharges of domestic sewage in the Johnson Creek watershed are on file at the DEQ They are listed in Table 7 A small domestic wastewater system serves the Happy Valley Homes mobile home park in unincorporated Clackamas County. The system includes a packaged treatment plant which discharges to Mitchell Creek, a tributary of Kelley Creek The NPDES permit is for a discharge of 9,000 gallons per day of secondary-treated effluent

During the high stream flow season, from November to March, a packaged treatment plant is also used to treat wastewater from the Pleasant Valley School in Portland (Gresham) The NPDES permit is for a discharge of 13,000 gallons per day to Kelley Creek During the low flow season, from April to October, domestic wastewater from the school is discharged to a holding pond which is periodically pumped out and transported to Gresham's wastewater treatment plant

Packaged treatment plants are small prefabricated plants that can be delivered by truck and installed on a prepared concrete pad They are generally viewed with disfavor by water quality regulators because they must be actively maintained to produce satisfactory effluent Packaged plants usually do not receive adequate maintenance and often fail to meet their prescribed effluent limits for this reason

TABLE 7
NPDES Permits for Wastewater Discharges

Permit No	Permittee	Location of Discharge	Volume (gal/day)	Type of Waste
100912	Happy Valley Homes, Inc	River mile 1 3 on Mitchell Creek	9,000	Domestic
100686	Centennial School District Pleasant Valley School	Unnamed tributary to Kelley Creek	13,000	Domestic[a]
101133	Precision Castparts Corp	Johnson Creek at river mile 3 0 and 3 5	365,000	Industrial - Cooling Water
0100-J	Industrial Materials Technology, Inc	Drywell at river mile 4 2	35 - 135	Industrial - Cooling Water
0200-J	Gresham Court Club, Inc which is now Cascade Court Club, Inc	One mile N of Johnson Creek at river mile 13 6	Unknown	Industrial - Swimming pool filter backwash
1700-J	Ted Decious Co , Inc	Various Locations	Varies	Industrial - Washwater
1700-J	Northwest Natural Gas	Seeps into Ground	Unknown	Industrial - Washwater

Note

a The packaged plant is used from November through March Discharges go to a holding pond from April through October The holding pond is periodically pumped out and wastes are taken to Gresham's treatment plant

SEPTIC TANK SYSTEMS

As indicated in Table 6, septic tank systems currently serve approximately 62 percent of the developed portion of the watershed Properly designed septic tank systems consist of a septic tank and drain field Wastewater drains first to the septic tank where solids accumulate and are broken down by bacteria The septic tank is usually an underground concrete or fiberglass structure Effluent from the septic tank overflows to a drain field where it percolates into the ground Septic tanks operate satisfactorily if they are designed to take account of soil and topographic conditions and are regularly maintained Septic tank systems fail by "surfacing", that is, effluent emerges at the surface rather than percolating into the ground

Within the Johnson Creek watershed, septic tank systems are more likely to operate satisfactorily in the area to the north of the creek where soils are very permeable and groundwater levels are considerably below the surface. South of the creek, where soils are less permeable, there is a greater potential for problems Paradoxically, it is in the area north of the creek that cess pits and septic tanks are being replaced by municipal sewers

This is because the area north of the creek overlies groundwater bodies that are used for drinking water supply by the City of Portland and a number of small water purveyors Discharges from thousands of individual cess pools and septic tanks are gradually increasing the nitrate content of groundwater High nitrate concentrations can be harmful to infants The Mid-County sewer project is designed to prevent nitrate from rising to harmful levels in the drinking water source

Cities and counties were contacted to identify septic tank problems in the watershed Clackamas County personnel indicated that septic tank systems are problematic in an area of the county bordered by I-205 on the east, King Road on the south, the City of Milwaukie on the west, and the Clackamas County boundary on the north During the winter, soils in this area often become saturated and effluent from septic tanks surfaces rather than percolating into the ground In a few cases, attempts have been made to solve the problem by constructing above-ground sand filters to increase treatment of septic tank effluent However, the cost of each filter is about $10,000, so they are not likely to be applied widely

■ MUNICIPAL WASTEWATER DISPOSAL AND JOHNSON CREEK WATER QUALITY

As described above, the large municipal sanitary sewer systems collect wastewater from the Johnson Creek watershed and convey it elsewhere. They do not discharge directly to Johnson Creek Even when Portland's combined sewer system overflows, it does so to the Willamette River rather than Johnson Creek Thus, operating as they should, the large municipal sanitary sewer systems have no adverse impact on water quality in Johnson Creek

An exception to this may be the Johnson Creek interceptor sewer The Johnson Creek interceptor, one of the large sewers built to direct combined sewage to the Columbia Boulevard treatment plant, parallels the creek from river mile 1 to river mile 12 5 at the Gresham city boundary Because this line was buried below the water table, it was constructed with holes in the pipe bottom to prevent the pipe from being forced to the ground surface from water pressure in the soils (i e , to prevent floatation) In its efforts to reduce groundwater infiltration to the combined system, the City has recently tried to plug some of the holes with concrete However, obtaining a permanent seal is proving difficult If the plugs can be maintained in place, then they would also prevent exfiltration Exfiltration of wastewaters from the pipe could occur if the pressure of water in the pipe is greater than the water pressure of the soils This is most likely to happen during dry periods when the water table is below the bottom of the pipe

In addition to the Johnson Creek interceptor sewer, wastewater discharges from failing septic systems and small collection systems such as the packaged treatment plants located on Mitchell and Kelley Creeks (tributaries to Johnson Creek) could have a minor impact on water quality The discharges from the treatment plants are too small to have much effect on water quality beyond their immediate vicinity

INDUSTRIAL WASTEWATERS

Currently, two percent of the land in the Johnson Creek watershed is used for industrial purposes Most industries within the watershed discharge their wastewater to the municipal sanitary sewer where it is treated and disposed of together with domestic sewage. A few industries discharge directly to surface or groundwater A few others may be illicitly discharging to the separate storm sewer system Direct industrial dischargers must obtain a permit under the NPDES system. Two kinds of direct industrial discharge permits are issued by the DEQ, general permits, and individual permits Individual permits are issued to industrial dischargers that do not fall within any of the 10 general permit categories, or are unusual in some way

One individual and four general direct industrial discharge permits are currently on file for the Johnson Creek watershed Information from the permits is summarized in Table 7, together with information on domestic wastewater discharge permits It should be noted that these permits are for the direct discharge of industrial wastewaters They do not cover the discharge of potentially-polluted urban runoff from industrial sites Separate permits are required for industrial stormwater discharges, and they are discussed later in this chapter

■ DIRECT INDUSTRIAL DISCHARGES

The largest industrial discharger, and the holder of the individual industrial discharge permit, is Precision Castparts Precision Castparts includes two casting foundries located next to each other on S E Johnson Creek Boulevard (a foundry is a plant where metals are melted and poured into molds or castings) One of the foundries uses titanium as a raw material, and one uses stainless steel alloys The plant which uses stainless steel alloys discharges its process cooling waters to Johnson Creek at river mile 3.5 The temperatures of these discharges are often high ranging from 64°F to 115°F (18°C to 46°C) Precision Castparts plans to eliminate this discharge in the next year

The four general industrial discharge permits are for Northwest Natural Gas which discharges vehicle washwater to the ground at a location just south of Johnson Creek at river mile 6 6, the Ted Decious Company which discharges washwater from pressure washing of buildings to the ground and to the separate storm sewer system at various locations, the Gresham Court Club which discharges swimming pool filter backwash water to the separate storm sewer system approximately 1 mile north of the creek at river mile 13 6, and Industrial Materials Technology which discharges small volumes of cooling water to a dry sump just north of Johnson Creek at river mile 4 2

Two other general permits were recently issued to permittees within the watershed They are for temporary discharges to storm drains from groundwater remediation work associated with oil spills

ILLICIT DISCHARGES TO STORM DRAINS

As noted above, most industrial process or cooling wastewaters generated in the Johnson Creek watershed are discharged to the municipal sanitary sewer system Only a few industries discharge directly to surface or groundwater However, it is suspected that some industrial wastewaters are being discharged to the separate storm sewer system in violation of the law These illicit discharges may be a result of historic illicit connections unknown to the present owner, lack of familiarity with the law, or a deliberate attempt to circumvent water quality regulations

In 1992 and 1993, municipalities in the watershed conducted investigations of storm sewer outfalls to determine whether flow was present during dry weather These investigations were conducted to obtain data for NPDES stormwater permit applications. Flow during dry weather could be an indication of an illicit discharge Table 8 shows the results of dry weather surveys in several local communities In general, unexplained flow was found in about one-quarter of the outfalls surveyed Some of the flow could be attributable to groundwater seepage, but it is likely that most is a result of illicit industrial discharges

TABLE 8
Results of Dry Weather Surveys in Johnson Creek

Outfall Study Conducted By	Number Investigated	Number Investigated with Flow	Percent of Investigated with Flow
City of Portland	111	30	27
City of Portland	33	7	21
City of Gresham	62	12	19
Clackamas County	45	12	27
TOTAL	**251**	**61**	**24**

INDUSTRIAL WASTEWATER DISCHARGES AND JOHNSON CREEK WATER QUALITY

Direct industrial discharges are not a major factor influencing Johnson Creek water quality Most industrial wastewater is routed to the municipal sanitary sewer system and conveyed out of the watershed Direct industrial discharges to surface and groundwater of the watershed are few and small in volume The sole exception is the Precision Castparts cooling water discharge which may exacerbate the elevated creek water temperatures that occur in the summer. As noted above, this discharge will be eliminated shortly

The industrial discharges with the most importance for water quality may be illicit discharges to the separate storm sewer system Because these discharges are untreated and may be continuous, they can have a significant adverse impact on water quality and aquatic life This is particularly true during the low flow period when little dilution is available and aquatic organisms are already under stress

Stormwater runoff from industrial sites can also be important with respect to water quality It is discussed in the following section, together with other elements of urban stormwater runoff

URBAN STORMWATER RUNOFF

Urban stormwater runoff is rainwater or surface water that runs off streets, parking lots, storage yards, roofs and other surfaces, and flows into a natural waterway, drainage ditch or storm sewer system As the runoff flows across these surfaces, it picks up pollutants such as bacteria, sediments, grease, oil, metals, garbage, pesticides, fertilizers, and detergents Pollutants are carried into a separate municipal storm sewer system and from there into local rivers and creeks (or in some cases they are discharged into the ground)

The quality of urban stormwater runoff depends on land use and the activities that occur in a drainage area Runoff from residential lands often contains pesticides and fertilizers associated with lawn and garden care, bacteria from pet wastes and litter, nutrients from yard debris, oil, grease, fuel, and detergents; antifreeze from automotive maintenance, and paints and solvents from home maintenance Runoff from transportation corridors often contains oil, grease, fuels and antifreeze from automotive leaks; cadmium and zinc from tire wear, and copper from brake pad wear Runoff from construction sites, which are present in all land uses, is a potential source of sediments and solvents Runoff from commercial and industrial areas may contain a wide range of pollutants depending upon the industrial or commercial activity Typical concentrations of pollutants in Portland's urban runoff from different land use types are shown in Table 9

■ STORMWATER DRAINAGE SYSTEMS

Urban stormwater is conveyed away from homes and businesses in ditches and underground pipes, or storm sewers, that discharge to the nearest convenient natural waterway In the more developed areas, the storm drainage system includes street curbs, gutters, inlets, and an extensive network of underground pipes In the less developed areas, runoff is routed to swales and open drainage ditches

North of Johnson Creek, and particularly in unincorporated Multnomah County, storm sewer design takes advantage of the natural permeability of the soil Storm sewers are routed to dry wells or sumps where stormwater percolates into the soil Elsewhere in the watershed soils are relatively impermeable and storm drainage is routed to surface streams

■ STORMWATER PERMITTING PROGRAM

As noted earlier, in 1987 Congress amended the Clean Water Act and required that municipal and industrial stormwater discharges be included in the NPDES system In

TABLE 9
Typical Pollutants of Concern Detected in Portland's Stormwater Runoff[a]

Parameter	Detection Limit		Predominate Land Use of the Drainage Area Sampled: Residential	Commercial	Industrial	Water Quality Standard[b]
Total Suspended Solids	1 mg/L	range	18 - 127	14 - 295	37 - 1080	NA
		median	46	69	142	
Biochemical Oxygen Demand	1 mg/L	range	nd - 30	nd - 108	12 - 160	NA
		median	7	11	49	
Total Phosphorus	0 05 mg/L	range	0 07 - 1 20	0 06 - 1 10	0 35 - 1 30	NA
		median	0 22	0 27	0 63	
Nitrate	0 1 mg/L	range	nd - 6 5	nd - 2 6	nd - 0 7	NA
		median	0 30	0 30	0 15	
Copper	0 001 mg/L	range	nd - 0 049	0 003 - 0 100	0 013 - 0 120	0 008
		median	0 012	0 022	0 045	
Lead	0 001 mg/L	range	0 003 - 0 038	0 014 - 0 270	0 008 - 0 170	0 028
		median	0 010	0 056	0 039	
Zinc	0 001 mg/L	range	0 041 - 0 310	0 041 - 0 920	0 190 - 8 100	0 057
		median	0 094	0 171	0 486	
Total Oil and Grease	0 5 mg/L	range	0 8 - 3 1	0 9 - 9 9	1 7 - 16 0	NA
		median	2 8	2 9	4 6	
Fecal Coliform	1 colony/ ml 100	range	775 - 23,000	nd - 20,000	nd - 3,100	200
		median	1,971	1,157	269	

Notes
- a Concentrations presented in the table represent event mean concentrations from samples collected during ten storm events (1991 – 1993)
- b These values for metals (i e , copper, lead, and zinc) represent the acute criteria for aquatic species These criteria are based on a hardness value of 43 mg/L which is an average hardness concentration for Johnson Creek
- NA Water quality standards do not exist for these parameters
- nd not detected

1990, the EPA issued regulations which require municipalities and industries to reduce pollution caused by urban stormwater runoff. The regulations require municipalities and specific classes of industries to apply for, and obtain, NPDES permits for their stormwater discharges

Municipal permit applications include the results of monitoring and laboratory testing of stormwater to identify the types and concentrations of pollutants in runoff from different urban land uses Municipal permit applications also include comprehensive stormwater management plans to reduce pollutants in urban stormwater runoff Portland, Gresham, and Clackamas County were all required to apply for municipal stormwater discharge permits Multnomah County is a co-applicant with both Portland and Gresham Milwaukie and Happy Valley are co-applicants with Clackamas County The three municipal permit applications were filed by these communities in May 1993 The DEQ expects to issue the stormwater permits discharge in 1995

The industrial stormwater permit applications include the results of twice-yearly sampling of all of an industry's stormwater discharges and a stormwater pollution prevention plan Currently, there are 20 permitted industrial stormwater discharges in the Johnson Creek watershed (see Appendix A) Existing stormwater permits within the Johnson Creek watershed cover discharges from construction, food processing, heavy industrial activities, light manufacturing activities, and transportation Additional industrial stormwater dischargers exist in the Johnson Creek watershed which have not yet obtained the required permits from the DEQ

When the NPDES stormwater regulations were developed by the EPA, it was recognized that controlling pollutants from non-point sources, such as urban runoff, was a very different proposition from the control of point sources The control of point sources had been achieved largely by the application of structural, end-of-the-pipe treatment systems End-of-pipe treatment is less applicable to non-point pollutant sources, such as urban runoff Urban runoff is discharged to streams at numerous locations, through pipes, in ditches and across the surface of the ground In a typical urban area, hundreds of systems would be needed to treat urban runoff Because so many are needed, the treatment systems would have to be passive, that is, unlike sewage treatment plants, they would have to operate unattended The technology of passive stormwater treatment facilities, usually referred to as pollution prevention, or water quality improvement facilities, is still evolving In many cases there is insufficient space in already developed areas to build the facilities Water quality improvement facilities are more practical in new development where they can be built as part of a comprehensive storm drainage system

The NPDES stormwater regulations emphasize source control the use of "best management practices," essentially good urban housekeeping measures, to reduce the availability of urban runoff pollutants at their source Key elements of the stormwater plans from jurisdictions in the watershed are summarized in Table 10 An exception to the source control emphasis is the requirement that structural water quality improvement facilities be built into new development in some communities Other structural controls may be needed in the future if source control proves to be insufficiently effective

TABLE 10
Management Practices Proposed for NPDES Municipal Storm Water Permits

DESCRIPTION OF MANAGEMENT PRACTICES / PROGRAM PARTICIPANTS	CITY OF PORTLAND	CITY OF GRESHAM	MULTNOMAH COUNTY	CLACKAMAS COUNTY*	ODOT
Structural and Source Controls for Residential and Commercial Areas					
Description of maintenance activities and maintenance schedule for structural controls to reduce pollutants	■	■	■	■	■
Description of planning procedures for developing, implementing, and enforcing controls to reduce the discharge of pollutants from areas of new development and significant redevelopment	■	■	■	■	■
Description of practices for operating and maintaining public streets, roads, and highways	■	■	■	■	■
Procedures to assure flood management projects assess impacts on the water quality of receiving waters and the existing structural flood control devices have been evaluated to determine if retrofitting the device is cost-effective	■	■	■	■	■
Program to monitor pollutants in runoff from operating or closed municipal landfills or other treatment, storage or disposal facilities for municipal waste	■		■	■	
Program to reduce pollutants associated with the application of pesticides, herbicides and fertilizers	■	■	■	■	■
Support government and community tree planting	■		■		
Evaluate practicability of providing financial incentives for property owners who protect natural areas considered to have valuable water quality characteristics	■		■		
Require operation and maintenance plans for facilities related to new private development	■	■	■	■	
Develop stormwater quality treatment facility requirements for new and redevelopment projects	■	■			
Program for Illicit Discharges and Improper Disposal Into the Storm Sewer System					
Program to implement and enforce an ordinance, orders or similar means to prevent illicit discharges to the storm sewer system	■	■	■	■	■
Description of procedures to conduct on-going field screening activities to search for illicit discharges	■	■	■	■	■
Procedures to investigate areas in question as detected during field screening	■	■	■	■	■
Procedures to prevent, contain, and respond to spills					
Program to promote, publicize, and facilitate public reporting of the presence of illicit discharges	■	■	■	■	■
Description of educational, public information, and other appropriate activities to facilitate proper management and disposal of used oil and toxic materials	■	■	■	■	■
Description of controls to limit infiltration of seepage from sanitary sewers to the municipal storm sewer system where necessary	■			■	

* Includes cities of Milwaukie and Happy Valley

TABLE 10

Management Practices Proposed for NPDES Municipal Storm Water Permits (continued)

DESCRIPTION OF MANAGEMENT PRACTICES / PROGRAM PARTICIPANTS	CITY OF PORTLAND	CITY OF GRESHAM	MULTNOMAH COUNTY	CLACKAMAS COUNTY*	ODOT
Program to Monitor and Control Pollutants from Industrial Facilities Hazardous Waste Treatment, Disposal, Recover Facilities, and Municipal Landfills					
Procedures for inspections and establishing and implementing control measures for such discharges	■	■	■	■	
Describe a monitoring program for stormwater discharges associated with the facilities identified above	■	■	■	■	
Program to Implement and Maintain Structural and Non-Structural BMPs to Reduce Pollutants from Construction Sites					
Procedures for site planning which incorporate consideration of potential water quality impacts	■	■	■	■	■
Requirements for nonstructural and structural BMPs	■	■	■	■	■
Procedures for identifying priorities for inspecting sites and enforcing control measures which consider the nature of the construction activity, topography, and the characteristics of soils and receiving water quality	■	■	■	■	■
Description of appropriate educational and training measures for construction site operators	■	■	■	■	■

* Includes cities of Milwaukie and Happy Valley

■ URBAN STORMWATER RUNOFF AND JOHNSON CREEK WATER QUALITY

Urban stormwater is the largest source of pollutants entering Johnson Creek Pollutants are primarily discharged to the creek during the wet season (November to May) following rainfall or snowmelt In general, stormwater runoff pollutants are discharged at a time when streamflow is relatively high Despite the high streamflow and the large amount of available dilution, instream concentrations of certain toxic metals (copper, lead, silver, and zinc) exceed applicable water quality standards

Although urban runoff contributes a large mass of pollutants to Johnson Creek, the effects of most pollutants associated with urban runoff on instream water quality are transitory Johnson Creek is relatively short and swift-flowing Most pollutants discharged to the creek are rapidly carried out to the Willamette River An important exception is sediments Many of the more toxic parameters in urban runoff, namely metals, are associated with sediments A portion of the sediments discharged with urban runoff settle out in the stream Unlike the other components of urban runoff, polluted sediments may influence water quality year-round

STORMWATER RUNOFF AND OTHER WASTEWATERS FROM RURAL AREAS

Most of the eastern end of the Johnson Creek watershed is open, rural land Agriculture is the major activity in the eastern-most portion of the watershed METRO estimates that approximately 30 percent of the watershed is devoted to agriculture, not including actively managed forests As part of their Greenspaces program, METRO interpreted aerial photographs of the Johnson Creek watershed flown in 1992 and 1993 and classified the various agricultural land uses Approximately 3,000 acres, or 50 percent of the agricultural lands, are devoted to cultivated crops or pasture Another 1,160 acres, or 29 percent of the agricultural lands, are nurseries About two percent of the agricultural lands is used for berry farms The remaining 19 percent of the agricultural acreage could not be classified

Sources of pollutants in rural areas of the Johnson Creek watershed include confined animal feeding operations (CAFOs) container nurseries, crop land, and grazing land. Discharges from two of these sources, CAFOs and container nurseries, are currently regulated by the DEQ Stormwater runoff from cropland and grazing lands which may contain eroded soil, pesticides, and fertilizers, is not regulated

■ CONFINED ANIMAL FEEDING OPERATIONS

Confined animal feeding operations (CAFOs), have considerable potential to harm water quality because they result in the accumulation of large amounts of animal waste at a single location. Animal waste, discharged to a stream untreated, has the same adverse effect on water quality as untreated human waste It can cause oxygen deletion, nutrient enrichment, and elevated pathogenic bacteria levels

CAFOs are regulated by the DEQ and the Oregon Department of Agriculture The DEQ defines a CAFO as any operation where animals are confined for four months out of the year, or more, or any operation which includes a wastewater facility for animal wastes CAFOs include feedlots, dairies and poultry production facilities The DEQ issues water pollution control facilities (WPCF) General 0800-J permits to CAFOs for the land application of wastewaters Although the permits are issued by the DEQ, the Oregon Department of Agriculture (ODA) maintains the permit files and administers the program To date, three permits for CAFOs have been issued within the Johnson Creek watershed In general, CAFO permits require that animal manure be stored properly so that there is no discharge to surface streams Manure must be applied to cropland at a rate that corresponds to the crops' need for nutrients

■ CONTAINER NURSERIES

Container nurseries are nurseries where plant stock is grown in containers rather than directly in the ground Nurseries, both in-ground and container nurseries, are a major business in the Johnson Creek watershed Containers are typically placed on graveled areas which act as underdrains Pesticides, fertilizers and large amounts of water are applied to the containers during the dry summer months With little or no soil to absorb them, pesticides and nutrients are washed into the underdrains. Until recently, drain water was discharged directly to drainage ditches and natural streams As a first step toward abatement, the Oregon Association of Nurserymen, the ODA, and the DEQ developed a voluntary program for container nurseries to develop irrigation water management plans The purpose of the plans is to eliminate discharge of irrigation water during the irrigation season (between May 1 and October 31 each year) To date, nineteen container nurseries have developed irrigation water management plans within the Johnson Creek watershed

According to the Multnomah County agricultural extension service, a number of the container nurseries are voluntarily implementing a new practice of using a plastic burlap type of material to cover the ground under the containers (as opposed to using a gravel underdrain system). This permeable ground cover is used to prevent erosion and overland flow

■ RURAL STORMWATER RUNOFF

Rural stormwater runoff is stormwater drainage and overland flow associated with open spaces, agricultural lands, managed forests, and sparsely developed lands outside urban areas It is the least regulated major source of water pollutants Runoff from open lands used for agriculture or silviculture differs from runoff from wilderness or natural areas Agricultural activities and, to a lesser degree, forestry involve the periodic disruption of vegetation and the land surface As a result the land becomes subject to much more rapid soil erosion. Eroded material is washed into natural stream channels at a rate that exceeds the stream's ability to move sediment downstream

Agriculture's role in soil erosion has been recognized for many years The dustbowl conditions of the 1930s were caused by soil erosion of marginal agricultural lands The federal government, through the Soil Conservation Service, and local soil and water conservation districts, has sought to prevent a repetition by promoting farming methods that minimize soil erosion However, even well-managed agricultural land still produces more sediment than natural areas

Various chemicals, principally pesticides and fertilizers, are used in agricultural areas. Some of these chemicals are washed from plants and the soil and swept into natural drainage channels Fertilizers washed into streams can result in nutrient-enrichment and the rapid growth of algae and other undesirable aquatic plants Recently, the City of Portland obtained a list of agricultural chemicals commonly used in the Johnson Creek drainage area This list includes more than 40 herbicides, fungicides, insecticides, and soil fumigants For nurseries and crops, insecticides, herbicides, and fungicides are typically applied by spraying The frequency of application generally ranges from two to six times a year

■ GRAZING

Livestock grazing is widespread in rural areas of the Johnson Creek watershed Unlike confined animal feeding operations, no permit is needed for conventional livestock grazing, where animals are not concentrated in a small space Grazing can adversely affect water quality when livestock consume so much of the vegetative cover that soil erosion results Furthermore, animals that use streams for their drinking water directly deposit fecal matter in the stream and accelerate erosion by consuming or trampling streamside vegetation Mismanaged grazing can cause increased stream water temperature as a result of loss of shading, and elevated bacteria and sediment concentrations

■ WASTEWATER FROM RURAL AREAS AND JOHNSON CREEK WATER QUALITY

The principal uncontrolled wastewater discharge from rural areas is stormwater runoff While there is little data on pollutant concentrations in rural runoff from the Johnson Creek watershed, evidence suggests that pollutants from the agricultural areas are adversely affecting aquatic life Particle size analysis of sediments in different reaches of the creek show higher concentrations of fine sediments in the upper watershed where agricultural activities take place These fine sediments clog stream bottom gravels and make them unsuitable for spawning fish Studies of macroinvertebrates, aquatic insects that provide food for fish, indicate that their number and diversity are much higher in the lower reaches of the creek than in the upper creeks A plausible explanation is that pesticides contained in runoff from agricultural areas are depressing macroinvertebrate populations Finally, studies by the U S Geological Survey have detected elevated pesticide levels in the sediments of Johnson Creek Based on the above, it is apparent that water quality and aquatic life in Johnson Creek would benefit from better control of agricultural stormwater runoff

SPILLS TO GROUND AND SURFACE WATERS

Spills to surface waters are usually not noticed or reported unless they are associated with fish kills The Oregon Department of Fish and Wildlife maintains memoranda and reports regarding reported fish kills and other problems dating back to 1972 Of the 22 reports of fish kills from 1972 to 1988, sources were only identified for four of the episodes Although these records indicate that spills severe enough to kill large numbers of fish are infrequent, their effects can be devastating Lesser spills that may have chronic, adverse effects on aquatic life probably go unreported Although there are a number of laws and regulations designed to prevent spills to surface waters they do not seem to be fully effective in protecting Johnson Creek

Because groundwater provides much of the dry weather flow in Johnson Creek, the quality of the groundwater will influence the quality of water in the creek West of Interstate 205, groundwater in the watershed flows generally westward toward the Willamette River In areas downstream of S E 45th Avenue, where the creek is often in a canyon, numerous small springs discharge groundwater to it Crystal Springs Creek, the major source of summertime flow in the lowest reaches of Johnson Creek, is fed by groundwater emerging from a spring at the the foot of an escarpment near S E 28th Avenue and S.E Woodstock Boulevard East of Interstate 205, groundwater flow is generally directed northward toward the Columbia Slough Depths to groundwater in the Beggars-tick Marsh area are in the range 10 to 15 feet, but grow much greater moving northward This reflects the granular character of soils in this area, where sumps are used to dispose of storm drainage waters (see discussion of watershed hydrology in flood management plan element)

Spills to the ground surface in the area east of Interstate 205 and north of Johnson Creek almost certainly percolate into the groundwater and move north toward Columbia Slough rather than south toward Johnson Creek It is less clear where spills to the ground surface elsewhere in the watershed will travel The great reduction in flow that occurs in the upper reaches of Johnson Creek in dry periods suggests that groundwater input to the creek is small, probably because much of the precipitation in the watershed runs off rapidly, or percolates into deep groundwater bodies far below Johnson Creek Groundwater flow to Johnson Creek may be limited to a few areas where groundwater depths are shallow and springs emerge, or where local soil conditions result in a perched water table

Although the relationship between spills that percolate into the ground and surface water quality in Johnson Creek is not known, spills or leaking underground tanks are potential sources of pollutants entering the creek in some parts of the watershed DEQ lists eight sites in the vicinity of Johnson Creek where soil or groundwater is known to be contaminated Four sites are listed as needing further action to clean them up It appears that current federal and state programs to clean up existing contaminated sites and to prevent future contamination provide the creek with a reasonable level of protection from spills to the ground

Pollution Control Strategy

Water quality in Johnson Creek has been, and continues to be, adversely affected by man's use of the watershed. In the last two decades, steps have been taken to improve water quality in the nation's streams, including Johnson Creek Despite improvements, the creek remains polluted, it cannot meet the national goal of "fishable, swimmable" waters Furthermore, it remains less of a natural resource than the community and the JCCC wish In developing a strategy for further improvement, it is necessary to first answer a number of questions that will allow prioritization of pollution control activities Which pollution sources are having the greatest adverse effect on the creek? Are there programs in place to control these pollution sources? How effective are the existing programs? The following paragraphs attempt to answer these questions The answers are summarized in Table 11 They provide the basis for the priorities embodied in the pollution prevention plan element

Direct permitted discharges of municipal and industrial wastewater are not a major problem for Johnson Creek A control program is well-established and has been in place for 20 years The RMP does not propose any new programs Rather, it focuses on ensuring that the existing programs are effective

Illicit industrial discharges to Johnson Creek via the separate storm sewer system are an important factor influencing water quality, particularly as they continue during periods of low creek flow These discharges should be connected to the municipal sanitary sewer, but are usually inadvertently or, occasionally, deliberately connected to the separate storm sewer system instead As part of their NPDES stormwater permit applications, Portland,

TABLE 11
Pollutant Sources and Their Importance to Johnson Creek

Pollutant Source	Existing Control Program?	Importance to Johnson Creek
Municipal/Industrial Wastewater		
• Direct discharges (permitted)	Yes	Low
• Failing septic tanks	Yes	Unknown, probably low
• Illicit connections	Yes*	High
Urban Runoff		
• Sediments and associated pollutants	Yes*	High
• Other pollutants	Yes*	Moderate
Spills	Yes	Moderate
Contaminated Groundwater	Yes	Unknown
Agricultural Wastewater		
• Rural runoff	No	High
• Container nurseries	Yes	Moderate
• Confined animal feeding operations	Yes	Low

Note

* These programs are currently in the planning phase, effectiveness of the program will likely improve as plans are implemented

Gresham, and Clackamas County are proposing programs to identify and eliminate illicit industrial connections The RMP seeks to accelerate abatement of these pollution sources

Urban runoff is the largest source of pollutants entering the stream Although many of the effects of urban runoff are transient, the discharge of polluted sediments (and associated pollutants) can exert a long-term adverse effect on water quality The existing urban runoff control program is at an early stage of development and emphasizes source control of pollutants No municipal permits for stormwater discharge have yet been issued in the watershed, and only 20 of an estimated 200 industries have obtained permits for their stormwater discharges The RMP seeks to build on the existing municipal stormwater runoff plans and supplement them with structural or end-of-pipe treatment systems where needed

Wastewaters and runoff from rural areas are also a significant, although largely unmeasured, source of pollutants Existing programs address the discharge of polluted irrigation water from container nurseries and from confined animal feeding operations, but they do not address the more general issue of rural runoff Pesticides contained in the sediments of Johnson Creek are probably attributable to rural runoff in the upper watershed. The RMP proposes a more active approach to control of pollutants in stormwater runoff in the non-urban portions of the watershed

Spills of various chemicals into Johnson Creek occur periodically These spills do not occur often, but can have a devastating effect on water quality and aquatic life Years of effort to improve a stream can be nullified in minutes, if a toxic chemical spill destroys a carefully-cultivated salmonid fish population Federal regulations require that some facilities develop spill control, containment, and countermeasure plans However, it does not appear that existing regulations are fully effective in preventing spills into Johnson Creek The RMP needs to ensure that the arrangements for spill prevention are effective

Plan Objectives and Actions

The pollution prevention plan is organized as a series of objectives and actions The objectives are general statements of intent based on the goals established by the Johnson Creek Corridor Committee They also respond to the pollution control priorities discussed earlier The actions are specific programs and practices necessary to achieve the objectives and reduce water pollution. They are described below. Table 12 lists the objectives and actions, identifies the party responsible for each action, and includes an estimate of the cost of each action In some cases, the party responsible for an action is a yet-to-be-formed watershed management organization (WMO) The WMO will be the successor organization to the Johnson Creek Corridor Committee (See Watershed Stewardship Plan Element)

OBJECTIVE PP-1
Prevent Pollution from Discharges of Municipal and Industrial Wastewater.

The actions under this objective address point sources of municipal and industrial wastewater in the Johnson Creek watershed

Action PP 1-1
Periodically review direct discharges with applicable effluent limits and correct any violations

There are three currently permitted direct discharges to Johnson Creek The Happy Valley Trailer Park treatment system discharges an average of 9,000 gallons per day of treated domestic effluent to a tributary of Johnson Creek Each year from November through March, the Pleasant Valley School treatment system discharges an average of 13,000 gallons per day of treated domestic effluent to a tributary of Johnson Creek Precision Castparts discharges an average of 365,000 gallons per day of spent cooling water to Johnson Creek at River Mile 3 5 Each of these dischargers is currently required to meet waste disposal limitations and comply with minimum monitoring and reporting requirements

Self-monitoring results are currently reported to the DEQ on a regular basis Copies of the reports will be forwarded from the DEQ to the WMO Where, and if, problems are

TABLE 12
Summary of Pollution Prevention Plan Element

Objectives and Actions	Implementing Agency/ Responsible Party	Estimated Cost of Action	Portion of Estimated Annual Cost of Action Attributable to JCRMP	Priority
Objective PP-1. Prevent pollution from discharges of municipal and industrial wastewater (JCCC Goals 1, 2, and 10)				
Action PP-1-1 Periodically review information on direct discharges with applicable effluent limits	WMO	Included in the cost of Action WS-1-3	Included in the cost of Action WS-1-3	C
Action PP-1-2 Permit no new direct municipal or industrial wastewaters to streams unless water quality is protected[1]	Oregon Dept of Environmental Quality	0	0	B
Action PP-1-3 Conduct study of bacteria sources to determine role of failing septic tanks	Cities and counties	$75,000 (one-time cost)	$75,000 (one-time cost)	A
Action PP-1-4 Search for and eliminate illicit connections to the separate storm sewer system	Cities and counties	Included in Action PP-2-1	0	A
Action PP-1-5 Eliminate permitted discharges of industrial wastewater to the municipal separate storm sewer system[2]	Cities and counties	$18,000 (one-time cost)	$18,000 (one-time cost)	A
Action PP-1-6 Construct sanitary sewers to serve the problem septic/ cesspool area adjacent to the creek between river miles 4 and 6[3]	Cities of Milwaukie and Portland, and Clackamas Co	$6,000,000 (initial cost)	0	C
Objective PP-2. Reduce pollutant discharge from urban stormwater runoff (JCCC Goals 1, 2, and 10)				
Action PP-2-1 Fully implement stormwater management plans developed for NPDES municipal stormwater permits[4]	Cities and counties	$800,000 per year	0	A
Action PP-2-2 Construct stormwater pollution reduction facilities in developed areas[5]	Cities and counties	$300,000 One-time cost and $15,000 annual cost	$300,000 One-time cost and $15,000 annual cost	A

NOTE
1 This action involves no extra work All proposed new discharges will be evaluated by DEQ in accordance with current procedures
2 Portland has implemented this action The RMP proposes to extend the action to Gresham and North Clackamas County
3 The priority of this action depends on the results of Action PP-1-3
4 The cost for this action represents planned expenditures on the Johnson Creek Watershed for the City of Portland, North Clackamas Co , and the City of Gresham Rescheduling activities would not increase cost
5 Estimated cost is for six high-priority stormwater pollution reduction facilities

TABLE 12
Summary of Pollution Prevention Plan Element (Continued)

Objectives and Actions	Implementing Agency/ Responsible Party	Estimated Cost of Action	Portion of Estimated Annual Cost of Action Attributable to JCRMP	Priority
Objective PP-2. Reduce pollutant discharge from urban stormwater runoff (JCCC Goals 1, 2, and 10) (continued)				
Action PP-2-3 Establish and implement comprehensive and effective basin-wide stormwater regulations for new developments[6]	Cities and counties (intergovernmental committee)	Included in Action PP-2-1	0	A
Action PP-2-4 Reduce pollutants in stormwater associated with construction activities	Cities and counties	Included in Action PP-2-1	0	A
Action PP-2-5 Ensure full compliance with industrial stormwater permits[7]	Oregon Department of Environmental Quality	$40,000 (One-time cost)	$40,000 (One-time cost)	A
Action PP-2-6 Periodically review information on municipal and industrial stormwater discharges	WMO	Included in Action WS-1-3	Included in Action WS-1-3	A
Objective PP-3. Reduce pollutant discharge from agricultural and other rural activities (JCCC Goals 1, 2, and 10)				
Action PP-3-1 Prepare water quality management plans for non-urban areas	Soil and Water Conservation Districts	$100,000 (One-time cost)	$100,000 (One-time cost)	A
Action PP-3-2 Develop and implement a rural non-point source pollution control program for non-commercial agricultural operations[8]	Soil and Water Conservation Districts	$40,000 (One-time cost)	$40,000 One-time (One-time cost)	B
Action PP-3-3 Periodically review information on container nurseries and confined animal feeding operation	WMO	Included in Action WS-1-3	Included in Action WS-1-3	C
Action PP-3-4 Periodically review compliance with Oregon Forest Practice rules	WMO	Included in Action WS-1-3	Included in Action WS-1-3	C

NOTE
6 Related action FM-1-1
7 This action is within DEQ's current responsibilities
8 Possible cost to private parties to abate pollution

TABLE 12
Summary of Pollution Prevention Plan Element (Continued)

Objectives and Actions	Implementing Agency/ Responsible Party	Estimated Cost of Action	Portion of Estimated Annual Cost of Action Attributable to JCRMP	Priority
Objective PP-4. Prevent accidental spills into creek and tributary storm drains (JCCC Goals 1, 2, and 10)				
Action PP-4-1 Periodically review effectiveness of existing arrangements for spill prevention and control	WMO/Portland Gresham, N Clackamas Cty	WMO cost included in Action WS-1-3	Included in Action WS-1-3	B

apparent or suspected, the WMO will work with the DEQ to ensure that any problems be corrected in a timely manner.

Action PP 1-2

Permit no new direct discharges of municipal or industrial wastewater to streams in watershed unless water quality is fully protected

As noted above, there are three current direct discharges to Johnson Creek Because water quality is already impaired and because very little dilution is available in the stream in the summer months, it would be preferable to avoid any new direct wastewater discharges Within the urban areas, new municipal or industrial wastewater discharges should be routed to the municipal sanitary sewer In rural or suburban areas, new residential or commercial development should be served by municipal sanitary sewers or effective septic tank systems If there are no practical alternatives to a new discharge, then it must be treated to the degree that it reliably meets all applicable stream water quality standards

The WMO will obtain notice of all new applications for waste discharges to Johnson Creek from the DEQ The organization will comment to the DEQ on the acceptability of the applications with respect to meeting in-stream water quality standards The proposed discharge will be evaluated with regard to its impact on the creek The WMO may decide that the addition of a cool, relatively clean discharge may benefit the creek by adding to the flow volume In most cases, new direct discharges will be opposed The WMO will oppose the use of package treatment plants unless long-term maintenance can be guaranteed

Action PP 1-3

Conduct study of bacteria sources in stream water and determine role of failing septic tanks in bacterial pollution

Bacteria levels in Johnson Creek waters are usually higher than desirable. Bacteria levels are higher during wet weather than during dry weather, but almost always exceed standards for water-contact recreation During wet weather, elevated bacteria levels are probably caused by stormwater washing domestic and wild animal excrement into the creek The source of bacteria during dry weather is unknown It could result from use of the creek by wild and domestic animals, or from failing septic tank systems or exfiltration from the Johnson Creek interceptor sewer In order to target remedial action, it would be desirable to pinpoint the source or sources of bacteria in the creek This can be done by examining the genetic structure of bacteria found in the creek A similar study in the Pipers Creek watershed in Seattle identified domestic cats as an important contributor to bacteria in the creek. If the bacteria in Johnson Creek are of human origin, then it is likely they come from failing septic tanks or the interceptor sewer

If it is determined that bacteria in creek waters are from pets, domestic animals and wildlife, then little can be done beyond implementing best management practices for stormwater runoff control to reduce the accumulation of various pollutants in the watershed (see Action PP-2) If the bacteria are shown to have a human origin, then the replacement of failing septic tanks and cesspools in certain parts of the watershed could be accelerated It is not certain, however, that the benefits of reducing the bacteria levels in the creek are commensurate with the costs of control Although it is always desirable to have relatively bacteria-free water in urban creeks, the actual threat to public health and aquatic life may be quite small

Action PP 1-4

Search for and eliminate illicit industrial discharges to the municipal storm sewer system

Illicit discharges to separate storm sewer systems are defined as any discharges that are not composed entirely of stormwater Discharge of excess fire-fighting water and industrial wastewater discharges permitted by DEQ are exceptions to the rule The latter circumstance is addressed in Action PP-1-5

Elimination of illicit discharges is a major goal of the stormwater management plans recently prepared by Portland, Gresham, and Clackamas County (see earlier discussion of urban stormwater regulations and also Action PP-2-2) Each jurisdiction's stormwater plan includes a multi-step program to eliminate illicit discharges over a five-year period None of the plans give special priority to the Johnson Creek watershed, so it may be several years before field crews investigating illicit connections reach the watershed The WMO will request each jurisdiction to give high priority to detection and elimination of illicit connections in the Johnson Creek watershed In establishing priorities within the watershed, it should be noted that illicit connections to combined sewers or to storm sewers that drain to sumps do not directly affect the creek

Action PP 1-5

Eliminate permitted discharges of industrial wastewater, other than stormwater, to the municipal separate storm sewer system

DEQ has historically issued permits which allow industries to discharge process or cooling wastewater to municipal storm sewers An industry must treat its wastewater to the extent deemed necessary by DEQ, but is then permitted to use the municipal separate storm sewer to convey the treated wastewater to its ultimate disposal point, usually a stream or river

The Clean Water Act amendments of 1987 made municipalities responsible for all pollutants discharged from their separate storm sewer systems to the waters of the United States Although industrial wastewater discharge permits state that responsibility and liability for all discharges lies with the permittee, the pollutants contained in a permitted industrial discharge to the storm sewer system could become the ultimate responsibility of the municipality To avoid this potential liability, Portland recently passed City Code Ordinance 17-39, which prohibits industrial process wastewater discharges, except for non-contact cooling water, to the municipal separate storm sewer system Industries must now discharge process wastewater to Portland's sanitary sewer system or to the waters of the United States through a private sewer system In either case, treatment would be required before discharge
There are currently no permitted industrial wastewater discharges to municipal separate storm sewers in the Johnson Creek watershed To avoid this undesirable circumstance in the future, jurisdictions without an ordinance, similar to that enacted by Portland, will adopt one

Action PP 1-6

Replace failing septic tanks with sanitary sewers

Cesspool and septic systems are often problematic in one of the oldest residential areas in the watershed The area is bordered by I-205 on the east, King Road on the south, 55th Street on the west, and Alberta Street on the north During wet weather, soils in this area often become saturated and effluent from cesspools and septic tanks discharges over the surface rather than percolating into the ground The only practical solution is to replace the septic tanks and cesspools with an underground sewage collection system

Several years ago, a study was conducted to determine which jurisdiction would build sewers in various portions of this area It was decided that the Clackamas County Service District #1 will service the area to the east of Linwood Ave , the City of Milwaukie will service the area to the west of Linwood Ave.; and the City of Portland will service the area that falls within the Portland Urban Services Boundary (basically, the portion of the area that lies north of Jordan Ave) Plans have been developed for the layout of the system, but construction funding has not been forthcoming, in part because of limitations imposed by State Proposition 5 The WMO will work with Clackamas County, the City of Milwaukie, the City of Portland, and local legislators to seek funding for sewer construction

OBJECTIVE PP-2
Reduce pollutant discharges from urban stormwater runoff.

The actions under this objective address the control of urban stormwater within the Johnson Creek watershed They build on the existing control programs being implemented by jurisdictions in the watershed

Action PP 2-1

Fully implement stormwater management plans developed for NPDES municipal stormwater permits

Pursuant to the Clean Water Act, municipal stormwater permit applications were submitted to the DEQ on May 17, 1993 by Portland, Gresham, and Clackamas County The Part 2 NPDES permit applications address stormwater discharges from the urbanized portion of the watershed, including the Cities of Portland, Gresham, Milwaukie, and Happy Valley, the portions of Multnomah and Clackamas Counties within the Urban Growth Boundary, and state-owned rights-of-way operated and maintained by the Oregon Department of Transportation (ODOT) At the heart of each permit application is a stormwater management plan. The management plan includes a variety of control measures designed to reduce stormwater pollution caused by urban runoff to the "maximum extent practicable " In general, the management plans emphasize the use of source controls rather than structural controls Source controls are measures that seek to prevent pollutants getting into stormwater Structural, or end-of-pipe, controls typically attempt to treat and remove pollutants after they have already contaminated stormwater The management plans address the following major categories of discharges

- Stormwater Discharges from Commercial and Residential Areas
- Illicit Discharges and Improper Disposal
- Industrial Discharges
- Stormwater Discharges from Construction Sites

Each permit application contains several control measures to address each of the above categories Table 10 summarizes the key provisions of each plan The plans will be implemented over an initial five-year permit period The WMO will work to ensure the management plans developed by each jurisdiction are fully implemented.

Action PP 2-2

Construct stormwater treatment facilities in developed areas

As noted above, the stormwater management plans prepared by Portland, Gresham, and Clackamas County emphasize source controls rather than structural or end-of-pipe controls In many cases, however, it is unlikely that source controls alone will be sufficiently effective An example might be a drainage basin with many roads, parking lots, and transportation-related businesses Although education may reduce the use of the storm sewer system for the disposal of vehicle washwater, for example, it will not affect the build up of oil and grease and brake residue on the paved surfaces Street-sweeping may reduce the availability of pollutant material on street surfaces, but it will not eliminate it In cases such as this, where stormwater runoff pollutant loads are expected to be great, reliable pollutant removal can best be achieved by a combination of structural and non-structural measures

The pollution potential of stormwater runoff could be greatly reduced by the installation of structural or end-of-pipe pollution reduction facilities that remove a portion of the contaminants from runoff before it enters natural waterways Pollution reduction facilities might include wet ponds, filters (employing a cheap, easily replaceable filter medium such as leaf compost) or detention vaults The choice of system depends on the amount and type of contaminants expected, availability of land, size of drainage area and maintenance requirements

It would be very expensive to construct pollution reduction facilities at all points where urban runoff enters Johnson Creek It will obviously be most cost-effective to construct pollution reduction facilities at outfall locations where pollutant loads are expected to be the highest As part of Portland's municipal stormwater sampling for its NPDES permit, pollutant concentrations were measured in a number of stormwater outfalls discharging to Johnson Creek. The highest concentrations of pollutants were measured in stormwater runoff from industrial and commercial land uses (see Table 9)

Fifteen potential sites for structural stormwater treatment facilities were identified and are shown in Table 13 The sites are located at the downstream end of drainages that have exhibited high pollutant concentrations in stormwater, or contain land uses likely to generate above average pollutant loads Conceptual sketch plans of the six highest priority stormwater pollution reduction facilities are shown in Figures 10 through 15 Three types of pollution reduction devices are proposed wet ponds, vegetated swales and detention vaults Wet ponds are ponds designed to retain some water year-round The permanent ponds would support emergent and floating wetland vegetation. The effectiveness of wet ponds depends on their ability to detain urban stormwater for a sufficient period of time to allow polluted sediments to settle out. Even if there is insufficient land available to provide an ideal detention time, wet ponds still produce water quality benefits because they serve as a buffer between the storm drainage system and the stream During the summer months storm drains often continue to drain small quantities of water from the urban area These small flows, which may include groundwater, runoff from irrigated lawns and landscaping, runoff from car washing, and washdown water from paved surfaces, are often more polluted that wet season urban runoff The wet pond may provide days of detention for these small flows, allowing their pollutant potential to be reduced before discharge to the creek The avoidance of sudden shock loads of pollutants to the creek is particularly important in the summer, when creek flows are at a minimum and over-summering juvenile salmonids at their most vulnerable

Vegetated swales provide some minimal pollution reduction by a combination of sedimentation and filtration through vegetation The longer the swale, and the slower the water moves through it, the greater the pollutant removal Like small wet ponds, their greatest benefit may be to intercept and delay small summertime shock loads

Both wet ponds and vegetated swales are designed to operate with a minimum of maintenance In fully developed urban areas, where there is no land available for wet ponds, detention vaults can provide some pollution reduction Conventional detention vaults can remove sediments and oil from urban runoff by sedimentation and flotation, when flows are small enough to allow relatively quiescent conditions within the vault Little or no removals can be expected in high flows, in fact, high flows will usually scour

TABLE 13
Stormwater Treatment Projects for Developed Areas

Outfall Location River Mile	Outfall Location Outfall Size	Characteristics of the Drainage Area	Sampling Results	Potential Water Quality Control Measure	Priority for Implementation
Main City Park in Gresham					
16 0	48" and 42"	Drainage from high density residential and commercial/industrial	NA	Treatment Wetlands	A
Johnson Creek west of Walters Street					
15 7	30"	High density residential and commercial	NA	Treatment Wetland	A
Eastman Parkway					
14 9	36"	Mixed single and multi-family residential	NA	Detention Pond	A
SE 106th and Foster Road					
7 4	18"	Foster Rd and commercial/ industrial land use	Relatively high levels of TSS, BOD, COD, nutrients, oil & grease, and metals	Detention Vault	A
Johnson Creek Blvd. east of Bell Station					
4 8	12"	Commercial/industrial land use	Relatively high levels of TSS, nutrients, oil & grease, and metals	Detention Vault	A
Johnson Creek Park					
1 3	30"	McLoughlin Blvd , residential / industrial land use	Relatively high levels of nutrients and metals	Vegetated Channel	A
Hogan Rd. Bridge					
17 8	12" and 18"	Drainage from Columbia Brickworks Inc	High levels of TSS	Detention Vault	B*
72nd St. north of Johnson Creek Blvd					
5 2	18"	Industrial/commercial land use	High levels of TSS, BOD, COD, nutrients, oil & grease and metals	Detention Vault	B*
Pleasantview Drive					
13 5	30"	Drainage from Powell Blvd	NA	Detention Pond/ Treatment Wetland	B
Flavel just east of I-205					
6 6	Drainage Ditch	I-205 and single family residential land use	NA	Vegetated Swale	B
Flavel and 92nd St					
6 4	24"	Commercial/industrial land use	Relatively high levels of mercury	Detention Vault	B

TABLE 13

Stormwater Treatment Projects for Developed Areas (Continued)

Outfall Location River Mile	Outfall Size	Characteristics of the Drainage Area	Sampling Results	Potential Water Quality Control Measure	Priority for Implementation
Harney and 82nd St.					
5 8	21"	82nd St and commercial land use	NA	Detention Vault	B
Harney and 80th St					
5 7	72"	I-205	NA	Treatment Wetland	B
Johnson Creek Blvd and Wichita					
4 2	24"	Johnson Creek Blvd and commercial/industrial land use	Relatively high levels of metals	Detention Vault	B
Ochoco St.					
0 7	48"	McLoughlin Blvd , residential and industrial land use	NA	Treatment Wetland	B

* Discharges from these outfalls have been identified as containing elevated levels of pollutants The sources of these discharges have been tracked to specific industrial facilities These discharges would be reduced or eliminated when industrial NPDES stormwater permitting regulations are fully implemented (see PP-2-5) The WMO will assist DEQ in locating industrial stormwater dischargers and coordinate stormwater plan implementation with jurisdictions However, because of their significant impact to water quality, these sites have been identified as high priority and included in this list as potential sites for water quality treatment facilities

out any accumulated materials in the vault It is apparent that unmaintained conventional vaults probably remove very few pollutants over a season Well-maintained vaults will produce some removals, but most of the accumulated material is likely to be coarse grit and sand The finer particles in urban runoff are thought to carry the greatest pollutant load It may be possible to improve the performance of vaults by developing a design that by-passes high flows around the vault and thereby preventing the scouring out of accumulated material Vaults installed as part of the RMP will include a high-flow by-pass

In recent years, considerable research has been conducted into new ways of reducing the pollution potential of urban runoff New technologies include filters using sand and leaf compost as filter media Several tests are underway in the Portland area If the tests are successful then these new technologies could be considered for use in the Johnson Creek watershed Currently, the City of Portland does not recommend the use of leaf compost filters

Because local experience with stormwater pollution reduction facilities is limited, it was thought prudent to initially construct six systems to gain experience, before building the other nine, and perhaps, proceeding to a larger scale construction program

Action PP 2-3

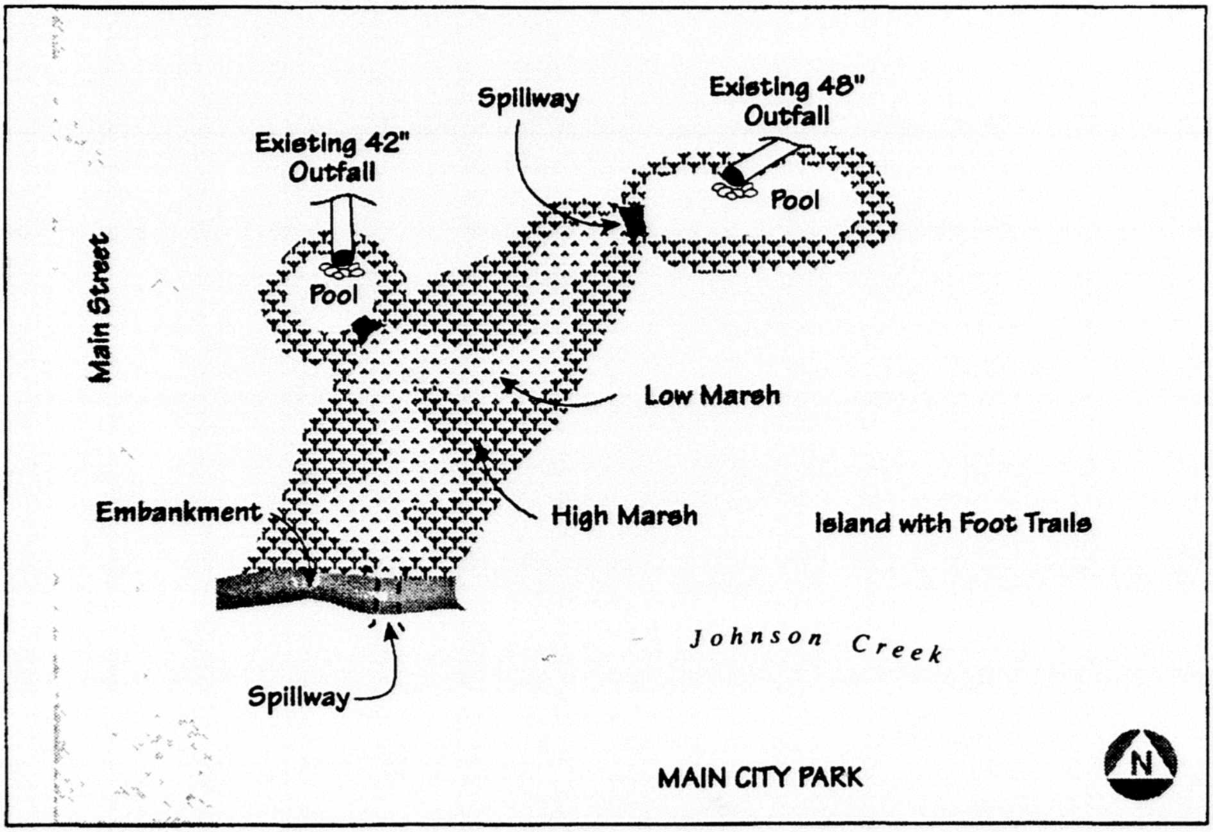
Establish and implement comprehensive and effective basin-wide stormwater regulations for new developments

As the watershed continues to develop, the potential for urban runoff pollution will increase To avoid this, the quality of stormwater discharged from new development and significant redevelopment will have to be controlled The goal should be to limit post-development pollutant loads to the maximum extent practicable

In most cases, stormwater quality control facilities are currently only required for public works projects and new development or redevelopment in designated environmental zones However, recent NPDES stormwater regulations (described in Action PP-2-1) require municipalities to develop system-wide comprehensive master plans to "develop, implement and enforce controls to reduce the discharge of pollutants from areas of new development and significant redevelopment " In response to this requirement, the cities of Portland, Gresham, Happy Valley, Milwaukie, and Clackamas and Multnomah Counties have proposed various plans for reducing pollutants in runoff from new development and significant redevelopment (see Table 10) New

FIG 10

Gresham Main City Park Water Quality Improvement Facilities

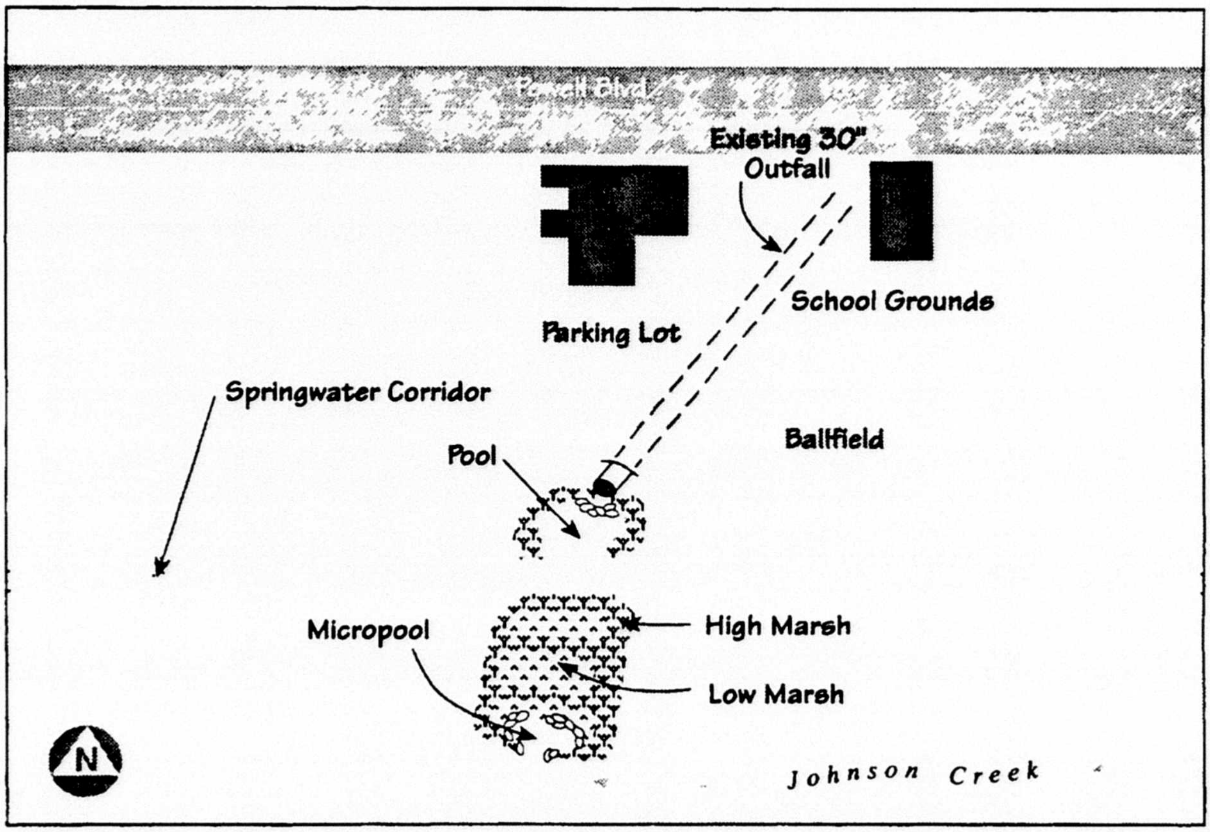


regulations, incentives, and education programs will assist developers in using the appropriate control measures in building the necessary stormwater-quality control facilities into their developments For example, the City of Portland recently published an updated technical design guidance manual for stormwater quality improvement facilities This manual will provide developers with guidance for selecting and designing stormwater quality treatment facilities to meet yet-to-be established city-wide stormwater quality treatment standards

Cities and counties in the Johnson Creek watershed will fully implement plans to meet the municipal NPDES requirement to reduce the discharge of pollutants from areas of new development and significant redevelopment Because the establishment of a comprehensive set of stormwater quality and quantity standards is technically complex and difficult, an intergovernmental committee will be established to consider the options and recommend an effective and equitable set of regulations for adoption and implementation by all jurisdictions within the watershed The intergovernmental committee will consider options that integrate water quantity and water quality requirements

FIG 11

Water Quality Improvement
Facilities West of Walters Street



Action PP 2-4

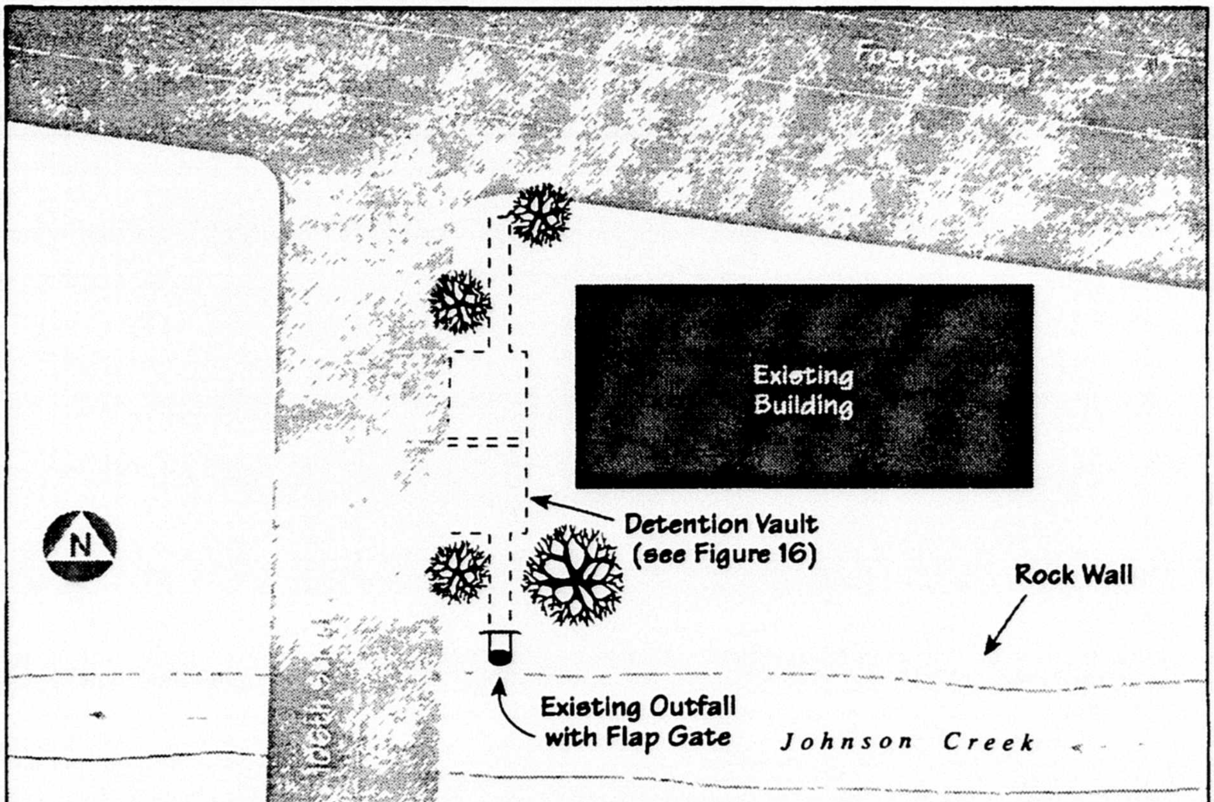
Reduce pollutants in stormwater associated with construction activities

As discussed earlier, sediment discharges to Johnson Creek are adversely affecting water quality and aquatic life In urban areas undergoing development, runoff from construction sites is generally noted as the largest source of sediment discharges. As development in the watershed progresses, the potential for the discharge of pollutants associated with construction sites will continue

A construction site operator is required to obtain an NPDES general permit from the DEQ to discharge stormwater from construction activities, including clearing, grading, and excavation, which result in a disturbance of five or more acres. The permit requires the permit holder to implement an erosion control plan for the construction site which will minimize the erosion from disturbed land during the construction activities and specifies minimum monitoring and reporting requirements The permit specifies that visible or measurable erosion that leaves the construction site is prohibited.

FIG 12

Water Quality Improvement Facilities at 106th and Foster Road

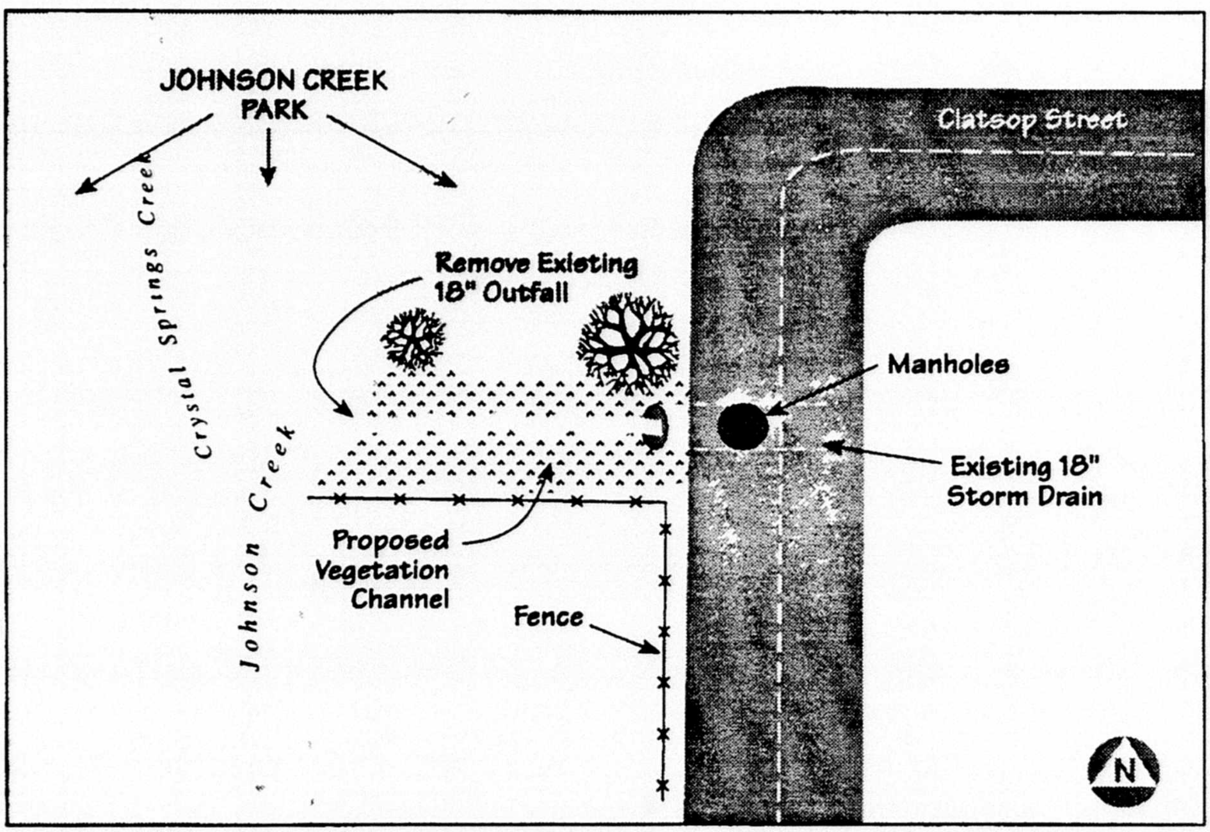


In addition, NPDES stormwater regulations (described in Action PP-2-1) require municipalities to develop programs to "implement and maintain structural and non-structural best management practices to reduce pollutants in stormwater runoff from construction sites to the municipal storm sewer system " The program must include procedures for site planning which incorporate consideration of potential water quality impacts, requirements for structural and non-structural best management practices, procedures for identifying priorities for inspecting sites and enforcing control measures, and educational and training measures for construction site operators The goal of this regulatory requirement is to ensure that appropriate measures to control pollutants from construction sites are implemented and properly inspected and maintained

In response to this requirement, municipalities have proposed in their stormwater management programs to review, and where necessary, improve existing programs to reduce pollutants associated with construction activities As with controls proposed for new developments (Action PP 2-3), new regulations, incentives, and educational and

FIG 13

Water Quality Improvement Facilities
at Johnson Creek Park



training programs will assist construction site operators in using appropriate control measures during construction

In order to reduce the discharge of pollutants associated with construction activities, the cities and counties in the Johnson Creek watershed will fully implement plans to meet the NPDES municipal requirements Under Action PP 2-6, the WMO will review annual reports of progress with implementation of this requirement that are submitted to the DEQ The WMO will use this information to check that compliance is occurring

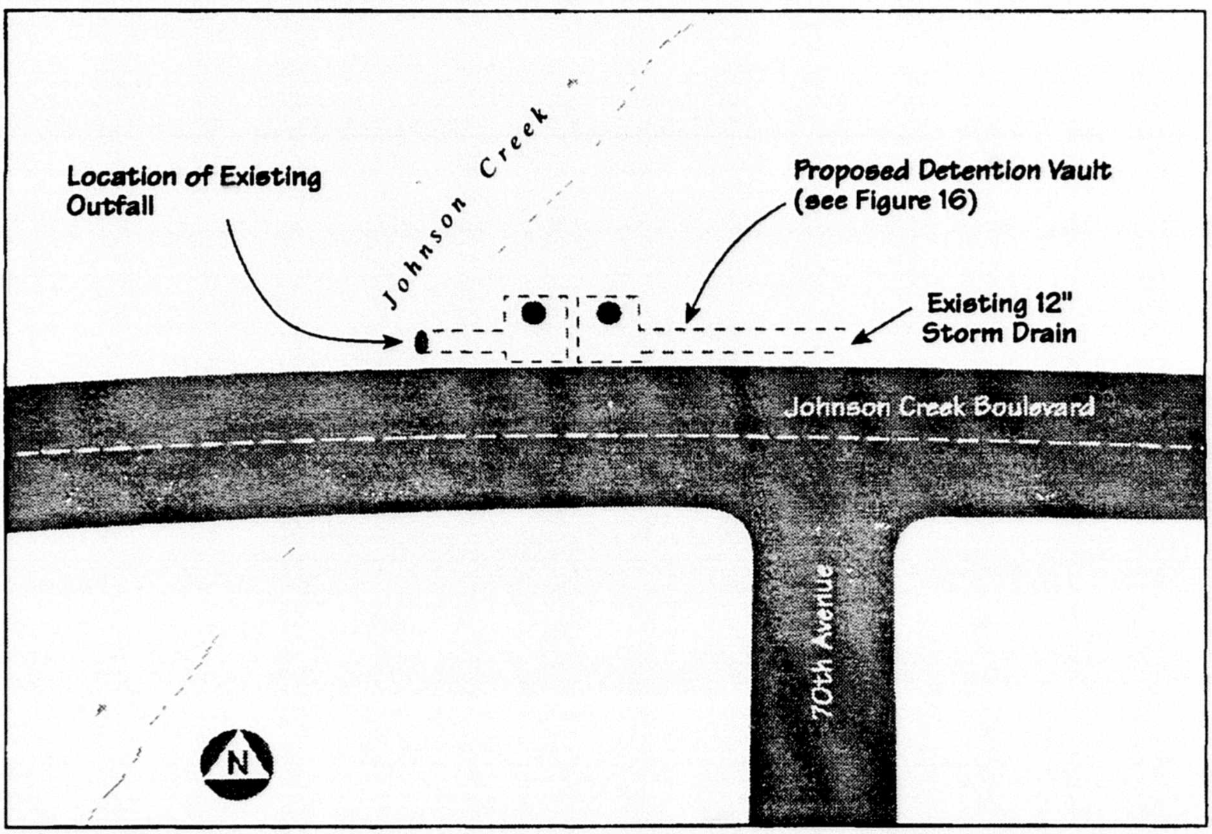
Action PP 2-5

Ensure full compliance with NPDES industrial stormwater permit requirements

The Clean Water Act requires that industrial facilities obtain a NPDES Industrial Stormwater Permit from the DEQ to discharge stormwater associated with industrial activity directly to surface waters or indirectly through a municipal separate storm sewer system. The application requires each industry to develop a Stormwater Pollution Control Plan (SWPCP) for preventing or reducing stormwater pollution from their facility. SWPCPs must contain a complete site description, a stormwater

FIG 14

Water Quality Improvement Facilities at Johnson Creek Blvd



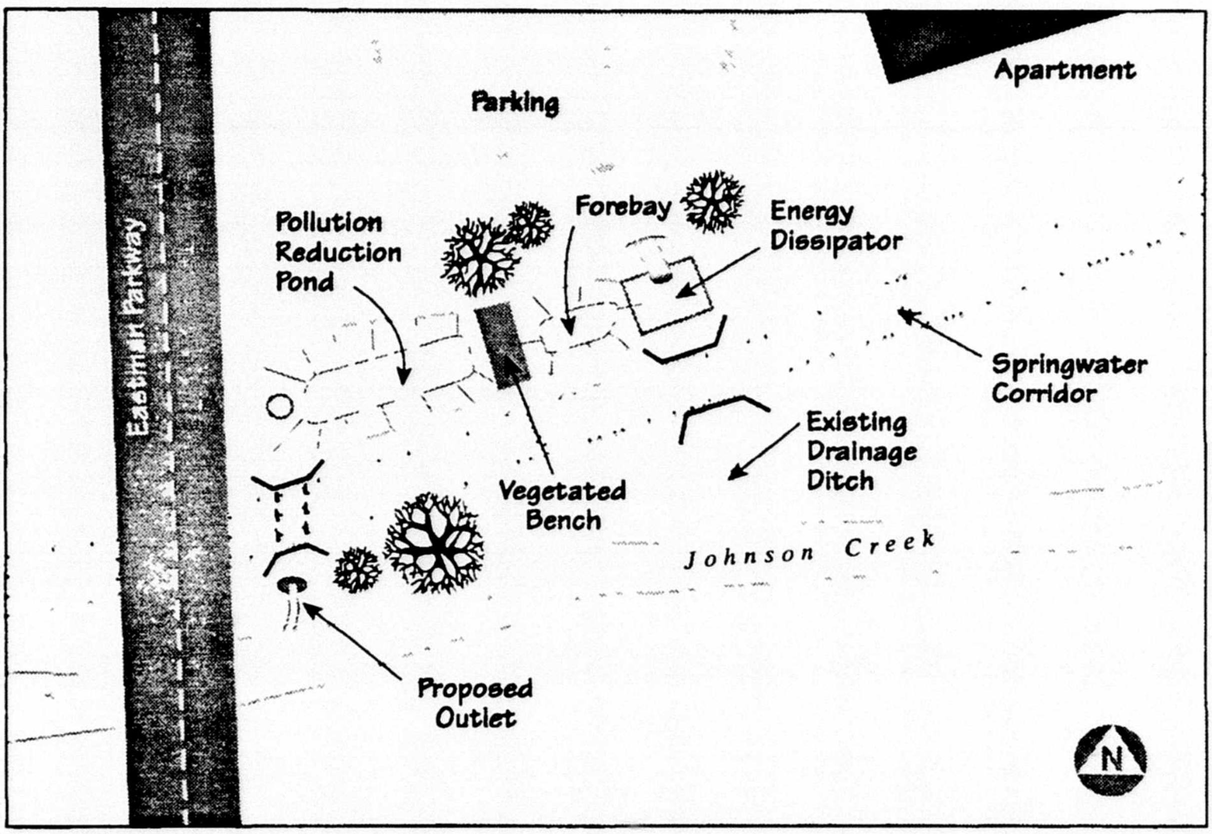
management plan and a description of procedures for spill control, maintenance, and employee education

As part of their Part 2 NPDES Municipal Stormwater Permit Applications, the co-applicants for the Portland, Gresham, and Clackamas County permits identified industries within their jurisdictions which may be required to apply for NPDES Industrial Stormwater Permits Approximately 200 industrial facilities were identified in the Johnson Creek watershed that may be required to obtain a stormwater permit. To date, only twenty industries in the Johnson Creek watershed (or roughly 10 percent) have applied for and received a stormwater discharge permit (they are listed in Appendix A)

Although responsibility for administering the industrial permit program belongs to the DEQ, cities and counties may have some interest in ensuring that industries that discharge to a municipal sewer comply with the industrial NPDES stormwater permit requirements This is because cities and counties are ultimately responsible for all

FIG 15

Water Quality Improvement Facilities at Eastman Parkway Site



discharges from their storm drains The WMO will work with cities and counties and the DEQ to help non-complying industries obtain the necessary discharge permits

Action PP 2-6

Periodically review information on municipal and industrial stormwater discharges

To ensure full compliance with the stormwater management plans developed by the municipal permittees, the WMO will review the annual compliance reports submitted to the DEQ by Portland, Gresham, and Clackamas County The WMO will obtain a copy of the industrial SWPCP implementation schedules and track progress Where compliance problems are evident, the WMO will work with the DEQ and local jurisdictions to ensure corrective action is taken

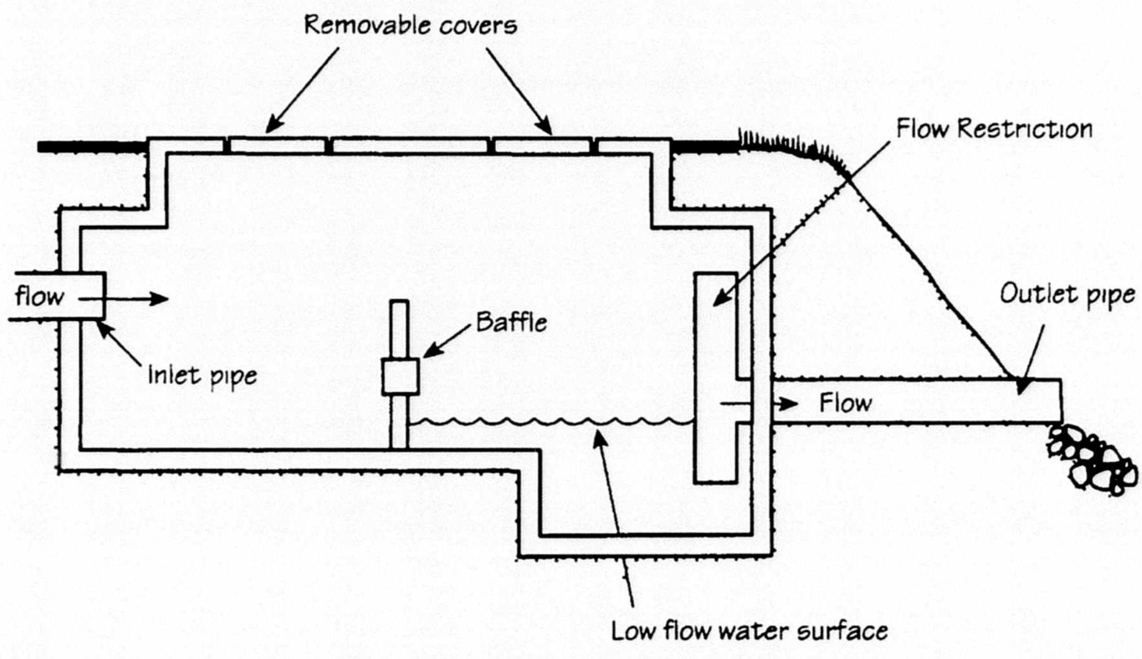
OBJECTIVE PP-3

Reduce pollutant discharge from agricultural and other non-urban economic activities.

Agricultural activities can have a profound effect on water quality In the Johnson Creek watershed where land use is one-third rural, improvements in water quality will depend on the prevention and control of water pollution from rural land uses

FIG 16

Typical Detention Vault



Action PP 3-1

Prepare water quality management plans for non-urban areas

Historically, agricultural lands have been largely exempt from laws protecting water bodies from non-point sources of pollution For example, the Clean Water Act addresses only urban and industrial stormwater discharges To address water quality impacts from agricultural activities, a water quality management plan will be developed for the rural portion of the watershed The plan will encourage voluntary implementation of best management practices (BMPs) to prevent or reduce water quality impacts from the following practices

- Cultivation of cropland
- Grazing
- Irrigation of cropland
- Application of pesticides
- Application of fertilizers

Although site-specific pollution control measures will be developed in the agricultural water quality management plan, the general characteristics of best management practices are described below.

To prevent erosion from cropland, practices will be implemented in the field to prevent the transport of sediments (e.g , conservation tillage, critical area planting, etc.) and to route runoff through facilities that will remove sediments (e g, vegetative filter strips, field borders, retention ponds, etc.).

The focus of grazing management will be on the riparian corridor, however, the health of the riparian system is also dependent on the proper management of upland areas Grazing management measures will be used to reduce the physical disturbance of the streambanks, reduce the discharge of sediments, animal wastes, nutrients, and chemicals to the creek, and allow for revegetation along the corridor Potential grazing management measures for the riparian corridor include fencing animals from selected areas of the corridor, providing stabilized access areas to the creek and providing alternative watering sites Potential grazing management measures for upland areas include proper treatment and use of pasture lands and proper grazing intensities

The goal of irrigation management is to reduce the amount of flow that is diverted from the creek, and to reduce non-point source pollution associated with irrigation return flows A current inventory of water users on the creek will be developed under Action FW-5-1 This will include a list of the water uses related to irrigation Irrigation management measures will be developed to reduce waste of irrigation water, improve water use efficiency, and reduce the total pollutant discharge from an irrigation system Specific practices might include improved irrigation scheduling, efficient water application, efficient water transport, utilization of runoff or tailwater, and drainage water management (Irrigation management measures for container nurseries are addressed separately under Action PP-3-3.)

The goal of pesticide management is to release fewer pesticides and/or less toxic pesticides into the environment and to use practices that minimize the discharge of pesticides to surface and groundwater Potential practices may include the fostering of natural enemies of pests, use of crop rotations, destruction of pest breeding areas, and proper application rates

The goal of fertilizer management is to minimize nutrient discharge to the creek and promote more efficient uses/applications of nutrients Methods for the application of nutrients can generally be improved to reduce the discharge of nutrients into receiving waters Practices include developing a nutrient budget for the crop, applying nutrients at the appropriate time, and applying nutrients in the amounts needed only

The program described above to control non-point sources of pollutants will be voluntary However, two recently established regulatory requirements may make some elements of the program mandatory Oregon's Senate Bill 1010 and the 1990 amendments to the federal Coastal Zone Management Act

Senate Bill 1010, which was recently passed in Oregon (ORS 568 900 to 568 933), applies to non-urban areas which lie within watersheds where total maximum daily loads (TMDLs) have been established for the receiving water In these non-urban areas, the Oregon Department of Agriculture (ODA) must prepare water quality management plans As discussed earlier, because Johnson Creek has been identified by the State as "water quality limited," TMDLs will be established at some time in the future The requirements in Senate Bill 1010 may, therefore, eventually affect the Johnson Creek watershed

The Coastal Zone Management Act was amended in 1990 to require the states to regulate non-urban areas located within the coastal zone boundary Within this boundary, states are required to develop and enforce specific management measures and practices to reduce non-point source pollution Although the Johnson Creek watershed is not currently included within the coastal zone boundary, the boundary is being reviewed The National Oceanic and Atmospheric Administration recommended that Oregon extend the boundary in the Columbia River Basin to include watersheds on the Willamette River downstream from Willamette Falls (which would include the Johnson Creek watershed) A final decision will be made by July of 1995 regarding the extension of this boundary If Portland is determined to be in the coastal zone, then portions of the RMP, including this action, may fulfill some of the Coastal Zone Act's requirements for nonpoint source pollution control

Responsibility for preparing the water quality management plan for non-urban portions of the watershed will belong to the soil and water conservation districts or whomever else is designated by the Oregon Department of Agriculture The WMO will work with the ODA, the DEQ, and the Clackamas and Multnomah County Soil and Water Conservation Districts to develop and implement a water quality management plan for the non-urban areas of the Johnson Creek watershed The plan will cover both commercial and non-commercial farms

Historically, the U.S Department of Agriculture, Natural Resources Conservation Service (NRCS) has advised farmers on environmentally-sound agricultural practices Small grants are available from the service to implement agricultural best management practices for pollution control Grants could be available to help implement the agricultural water quality control plan

Action PP 3-2

Develop and implement a rural non-point source pollution control program for non-commercial agricultural operations

A rural non-point source pollution program for non-commercial agricultural operations will be developed to prevent pollution from non-commercial ranches and farms typically not covered by state and federal programs for commercial farmers Small non-commercial farms are common in the Johnson Creek watershed as they are on the fringes of many metropolitan areas A similar program for non-commercial farms is in progress in the Tualatin watershed The WMO working with the Multnomah and Clackamas County Soil and Water Conservation Districts will establish a list of best management practices for preventing pollution from small farms, horse pastures, etc., that are applicable to conditions in the Johnson Creek watershed A key source of information will be the ODA publication, entitled "Water Quality Protection Guide Recommended Pollution Control Practices for Rural Homeowners and Small Farm Operations " The non-point source pollution control program will emphasize education and dissemination of information on pollution prevention to rural homeowners and small farmers Compliance with the identified best management practices will be voluntary However, if the voluntary program proves to be ineffective, then the counties may wish to consider adopting a non-point source pollution control ordinance, similar to one in effect in Thurston County, Washington

Action PP 3-3

Periodically review information on container nurseries and confined animal feeding operations.

The DEQ is the lead agency for water quality programs in Oregon but has designated the ODA as its management agency for water quality programs related to agriculture To date, the DEQ and the ODA have developed water quality programs for two categories of agricultural operations container nurseries and confined animal feed operations (CAFOs)

Currently, the ODA does not have an estimate of the compliance rate for container nurseries or CAFOs with the above programs To inform the container nursery industry of the Statewide Container Irrigation Water Management Plan, the ODA mailed notices to all 4,950 Oregon licensed nursery growers, greenhouse growers, and nursery stock dealers The ODA does not know how many of the licensed growers meet the definition of "container nursery", therefore, compliance can not be estimated The ODA relied on the cattlemen's associations to distribute information regarding the permitting program for CAFOs Once again, the ODA has no estimate of the compliance rate for CAFOs because an inventory of existing CAFOs does not exist

The WMO will obtain copies of the information provided to the ODA by container nurseries and the WPCF Permits issued for CAFOs by the DEQ The WMO will work with the agricultural agencies (e g , the ODA, the NRCS, the Soil and Water Conservation Districts) to encourage full compliance with the requirements of the programs, including the removal of all instream recirculation ponds for container nurseries The WMO will also work with the agricultural agencies to identify container nurseries and CAFOs which have not complied with the above programs The WMO will then work with the agricultural agencies to educate these operators about the programs to improve compliance If a complaint is reported or a problem is suspected with a container nursery or CAFO, the WMO will work with the ODA regarding appropriate follow-up inspection and enforcement activities

Action PP 3-4

Periodically review compliance with the Oregon Forest Practice Rules

The Oregon Forest Practices Act regulates forest operations on private and state forest lands Under the Act, forest harvesting and related activities must be reported to the State Forester In some cases (e.g , when harvesting operations occur within 100 feet of a stream which supports anadromous fish), a written plan must be approved by the State Forester before operations are conducted The Act also provides specific rules for the protection of riparian areas and sensitive resource sites such as significant wetlands or habitat for sensitive species

By law, mills are not allowed to accept timber unless a record is provided that the State Forester was notified of the harvest The State Forester offers subscriptions to the notifications submitted The WMO will obtain a subscription for notifications submitted to conduct forestry-related activities in the Johnson Creek watershed The WMO will review notifications and discuss any concerns with the State Forester Where deemed necessary, the WMO may decide to contact the landowner and encourage appropriate control measures (as required under the Forest Practices Act) to protect water quality and natural resources If problems associated with forestry related activities are reported to the WMO (e.g , sediments and debris noted in flow downstream from activities), the WMO will work with the State Forester regarding effective enforcement activities

Objective PP-4
Prevent Accidental Spills into Creek and Tributary Storm Drains

Public consciousness of the potentially devastating effects of oil and chemical spills on the environment has led to a proliferation of laws and regulations Despite the existence of these regulations, spills continue to adversely affect Johnson Creek The approach taken here is to try to ensure that existing regulations are properly implemented in the watershed

Action PP 4-1

Periodically review effectiveness of spill prevention and control regulations

Spills to Johnson Creek are reported and investigated only when they are associated with fish kills The Oregon Department of Fish and Wildlife maintains memos and reports regarding fish kills and other problems dating back to 1972 From 1972 to 1988, twenty-two reports of fish kills were recorded in Johnson Creek (average of more than one per year) Sources of these fish kills were identified only four times

To prevent spills from occurring, federal, state, and local regulations have been enacted to regulate the generation, storage, transport, and disposal of hazardous compounds, including

- Federal Resource Conservation and Recovery Act (RCRA)
- Federal Clean Water Act (CWA)
- Federal Superfund Amendments and Reauthorization Act (SARA) Title III
- Federal Clean Air Act
- State of Oregon Administrative Rules
- State Fire Marshal
- State Uniform Fire Code
- Municipal NPDES Stormwater Permits

The intent of these regulations is to prevent or minimize the potential release of toxic compounds into the environment These complex, inter-related regulations are administered by several different agencies (e g , U.S. EPA, the DEQ, the state fire marshal, and municipal governments)

The WMO will determine how existing regulations are applied in the watershed and which industries are covered. If a potential spill or accidental release is reported (e.g , a fish kill occurs and residents or volunteers report water quality problems), the WMO will work collaboratively with state and local response teams to determine the source of the spill To prevent a recurrence, the WMO will examine the cause of the spill and work with responsible agencies to correct any deficiencies in the way spill regulations are implemented and to streamline procedures for spill response The WMO will also assist responsible agencies with improvements in code compliance

FLOOD MANAGEMENT PLAN ELEMENT

INTRODUCTION

Johnson Creek originates in the hills near Cottrell and flows westward approximately 25 miles to its confluence with the Willamette River The Johnson Creek watershed, which has an area of approximately 54 square miles, was first settled by people of European ancestry in 1847 when a sawmill was established Today, the western two-thirds of the watershed is primarily developed as low-density residential land use with pockets of high-density residential, commercial, and industrial land uses The eastern third is rural, consisting mainly of small ranches, farms, and nurseries

Settlement of a watershed creates conflicts between the creek's natural processes and the human desire for stability and predictability Farmers straighten and change the course of creek channels to preserve farm lands and to increase the efficiency of farming operations Since flat land is easy to develop, builders are attracted to the flood plain Creek channels are filled and bridged and their courses changed to facilitate development At the same time, the creek channels are expected to carry away the increased flows that result from development of the watershed. Almost inevitably, this sequence of events results in flooding of properties

Flooding on Johnson Creek first became a problem in the 1920s after construction of a railroad accelerated settlement of the watershed In 1933 and 1934, the federal Works Progress Administration widened, channelized, and rock-lined much of the lower-half of the creek The project was driven primarily by a desire to provide work during the Great Depression rather than by a need to control damaging floods Containment of the creek in a defined channel undoubtedly reduced the frequency of floods and increased the availability of buildable land in the historic flood plain

The channel improvements in the 1930s did not solve the flooding problem Damaging floods continued to occur on Johnson Creek The most severe flood recorded occurred in 1964 when damages totaled approximately $3,000,000, expressed in 1994 dollars More recently, the flood that occurred on February 24, 1994, caused estimated damages of about $375,000

Several unsuccessful attempts were made in the 1970s and 1980s to solve the flooding problem on Johnson Creek Now the Johnson Creek Corridor Committee has developed a plan to reduce flood damage, but this time as part of a comprehensive resource management plan for the watershed

WATERSHED HYDROLOGY

CLIMATE

Average annual rainfall in the Johnson Creek watershed varies from about 40 inches at the mouth to 70 inches in the upper watershed, with a watershed-wide average of 53 inches Approximately 85 percent of the total annual rainfall occurs during the "wet season" which begins in October and runs through the end of May Most winter precipitation falls as rain in large storms that last for several days Average snowfall is 8 inches per year The remaining 15 percent of the total annual rainfall occurs in short, intense storms in summer and fall

Three rain gage stations located in the Johnson Creek watershed have continuous records since 1976 The longest continuous rainfall record in the Portland area was collected at the U.S Customs House from 1872 until 1973, the current primary gage for the Portland metropolitan area is located at the Portland International Airport (1946–present) Neither of these long-term gages are located in the Johnson Creek watershed The maximum recorded 24-hour rainfall in the Portland area was 7.66 inches on December 12-13, 1882 This amount exceeds the 24-hr, 100-yr (0 01 annual probability) storm intensity of approximately 5 inches, derived from the U.S Weather Bureau's intensity-duration-frequency charts The greatest rainfall amount recorded in a 24-hour period since 1940 (corresponding to the time when flow gage records were first available for Johnson Creek) is 4 4 inches on October 26-27 1994

Temperature has also played an important part in the flooding history of Johnson Creek Cold weather freezes the ground and decreases infiltration capacity If a snowstorm is followed by warming temperatures and rain, the frozen ground will prevent infiltration of the snowmelt and rainfall These conditions caused the flood which occurred in December 1964 A snow storm on December 21, 1964, was followed immediately by rain on December 22nd The temperature increased 72°F within 24 hours, causing the snow to melt as the rain fell This resulted in the highest flow ever recorded in Johnson Creek, 2,620 cubic feet per second (cfs)

LAND USE AND WATERSHED HYDROLOGY

The hydrology of the Johnson Creek watershed is affected by land use As portions of the watershed are developed, runoff characteristics are altered When forested areas are logged and replaced by agricultural fields, less rainfall is intercepted by vegetation When urban development occurs, impermeable surfaces such as roofs, streets, parking lots, and driveways replace the original vegetated land surface, increasing both the volume and the speed of runoff

Hydrologists have shown that development in a watershed usually increases the magnitude of the peak flow in the stream draining the watershed. The peak flow also occurs sooner than in undeveloped conditions More water runs off rapidly during a storm rather than being detained in natural depressions and percolating into the ground Because less water percolates into the ground, less is available to supplement stream flow after the storm has passed Water entering the creek from the ground is the primary source of stream flow during dry periods Thus, development tends to increase peak flows and diminish low flows This phenomenon has probably occurred in the Johnson Creek watershed, although it is not evident from the records of streamflow Diversion of water for irrigation has occurred throughout the period of record and masks the effects of land use changes in the watershed.

Existing land use in the Johnson Creek watershed is about 31 percent forest, farms, and open space, 4 percent parks, 19 percent agricultural, and 35 percent low-density residential High-density residential areas, commercial, and industrial areas occupy 4, 5, and 2 percent of the watershed, respectively If the watershed develops as envisioned in current city and county comprehensive plans (zoning plans), the proportion of residential land use will expand at the expense of forests and open space Future land use, based on current community general plans, is expected to be 63 percent low-density residential, 18 percent agriculture, 4 percent parks, 6 percent high-density residential, 5 percent commercial and 4 percent industrial (see Figure 9)

RUNOFF AND DRAINAGE

The approximately 54-square mile Johnson Creek watershed can be divided into two areas based upon general hydrologic characteristics the northern hydrologic area and southern hydrologic area The northern hydrologic area generally consists of the area north of Johnson Creek between SE 82nd Avenue and Grant Butte. The northern hydrologic area occupies about 40 percent of the watershed The southern hydrologic area consists of the remaining portion of the watershed The hydrologic areas are shown in Figure 17

Subsurface soil conditions are quite different in the two hydrologic areas Soils in the northern hydrologic area are very permeable Most of the precipitation over the northern hydrologic area percolates into the ground rather than running off to Johnson Creek A portion of the stormwater from the northern hydrologic area reaches Johnson Creek via springs and seeps, but most of it flows northward, below the surface, towards the Columbia Slough On the other hand, soils in the southern hydrologic area are rather impermeable Most of the precipitation falling on the southern hydrologic area runs off to Johnson Creek and its tributaries

Approximately nine square-miles of the watershed in the Lents-Powellhurst neighborhood is hydrologically isolated from Johnson Creek except during floods Lying within the northern hydrologic area, the Lents-Powellhurst neighborhood has permeable soils and little runoff Prior to development, what little runoff that occurred probably drained to a number of shallow depressions including Beggars-tick Refuge Now, drainage from streets, parking lots, and other impermeable surfaces in the area is routed to dry wells or sumps Sumps are designed to accelerate the percolation of stormwater into the ground The area served by sumps is shown in Figure 18 Fill placed during construction of S E Foster Road and in its vicinity has also altered the drainage patterns Before development, seasonal overflows from Johnson Creek and nearby springs and seeps probably supplied water to fairly extensive wetlands in the vicinity of Beggars-tick Refuge Currently, Johnson Creek only flows across S.E Foster Road to the wetlands area during floods

Due to the characteristics of the two hydrologic areas, Johnson Creek and most of its tributaries begin in the southern hydrologic area There are no major surface streams in the northern hydrologic area except Crystal Springs Creek Crystal Springs Creek, which begins as a groundwater discharge at the base of a steep terrace escarpment, flows in a southerly direction over relatively impermeable alluvial deposits near the Willamette River. The confluence of Crystal Springs Creek and Johnson Creek is located in Johnson Creek Park at river mile 0.5

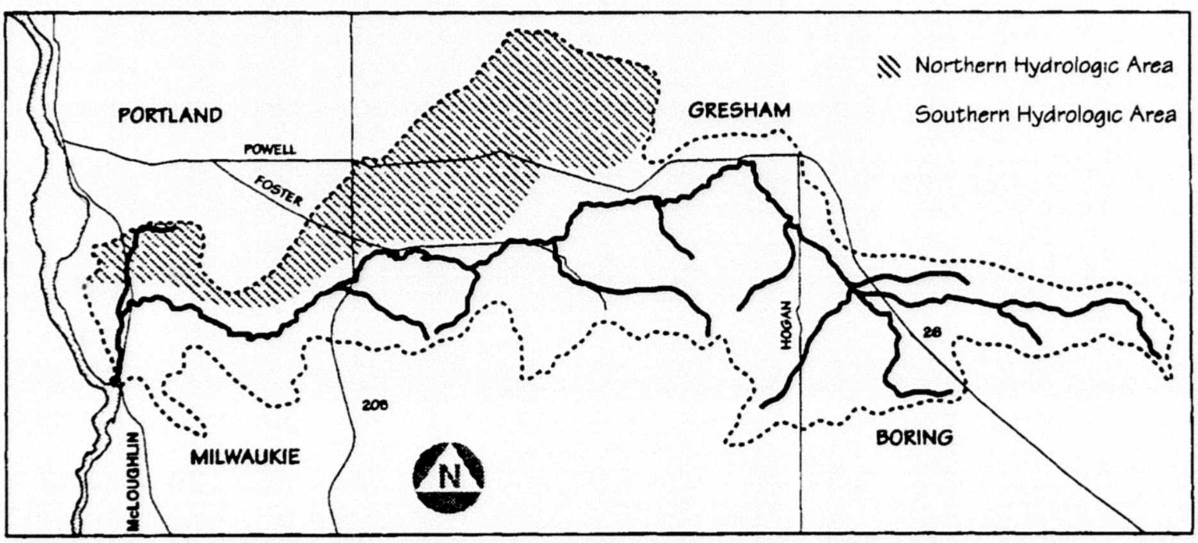
Drainage patterns in the far western end of the watershed have been altered by the construction of a combined sewer system The Sellwood, Eastmoreland, Westmoreland and Woodstock districts drain to the City of Portland's combined sewer system rather than to Johnson Creek The extent of the area served by combined sewers is shown in Figure 18 During light rainfall, surface runoff and sanitary sewage is directed to Portland's Columbia Boulevard sewage treatment plant and then discharged to the Columbia River During moderate to heavy rainfall, the capacity of the untreated combined sewer system is exceeded and combined sewage is discharged directly into the Willamette River at several locations. Combined sewage is never discharged into Johnson Creek

STREAM FLOW

There are two flow gaging stations on Johnson Creek operated by the U.S Geological Survey (USGS) The Sycamore gaging station is located east of S E 145th Avenue at river mile 10.8 This gage measures flow from the upper 26 5 square miles, or about one-half

FIG 17

Hydrologic Areas



of the watershed Continuous records for the Sycamore station are available from 1940 to the present A second gaging station was installed in 1989 at the Milport Road bridge near the mouth of the creek The Milport gage measures flow from 51.8 square miles, or almost 100 percent of the watershed

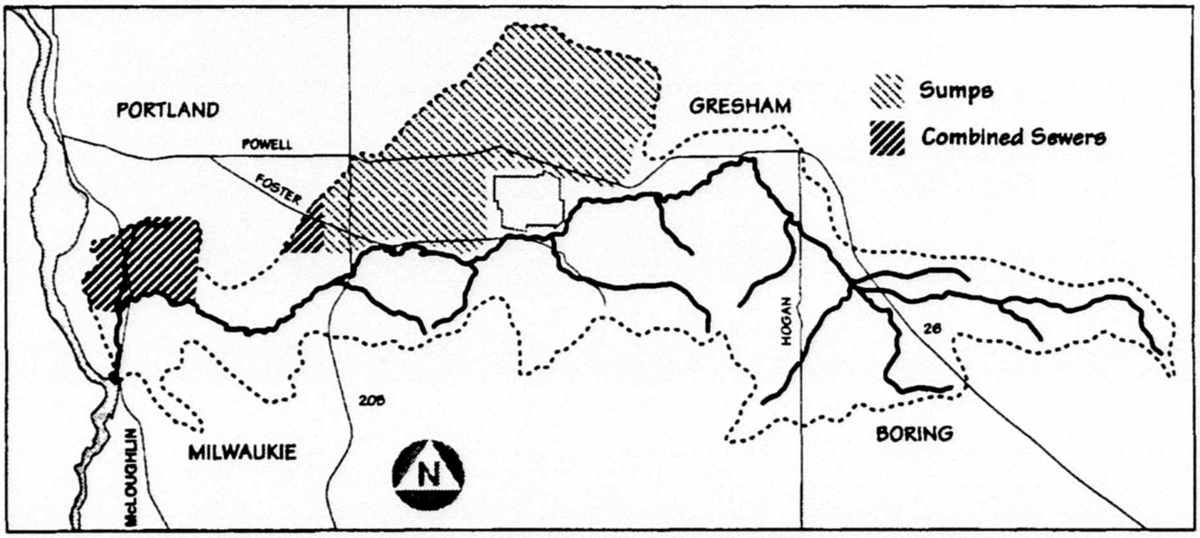
The long-term average flow at the Sycamore gage is approximately 53 cfs The long-term average annual discharge is 39,400 acre-feet Maximum flow usually occurs in December or January Minimum flow occurs in August or September. The maximum flow of 2,620 cfs was recorded at the gage during the December 1964 flood The minimum flow recorded was 0 08 cfs, which occurred in August 1966.

Although long term data are not available from the Milport Road gage, a comparison of its flow records with those from the Sycamore gage is revealing In the 1990 water year, the total annual flow measured at the Sycamore gage was 30,570 acre-feet The corresponding value for the Milport gage was 43,240 acre-feet Although the watershed upstream of the Milport gage is almost twice as large as the watershed upstream of the Sycamore gage, total annual flow was only 45 percent higher This is due to the high infiltration capacity of the soils in the northern hydrologic area and the combined sewer system located in the western portion of the watershed

During dry periods when flow at the Sycamore gage was around 1 cfs, the Milport gage recorded a flow of about 16 cfs primarily due to inflow from Crystal Springs Creek. Thus, the upper portion of the watershed in the southern hydrologic area contributes a disproportionate share of total surface runoff, while the northern hydrologic area is primarily responsible for summertime base flow in the lower reaches of Johnson Creek This is consistent with the earlier discussion of the hydrologic properties of the soils in the Johnson Creek watershed

FIG 18

Sumps and Combined Sewers



FLOODING

Hydrologists characterize floods by their frequency of occurrence. For example, a 20-year flood is a flood that is expected to occur, on average, once every 20 years It is an abbreviation for a "20-year return period flood " Its precise definition is a flood that has a 1-in-20 chance of occurring in any given year. It is a useful statistical concept, but it does not mean that a flood of that size will necessarily occur during a particular 20-year period On average and over a long period of time, floods of that size can be expected to occur once every 20 years Similarly, a 100-year flood is a flood that might be expected to occur only once every 100 years on the average This extreme event has a one percent chance of occurrence in any given year but could actually occur several times within a 100-year period, or not at all

All estimates of the size and frequency of future floods are based on an analysis of past streamflow and rainfall records and the assumption that climactic conditions will remain the same If climactic conditions change, then predictions of future flooding may be in error

HISTORIC FLOODING

Damaging floods have occurred on Johnson Creek at least 6 times in the last 30 years The worst flood on record occurred in 1964, with a peak flow of 2,620 cfs measured at the Sycamore gage After the 1964 flood, the Corps conducted a survey that indicated that about 1,500 structures were flooded, primarily between S E 82nd Avenue and S E 122nd Avenue. In their 1990 reconnaissance study report on Johnson Creek, the Corps estimated that about 2,000 structures lie within the 100-year flood plain below river mile 12 3

On February 24, 1994, a flood occurred on Johnson Creek with a peak flow of 1,780 cfs at the Sycamore gage. It was estimated to be a 5-year return period flood Approximately 40 structures were affected The most severe flooding occurred in the Lents area along S E Foster Road between S E 106th Street and S E 112th Street

FUTURE FLOODS

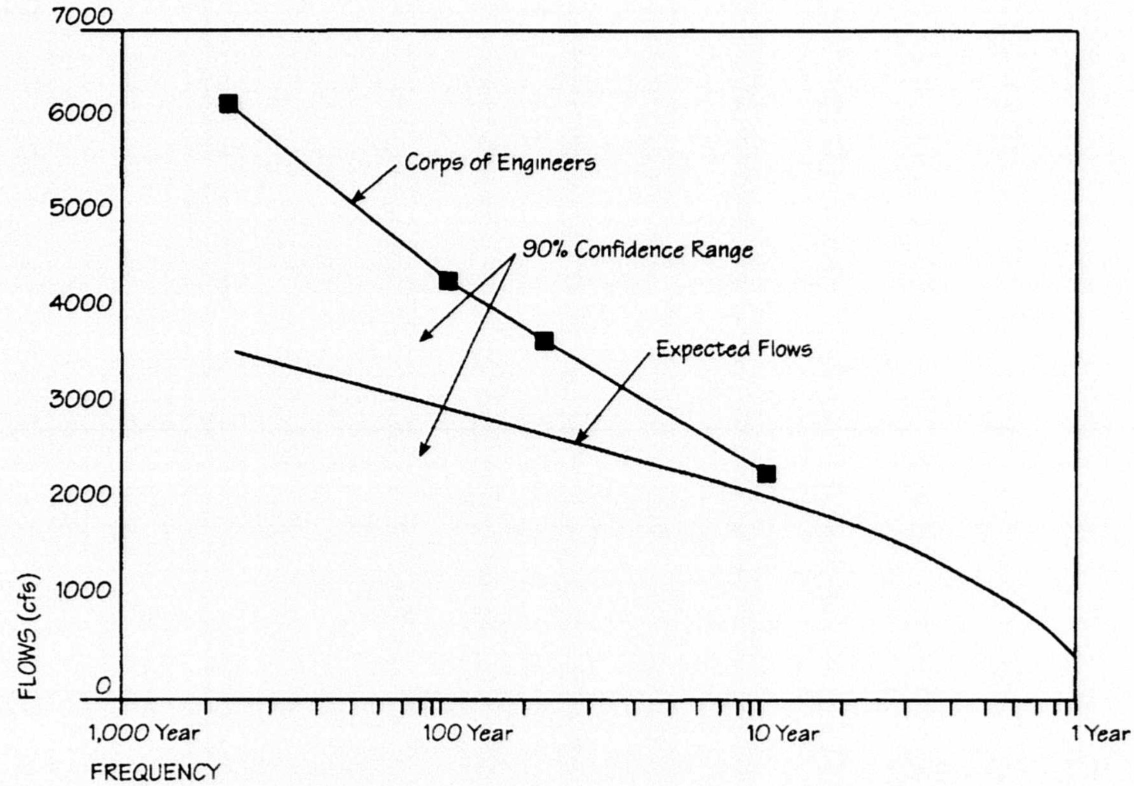
Two techniques are used to predict and analyze the severity of future floods gage analysis and basin simulation Gage analysis uses the long-term flow records available at the Sycamore gage to predict the peak flow and frequency of future floods, assuming no major changes in land use or vegetative cover in the watershed. Basin simulation uses computer models to simulate the behavior of the watershed and predict future peak flows under altered land use conditions The computer models predict water surface elevations in floods of different sizes and allow evaluation of different flood reduction schemes.

■ GAGE ANALYSIS

Peak flood flows and frequencies obtained from a statistical analysis of gage records at Sycamore are shown in Figure 19 The results are compared to the Corps' estimates of peak flood flows made for the Multnomah County Flood Insurance Study (FIS) in 1980 For more frequent floods, those with less than 10-year return period, the estimates from the gage analysis are similar to those reported by the Corps However, for less frequent floods, the Corps estimates are much higher than the estimates based on gage analysis. For example, the Corps estimates the peak flow associated with a 100-year flood to be 4,350 cfs The corresponding estimated peak flow from gage record analysis is only 3,200 cfs, or 1,150 cfs lower (i e , 26 percent lower) than the Corps' estimate The difference in estimates is partly attributable to the 53-year stream-flow record available in 1994 compared to the 39-year record available to the Corps in 1980

FIG 19

Predicted Flows at Sycamore Gage



■ BASIN SIMULATION

The most commonly used basin simulation models were developed by the U S Army Corps of Engineers Hydrologic Engineering Center (HEC) The models, HEC-1 and HEC-2, were used by Kurahashi and Associates (KAI), a member of the RMP consultant team, to model the Johnson Creek watershed The hydraulic model, HEC-2, was used by the Corps of Engineers (Corps) in their earlier studies of Johnson Creek However, the earlier work completed by the Corps was based on cross-sections of the creek channel measured more