City of Sherwood, Oregon
ORDINANCE NO. 93-972

AN ORDINANCE APPROVING LEGISLATIVE AMENDMENTS TO THE COMMUNITY DEVELOPMENT PLAN AND ZONING CODE, INCLUDING REFERENCE TO AND FOR INCORPORATION OF THE STORM WATER MANAGEMENT MASTER PLAN FOR SHERWOOD INTO THE CITY COMPREHENSIVE PLAN, AND ESTABLISHING AN EFFECTIVE DATE.

WHEREAS, the City's current storm water master plan dates from 1981 and in the subsequent period major and significant changes have occurred in the best practices for storm water quantity and quality management in urban settings; and

WHEREAS, the Community Development Plan Parts 2 and 3 state the City shall maintain the high environmental quality of the City and minimize degradation from growth, and will protect water quality from erosion and stormwater runoff by the preparation of a stormwater management plan; and

WHEREAS, the communities and government agencies of the Tualatin River Basin, of which Sherwood is a part, are under court and Oregon Environmental Quality Commission (EQC) order to dramatically improve Tualatin River water quality in part through the control and treatment of surface water quality; and

WHEREAS, regional efforts at meeting the new storm water management mandates are being coordinated through the Unified Sewerage Agency (USA), but Sherwood's sub-basins are not listed for priority planning consideration in USA's current plans; and

WHEREAS, the Sherwood City Council adopted Resolution No. 92-520 on April 8, 1992, adopting a statement of storm water management principles and directing that the City Storm Water Management Master Plan be updated; and

WHEREAS, on May 26, 1992, the City obtained a planning grant from the Oregon Department of Land Conservation and Development (DLCD) to develop such a plan, and the City contracted with David Evans and Associates (DEA) to prepare said Plan update; and

WHEREAS, in the course of preparing the Plan, DEA, City staff, and City Council held meetings with interested citizens; affected agencies such as USA have reviewed and commented on the Plan; and DEA has made three progress presentations to the City Council, resulting in numerous amendments to the Plan; and

WHEREAS, given the current high rates of development in the City, it is of paramount importance to establish up-to-date and comprehensive storm water management plans and practices as soon as possible so that facility financing, acquisition and development can begin in the most timely manner; and

WHEREAS, on April 28, 1993, the City Council conducted a preliminary public hearing on the plan and heard and considered all testimony received, and directed that appropriate changes be made; and

WHEREAS, on May 26, 1993, the City Council adopted Resolution No. 93-542 adopting a draft Stormwater Management Master Plan and referring the same to the City Planning Commission who held a public hearing on said plan (City File No. PA 93-3), on July 6, 1993.

NOW, THEREFORE, THE CITY ORDAINS AS FOLLOWS:

Section 1. Plan Adopted. The City Storm Water Management Master Plan prepared by David Evans and Associates and attached hereto as Exhibit "A" is hereby APPROVED and ADOPTED.

Section 2. Community Development Plan Amended. Community Development Plan Parts 2 and 3 are hereby amended, incorporating the Stormwater Management Master Plan as Appendix E as follows:

Community Development Plan Part 2, Chapter 5:

1. Modify the current policy as follows:

The City will only permit development that is consistent with the Storm Water Management Master Plan for Sherwood, 1993, and Department of Environmental Quality (DEQ) water quality standards.

Community Development Plan Part 2, Chapter 7:

2. Modify the current statement as follows:

In March 1989, DEQ issues draft rules for storm water quality control to all jurisdictions in the Tualatin River subbasin. The City of Sherwood is required to comply with the rules and participate in the development of a Surface Water Drainage Management Plan for the region. When the plan is completed, this section will be amended accordingly. In 1992 and 1993, the City prepared a Stormwater Management Master Plan for the Sherwood region. The Plan was adopted by the City in 1993 to provide a comprehensive program for controlling storm water runoff in a time of rapid growth. When the USA prepares a regional plan for Sherwood, the City's Master Plan will be updated for consistency, as necessary.

3. Modify the current objectives as follows:

(1) Comply with the Stormwater Management Master Plan for Sherwood, 1993, and DEQ stormwater control rules until completion of a Drainage Management Plan.

Community Development Plan Part 3, Zoning Code Section 6.600:

4. Modify the current standards as follows:

Stormwater facilities, including appropriate source control and conveyance facilities, shall be installed in new developments and shall connect to the existing downstream drainage systems consistent with the Stormwater Management Master Plan for Sherwood, 1993, and the Comprehensive Plan.

Section 3. Effective Date. This Ordinance shall become effective thirty (30) days after passage and approval.

Duly passed by the City Council this 8th day of September, 1993.

Approved by the Mayor this 8th day of September

Walter Hitchcock

Walter Hitchcock, Mayor

Attest:

Polly Blankenbaker

Polly Blankenbaker, City Recorder

	AYE	NAY
Boyle	X	
Cottle	X	
Hitchcock	X	
Kennedy	X	
Shannon	Absent	

LEGEND

- URBAN GROWTH BOUNDARY
- MAJOR BASINS
- MINOR BASINS
- SUB BASIN

N.T.S.

DAVID EVANS AND ASSOCIATES, INC.
ENGINEERS, SURVEYORS, PLANNERS, LANDSCAPE ARCHITECTS

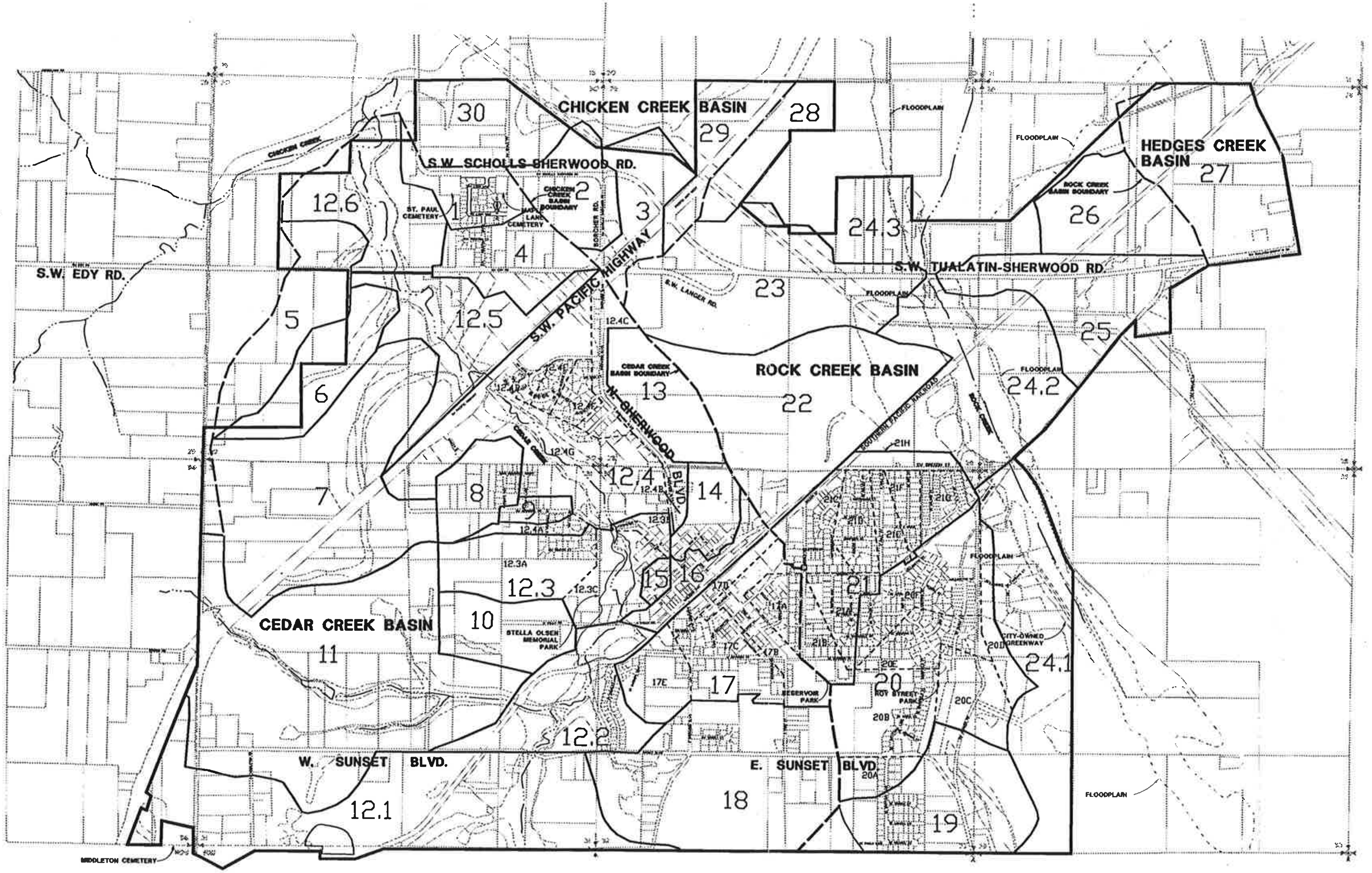

FIGURE 3.
SUBDIVIDED DRAINAGE BASINS

EXHIBIT A

STORMWATER MASTER PLAN

Prepared for

The City of Sherwood
90 N.W. Park
Sherwood, Oregon 97140

Prepared by

David Evans and Associates, Inc.
2828 S.W. Corbett Avenue
Portland, Oregon 97201

May 12, 1993

Contributions by

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EXECUTIVE SUMMARY

This stormwater master plan is a comprehensive planning document. It describes the current and future stormwater conditions in Sherwood and the facilities needed to properly manage stormwater within the community's urban growth boundary (UGB). The plan was prepared by David Evans and Associates, Inc., (DEA) under contract with the City of Sherwood (City).

Preparation of this document came as a result, in part, of Resolution No. 92-520 which was passed by the City Council on April 5, 1992. Among other things, this resolution directed City staff to coordinate the preparation of a stormwater master plan for all areas of the City, and develop appropriate fees and charges to ensure the plan's implementation in a timely manner.

The plan includes an introductory chapter with a discussion about the authorization, purpose, and scope of the document. It also includes a discussion of the study area which emphasizes that the two major stream corridors that flow through the community, Cedar Creek and Rock Creek, play crucial roles in determining the stormwater conditions in the community.

The existing stormwater facilities (catch basins, pipes, culverts, ditches, channels, ponds, marshes, etc.) are identified and reviewed in the plan. The hydraulic capacities of stormwater pipes in the community are also reviewed. A listing of the stormwater pipes and their material types and dimensions is included in Appendix B. A facilities inventory map which shows the location of drainage pipes is included in a map pocket at the back of this report.

Both stormwater quantity and quality are investigated in this plan. The hydrologic characteristics of the community are identified (soils, topography, vegetation, etc.) and stormwater run-off rates are predicted for existing conditions and future conditions. Future conditions correspond to full build-out and development of the community according to the approved Comprehensive Plan. Results of the hydrologic analysis indicate that in undeveloped areas of the community, areas north of Highway 99 for example, the stormwater run-off rates will increase by approximately 500 percent as a result of development. In contrast, stormwater run-off rates from Old Town will not increase since this area is fully developed. Stormwater quality in the community is reviewed by presenting the results of site-specific stormwater sampling and analyses. None of the data that were collected as part of this limited study indicate a significant problem with water quality in the community at this time. However, portions of the Frontier Leather Company property, which were found to be contaminated with high concentrations of metals (especially chromium) in other studies, should be evaluated further.

Based on the review of existing facilities, water quantity and quality, and future conditions, a capital improvement plan was prepared which recommends specific capital improvements over the next 20 years. Improvements range from replacing ditches with drainage pipe (for public safety and erosion control) to adding eight local stormwater treatment facilities at various locations in the community (for water quality control). The total estimated costs for all improvements over the 20-year period is approximately $2.8 million. The estimated cost for the first five-year improvement period is approximately $1.4 million.

Methods of financing the needed improvements are also presented in the document. Because of a recent constitutional amendment to State tax law (Measure 5), the user fee charge system which is currently in place may be considered a form of property tax. For this reason, the existing user fee, in its current form, may not remain as a viable method for financing operation and maintenance of the stormwater facilities. On the other hand, methods of financing that do appear to be viable include accepting contributed stormwater facilities from private developments if they meet the City's approval; assessing system development charges (SDCs) to new users of the stormwater system; and using general obligation or revenue bonds to finance the higher priority capital improvements.

Four public meetings were held during the development of this stormwater master plan and one public hearing was held after the plan was near final. These meetings are summarized in the last chapter of the document.

CHAPTER 1 - INTRODUCTION

AUTHORIZATION

The City's previous storm drainage plan was completed in 1981. This plan was intended to be one element of the City's Comprehensive Plan, to be used for extending public services in an orderly fashion into areas where new growth was expected. The plan had four main objectives: 1) define the City's existing drainage system; 2) define the City's drainage basin boundaries and subbasin boundaries; 3) prepare preliminary designs of major drainage improvements to serve the ultimate growth needs of the City; and, 4) prepare cost estimates for the needed improvements identified in the plan.

The previous storm drainage plan contains useful information on many of the drainage facilities in the community. However, some of the information is out-dated because of rapid growth in the community over the last 5 years and changes in the rules and regulations which pertain to stormwater drainage. The previous storm drainage plan is no longer an up-to-date or comprehensive stormwater planning document.

City staff and officials recognized a need for a more comprehensive document for stormwater master planning. This need was brought to light last fall and winter in the Murdock and Sunset drainage basins where rapid growth and development was occurring. Construction in these basins during wet weather resulted in erosion, minor flooding, and concern for water quality due to stormwater run-off from construction sites. In discussing the problems in these two specific drainage basins, it became clear that a comprehensive, city-wide stormwater master plan update was needed.

On April 5, 1992, the City Council passed Resolution No. 92-520 which included a set of stormwater management principles to be followed by City staff; City boards and commissions; the development community; and property owners within the City. A complete copy of the resolution is included in Appendix A. The stormwater management principles established in the resolution are listed below:

a. No property should suffer increased run-off rates above present levels as a result of upstream development, unless a subbasin stormwater management plan has been approved.

b. All stormwater discharged into a stream or wetland shall be substantially treated and all water emanating from the City and discharging into the proposed Tualatin River National Wildlife Refuge shall be of a quality to enhance the overall functioning of the Refuge.

c. All significant wetlands and associated riparian zones within the City shall be preserved. Lesser wetlands and associated riparian areas, if disturbed, shall be mitigated in a predesignated location in accordance with a City wetlands inventory approved by all appropriate state and federal agencies.

d. A stormwater master plan shall be prepared for all areas of the City and the appropriate fee and charges shall be adopted to ensure its implementation in a timely manner.

e. All streams or ponds, and associated riparian areas, shall be protected from the impacts of development and/or returned to natural conditions, to the greatest extent practicable, and maintained in a manner that allows maximum public enjoyment while preserving the functioning of the natural ecology.

f. The City shall, in cooperation with the Sherwood School District and other educational bodies, become a catalyst for the educational use and research of City waters, wetlands, and natural areas.

g. The City shall take a lead role in working with other jurisdictions, federal and state resource agencies, and impacted land owners in implementing the preceding goals through intervention up and down streams of all City water courses, including those flowing to areas outside of the UGB.

Furthermore, the resolution also directed City staff to obtain funding or budget for the comprehensive stormwater master plan listed in Item d. Staff submitted a grant application for the master plan to the Oregon Department of Land Conservation and Development (DLCD) in 1992, and funding was subsequently awarded.

On June 11, 1992, the City contracted with DEA to prepare the comprehensive, city-wide stormwater master plan. Because the plan addresses stormwater issues broadly (water quantity and quality, ordinances, funding, etc.) it is referred to as a stormwater, rather than a drainage, master plan throughout this document.

PURPOSE AND SCOPE

The purpose of this study is to prepare a comprehensive planning document to be used for directing the City's stormwater management efforts within its entire UGB. The plan can be considered as a technical resource document to be used by City staff in their efforts to make wise stormwater management decisions. The document helps answer the following questions. What are the existing facilities? What facilities will be needed in the future? When will they be needed? How much will they cost?

In addition to addressing concerns about flooding and erosion control (which are traditional stormwater management concerns), this stormwater master plan also evaluates water quality concerns. The impact of stormwater run-off on water quality has recently become an important issue, both locally and nationally.

At the local level, concerns have been raised about the impact of stormwater run-off on the Tualatin River. The Oregon Department of Environmental Quality (DEQ) has declared the Tualatin River to be "water quality limited" because of high concentrations of phosphorus in the water column, and related nuisance algal growth. Much of the phosphorus that reaches the Tualatin River was originally thought to be associated with stormwater run-off. However, more recent scientific findings suggest that the concentration of phosphorus in the Tualatin River is controlled to a large degree by the naturally existing concentration of phosphorus in the native soil and groundwater. This issue is currently under review by the Unified Sewerage Agency (USA), the designated agency for surface and stormwater management in this area. Two tributaries of the Tualatin River (Cedar and Rock Creeks) flow through the City.

The concern about the impact of stormwater run-off on water quality has also grown at the national level (discussed in more detail in Chapter 4). Currently, large and medium sized municipalities must obtain stormwater discharge permits from the U.S. Environmental Protection Agency (EPA) or a delegated state agency. This stormwater master plan was developed with due consideration given to the future federal permitting requirements that may affect the City.

The document is organized in a format which allows for problem identification and resolution. For example, Chapters 2 through 5 contain information about existing stormwater facilities; stormwater quantity; stormwater quality; and operation and maintenance practices. Chapter 6 contains a discussion of alternatives that are typically used by communities for stormwater management. Chapter 7 contains more detailed information on specific improvements that are needed in Sherwood together with a recommended implementation schedule and cost estimates for the improvements. Chapter 8 is a financing plan which includes a discussion of alternatives for generating revenue to pay for the needed stormwater system improvements. Finally, Chapter 9 is a summary of the public involvement process designed to provide the public and City staff and officials with the opportunity of participating in development of the master plan.

STUDY AREA

The City of Sherwood is located in Washington County, Oregon, approximately 20 miles southwest of Portland, Oregon. The location of the City of Sherwood in relationship to other nearby communities and transportation corridors is shown in Figure 1.

Sherwood has experienced rapid growth over the last few years. The population of Sherwood was approximately 2,386 in 1980, and 3,093 in 1990, according to census figures. The estimated population as of January 1993, is 3,800. Based on the inventory of currently developed or developing lots, the City expects to be approaching a population of 6,000 by late 1994. This strong growth trend is likely to continue for several years because of: the City's proximity to Portland and other employment centers; its attractive natural setting; the availability of undeveloped land; and the appealing character of the community. At the current rate of growth, the City could reach its planned capacity population (about 15,000) by the year 2005, or earlier.

A wide range of terrain, vegetation, and land uses exists in the community. The southern edge of the community consists of steep, wooded slopes; rolling hills; and residential development. The northern edge of the community consists of flat, agricultural land; farmsteads; some commercial development; and new residential development. Highway 99 West (a major transportation corridor between Portland and western Oregon) runs through the northern portion of the UGB. Sherwood Old Town is located in the heart of the community. The Old Town area consists of historic buildings, commercial properties, newer and historic homes, city offices, and two city parks.

Two major stream corridors run through Sherwood and they play a crucial role in determining the stormwater conditions in the community. Rock Creek begins in the hills southeast of Sherwood and it enters the community near Oregon Street and the eastern edge of the UGB. The upper Rock Creek Basin consists of an area of approximately three square miles. Approximately 40 percent of the stormwater run-off from Sherwood's urban growth area enters Rock Creek. Cedar Creek begins in the hills southwest of Sherwood and it enters the community near West Sunset Boulevard. The upper Cedar Creek Basin consists of an area of approximately six square miles. Approximately 55 percent of the stormwater run-off from the urban growth area enters Cedar Creek. Approximately four percent of the run-off from the community enters Chicken Creek located at the extreme northern edge of the urban growth area. The remaining one percent of the stormwater run-off enters Hedges Creek northeast of the community.

N.T.S.

DAVID EVANS AND ASSOCIATES, INC.

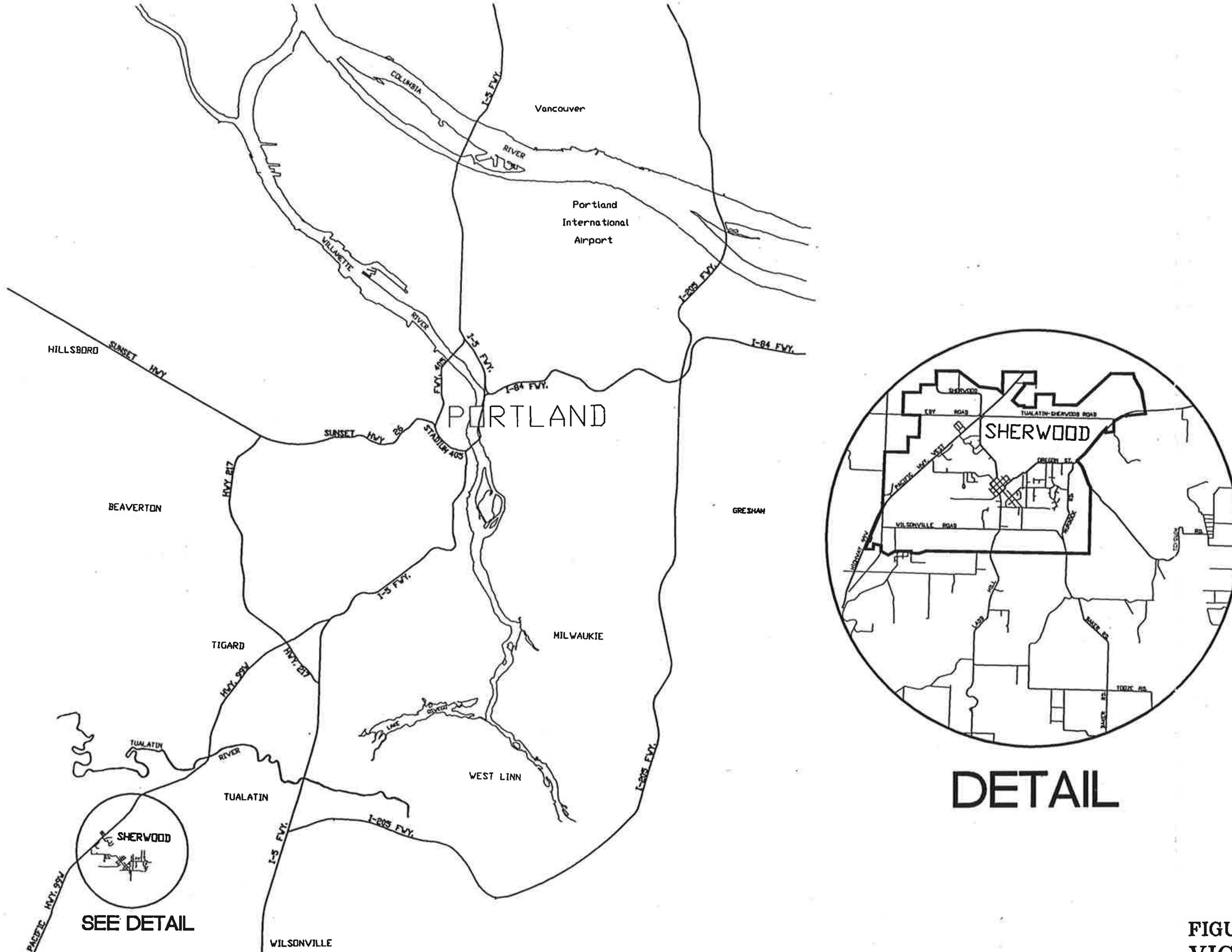

FIGURE 1.
VICINITY MAP
(CITY OF SHERWOOD)

A National Wildlife Refuge, which would encompass approximately 3,000 acres, is being planned for the Sherwood area by the U.S. Fish and Wildlife Service (USFWS). The refuge is intended to preserve valuable open space and wildlife habitat, contribute to the local economy, add educational opportunities, and play an important role in preserving water quality in the area. The refuge would be located northeast of the community and include portions of the Rock Creek flood plain which are within the City's UGB. It is critical that stormwater run-off from the community which enters the wildlife refuge be of high quality to enhance the functions of the refuge.

CHAPTER 2 - FACILITIES INVENTORY

Stormwater facilities typically include inlets and catch basins to collect stormwater; curb and gutters, pipes and manholes, culverts, ditches and channels to convey stormwater; and detention basins, ponds, marshes, and wetlands to detain and treat stormwater. The stormwater facilities that exist in Sherwood are located in the four major drainage basins that exist in the community (Cedar, Rock, Chicken, and Hedges Creek Basins).

The four major drainage basins that exist within the community are shown in Figure 2. For this study, these major basins have been divided into 26 minor basins and given a number designation. Furthermore, minor basins have been divided into even smaller subbasins and given a letter designation. For example, Basin 21 in the Rock Creek drainage is subdivided into eight subbasins designated as Basins 21A through 21H. Even greater labeling detail is used in other areas. For example, Basin 12 along Cedar Creek is broken into five parts; 12.1 through 12.5, which each have their own subbasins (12.1A, 12.2A, etc.) The fully subdivided drainage basins that were used in this study are shown in Figure 3.

The existing stormwater facilities in the City are shown on the inventory map located in the map pocket at the back of this report. The existing stormwater pipes are labeled with a basin number, a pipe number, and a corresponding pipe diameter. For example, there are 10 pipes in Basin 17 which are labeled 17.1 through 17.10. Each pipe is also labeled with its pipe diameter. Additional information about the pipes such as their length, material, and estimated condition is contained in Appendix B.

Cedar, Rock, and Chicken Creeks currently serve as the backbone of the City's stormwater drainage system. The present system conveys stormwater with pipes, culverts, and ditches over reasonably short distances to these Creeks and ultimately into the Tualatin River. The natural drainage channels and topography of the area alleviate the need for pump stations and long sections of pipe.

In some parts of the community, stormwater facilities include curb and gutters with catch basins and underground pipes. In other parts of the community, no constructed stormwater facilities exist and drainage follows natural features. The emphasis of the following discussion is on the basins and subbasins which contain stormwater facilities.

LEGEND

URBAN GROWTH BOUNDARY

MAJOR BASINS

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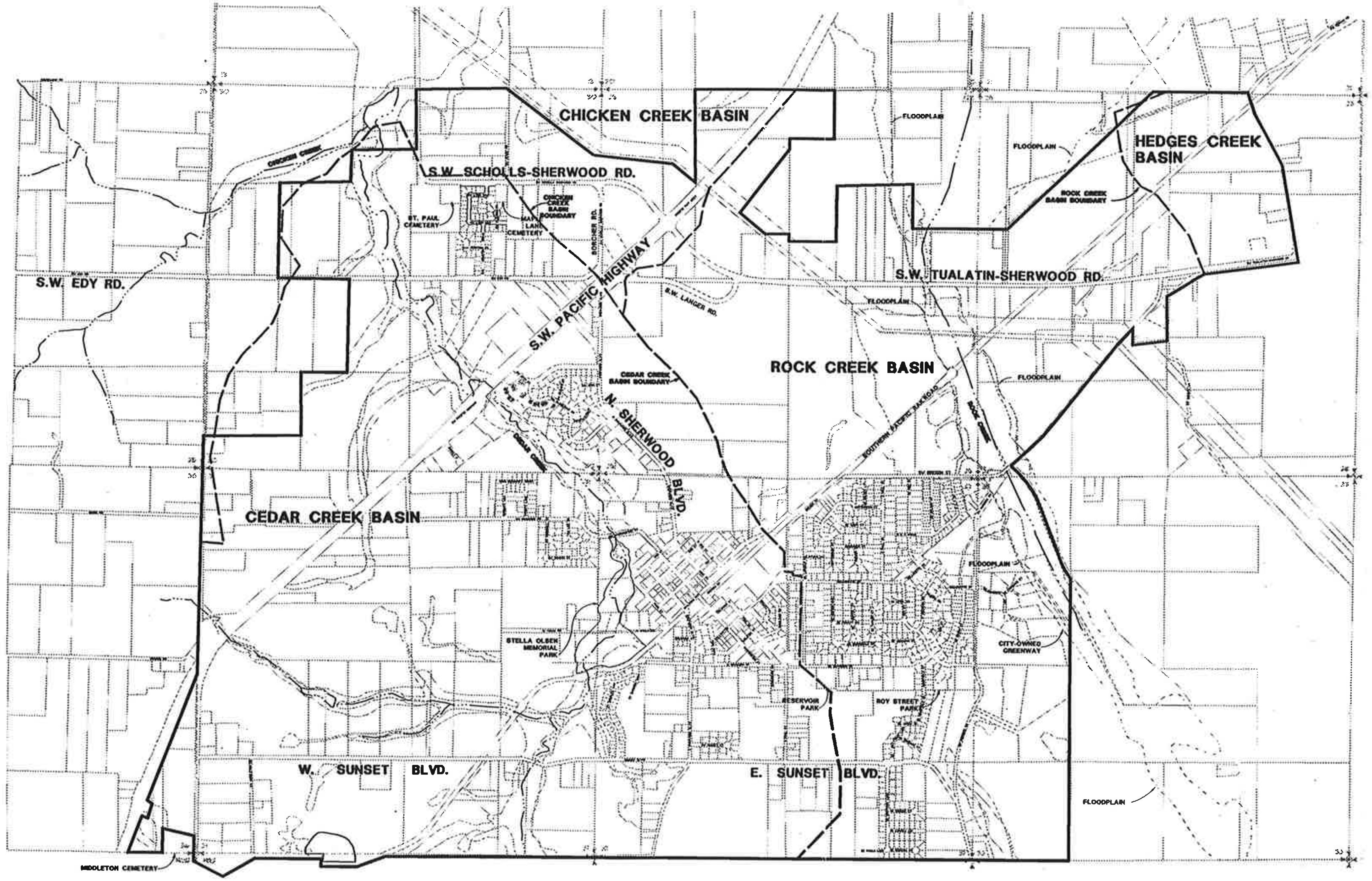

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FIGURE 2.
MAJOR DRAINAGE BASINS IN SHERWOOD

CEDAR CREEK BASIN

Cedar Creek is the most predominant surface water feature within Sherwood's UGB. The Creek flows from south to north through the community, passing through six culverts. These culverts were all functioning properly during our field inspections. Specific information about each culvert is listed on the facilities inventory map.

Many wetland areas exist within Cedar Creek's flood plain. These wetlands are important stormwater features since they provide important natural stormwater detention and treatment benefits.

Old Town (Basins 14, 15, and 16)

The stormwater facilities in the Old Town area consist of curb and gutters, catch basins, and underground drainage pipes. Stormwater run-off is collected along the curb and gutters, enters the catch basins, flows through the drainage pipes and ultimately into Cedar Creek at various locations.

Some of the facilities in this area are in need of maintenance attention. For example, some of the catch basins are filled with sediment and other debris, which reduces their hydraulic capacity. Catch basins should be cleaned regularly to prevent flooding.

During periods of heavy rainfall, water will "pond" in isolated locations within the Old Town area. "Ponding" (depressions filling with stormwater) occurs as a result of catch basins becoming clogged or being spaced too far apart, or improper roadway grading. Specific stormwater improvements for this area are discussed in Chapters 6 and 7.

Basin 17

Basin 17 is located directly southeast of the Old Town area, across the tracks of the Southern Pacific Railroad. Water flows from this Basin into Cedar Creek throughout the year. The source of the flow in the summertime is believed to be natural springs.

Stormwater facilities in this Basin include a mix of curb and gutters, ditches, catch basins, underground pipes, and the riparian wetland area along Cedar Creek. Although most of the facilities in Basin 17 are older, they appear to be functioning properly. The steep terrain in this Basin makes it easy to convey stormwater run-off away from homes and into Cedar Creek.

New pipes, curb and gutters, and manholes have been installed in the vicinity of South Sherwood Boulevard, located at the lower part of the drainage basin. These are important additions because the location of South Sherwood Boulevard (near the bottom of the drainage basin) would make it susceptible to flooding. The new stormwater facilities were functioning properly during our field visits.

Basins 1, 8, 9, 12.3, and 12.4

Basins 1, 8, 9, 12.3, and 12.4, are the remaining minor basins in the Cedar Creek Basin that have appreciable stormwater facilities. The drainage characteristics of these Basins are very similar. Rather than having a network of pipes, the stormwater facilities function independently, draining a particular area into Cedar Creek.

The facilities in the area are predominately curb and gutters, catch basins, and underground pipes. The terrain is steep in most locations except in the Cedar Creek flood plain. The close proximity of the Creek and the topography of the area alleviate many of the problems associated with stormwater run-off.

The wetlands in Stella Olsen Memorial Park are also beneficial features. They provide detention and treatment areas for stormwater run-off. The wetlands have adequate capacity to detain large volumes of run-off caused by precipitation in the Basin because the area is flat and has various obstructions, such as beaver dams, which cause the Creek to slow and pool. When large volumes of run-off enter the wetland, the velocity of the flow decreases and the water is distributed over the Park. The volume of water in the wetland is constantly fluctuating with the stage of Cedar Creek. The volume increases during storms and recedes afterwards. This wetland area protects downstream properties from flooding by acting as a natural stormwater detention facility. Wetlands also remove pollutants from stormwater run-off.

The facilities in these Basins are functioning properly based on our review.

ROCK CREEK BASIN

Rock Creek is smaller than Cedar Creek but still important to drainage in Sherwood. During extremely dry summers (like the summer of 1992) the Creek can become dry during late summer, but during the wintertime it flows full. The Creek passes through three culverts in the community as shown on the facilities inventory map. These culverts are sized adequately for existing flows. However, upsizing the culvert on Oregon Street may be necessary in the future as discussed in Chapters 6 and 7.

Because of its size, the Rock Creek Flood Plain has a large capacity to detain and treat stormwater run-off. This natural benefit makes it a critical part of the stormwater system in the Rock Creek Basin.

Basin 20

Stormwater facilities in this Basin include catch basins, curb and gutters, ditches, and underground pipes. The terrain is steep enough to allow for a minimal number of pipes and for curb and gutter flow to dominate. Run-off is directed towards gutters and catch basins and then conveyed by pipes to Rock Creek.

Stormwater run-off from Basin 20 flows northeasterly from Sunset Boulevard towards the intersection of Murdock Road and Oregon Street. It flows under Oregon Street through two, 36-inch diameter culverts. Run-off from Basin 20 has been increasing due to extensive development in the area. To protect receiving waters, a stormwater treatment facility is currently planned for this Basin. Once completed, stormwater will flow through the facility before being discharged into Rock Creek.

Basin 20 is referred to as the Murdock Basin. More specific information about stormwater management in this Basin is presented in the City's Stormwater Management Plan for the Murdock and Sunset Basins (DEA, 1992).

The facilities in Basin 20 are new, in good condition, and functioning properly. However, with continued development, additional facilities may be needed in the future.

Basin 21

The facilities in Basin 21 are very similar to those in Basin 20. They consist of catch basins, curb and gutters, ditches, and underground pipes. The facilities are more interconnected in Basin 21 than Basin 20, however. Stormwater run-off from this Basin enters catch basins and pipes and is eventually discharged into Rock Creek.

The top of this drainage basin is located near S.E. Division Street. Stormwater run-off flows from this area in a northerly direction towards Oregon Street. It enters a main interceptor line on Oregon Street and flows eastward into Rock Creek.

Although the discharge from this Basin is near the proposed treatment facility in Basin 20, the run-off from Basin 21 cannot be directed to this facility easily by gravity flow. A separate stormwater treatment facility would be needed to serve this Basin.

The facilities in this Basin are new. They are in good condition, and functioning properly with one exception. Erosion is occurring in the open ditch that runs along Oregon Street. The ditch should be replaced with drainage pipe to prevent further erosion from occurring and for pedestrian and vehicle safety. According to City staff, they have scheduled replacement of the ditch with drainage pipe for 1993.

CHICKEN CREEK BASIN

Chicken Creek flows into Cedar Creek just north of the City's UGB. The Chicken Creek Basin occupies only a small portion of the UGB and it is of minor concern with regard to stormwater facilities at this time. It may become more important in the future as this area is developed according to the comprehensive plan. This area may require drainage pipe and a local stormwater treatment facility. Specific recommendations are listed in Chapters 6 and 7.

HEDGES CREEK BASIN

A small portion of the stormwater run-off from the community (approximately one percent or less) enters the Hedges Creek Basin. This area is currently zoned for industrial development. As this area develops in the future, City staff should coordinate closely with developers to ensure that proper stormwater facilities are constructed in conjunction with development.

SYSTEM INVENTORY

Appendix B is a detailed inventory of the City's stormwater drainage facilities. This inventory was completed by reviewing and updating the City's existing stormwater facilities and verifying information in the field. The inventory contains information about stormwater pipes and their corresponding capacities. The listed information includes location, length, diameter, material, average slope, condition, and capacities.

Some of the original inventory information on stormwater facilities included in the 1981 storm drainage plan was incorrect or out of date. This original inventory information has been reviewed by staff from DEA and the City, and modifications and additions have been made where necessary.

The stormwater facilities listed in Appendix B are also shown in the facilities inventory map which is located in the map pocket at the back of this report. Pipe locations and descriptive information about the facilities are shown on the map.

HYDRAULIC CAPACITY

The hydraulic capacities of the existing stormwater facilities were estimated as part of the inventory process. The capacities of the open channels and ditches were estimated by applying Manning's equation for open-channel flow assuming steady, uniform flow. To use this approach, the following information must be known: the channel material and condition; average slope of the channel; and the geometry of the channel. This information was obtained through field investigations of the open channels in the community, where possible. In areas where field verification was not feasible, channel configurations were estimated with topographic maps, aerial photographs, and reference to nearby conditions. Some of the channel configurations used in this study are listed in Table 1.

The hydraulic capacities of stormwater pipes and culverts were estimated using Manning's equation for full pipe flow assuming steady, uniform flow. Again, the data that were required included the pipe material and condition, average slope of the pipe, and pipe geometry.

The hydraulic capacities of the stormwater facilities are listed in Appendix B. The minimum, average, and maximum flow rates that can pass through the facilities were estimated by considering the minimum, average, and maximum, slopes of the open channels or pipes.

TABLE 1

Channel Configurations

CHANNEL	CROSS SECTION #	SIDE SLOPE (ft/ft)	DEPTH (ft)	TOP WIDTH (ft)	MATERIAL	CONDITION	MANNING'S COEFF.	AREA (sq. ft)	W.P. (ft)	R (ft)
CEDAR CREEK	1	1	3.00	18.00	GRASS	AVERAGE	0.031	45.00	4.71	9.55
	2	1	2.50	17.00	GRASS	AVERAGE	0.031	36.25	4.45	8.14
	3	1	3.25	9.00	GRASS	AVERAGE	0.031	18.69	2.36	7.93
ROCK CREEK	1	1	3.50	9.00	GRASS	AVERAGE	0.031	19.25	2.36	8.17
	2	1	3.50	10.00	GRASS	AVERAGE	0.031	22.75	2.62	8.69
1 - GENERAL	1	1	3	10	GRASS	AVERAGE	0.031	21.00	2.62	8.02
2 - GENERAL	1	1	2	6	GRASS	AVERAGE	0.031	8.00	1.57	5.09

ABBREVIATIONS:

Coeff. - Coefficient
ft - feet
R - hydraulic radius
sq. ft - square feet
W.P. - Wetted Perimeter

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CHAPTER 3 - STORMWATER QUANTITY

Stormwater facilities must be provided to collect and convey the stormwater run-off resulting from both routine and extreme storm events.

The quantity of stormwater run-off produced following any storm event is a function of the hydrologic characteristics of a drainage basin. These characteristics include: topography; type and amount of vegetation; type of soils; hydrologic soil groups; amount of impervious surfaces; and local climatological conditions.

Because of the relationship of soils to stormwater run-off, the type of soils that exist within the community and their corresponding hydrologic groups are of particular interest to this study. Approximately 50 different soil groups are found within the City's UGB. These various soil types are listed and shown in Figure 4. These soil types are further divided into five different hydrologic groups, which are shown in Figure 5. The hydrologic soil group determines the run-off characteristics of the soil. For example, soils of Hydrologic Group A are generally course-grained; they absorb water rapidly, resulting in a low to moderate amount of run-off. In contrast, soils of Hydrologic Group D are generally fine-grained; they absorb water slowly, resulting in a large amount of run-off.

Many different methods exist for evaluating basin hydrology. We selected two computer simulation methods for this study.

For the smaller urban areas within the City, we used a method developed by the Soil Conservation Service (SCS) and described in Technical Release 55 (TR55) entitled, "Urban Hydrology of Small Watersheds, 2nd Edition". We selected the TR55 methodology for this study because it is widely accepted; it is based on cover types, land use, and soil characteristics; it is not data intensive; and it provides reasonable estimates of peak stormwater run-off rates. Moreover, these procedures are applicable to small drainage basins that are undergoing urbanization like many of the basins in the City.

For portions of the Cedar Creek and Rock Creek Basins which are outside of the City, we used a method developed by the U.S. Army Corps of Engineers (COE). This methodology is commonly referred to as Hydrology Engineering Center Model 1 (HEC-1). We selected HEC-1 because it is based on run-off hydrographs which are more appropriate for larger basins.

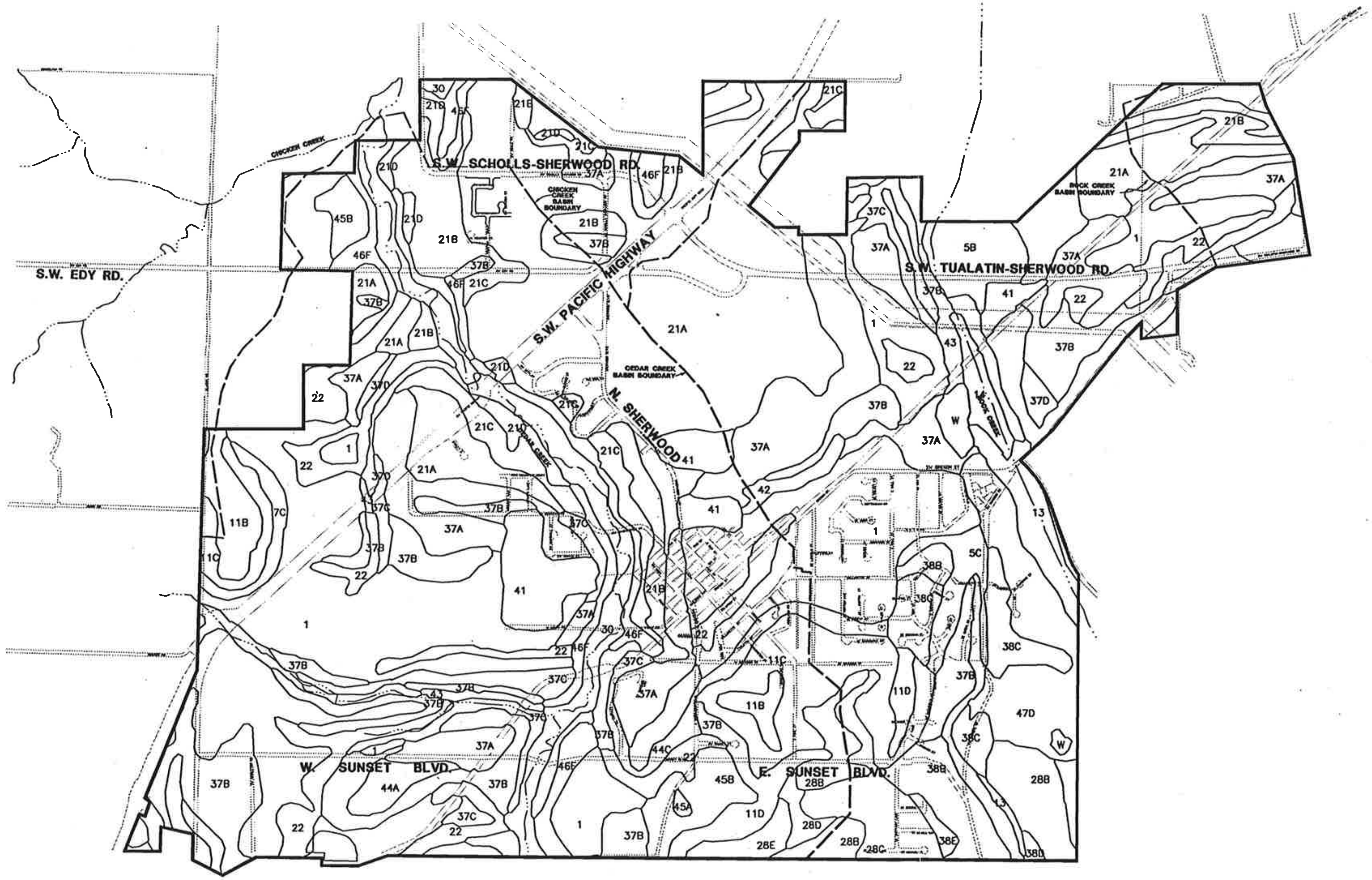
LEGEND

- URBAN GROWTH BOUNDARY
- MAJOR BASINS
- 21C SOIL DELINIATION

N.T.S.

DAVID EVANS AND ASSOCIATES, INC.

ENGINEERS, SURVEYORS, PLANNERS, LANDSCAPE ARCHITECTS



SCS CODE	SOIL TYPE/SLOPE	HYDROLOGIC GROUP
1	ALOHA SILT LOAM NEARLY LEVEL	C
5B	BRIDEWELL STONY SILT LOAM (0-7%) SLOPE	B
5C	BRIDEWELL STONY SILT LOAM (7-12%) SLOPE	B
5D	BRIDEWELL STONY SILT LOAM (12-20%) SLOPE	C
7C	CASCADE SILT LOAM (7-12%) SLOPE	C
11B	CORNELIUS AND KINTON SILT LOAM (2-7%) SLOPE	C
11C	CORNELIUS AND KINTON SILT LOAM (7-12%) SLOPE	C
11D	CORNELIUS AND KINTON SILT LOAM (12-20%) SLOPE	C
13	COVE SILTY CLAY LOAM NEARLY LEVEL	D
14	COVE CLAY	D
21A	HILLSBORO LOAM (0-3%) SLOPE	B
21B	HILLSBORO LOAM (3-7%) SLOPE	B
21C	HILLSBORO LOAM (7-12%) SLOPE	B
21D	HILLSBORO LOAM (12-20%) SLOPE	B
22	HUBERLY SILT LOAM NEARLY LEVEL	D
27	LABISH MUCKY CLAY NEARLY LEVEL	D
28B	LAURELWOOD SILT LOAM (3-7%) SLOPE	B
28C	LAURELWOOD SILT LOAM (7-12%) SLOPE	B
28D	LAURELWOOD SILT LOAM (12-20%) SLOPE	B
28E	LAURELWOOD SILT LOAM (20-30%) SLOPE	B
30	MCBEE SILTY CLAY LOAM NEARLY LEVEL	B
37A	QUATAMA LOAM (0-3%) SLOPE	C
37B	QUATAMA LOAM (3-7%) SLOPE	C
37C	QUATAMA LOAM (7-12%) SLOPE	C
37D	QUATAMA LOAM (12-20%) SLOPE	C
38B	SAUM SILT LOAM (2-7%) SLOPE	C
38C	SAUM SILT LOAM (7-12%) SLOPE	C
38E	SAUM SILT LOAM (20-30%) SLOPE	C
38F	SAUM SILT LOAM (30-60%) SLOPE	C
41	URBAN LAND NEARLY LEVEL	C
42	VERBOORT SILTY CLAY LOAM NEARLY LEVEL	D
43	WAPATO SILTY CLAY LOAM NEARLY LEVEL	D
44A	WILLAMETTE SILT LOAM (0-3%) SLOPE	B
44B	WILLAMETTE SILT LOAM (3-7%) SLOPE	B
44C	WILLAMETTE SILT LOAM (7-12%) SLOPE	B
45A	WOODBURN WILT LOAM (0-3%) SLOPE	C
45B	WOODBURN WILT LOAM (3-7%) SLOPE	C
45C	WOODBURN WILT LOAM (7-12%) SLOPE	C
46F	XEROCHREPTS AND HAPLOXEROLLS (20-60%) VERY STEEP SLOPE	XERO-B HAPL-C
47D	XEROCHREPTS-ROCK OUTCROP COMPLEX (5-30%) SLOPE	D
W	WATER	

FIGURE 4.

SOIL TYPES IN SHERWOOD

As discussed earlier, we divided the four major drainage basins contributing to stormwater run-off in the City into 26 smaller minor basins for analysis. Minor basin boundaries were selected based on soils, topography, existing pipe locations, and land use. The minor basins selected for this study were introduced earlier in Chapter 2 and are shown in Figure 3.

Flow rates were predicted from each of the minor basins for existing conditions and future conditions by using the computer methodologies discussed above.

Existing conditions were determined by reviewing topographic maps, aerial photographs and soil surveys, and field verifying this information. The predicted existing flow rates for the 2-, 5-, 10-, 25-, 50-, and 100-year storm event are listed in Table 2.

Future flow rates were determined by predicting the conditions for complete build out, based on the zoning densities allowed in the City's Comprehensive Plan. Since the estimate of future flow rates is based on complete build out, it will be an overestimate of the flow rates in the near future. However, as the community continues to grow and development to the maximum density occurs, the future flow rate predictions will become more accurate.

The predicted future flow rates for the 2-, 5-, 10-, 25-, 50-, and 100-year storm events are listed in Table 3.

Based on our analysis, the flow rates in the community will increase substantially in specific areas. For example, the 25-year flow rate from Basin 2 (north of Highway 99), which currently has few developed areas, will increase by approximately 500 percent. In contrast, the 25-year flow rate from Basin 16 (Old Town) will not increase at all because this area is fully developed.

The percentage increase in 25-year flow rates between existing and future conditions are listed in Table 4.

Stormwater facilities will need to be added and upgraded as the community develops and stormwater run-off increases. The hydrologic analysis presented above helps us identify specific drainage basins on which to focus our attention. Facilities that will be needed in the future are prioritized and discussed in detail in Chapters 6 and 7.

TABLE 2

Existing Conditions Hydrology

MINOR BASIN #	AREA (acres)	Tc (hours)	EXISTING SCS CN	STORMWATER RUN-OFF (cfs) BASED ON GIVEN RETURN PERIOD					
				2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
1	26	1.5	70	1	1	2	3	5	6
2	36	0.5	64	1	1	2	3	5	7
3	37	0.1	76	3	6	10	13	17	20
4	40	0.2	76	3	6	10	13	17	20
5	55	0.3	82	8	13	20	24	30	35
6	45	0.3	77	4	7	11	15	19	23
7	158	1	88	31	44	58	68	80	90
8	28	0.2	80	4	6	9	12	15	17
9	7	0.1	82	1	2	3	4	4	5
10	37	0.5	80	4	7	10	13	17	20
11	237	0.5	76	15	30	50	65	85	102
12.1	170	0.75	76	10	19	32	42	55	66
12.2	63	0.4	67	1	3	5	8	12	16
12.3A	40	0.3	86	9	13	18	21	25	29
12.3B	6	0.1	73	0	1	1	2	2	3
12.3C	25	0.3	71	1	2	4	5	7	9
12.4A	6	0.3	78	1	1	2	2	3	3
12.4B	10	0.1	93	4	5	7	8	9	10
12.4C	18	0.1	81	3	5	7	9	11	12
12.4D	3	0.1	75	0	0	1	1	1	2
12.4E	5	0.1	75	0	1	1	2	2	3
12.4F	8	0.1	75	1	1	2	3	3	4
12.4G	102	0.1	77	11	19	31	39	50	59
12.5	65	0.1	78	8	14	21	26	33	39
12.6	56	0.5	72	2	4	8	11	15	19
13	39	0.1	75	3	6	10	13	17	20
14	22	0.75	88	5	7	9	10	12	14
15	5	0.1	79	1	1	2	2	3	3
16	21	0.2	83	4	6	9	10	13	15
17A	12	0.4	83	2	3	4	5	7	7
17B	25	0.3	82	4	6	9	11	14	16
17C	29	0.1	82	5	8	12	15	18	21
17D	9	0.1	92	3	5	6	7	8	9
17E	22	0.3	68	1	1	2	3	5	6
18	134	0.5	72	5	10	20	27	37	45
19	71	0.75	76	4	8	13	17	23	27
20A	12	0.2	66	0	1	1	2	3	3
20B	37	0.1	67	1	2	4	7	10	12
20C	23	0.4	75	1	3	5	6	8	10
20D	12	0.1	79	2	3	4	5	6	8

MINOR BASIN #	AREA (acres)	Tc (hours)	EXISTING SCS CN	STORMWATER RUN-OFF (cfs) BASED ON GIVEN RETURN PERIOD					
				2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
20E	22	0.1	80	3	5	8	10	12	15
20F	40	0.1	77	4	8	12	15	19	23
21A	16	0.2	79	2	3	5	6	8	9
21B	12	0.1	78	1	3	4	5	6	7
21C	21	0.1	77	2	4	6	8	10	12
21D	16	0.1	80	2	4	6	7	9	11
21E	10	0.1	76	1	2	3	4	5	5
21F	9	0.1	82	2	3	4	5	6	6
21G	13	0.1	86	3	5	7	8	9	11
21H	9	0.1	83	2	3	4	5	6	7
22	128	0.75	75	6	13	22	29	39	47
23	124	0.2	79	15	25	39	49	62	74
24.1	97	0.5	76	6	12	20	26	35	42
24.2	110	0.2	79	13	22	35	44	55	65
24.3	54	0.5	75	3	6	10	14	18	22
25	71	0.5	94	24	31	40	45	52	58
26	53	0.4	85	10	15	22	26	31	35
27	97	0.5	78	8	15	24	30	39	46
28	30	0.5	83	5	7	10	13	16	18
29	32	0.5	81	4	6	10	12	15	18
30	48	0.5	75	3	5	9	12	16	19
*	3,977	0.34	69	--	--	--	--	1295	--
**	1,903	0.35	69	--	--	--	--	627	--

ABBREVIATIONS:

cfs - cubic feet per second
CN - Curve Number
SCS - Soil Conservation Service
Tc - Time of concentration
yr - year

NOTES:

* Indicates the predicted flow rate from Cedar Creek as it enters the urban growth boundary (UGB).
* * Indicates the predicted flow rate from Rock Creek as it enters the UGB.

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TABLE 3

Future Conditions Hydrology

MINOR BASIN #	AREA (acres)	Tc (hours)	FUTURE SCS CN	STORMWATER RUN-OFF (cfs) BASED ON GIVEN RETURN PERIOD					
				2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
1	26	1.5	83	3	4	6	8	10	11
2	36	0.5	87	8	11	15	18	21	24
3	37	0.1	92	11	15	19	22	26	29
4	40	0.2	89	12	17	22	25	30	33
5	55	0.3	84	10	15	22	27	33	37
6	45	0.3	85	9	14	19	23	28	31
7	158	1	88	31	44	58	68	80	90
8	28	0.2	82	5	7	11	13	16	19
9	7	0.1	85	2	2	3	4	5	5
10	37	0.5	85	7	10	14	17	21	23
11	237	0.5	84	39	60	87	106	127	145
12.1	170	0.75	89	39	54	71	82	97	109
12.2	63	0.4	88	13	19	25	29	35	39
12.3A	40	0.3	90	12	16	21	25	29	32
12.3B	6	0.1	91	2	3	4	4	5	6
12.3C	25	0.3	71	1	2	4	5	7	9
12.4A	6	0.3	88	2	2	3	3	4	5
12.4B	10	0.1	93	4	5	7	8	9	10
12.4C	18	0.1	89	6	8	10	12	14	16
12.4D	3	0.1	75	0	0	1	1	1	2
12.4E	5	0.1	75	0	1	1	2	2	3
12.4F	8	0.1	75	1	1	2	3	3	4
12.4G	102	0.1	82	19	29	42	51	64	73
12.5	65	0.1	89	21	28	37	44	51	58
12.6	56	0.5	82	8	12	18	22	28	32
13	39	0.1	88	12	16	22	25	30	34
14	22	0.75	93	6	8	11	12	14	16
15	5	0.1	88	1	2	3	3	4	4
16	21	0.2	83	4	6	9	10	13	15
17A	12	0.4	83	2	3	4	5	7	7
17B	25	0.3	87	6	9	12	14	16	19
17C	29	0.1	85	7	10	14	17	20	23
17D	9	0.1	92	38	50	64	74	86	95
17E	22	0.3	84	4	6	9	11	13	15
18	134	0.5	87	29	42	57	67	80	90
19	71	0.75	79	6	11	17	21	27	32
20A	12	0.2	79	1	2	4	5	6	7
20B	37	0.1	81	6	10	14	18	22	26
20C	23	0.4	86	5	7	10	12	14	16
20D	12	0.1	89	4	5	7	8	9	11

MINOR BASIN #	AREA (acres)	Tc (hours)	FUTURE SCS CN	STORMWATER RUN-OFF (cfs) BASED ON GIVEN RETURN PERIOD					
				2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
20E	22	0.1	82	4	6	9	11	14	16
20F	40	0.1	84	9	13	18	22	27	30
21A	16	0.2	83	3	4	7	8	10	11
21B	12	0.1	83	2	4	5	6	8	9
21C	21	0.1	86	5	8	11	13	15	17
21D	16	0.1	85	4	6	8	9	11	13
21E	10	0.1	76	1	2	3	4	5	5
21F	9	0.1	82	2	3	4	5	6	6
21G	13	0.1	87	4	5	7	8	10	11
21H	9	0.1	91	3	4	6	6	8	8
22	128	0.75	88	27	39	51	60	71	80
23	124	0.2	89	38	51	67	78	92	104
24.1	97	0.5	84	16	24	36	43	52	59
24.2	110	0.2	93	42	54	70	80	93	103
24.3	54	0.5	85	10	15	21	25	30	34
25	71	0.5	95	26	33	41	47	54	60
26	53	0.4	92	19	24	31	35	40	45
27	97	0.5	88	23	32	43	50	59	67
28	30	0.5	87	7	10	13	15	18	20
29	32	0.5	88	8	11	14	17	20	22
30	48	0.5	85	9	13	19	22	26	30
*	3,977	0.34	75	--	--	--	--	1796	--
**	1,903	0.35	75	--	--	--	--	869	--

ABBREVIATIONS:

cfs - cubic feet per second
CN - Curve Number
SCS - Soil Conservation Service
Tc - Time of concentration
yr - year

NOTES:

* Indicates the predicted flow rate from Cedar Creek as it enters the urban growth boundary (UGB).
* * Indicates the predicted flow rate from Rock Creek as it enters the UGB.

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TABLE 4

Percent Increase in Flow Rate from Existing to Future Conditions

MINOR BASIN #	AREA (acres)	25-yr EXISTING FLOW RATE (cfs)	25-yr FUTURE FLOW RATE (cfs)	FUTURE FLOW RATE INCREASE
1	26	3	8	167%
2	36	3	18	500%
3	37	13	28	115%
4	40	13	25	92%
5	55	24	28	17%
6	45	14	23	64%
7	158	68	68	0%
8	28	12	13	8%
9	7	4	4	0%
10	37	13	17	31%
11	237	62	106	71%
12.1	170	40	82	105%
12.2	63	8	34	325%
12.3A	40	21	24	14%
12.3B	6	2	4	100%
12.3C	25	5	5	0%
12.4A	6	2	3	50%
12.4B	10	7	7	0%
12.4C	18	8	12	50%
12.4D	3	1	1	0%
12.4E	5	2	2	0%
12.4F	8	3	3	0%
12.4G	102	37	51	38%
12.5	65	25	43	72%
12.6	56	11	22	100%
13	39	13	25	92%
14	22	10	12	20%
15	5	2	3	50%
16	21	10	10	0%
17A	12	5	5	0%
17B	25	11	14	27%

MINOR BASIN #	AREA (acres)	25-yr EXISTING FLOW RATE (cfs)	25-yr FUTURE FLOW RATE (cfs)	FUTURE FLOW RATE INCREASE
17C	29	15	17	13%
17D	9	7	7	0%
17E	22	3	11	267%
18	134	25	66	164%
19	71	17	21	24%
20A	12	1	4	300%
20B	37	6	17	183%
20C	23	6	12	100%
20D	12	5	8	60%
20E	22	10	11	10%
20F	40	15	22	47%
21A	16	6	8	33%
21B	12	4	6	50%
21C	21	8	12	50%
21D	16	7	9	29%
21E	10	4	4	0%
21F	9	4	4	0%
21G	13	8	8	0%
21H	9	5	6	20%
22	128	28	59	111%
23	124	48	78	63%
24.1	97	24	42	75%
24.2	110	43	80	86%
24.3	54	14	25	79%
25	71	45	47	4%
26	53	26	33	27%
27	97	30	50	67%
28	30	13	15	15%
29	32	12	17	42%
30	48	12	22	83%

ABBREVIATIONS:

cfs - cubic feet per second

yr - year

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CHAPTER 4 - STORMWATER QUALITY

GENERAL CHARACTERISTICS AND CONCERNS

Stormwater run-off contains materials that may degrade the quality of the waterways that the run-off enters and harm stream ecology. These potentially harmful materials include sediments, organics, nutrients, and metals.

Sediments and other solid materials are a concern, in part, because they add turbidity to a receiving stream. Turbidity can harm stream ecology in a number of ways. It can reduce light penetration and photosynthesis; it can hinder fish respiration; and it can reduce visibility which affects their ability to find food. Additionally, the deposition of solid materials on the stream bottom can harm benthic (bottom dwelling) organisms and their habitat. The amount and form of solids contained in a stormwater sample are measured in laboratory tests for total solids (TS), total suspended solids (TSS), and total dissolved solids (TDS).

Organic materials are a concern because they can affect the amount of dissolved oxygen available in the water column for fish and other aquatic organisms which use dissolved oxygen for respiration. A reduction in dissolved oxygen occurs as the organic materials are naturally biodegraded by stream bacteria that utilize the organic material as a food source and the oxygen for respiration during metabolism. The amount of organic materials contained in stormwater run-off is measured in laboratory tests for biochemical oxygen demand (BOD), and chemical oxygen demand (COD).

Nutrients such as nitrogen and phosphorus are a concern because their presence can lead to excessive algal growth and undesirable fluctuations in pH and dissolved oxygen resulting in toxicity and nuisance conditions. Under some environmental conditions, algae grow rapidly to nuisance levels if a growth limiting nutrient (such as phosphorus) is provided in sufficient concentrations. Nitrogen compounds are generally measured as total Kjeldahl nitrogen (TKN), ammonia (NH_3), and nitrite plus nitrate (NO_{2+3}). Phosphorus compounds are generally measured as total phosphorus (TP), soluble phosphorus (SP), and ortho phosphorus (OP).

Metals are of interest because if they are present in significant concentrations they are toxic to aquatic organisms. Because the discharge of stormwater occurs intermittently, acute toxicity is a concern, whereas chronic toxicity is generally not. Metals of interest include lead (Pb), copper (Cu), and zinc (Zn).

In 1983, the EPA initiated the National Urban Run-off Program (NURP). During the course of their study they evaluated the chemical characteristics of stormwater run-off for a number of different areas by land use category. The chemical characteristics of stormwater vary considerably depending on the nature of the run-off surface, as shown in Table 5.

TABLE 5

Median Run-off Concentration By Land Use Category

Parameter (mg/L)	Land Use Category: Residential	Commercial	Mixed	Open/Nonurban
BOD	10.0	9.3	7.8	---
COD	73.0	57.0	65.0	40.0
TSS	101.0	69.0	67.0	70.0
Pb	0.144	0.104	0.114	0.030
Cu	0.033	0.029	0.027	---
Zn	0.135	0.226	0.154	0.195
TKN	1.90	1.180	1.290	0.965
NO_{2+3}	0.736	0.572	0.558	0.543
TP	0.383	0.201	0.263	0.121
SP	0.143	0.080	0.056	0.026

Source: National Urban Run-off Program as reported in Stahre and Urbonas (1990)

ABBREVIATIONS:

BOD - Biochemical Oxygen Demand
COD - Chemical Oxygen Demand
Cu - Copper
mg/L - milligrams per Liter
NO_{2+3} - Nitrite plus nitrate
Pb - Lead
SP - Soluble Phosphorus
TP - Total Phosphorus
TSS - Total Suspended Solids
TKN - Total Kjeldahl Nitrogen
Zn - Zinc

SITE-SPECIFIC STORMWATER CHARACTERISTICS

Limited stormwater sampling and chemical analysis was conducted in the community as part of this study. Samples were collected and analyzed for many of the same parameters analyzed in EPA's NURP study to provide a basis for comparison. Sample sites were selected so that stormwater run-off from different types of land uses could be characterized.

The locations of the stormwater sampling sites that we used in this study are shown in Figure 6. The sites and general land use characteristics associated with these sites are listed below.

(S1) Rock Creek @ Oregon Street: Undeveloped/Residential
(S2) Rock Creek @ Highway 99: Undeveloped Land
(S3) Cedar Creek @ S.W. Edy Road: Developing Land (Construction Activities)
(S4) Cedar Creek @ Sunset Boulevard: Undeveloped Land
(S5) Cedar Creek Tributary @ Division Street: Residential
(S6) Cedar Creek @ Stella Olsen Memorial Park: Park Land

Surface water samples were collected on November 23, 1992, at all of the sites listed above. The weather remained clear and warm throughout the day. There were no clouds, a light breeze, and the temperature was approximately 65°F. Rain in the previous week generated sufficient run-off for sampling. The results of the sampling conducted on this day are listed in Table 6.

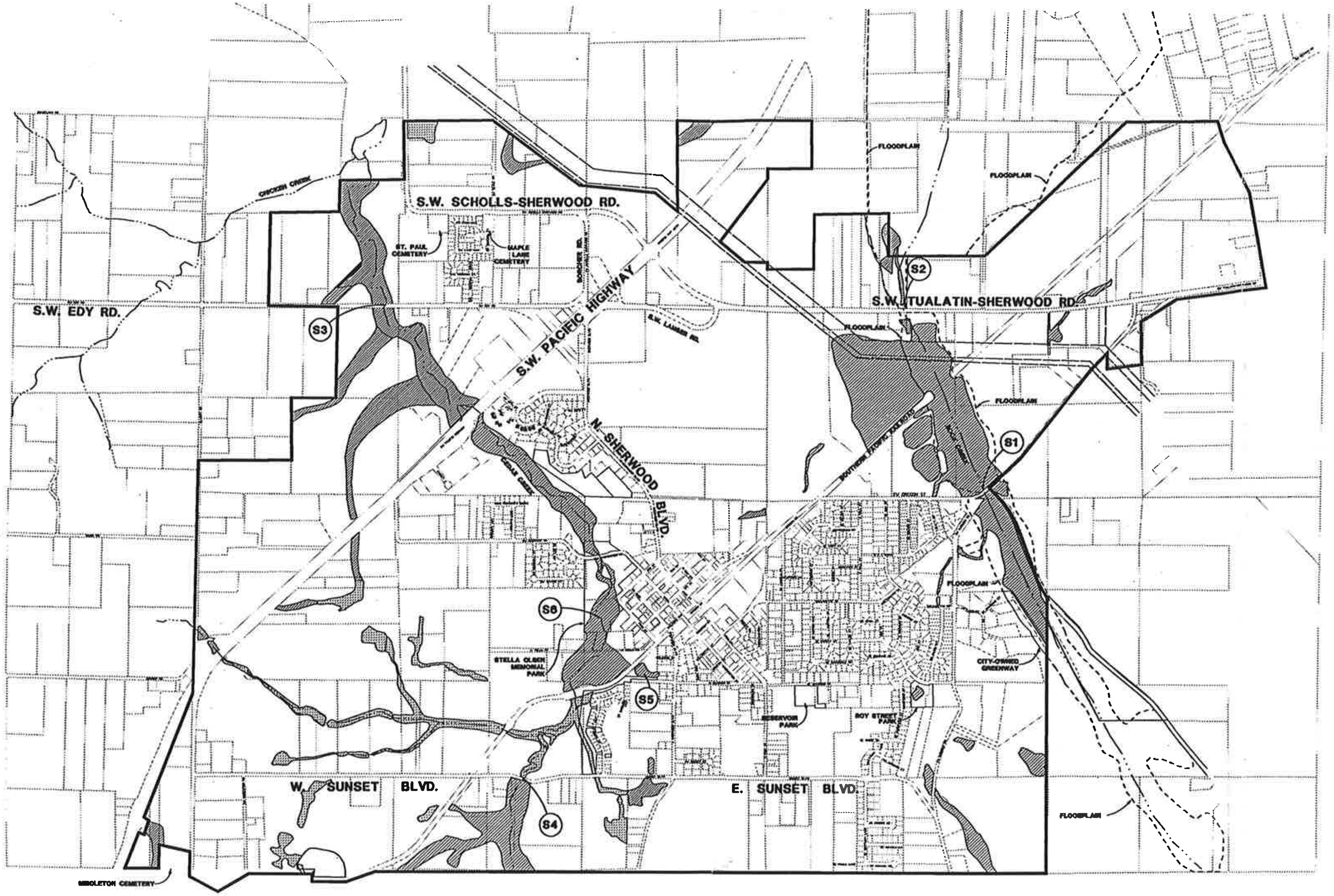
Surface water samples were also collected on January 19, 1993, at each of the six sample locations. It was raining hard throughout the day. There was heavy cloud cover, light to medium winds, and the temperature was approximately 40°F. Snow remained in many locations from previous snow storms. Flow rates at the sample locations were a third greater than they had been during the sampling effort of November 23, 1992. The results of the sampling conducted on this day are listed in Table 7.

Results from the two sampling efforts indicate that the quality of surface water and stormwater discharges varies in Sherwood from storm to storm, and from site to site.

For example, the concentration of solids measured as TSS was considerably lower during the first period of sampling than during the second. The highest concentration of TSS during the first period was 12 mg/L and the highest concentration during the second period was 77 mg/L. The increase in solids during the second period was due to erosion and flushing of surface debris during a heavy rain storm that occurred on the day of the sampling.

LEGEND

WETLANDS
URBAN GROWTH BOUNDARY
S1 STORMWATER SAMPLING LOCATION
100 YEAR FLOODPLAIN LINE



N.T.S.

DEA
DAVID EVANS AND ASSOCIATES, INC.
ENGINEERS, SURVEYORS, PLANNERS, LANDSCAPE ARCHITECTS

FIGURE 6.
STORMWATER SAMPLING SITES

TABLE 6

City of Sherwood Stormwater Master Plan
Water Quality Monitoring

November 23, 1992 (Sample Date)

SAMPLE SITE	SAMPLE LOCATION	TSS (mg/L)	TDS (mg/L)	TKN (mg/L)	NH3 (mg/L)	NO2+3 (mg/L)	TP (mg/L)	Cu (mg/L)	Pb (mg/L)	Zn (mg/L)
Rock Creek @ Oregon Street	S1	10	80	1.1	ND	0.81	0.19	ND	ND	ND
Rock Creek @ Highway 99	S2	11	146	*	ND	0.608	0.21	ND	ND	ND
Cedar Creek @ Edy Road	S3	12	74	0.5	ND	1.912	0.13	ND	ND	ND
Cedar Creek @ Sunset Boulevard	S4	2	77	0.3	ND	2.108	0.08	ND	ND	ND
Cedar Creek Tributary @ Division Street	S5	1	156	ND	ND	1.2	0.13	ND	ND	ND
Cedar Creek @ Stella Olsen Memorial Park	S6	6	83	0.3	ND	2.011	0.1	ND	ND	ND
Detection Limits		1	1	0.2	0.2	0.1	0.05	0.05	0.1	0.05

SAMPLE SITE	SAMPLE LOCATION	TEMP (C)	DO (mg/L)	DO SAT (mg/L)	DO %SAT	pH	S.COND (microsiemens/cm)
Rock Creek @ Oregon Street	S1	8.2	5.7	11.77	48	6.4	95.0
Rock Creek @ Highway 99	S2	8.4	3.9	11.71	33	6.4	126.0
Cedar Creek @ Edy Road	S3	8.3	7.0	11.74	60	6.8	98.0
Cedar Creek @ Sunset Boulevard	S4	8.3	7.2	11.74	61	7.0	78.0
Cedar Creek Tributary @ Division Street	S5	11.9	6.5	10.79	60	7.4	172.0
Cedar Creek @ Stella Olsen Memorial Park	S6	8.1	7.1	11.80	60	7.1	86.0

ABBREVIATIONS:

C - Celsius
cm - centimeter
Cu - Copper
DO - Dissolved Oxygen
DO SAT - Saturation Dissolved Oxygen value
DO %SAT - Field Dissolved Oxygen % of Saturation Dissolved Oxygen
mg/L - milligrams per Liter
ND - Non Detect
NH3 - Ammonia
NO2+3 - Nitrite plus nitrate
Pb - Lead
pH - potential of Hydrogen
S.COND - Specific Conductivity
TDS - Total Dissolved Solids
TEMP - Temperature
TKN - Total Kjeldahl Nitrogen
TP - Total Phosphorus
TSS - Total Suspended Solids
Zn - Zinc

NOTES:

* Insufficient sample volume to obtain valid results.

1. TEMP, DO, PH, and S.COND, measured with Hydrolab Data Sonde Water Quality Probe.
2. Values for DO SAT and DO %SAT are presented for comparison to the actual field measurement.

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TABLE 7

City of Sherwood Stormwater Master Plan
Water Quality Monitoring

January 19, 1993 (Sample Date)

SAMPLE SITE	SAMPLE LOCATION	TSS (mg/L)	TDS (mg/L)	TKN (mg/L)	NH3 (mg/L)	TP (mg/L)	COD (mg/L)
Rock Creek @ Oregon Street	S1	7	113	0.5	ND	0.84	18
Rock Creek @ Highway 99	S2	77	71	0.6	ND	0.19	13
Cedar Creek @ Edy Road	S3	59	63	0.7	ND	0.14	10
Cedar Creek @ Sunset Boulevard	S4	50	71	0.6	ND	0.14	15
Cedar Creek Tributary @ Division Street	S5	45	62	0.5	ND	0.27	24
Cedar Creek @ Stella Olsen Memorial Park	S6	4	82	0.6	ND	0.19	11
Detection Limits		1	1	0.2	0.2	0.05	1

SAMPLE SITE	SAMPLE LOCATION	TEMP (C)	DO (mg/L)	DO SAT (mg/L)	DO %SAT	pH	S.COND (microsiemens/cm)
Rock Creek @ Oregon Street	S1	2.9	8.7	13.5	65	6.2	99.0
Rock Creek @ Highway 99	S2	2.6	9.4	13.6	69	6.3	145.0
Cedar Creek @ Edy Road	S3	2.5	12.5	13.6	92	6.6	75.0
Cedar Creek @ Sunset Boulevard	S4	3.4	12.2	13.3	91	6.7	72.0
Cedar Creek Tributary @ Division Street	S5	4.4	12.2	13.0	94	6.6	60.0
Cedar Creek @ Stella Olsen Memorial Park	S6	3.2	12.4	13.4	93	6.7	71.0

ABBREVIATIONS:

C - Celsius
cm - centimeter
COD - Chemical Oxygen Demand
DO - Dissolved Oxygen
DO SAT - Saturation Dissolved Oxygen value
DO %SAT - Field Dissolved Oxygen % of Saturation Dissolved Oxygen
mg/L - milligrams per Liter
ND - Non Detect
NH3 - Ammonia
pH - potential of Hydrogen
S.COND - Specific Conductivity
TDS - Total Dissolved Solids
TEMP - Temperature
TKN - Total Kjeldahl Nitrogen
TP - Total Phosphorus
TSS - Total Suspended Solids

Notes:

1. TEMP, DO, DO % SAT, DO SAT, PH, and S.COND, measured with Hydrolab Data Sonde Water Quality Probe.
2. Values for DO SAT and DO %SAT are presented for comparison.

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In contrast to these general results, the concentration of TSS was low in Cedar Creek at Stella Olsen Park and in Rock Creek at Oregon Street during both sample periods. The concentration of TSS in Cedar Creek at Stella Olsen Park was 6 and 4 mg/L, respectively, and in Rock Creek at Oregon Street was 10 and 7 mg/L, respectively, during the first and second sample periods. These relatively low concentrations of TSS are presumably due to the "cleansing" action of the wetland vegetation that exists in the Cedar Creek and Rock Creek flood plains at these locations. The higher concentrations of TSS that occurred at other locations along Cedar and Rock Creeks are a result of stormwater discharges that were located near the sample sites and not afforded the opportunity of wetland treatment.

The concentration of organic material was only measured directly during the second period of sampling. The concentration of organic material measured as COD varied from a low of 10 mg/L in Cedar Creek near S.W. Edy Road, to a high of 24 mg/L in the Cedar Creek tributary located near South Sherwood Boulevard. These are both moderately high concentrations of COD.

The dissolved oxygen values also provide indirect information about the amount of organic material in the Creeks. In general, waters with low concentrations of dissolved oxygen have higher concentration of organic material. The lower dissolved oxygen concentrations are a result of the utilization of oxygen by bacteria as they biodegrade the organic material that is present in the water. Rock Creek had lower concentrations of dissolved oxygen than Cedar Creek during both sample periods. This trend may indicate higher concentrations of organic material in Rock Creek than in Cedar Creek. It may also indicate that greater mixing and turbulence occurs in Cedar Creek which would add oxygen to the water column.

Stormwater discharges could have a small impact on the amount of organic material and dissolved oxygen in Cedar and Rock Creeks. However, they are both affected to a greater extent by natural processes. Both Cedar and Rock Creeks are relatively slow-moving and they contain an abundance of wetland vegetation and other plant materials within their flood plains which grow and decay naturally. This natural process results in higher concentrations of organic material and lower concentrations of dissolved oxygen.

The concentration of TP in the samples was reasonably low in all cases except for the sample collected in Rock Creek at Oregon Street during the second sample period. The concentration of TP on this date and at this location was 0.84 mg/L. All other readings of TP were equal to or less than 0.27 mg/L. These values for TP are generally in line with the results found during the NURP study (Table 5). The average run-off concentrations of TP found during the NURP study ranged from a low of 0.121 mg/L for open and nonurban areas, to a high of 0.383 mg/L for residential areas. In contrast, the concentration of TP was much higher in studies conducted by USA near 185th Avenue in Beaverton. In USA's study, the average concentration of TP was 1.54 mg/L for stormwater run-off samples collected in October and November of 1991.

The concentration of phosphorus in stormwater discharges within the Tualatin River Basin may be more of a concern now than in the future. Recent scientific findings indicate that the concentration of phosphorus in the Basin may be primarily controlled by the naturally existing concentrations of phosphorus in the native soil and groundwater. Earlier findings suggested that the concentration of phosphorus in the Tualatin River could be lowered by reducing the concentration of phosphorus in stormwater and sewage effluent. These earlier findings may not be correct. Studies are currently being conducted by USA and the U.S. Geologic Survey to resolve this question.

No detectable concentrations of copper, lead, or zinc, were found in any of the samples collected during this study. Furthermore, based on the nature of the community and absence of major industries, one would not expect contamination of stormwater with metals to be a concern, with one exception. That one exception is stormwater run-off from the Frontier Leather Company property. Portions of this property are contaminated with high concentrations of metals, especially chromium, based on soil and groundwater analyses conducted by Tetra Tech Inc. (1993), for DEQ. Although metals have limited mobility in water (because they tend to attach to soil particles and other surfaces), stormwater run-off from this property may be carrying metals into Rock Creek. Additional analysis of the contaminated soils and groundwater at the Frontier Leather property should be conducted. Special attention should be placed on evaluating the potential for migration of contaminants from the property to Rock Creek through surface or groundwater flow. This type of study is outside the scope of this stormwater master plan.

In summary, the concentrations of solids in stormwater run-off were found to be highest during storm periods. Where wetland vegetation exists, solids concentrations were reduced due to sedimentation and filtration. The moderately high concentrations of organic material and related low concentrations of dissolved oxygen found in Rock and Cedar Creeks are due to naturally decaying vegetation. The concentrations of phosphorus in stormwater discharges were slightly less than found in national and local studies. The metal concentrations found during this study were low. However, stormwater run-off from the Frontier Leather Company property is suspect and should be evaluated further.

None of the data that were collected as part of this limited study indicate a significant problem with water quality in the community at this time. However, it would be good public policy and, in fact, far-sighted to consider the need for treating stormwater run-off from the community. The long-term cumulative impacts of stormwater run-off were not evaluated as part of this study. These long-term impacts and the expectation that water quality rules and regulations will become more stringent warrants consideration of constructing stormwater treatment facilities in the community now. In the future, urbanization and pollutant levels will increase, and the availability and price of land for treatment facilities will become a constraining factor.

STORMWATER RULES AND REGULATIONS

The stormwater permitting rules recently adopted by EPA will affect stormwater management in Sherwood in the near future.

As part of the new EPA rules, National Pollutant Discharge Elimination System (NPDES) permits must now be obtained to regulate the discharge of stormwater. In Oregon, these rules are being implemented by DEQ according to their agreement with EPA. These new rules come as a result of both increased understanding about the environmental impacts of stormwater run-off and several years of litigation.

Based on the results of their nationwide study of urban run-off, conducted from 1978 to 1983, EPA concluded that stormwater run-off from urban areas generally contains significant quantities of pollutants (metals, bacteria, nutrients, organics, solids, etc.)

Litigation concerning stormwater run-off started soon after the 1972 Federal Water Pollution Control Act (Clean Water Act) was passed. Parts of the 1972 Act were challenged by organizations such as the National Resources Defense Council because stormwater run-off was exempted from these regulations. These legal challenges continued until the enactment of the Clean Water Act of 1987 which began the regulation of stormwater discharges from industries and municipalities.

Currently, most industries in Oregon are required to obtain permits from DEQ that regulate the discharge of stormwater from their sites. These permits require implementation of stormwater pollution control plans which specify requirements for materials storage, spill control, preventative maintenance, erosion control, and stormwater monitoring.

Currently, large municipal entities (cities and counties with populations greater than 250,000) and medium size municipal entities (cities and counties with populations between 100,000 and 250,000) must obtain stormwater discharge permits. The process of obtaining a stormwater discharge permit can be time consuming and expensive. Municipalities must prepare and submit a two-part application to DEQ for review and approval. This two-part application generally consists of several hundred pages of documentation. The application requires information about the existing stormwater system; outfall locations; legal authority to control stormwater; tributary areas; land use and soil types; location of industrial facilities, landfills, and hazardous waste facilities; and more.

Municipal entities that have populations less than 100,000 (such as the City of Sherwood) are not currently required to obtain stormwater discharge permits. However, new rules are currently being developed for this category of municipality. These rules and regulations were originally scheduled to be issued in October of 1992. That date has now been extended to October of 1994.

It is probable that the new stormwater rules and regulations for municipalities less than 100,000 will have some impact on stormwater management in Sherwood. However, the community is currently putting itself in a favorable position to meet these new rules and regulations by developing this stormwater master plan. This stormwater master plan intentionally contains many of the existing requirements for medium and large municipalities. The scope of this stormwater master plan is comprehensive. It will prepare the community to achieve compliance readily with the new rules and regulations for municipalities with populations less than 100,000 once they are issued.

The City is also impacted directly by the rules and regulations of USA. The City has an intergovernmental agreement with USA whereby USA's surface water management rules effectively become the City's rules. Of particular interest are the rules that require on-site detention facilities and on-site water quality facilities for new developments. Briefly, on-site detention facilities may be required if additional run-off from new developments results in deficiencies in the downstream conveyance system. On-site water quality facilities may be required unless the site topography or soil make it impractical, or there is a regional stormwater treatment facility in the near vicinity. The specific rules which pertain to on-site detention and water quality facilities are included in Appendix A.

The technical basis for the rules which require water quality treatment facilities is currently under question. As discussed earlier, it may not be possible to significantly reduce the phosphorus concentration in the Tualatin River by treating stormwater (one of the primary purposes of the original rules). Recent findings suggest that the concentration of phosphorus in the Tualatin River is primarily controlled by the naturally existing concentration of phosphorus in the native soil and groundwater.

Although the emphasis on removing phosphorus may change in the future, USA will likely continue to require stormwater treatment facilities for removing other pollutants.

CHAPTER 5 - OPERATION AND MAINTENANCE

EXISTING OPERATION AND MAINTENANCE PRACTICES

The City's Public Works Department is responsible for operating and maintaining stormwater facilities. Facilities are maintained on a regular basis and as specific needs arise, but no formal maintenance schedule is currently followed. For example, catch basins are generally cleaned twice per year or as conditions warrant; catch basins which become clogged are cleaned immediately to prevent flooding. Inspection of facilities occurs as part of performing general maintenance activities in the community.

RECOMMENDED OPERATION AND MAINTENANCE PRACTICES

Many of the maintenance activities recommended below are currently practiced by City staff. However, we recommend that the City consider developing a more formalized maintenance program and schedule based on the approach outlined below. This approach consists of a preventative maintenance program, a routine maintenance program, and a program for responding to emergency spills.

Preventative Maintenance

Preventative maintenance consists of all measures taken to prevent conditions from developing which would reduce the stormwater system's ability to function properly. As noted above, many of these maintenance activities are currently being implemented.

Maintenance tasks for a preventative program would include: street cleaning; leaf removal; garbage pickup; hazardous waste removal; and sediment control. Street cleaning priorities should be based on use patterns. The streets that have the most traffic should be cleaned most often because they collect greater amounts of sediment, debris, and other problem materials and pollutants. A city leaf removal program will reduce the potential for storm sewer blockage and subsequent flooding caused by leaf debris. Adequate garbage service should be provided to ensure that refuse is disposed of in a sanitary landfill and not washed down the storm drain. A municipally sponsored hazardous waste program would give citizens the opportunity to properly dispose of household wastes, such as motor oil, paint, pesticides, and herbicides (the City currently participates in the household hazardous waste program sponsored by the Metropolitan Service District—METRO). Sediment associated with new development can be controlled by requiring builders to implement proper erosion control measures as a condition of obtaining a building permit.

Routine Maintenance

Routine maintenance consists of maintenance practices that are done at regular intervals to ensure satisfactory performance of the stormwater system. Specific tasks to be included in a routine maintenance program are discussed below.

Drainage channels should be maintained by removing debris and other materials that significantly impede stormwater flow. Excessive sediment should also be removed. Attention should be paid to controlling erosion in channels by maintaining vegetation and providing channel protection such as rip-rap, where necessary.

Pipes and culverts should be cleaned by flushing them with water; pulling a cleaning pig through them; or removing the obstructions with a hand tool. The conditions of pipes should be reviewed periodically by visual inspection and by using television equipment.

Stormwater detention and treatment facilities should be maintained by removing excessive sediment; removing over-abundant plant material; repairing fences and other safety structures; inspecting erosion control features and adding protection where necessary; and inspecting and repairing inlet and outlet control structures.

Manholes should be inspected routinely. Where necessary, excess sediment should be removed. Manholes should also be used to inspect entrance and exit pipes for sediment build-up or structural failures.

Stormwater catch basins, inlets and trash screens should be inspected regularly. Excessive sediment and debris should be removed to ensure that they do not become clogged.

Table 8 below is a maintenance activity schedule. It contains a listing of suggested maintenance activities, and a schedule of frequency for the activities. It is intended to be used as a general guide by the City public works staff in developing a more specific maintenance activity schedule for the City, as staffing and funding allow.

TABLE 8

Stormwater Facilities Maintenance Schedule

MAINTENANCE OPERATION	SUGGESTED FREQUENCY					
	WEEKLY	MONTHLY	QUARTERLY	BI-ANNUALLY	ANNUALLY	AS NEEDED
PREVENTATIVE:						
Street Cleaning				X		
Leaf Removal					X	
Garbage Pickup	X					
Hazardous Waste Removal			X			
Sediment Control						X
ROUTINE:						
Channels					X	
Pipes/Culverts					X	
Detention/Treatment Facilities				X		
Manholes					X	
Catch Basins/Inlets				X		

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Emergency Response

A formal emergency spill response plan has been developed for Washington County. It was developed in 1992 by the Washington County Department of Public Safety, in cooperation with other County agencies and the American Red Cross. We suggest that this emergency spill response plan be reviewed and adopted by the City for use in responding to emergencies involving oil or hazardous materials. Washington County's plan is included in Appendix C.

MAINTENANCE COSTS

Maintenance costs have been evaluated by discussing staffing and budget with Tad Milburn, the City's Public Works Director. According to Mr. Milburn, approximately seven members of staff charge labor expenses to the City's stormwater budget (if administrative staff are included). The budget for July 1992 through July 1993 included a total payroll budget of $30,749, and a materials budget of $62,700, or a total of $93,449. To date, approximately 70 percent of the budget has been spent.

In the future, maintenance costs will increase substantially. Costs will increase as the community grows and more facilities are added that must be maintained. For example, the local stormwater treatment facilities that are proposed in the capital improvement plan (Chapter 7) will require routine maintenance. Sediment, debris, and vegetation will have to be removed from these facilities to ensure that they function properly. Inlet and outlet control structures will have to be inspected and repaired if necessary.

Based on the recommendation in the capital improvement plan (Chapter 7), we estimate that maintenance costs will double in the next five years.

CHAPTER 6 - ALTERNATIVE ANALYSIS

GENERAL ALTERNATIVES

Many methods exist for controlling both the discharge rate and the quality of stormwater run-off. The majority of these methods can be classified into four general categories: detention facilities; infiltration facilities; storm sewer facilities; and vegetative practices.

Detention Facilities

Detention facilities are used to detain and treat stormwater run-off. They provide temporary storage of stormwater and reduce the rate of run-off during and following a storm event. Detention facilities are generally not designed to store all stormwater discharged from an area but rather they are designed to control the rate of the discharge. Some typical facilities include ponds, concrete basins, and buried vaults.

Detention facilities can also be effective in removing soil particles as a result of sedimentation. Upon entering a detention facility, stormwater velocity is reduced and larger particles fall from solution due to the influence of gravity.

Detention facilities have limitations and concerns associated with their use which must be kept in mind: they may be a safety hazard to children and others, and require fencing; they are not effective in removing dissolved pollutants; they can only be constructed in areas where land is available; and, they only prevent flooding of downstream properties.

Infiltration Facilities

Infiltration facilities include trenches, basins, and drain fields made of coarse granular material. Stormwater run-off is diverted to these facilities and is allowed to percolate into the underlying soils thereby reducing the quantity of surface run-off. Physical treatment occurs as the stormwater is filtered through the infiltration material and native soil.

Infiltration facilities are effective in areas where the native soil conditions and the underlying groundwater table are conducive to percolation. These areas can be characterized generally as having medium or coarse textured soils and a deep groundwater table.

Infiltration facilities are not effective in areas having fine textured soils or shallow groundwater tables because stormwater will not percolate rapidly into the subsurface in these areas. The use of infiltration facilities may raise concerns in some areas about the potential for transporting pollutants to the groundwater.

We do not recommend their use in Sherwood generally, because of unfavorable soil conditions, high groundwater, and concern about transporting pollutants to the groundwater.

Storm Sewer Facilities

Storm sewer facilities are accessories included in storm sewer systems for stormwater quality control. They include sedimentation manholes, trapped catch basins, water quality inlets, and like facilities. They function by providing a location within the storm sewer system where stormwater velocity is reduced and sedimentation can occur. They can also be used to remove floatable pollutants, such as petroleum products, by routing stormwater below baffles and trapping the floating materials at the surface.

The limitations associated with these facilities are: they are only applicable where a storm sewer is in place; they provide no removal of soluble pollutants or fine sediments; they require routine maintenance; and they are generally not large enough to provide stormwater storage volume or attenuation of peak flows.

Vegetative Practices

Vegetative practices are all stormwater control methods that utilize vegetation. They include bioswales, filter strips, shallow marshes, site landscaping, and naturally occurring areas that are vegetated.

Vegetative practices are effective in removing pollutants from stormwater as a result of filtration, infiltration, sorption to soil particles, and biologic uptake of nutrients and trace elements. They have the added benefit of enhancing wildlife habitat value and reducing stormwater run-off velocity.

Vegetative practices are not an effective means of controlling the magnitude of stormwater run-off. They do not provide significant stormwater storage volumes for attenuation of peak flows. They may require routine maintenance such as mowing or plant harvesting, and may not be appropriate in some urban settings because of space limitations.

Structural and Nonstructural Alternatives

Stormwater management alternatives may also be classified as structural or nonstructural. Some of these alternatives that may be applicable for the City, and their purposes are listed in Table 9 below.

TABLE 9

Structural and Nonstructural Stormwater Control Alternatives

ALTERNATIVE	EROSION CONTROL	FLOOD CONTROL	WATER QUALITY CONTROL
STRUCTURAL:			
Pipe Replacement		X	
Pipe Rehabilitation		X	
Pipe Additions		X	
Inlet/Catch Basin Additions		X	
Drop Catch Basins			X
Sedimentation Manholes			X
Channel Widening	X	X	
Channel Protection	X		
Channel Seeding	X		X
Channel Replacement	X	X	
Channel Additions	X	X	
Detention Basins		X	X
Wetland Treatment		X	X
Sedimentation Basins	X	X	X
Bioswales	X	X	X
Infiltration Basins		X	
Upstream Diversion	X	X	X
NONSTRUCTURAL:			
Operation and Maintenance	X	X	X
Stormwater Ordinance	X	X	X
Land Use Planning/Zoning	X	X	X
Public Education	X	X	X
Flood Insurance		X	
Development Ordinance	X	X	X
Design Standards	X	X	X
Emergency Response Procedures			X

Concern Areas

We have identified several areas of concern and opportunity in our evaluation of stormwater conditions with the City's UGB. These areas are discussed below under the heading of the major drainage basin where the concern or opportunity exists.

Cedar Creek

We encountered minor flooding (standing water) in Old Town while we were conducting field work during a heavy rain storm. We found standing water on the south side of First Street between Pine and Washington Streets. We also found standing water on the south side of Second Street between Pine and Washington Streets, and between Washington and Main Streets. The alternative that we propose to alleviate this problem is the addition of catch basins which will drain into existing drainage pipe. This area should also be graded uniformly in conjunction with any roadway improvements to prevent stormwater from "ponding" in poorly graded areas, or areas that have settled.

Flooding also occurs in the Old Town area near a house located at the intersection of Railroad Avenue and West Villa Road. We propose to install an area drain and short section of pipe to address this problem.

Erosion is currently occurring near the intersection of Park and Third Streets—along the pathway that leads to the trail and boardwalk system along Cedar Creek. The slope in this area also appears to be unstable. Some form of erosion and slope protection should be provided at this location. Such improvements could be incorporated into a more general upgrading of the entrance to the trail system.

Although the Cedar Creek Flood Plain currently provides substantial flood control benefits, we believe that the City should also add a detention facility on Cedar Creek in the future for additional flood control. This detention facility would be constructed immediately upstream from the culvert that runs underneath the Southern Pacific Railroad. The detention facility would consist of a concrete weir box placed around the upstream end of the culvert. A removable sluice gate would be installed in the weir box, which would allow the City to control the upstream water surface elevation. The addition of this facility should be coordinated closely with the Southern Pacific Railroad. During design of this facility, careful attention should be paid to the elevation of upstream properties to prevent flooding from occurring on these properties when the facility is in use. The practice of using the railroad fill as a dike may not be appropriate, and should be reviewed carefully during design. This area is currently functioning as an undesigned detention facility because of the limited capacity of the culvert located here and the storage capacity of the flood plain.

The opportunity exists for the City to construct several local stormwater treatment facilities in the Cedar Creek Basin. The following five sites have been identified on a preliminary basis:

1. North of Sunset Boulevard;
2. Stella Olsen Park;
3. West of South Sherwood Boulevard;
4. West of N.W. Gleneagle Drive; and,
5. North of S.W. Edy Road.

The approximate locations of these sites are shown on Figure 7. The symbols for the sites indicate highly generalized locations only. Specific properties have not been selected at this time.

No detailed technical or legal review of these sites has been conducted as part of this study. Sites have been identified based on their logical location within the watershed; proximity to major drainage pipes; and the apparent availability of land at the site. Additional investigations of these sites should be conducted prior to final selection and design.

USA has identified an area along Cedar Creek, near the northern limits of the UGB, as a possible site for a regional stormwater treatment facility. The City should continue to coordinate with USA to ensure that local and regional stormwater treatment sites are selected to complement one another.

Many areas exist in the Cedar Creek Basin which are zoned for residential development, and are currently undeveloped. To accommodate growth in these areas, we propose to plan for the installation of stormwater trunk sewers to serve these areas in the future. These areas are located in Basin 18 along E. Sunset Boulevard, in Basin 4 along S.W. Edy Road, and in Basin 1 along S.W. Scholls-Sherwood Road.

Rock Creek

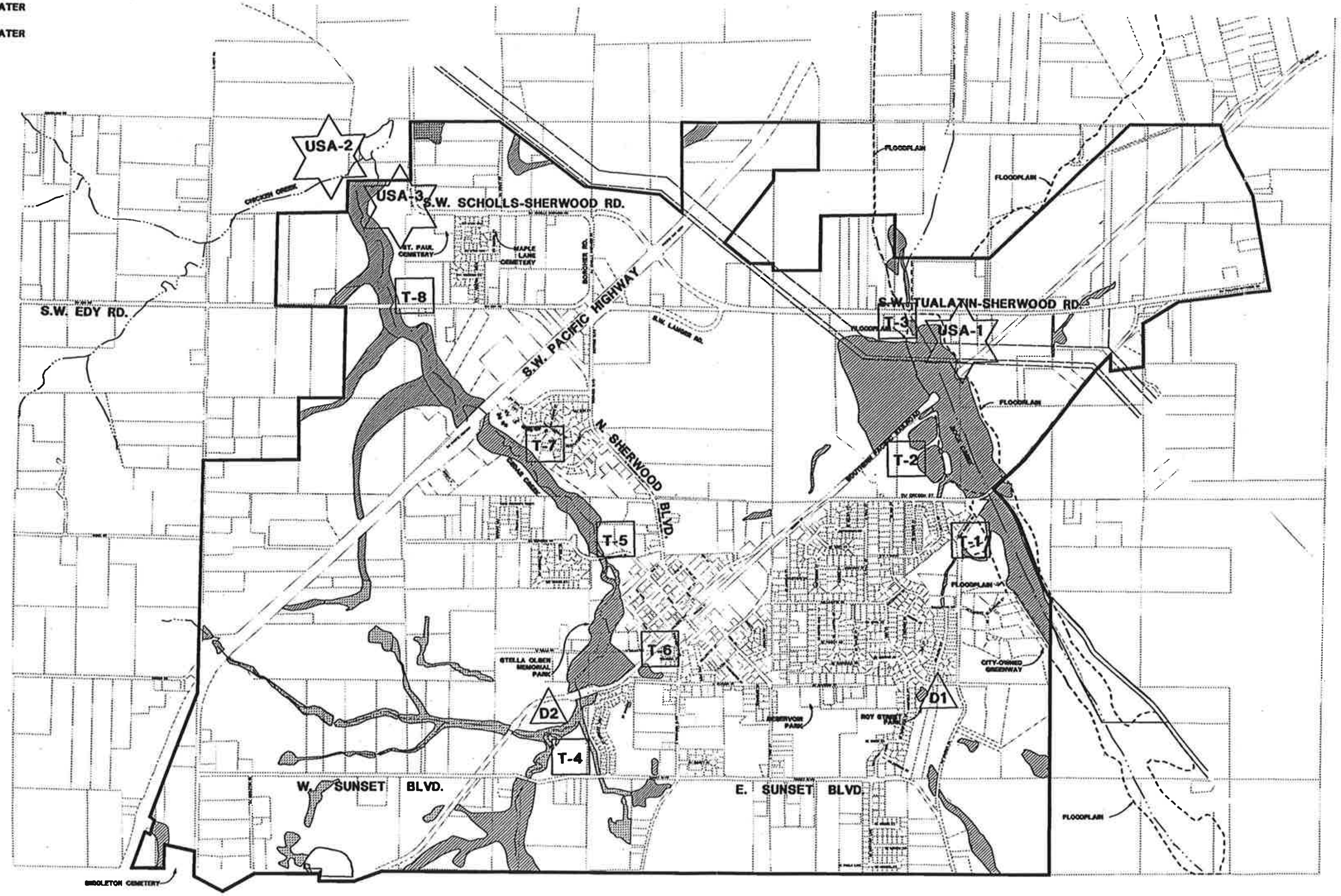
Currently, the open ditch which runs along Oregon Street serves as a major conduit for stormwater. The ditch is eroding in several locations and it also poses a threat to public safety for both motorists and pedestrians. This ditch should be replaced with approximately 400 feet of 36-inch diameter drainage pipe. Because of the concern for public safety, this improvement has already been given a high priority by City staff. They have budgeted for this improvement in 1993.

LEGEND

- WETLANDS
- URBAN GROWTH BOUNDARY
- 100 YEAR FLOODPLAIN LINE
- USA-1 PROPOSED REGIONAL STORMWATER TREATMENT SITES, UNIFIED SEWERAGE AGENCY
- T-1 PROPOSED CITY STORMWATER TREATMENT SITES.
- D1 PROPOSED CITY STORMWATER DETENTION SITES

N.T.S.

DAVID EVANS AND ASSOCIATES, INC.



THE SYMBOLS AT THE PROPOSED SITES INDICATE HIGHLY GENERALIZED LOCATIONS ONLY. NO SPECIFIC PROPERTIES OR SITES HAVE BEEN SELECTED.

FIGURE 7.

PROPOSED STORMWATER TREATMENT AND DETENTION SITES

The culvert which allows Rock Creek to pass under Oregon Street does not have adequate capacity for the expected future growth. During one of our field investigations, the culvert had reached its capacity and headwater was building above the culvert approaching the elevation of the roadway. City Public Works staff report that Oregon Street is flooded at least once every two or three years at this location. We recommend that the existing culvert be replaced with one of higher capacity in the near future. Alternatively, a bridge could be constructed over the stream channel in conjunction with the planned reconstruction of Oregon Street at this location.

Additional improvements for flood control are needed in the Murdock Basin, upstream from the Rock Creek culvert. In particular, a stormwater detention facility has been recommended for the Murdock Basin at the Roy Street Park. Please refer to the City's Stormwater Management Plan for the Murdock and Sunset Basins (DEA, 1992) for additional discussion.

The opportunity exists for the City to construct several local stormwater treatment facilities in the Rock Creek Basin. The following three sites have been identified on a preliminary basis:

1. S.W. Edy Road west of town;
2. East of Murdock Road; and,
3. North of Oregon Street.

The general locations of these sites are shown on Figure 7. Again, these are highly generalized locations, at this time, and not specific properties.

No detailed technical or legal review of these sites has been conducted at this time. Sites have been identified based on their logical location within the watershed; proximity to major drainage pipes; and the apparent availability of land at the site. Additional investigations of these sites should be conducted prior to final selection and design.

USA has identified one area along Rock Creek, upstream of the Rock Creek culvert under S.W. Tualatin-Sherwood Road, as a possible site for a regional stormwater treatment facility. The City should continue to coordinate with USA to ensure that local and regional stormwater treatment sites are selected to complement one another.

As new development continues in the Basin in accordance with the Comprehensive Plan, additional stormwater pipes will have to be constructed to convey stormwater. The largest of these pipes are often called trunk lines or interceptors. Based on zoning, we anticipate that at least two interceptors will be needed. One would run parallel to S.W. Tualatin-Sherwood Road in an easterly direction. The other would be located somewhere between S.W. Tualatin-Sherwood Road and the Southern Pacific Railroad in an area that is currently undeveloped.

Chicken Creek

The Chicken Creek Basin occupies only a small portion of the UGB and it is of minor concern with regard to stormwater facilities at this time. However, it may become more important in the future as this area is developed according to the Comprehensive Plan. Based on zoning and location, we believe that a nominal amount of storm drainage interceptor pipe (about 1,000 feet) will be needed in this area in the future. No local stormwater treatment facilities are anticipated for this area at this time. However, depending on the nature and extent of growth in the Basin, on-site treatment facilities should be considered in conjunction with development.

Hedges Creek

The Hedges Creek Basin is also of minor concern with regard to stormwater facilities at this time. However, the City should work closely with developers to ensure that this area, which is zoned for industrial use, be provided with proper stormwater facilities at the time of development.

CHAPTER 7 - CAPITAL IMPROVEMENT PLAN

A capital improvement plan is a plan which describes how the improvements that are needed in a community will be addressed. It consists of a list and description of specific improvements that are planned; an estimate of the cost of each improvement; and an estimate of the time period in which the improvement will be constructed.

PRIORITIES

It is useful to determine when the various stormwater system improvements that have been identified should be constructed. Improvements should be made based on the urgency of the need. Towards that end, we have developed a priority array of system improvements to assist us in recommending the timing of improvements. The array has three categories of priority: "High Priority" improvements are those improvements which would prevent loss of life or frequent damage to property or the environment; "Medium Priority" improvements are those which would prevent periodic damage to property or the environment; and, "Low Priority" improvements are all others. The priority array is shown in Table 10.

CAPITAL IMPROVEMENT COSTS

We have prepared preliminary cost estimates in 1993 dollars for the various stormwater system improvements which have been recommended. These cost estimates are for construction costs (materials and labor), engineering, and land, where applicable. The cost of land has been determined by estimating the amount of land needed for a particular facility, and assuming a land value of $4,000 per acre for land in the flood plain, and $25,000 per acre for "developable" land. The cost estimates are planning level estimates, not refined construction estimates since the facilities have not been designed yet. However, these estimates are reasonable for planning purposes. As an example, the cost estimate for placing drainage pipe along Oregon Street was made by multiplying the number of lineal feet of pipe needed, by the construction cost (materials and labor) of pipe per lineal foot. This construction cost was multiplied by 1.2 to reflect an estimated cost of engineering of 20 percent.

The cost of each of the system improvements has also been evaluated in terms of how it will benefit new developments. This evaluation was conducted in order to allocate costs equitably for system development charges. For example, where drainage improvements are being undertaken entirely for the purpose of serving a new development, the percent benefit would be 100 percent. Where drainage improvements would benefit an entire area including new developments, the percentage benefit to the new developments has been estimated.

TABLE 10

City of Sherwood Stormwater Master Plan
Priority Array of Stormwater System Improvements

Location	Improvements	High Priority	Medium Priority	Low Priority
Park Street/Cedar Creek	Erosion Control	X		
Old Town	Inlets/Drainage Pipe	X		
Stella Olsen Park	Local Treatment Facility	X		
Cedar Creek near railroad	Detention Facility		X	
South Sherwood Blvd.	Local Treatment Facility		X	
N.W. Gleneagle Drive	Local Treatment Facility	X		
S.W. Scholls-Sherwood Road	Regional Treatment Facility		X	
S.W. Scholls-Sherwood Road	Drainage Pipe (1,000', 21")		X	
S.W. Edy Road	Drainage Pipe (1,000', 18")		X	
S.W. Edy Road	Local Treatment Facility		X	
S.W. Tualatin-Sherwood Road	Drainage Pipe (2,000', 18")		X	
S.W. Tualatin-Sherwood Road	Local Treatment Facility		X	
S.W. Tualatin-Sherwood Road	Regional Treatment Facility		X	
North of Oregon Street	Drainage Pipe (2,500', 24")			X
Oregon Street	Drainage Pipe (400', 36")	X		
Roy Street Park	Detention Facility	X		
Murdock Road	Local Treatment Facility	X		
North of Oregon Street	Local Treatment Facility	X		
Oregon Street	Rock Creek Culvert	X		
Sunset Blvd.	Drainage Pipe (2,000', 18")		X	
Sunset Blvd.	Local Treatment Facility		X	
Chicken Creek Basin	Drainage Pipe (1,000', 18")			X

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Table 11 below is a summary of the recommended stormwater system improvements and their construction costs. The costs are listed under the heading of the period where the improvement is most likely to take place. For planning purposes, we refer to four discrete time periods in five-year intervals: from 0-5 years; from 5-10 years; from 10-15 years; and from 15-25 years.

The recommended time periods for improvements were developed by considering the priority of the improvements (as listed in Table 10) and the need for phasing improvements over time to spread out costs.

FIVE-YEAR PLAN

The capital improvements that have been recommended for implementation within a five-year time frame (and their associated costs) include the following nine projects:

1. Adding erosion control features at the Park Street entrance to the Cedar Creek trail system ($5,000);

2. Adding inlets and drainage pipe in Old Town to alleviate minor flooding problems ($20,000);

3. Constructing a local stormwater treatment facility in the vicinity of Stella Olsen Park ($200,000);

4. Constructing a local stormwater treatment facility in the vicinity of N.W. Gleneagle Drive ($205,000);

5. Replacing the open ditch along Oregon Street with 36-inch diameter drainage pipe ($25,000);

6. Constructing a detention facility at the Roy Street Park ($100,000);

7. Constructing a local stormwater treatment facility on Murdock Road ($400,000);

8. Constructing a local stormwater treatment facility north of Oregon Street ($350,000); and,

9. Replacing the Rock Creek culvert under Oregon Street ($60,000).

The total estimated cost for implementing the five-year plan would be approximately $1,365,000.

TABLE 11

City of Sherwood Stormwater Master Plan
Capital Improvements Summary

Location	Improvements	Cost per Improvement Period (1993 Dollars)				Percent Benefitting New Development
		0-5 years	5-10 years	10-15 years	15-20 years	
Park Street/Cedar Creek	Erosion Control	$5,000				0%
Old Town	Inlets/Drainage Pipe	$20,000				0%
Stella Olsen Park	Local Treatment Facility	$200,000				30%
Cedar Creek near railroad	Detention Facility		$75,000			50%
South Sherwood Blvd.	Local Treatment Facility		$230,000			10%
N.W. Gleneagle Drive	Local Treatment Facility	$205,000				30%
S.W. Scholls-Sherwood Road	Regional Treatment Facility		$0			30%
S.W. Scholls-Sherwood Road	Drainage Pipe (1,000', 21")		$50,000			70%
S.W. Edy Road	Drainage Pipe (1,000', 18")		$45,000			70%
S.W. Edy Road	Local Treatment Facility		$225,000			80%
S.W. Tualatin-Sherwood Road	Drainage Pipe (2,000', 18")			$90,000		90%
S.W. Tualatin-Sherwood Road	Local Treatment Facility		$250,000			90%
S.W. Tualatin-Sherwood Road	Regional Treatment Facility		$0			20%
North of Oregon Street	Drainage Pipe (2,500', 24")				$130,000	90%
Oregon Street	Drainage Pipe (400', 36")	$25,000				10%
Roy Street Park	Detention Facility	$100,000				40%
Murdock Road	Local Treatment Facility	$400,000				40%
North of Oregon Street	Local Treatment Facility	$350,000				20%
Oregon Street	Rock Creek Culvert	$60,000				30%
Sunset Blvd.	Drainage Pipe (2,000', 18")			$90,000		60%
Sunset Blvd.	Local Treatment Facility		$200,000			70%
Chicken Creek Basin	Drainage Pipe (1,000', 18")				$45,000	90%
TOTALS		**$1,365,000**	**$1,075,000**	**$180,000**	**$175,000**	

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The largest and most costly projects involve construction of the local stormwater treatment facilities. To reduce costs for the five-year plan, we recommend that the City consider implementing the local stormwater treatment alternatives in three phases: Phase I would consist of further evaluating site needs and constraints and purchasing the land for the treatment facilities; Phase II would consist of designing the "High Priority" facilities; and, Phase III would consist of constructing the "High Priority" facilities.

CHAPTER 8 - FINANCING PLAN

USER CHARGES

The City currently finances operation and maintenance of stormwater facilities under the terms of a stormwater utility developed by USA. This utility allows the City (and USA) to collect monthly fees from all users based on standard utility rate making principles. In theory, these monthly charges are set at sufficient rates to pay for operation and maintenance costs. The current monthly charge is $3.00 per user; $2.00 of this fee goes to the City, and $1.00 goes to USA. The City has used monthly charges primarily to finance system maintenance. In the future, growth in customer base or fee increases may allow monthly charges to apply to limited capital projects.

SYSTEM DEVELOPMENT CHARGES (SDCs)

In recent years, the City has financed capital improvements increasingly through system development charges (SDCs). These charges are directed at new developments and new users. In Oregon, SDCs are specifically provided for under Oregon Revised Statutes. They consist of two parts; a reimbursement fee, and an improvement fee. The reimbursement fee covers part of the cost of the existing facilities that benefit the new user. The improvement fee covers the cost of new facilities that will be necessary to meet the demands of new users. SDCs can generate reasonably large amounts of revenue over time to pay for capital improvements.

The current stormwater SDC used by the community was developed by USA. It is based on the area of impermeable surface of the property being served. The base charge has been set at $180.00 per Equivalent Service Unit (ESU) for water quality, and $100.00 per ESU for water quantity. One ESU has been defined as 2,640 square feet. Larger areas are prorated from the base amount.

PROPERTY TAXES

In some communities, the property tax supported General Fund is used infrequently to finance stormwater facilities. Generally, this method of financing is only used when the capital and operation and maintenance cost of the needed facility are low. The project must also be interpreted to be of general benefit to everyone in the community. The City has not generally used this method to finance stormwater capital improvements.

ROADWAY FUNDING

Stormwater drainage facilities are integral parts of all modern roadways. Stormwater facilities that are added as part of roadway projects benefit the communities that the roadways pass through, even though the communities may not fund them. For example, the stormwater facilities that were added in conjunction with improvements to S.W. Tualatin-Sherwood Road were funded by Washington County. These improvements included stormwater inlets, internal roadway drainage pipes, and a water quality treatment swale located near Rock Creek. When the drainage facilities are not designed with reserve capacity, however, they may provide limited benefit to nearby properties.

In the past, City stormwater operations and capital improvements were paid in large part, out of the City street fund, which received the bulk of its revenue from state-shared fuel taxes. With the advent of USA's stormwater utility, the street fund's role has been diminished.

CONTRIBUTED FACILITIES

Stormwater facilities are added in conjunction with new developments. Sometimes these facilities are small, benefitting only the development, and other times they are large, benefitting the general community. When the City takes over ownership of these facilities they can be considered contributed facilities. Examples would include: roadways and their associated drainage systems, originally built by developers, which become city streets; and on-site stormwater detention and treatment ponds which become city property.

If these contributed facilities were calculated into the applicable SDC, the City, as required by State statute, offers credits against the charges.

TAXING DISTRICTS

Taxing districts are sometimes formed to fund projects in special, well-defined areas. These taxing districts are commonly referred to as local improvement districts (LIDs). They are often formed by property owners who see the need for infrastructure improvements that will specifically benefit their area and not the community as a whole. This type of financing is generally incidental when compared to the overall financing needs of a community.

At one point in Sherwood's recent history (1980-84) LIDs were used extensively for infrastructure expansion. Although this infrastructure has contributed greatly to the City's current growth levels, the LIDs themselves were not financially successful. This lack of financial success, and new restrictions on LIDs resulting from Ballot Measure 5, have caused the City to abandon this method in recent years.

In addition, the City's responsibility to repay the $1,000,000 refunding bond issued in 1990 to "bail out" failed LIDs weighs against this option.

BONDING

Bonds are long-term notes issued by corporations or government entities for the purpose of financing major projects. The borrower receives money now, in return for a promise to pay later, with interest. The bonding powers of communities are often used to secure funding for large stormwater projects. This method of financing allows a community to obtain the needed capital quickly under the terms of a specific financial arrangement. Payment of the bond itself would be made with funds resulting from one of the other methods of financing discussed in this section of the report.

RECOMMENDED FINANCING METHODS

The current method of financing operation and maintenance of stormwater facilities in Sherwood was developed by USA, as discussed above. The user fee charge is currently being challenged in court. According to USA staff, one property owner has recently filed suit contesting that the user fee charge is a form of property tax and is illegal under the recent constitutional amendment to State tax law (Measure 5).

Similar suits have been filed in Gresham and in Roseburg. In both cases, the tax court ruled in favor of the property owners that filed the suits. The tax court ruled that the fee was a tax. The matter has been appealed to the Supreme Court. According to USA staff, their stormwater utility charge was established in the same manner as these other communities, and they expect to get the same ruling at the tax court as in the previous two cases. If this unfavorable ruling occurs, they would request a stay until a final decision is rendered by the Supreme Court.

In view of recent developments, it appears possible that the existing stormwater utility charge, in its current form, may not remain as a viable method for financing operation and maintenance of stormwater facilities.

The City should continue to encourage and accept contributed facilities provided they are consistent with the terms of this stormwater master plan. General obligation or revenue bonds should be considered for those higher priority capital improvements not attributable to new development. LIDs may also have some utility but should be carefully weighed against the City's recent bad experience with this funding mechanism. Use of the General Fund is not recommended.

Since portions of the stormwater capital improvements may be financed through SDCs, it is useful to consider SDC development briefly. SDCs are developed by considering the percent of the proposed capital improvement which will benefit new development and the amount of impervious area added as a result of new development.

The percents of the proposed capital improvements benefitting new development were presented earlier in Table 11. Information about the amount of impervious area added as a result of new development (both public and private) is summarized below in Tables 12 and 13. The combined information presented in Tables 11, 12, and 13 would be used by the City's financial consultant to develop stormwater SDCs for the community. SDC development would be one of the next logical steps in securing financing for implementation of the recommended capital improvement plan.

TABLE 12

Impervious Area Analysis for Developing Drainage Basins
Existing Conditions

Basin #	Basin Area (Acres)	Streets and Roads Total Area (Acres)	Impervious Areas Parking Lots, etc. Total Area (Acres)	Commercial and Business Districts		Residential Districts		Total Public Impervious Area (Acres)	Total Private Impervious Area (Acres)
				Total Area (Acres)	Impervious Area (Acres)	Total Area (Acres)	Impervious Area (Acres)		
1	26	0	0	0	0	13.05	4.95	0	4.95
2	36	2.9	0	0	0	0	0	2.9	0
3	37	12	0	0	0	0	0	12	0
4	40	0	0	0	0	22.4	2.68	0	2.68
5	55	0	0	0	0	0	0	0	0
6	45	0	0	0	0	0	0	0	0
7	158	16.6	5.5	0	0	0	0	16.6	5.5
8	28	0	0	0	0	7.1	4.62	0	4.62
9	7	0	0	0	0	7.3	2.77	0	2.77
10	37	0	0	0	0	0	0	0	0
11	237	0	0	0	0	0	0	0	0
12.1	170	11.9	0	0	0	29.7	3.56	11.9	3.56
12.2	63	0	0	0	0	3.2	0.38	0	0.38
12.3a	40	0	0	15.4	11.08	5.4	2.05	0	13.13
12.3b	6	0.5	0	0	0	1.1	0.13	0.5	0.13
12.3c	25	0	0	0	0	0	0	0	0
12.4a	6	0	0	0	0	1.5	0.57	0	0.57
12.4b	10	4.8	0	0	0	4.4	2.68	4.8	2.68
12.4c	18	0	5.5	0	0	9.2	3.51	0	9.01
12.4d	3	0	0	0	0	3.1	1.19	0	1.19
12.4e	5	0	0	0	0	5.2	1.98	0	1.98
12.4f	8	0	0	0	0	8	3.04	0	3.04
12.4g	102	25.5	0	0	0	15.3	5.81	25.5	5.81
12.5	65	9	0	0	0	0	0	9	0
12.6	56	0	0	0	0	0	0	0	0
13	39	0	7	0	0	2.7	1.76	0	8.76
14	22	0	6	0	0	6.5	4.23	0	10.23
15	5	0	0	0	0	4.6	1.75	0	1.75
16	21	0	0	1.1	0.79	19.6	7.98	0	8.77

Basin #	Basin Area (Acres)	Streets and Roads Total Area (Acres)	Impervious Areas Parking Lots, etc. Total Area (Acres)	Commercial and Business Districts		Residential Districts		Total Public Impervious Area (Acres)	Total Private Impervious Area (Acres)
				Total Area (Acres)	Impervious Area (Acres)	Total Area (Acres)	Impervious Area (Acres)		
17a	12	0	0	0	0	12.1	4.61	0	4.61
17b	25	0	0	2.5	1.8	20.1	7.63	0	9.43
17c	29	0	0	0	0	19.7	7.49	0	7.49
17d	9	0	0	8.9	6.4	0	0	0	6.4
17e	22	0	0	0	0	5.2	1.3	0	1.3
18	134	0	0	0	0	18.7	3.74	0	3.74
19	71	0	0	0	0	0	0	0	0
20a	12	0	0	0	0	0	0	0	0
20b	37	0	0	0	0	0	0	0	0
20c	23	0	0	0	0	0	0	0	0
20d	12	2.2	0	0	0	0	0	2.2	0
20e	22	0	0	0	0	14.8	5.62	0	5.62
20f	40	0	0	0	0	28.7	10.91	0	10.91
21a	16	0	0	0	0	15.1	3.78	0	3.78
21b	12	0	0	0	0	11.4	2.85	0	2.85
21c	21	0	0	0	0	14.4	3.6	0	3.6
21d	16	0	0	0	0	15.7	3.93	0	3.93
21e	10	0	0	0	0	6.6	1.65	0	1.65
21f	9	0	0	0	0	9.8	3.72	0	3.72
21g	13	1.1	0	0	0	8.2	3.12	1.1	3.12
21h	9	0	0	4.3	3.11	0	0	0	3.11
22	128	0	12.7	0	0	0	0	0	12.7
23	124	0	0	0	0	0	0	0	0
24.1	97	0	0	0	0	27.1	3.52	0	3.52
24.2	110	5	19.3	0	0	0	0	5	19.3
24.3	54	7.23	0	0	0	0	0	7.23	0
25	71	0	40.9	0	0	0	0	0	40.9
26	53	0	6.8	0	0	0	0	0	6.8
27	97	5.8	0	0	0	0	0	5.8	0
28	30	0	0	0	0	0	0	0	0
29	32	5.78	0	0	0	0	0	5.78	0
30	48	0	0	0	0	0	0	0	0
TOTALS	2768.0	110.3	103.7	32.2	23.2	397.0	123.1	110.3	250.0

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Table 13

Impervious Area Analysis for Developing Drainage Basins
Future Conditions

Basin #	Basin Area (Acres)	Streets and Roads Total Area (Acres)	Impervious Areas Parking Lots, etc. Total Area (Acres)	Commercial and Business Districts		Residential Districts		Total Public Impervious Area (Acres)	Total Private Impervious Area (Acres)
				Total Area (Acres)	Impervious Area (Acres)	Total Area (Acres)	Impervious Area (Acres)		
1	26	0	0	7.8	6.63	18.3	8.92	0	15.55
2	36	2.9	0	0	0	33.4	21.71	2.9	21.71
3	37	12	0	9	7.65	16.5	10.73	12	18.38
4	40	0	0	19.9	16.91	19.9	12.94	0	29.85
5	55	0	0	0	0	55.4	21.05	0	21.05
6	45	0	0	0	0	44.7	16.98	0	16.98
7	158	16.6	5.5	8.9	7.57	127	65.44	16.6	78.51
8	28	0	0	0	0	28.4	12.7	0	12.7
9	7	0	0	3.6	2.59	3.6	1.37	0	3.96
10	37	0	0	7.7	5.54	29.1	11.06	0	16.6
11	237	0	0	7.1	5.11	230.1	87.44	0	92.55
12.1	170	11.9	0	112.8	81.22	44.7	16.99	11.9	98.21
12.2	63	0	0	22.1	15.91	41	26.65	0	42.56
12.3a	40	0	0	22	15.84	18	6.84	0	22.68
12.3b	6	0.5	0	5.3	4.23	0	0	0.5	4.23
12.3c	25	0	0	0	0	0	0	0	0
12.4a	6	0	0	3	2.16	3	1.14	0	3.3
12.4b	10	4.8	0	0	0	4.4	2.86	4.8	2.86
12.4c	18	5.5	5.5	0	0	12.9	8.39	5.5	13.89
12.4d	3	0	0	0	0	3.1	1.19	0	1.19
12.4e	5	0	0	0	0	5.2	1.98	0	1.98
12.4f	8	0	0	0	0	8	3.04	0	3.04
12.4g	102	25.5	0	0	0	38.1	22.71	25.5	22.71
12.5	65	9	0	0	0	55.5	37.08	9	37.08
12.6	56	0	0	0	0	56	21.28	0	21.28
13	39	0	7	9.1	6.55	27.4	17.81	0	31.36
14	22	0	6	0	0	6.5	4.23	0	10.23
15	5	0	0	1.6	1.15	4.6	2.99	0	4.14
16	21	0	0	0	0	19.2	7.73	0	7.73
17a	12	0	0	4	0	12.1	4.61	0	4.61

Basin #	Basin Area (Acres)	Streets and Roads Total Area (Acres)	Impervious Areas Parking Lots, etc. Total Area (Acres)	Commercial and Business Districts		Residential Districts		Total Public Impervious Area (Acres)	Total Private Impervious Area (Acres)
				Total Area (Acres)	Impervious Area (Acres)	Total Area (Acres)	Impervious Area (Acres)		
17b	25	0	0	0	0	21.1	11.09	0	11.09
17c	29	0	0	5.8	4.18	29.3	12.8	0	16.98
17d	9	0	0	0	0	3.1	2.02	0	2.02
17e	22	0	0	18.7	13.46	21.6	11.31	0	24.77
18	134	0	0	0	0	115	63.71	0	63.71
19	71	0	0	0	0	70.6	22.45	0	22.45
20a	12	0	0	2.6	1.87	11.8	4.48	0	6.35
20b	37	0	0	0	0	34.6	13.15	0	13.15
20c	23	0	0	0	0	23.5	9.82	0	9.82
20d	12	2.2	0	0	0	10.2	4.84	2.2	4.84
20e	22	0	0	0	0	21.9	8.32	0	8.32
20f	40	0	0	0	0	39.9	19.81	0	19.81
21a	16	0	0	0	0	15.9	6.04	0	6.04
21b	12	0	0	0	0	12.7	4.83	0	4.83
21c	21	0	0	0	0	20.6	9.79	0	9.79
21d	16	0	0	0	0	15.7	6.91	0	6.91
21e	10	0	0	0	0	6.6	1.65	0	1.65
21f	9	0	0	0	0	9.8	3.72	0	3.72
21g	13	1.1	0	0	0	11.7	6.2	1.1	6.2
21h	9	0	0	8.6	6.19	0	0	0	6.19
22	128	0	12.7	25	18	89.9	49.74	0	80.44
23	124	0	0	52.1	42.34	71.9	46.74	0	89.08
24.1	97	0	0	0	0	96.6	39.25	0	39.25
24.2	110	5	19.3	86.1	61.99	0	0	5	81.29
24.3	54	7.23	0	0	0	46.77	30.4	7.23	30.4
25	71	0	40.9	30.2	21.74	0	0	0	62.64
26	53	0	6.8	45.7	32.9	0	0	0	39.7
27	97	5.8	0	91.2	65.66	0	0	5.8	65.66
28	30	0	0	30	21.6	0	0	0	21.6
29	32	5.78	0	26.22	18.87	0	0	5.78	18.87
30	48	0	0	48	27.72	0	0	0	27.72
TOTALS	2768.0	115.8	103.7	714.1	515.6	1766.9	846.9	115.8	1466.2

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CHAPTER 9 - PUBLIC INVOLVEMENT

PUBLIC MEETING - NUMBER ONE

The first public meeting on this stormwater master plan was held on July 9, 1992. Direct mail notices of this meeting were sent to those people who attended the meetings on the Murdock Basin Plan. The City Manager, two representatives from DEA, and five citizens attended. Jim Rapp, Sherwood's City Manager, began the meeting with a brief introduction. He discussed the need for the City to treat its stormwater in order to mitigate the impact of Cedar, Rock, and Chicken Creeks on the Tualatin River. He also urged the citizens in attendance to inform others about the meeting in order to increase public involvement. Mr. Rapp concluded by introducing Ken Vigil, a representative from DEA, who addressed the purpose and scope of the project.

Mr. Vigil explained that stormwater management was a concern because of flooding, erosion, and pollution control. A recent judicial decision mandates the EPA to improve the water quality of the Tualatin River. This in turn forces municipalities that reside in the Tualatin River Basin to remove excess phosphorus from stormwater run-off. Phosphorus is a limiting nutrient in algal cell growth and the predominant pollutant of concern in the Tualatin River. Excess phosphorus concentrations cause increased algal growth, resulting in fluctuations in pH and dissolved oxygen concentrations. Many aquatic organisms are adversely affected by these fluctuations.

He went on to emphasize that the stormwater master plan will be a general planning document and not an engineering design report. Mr. Vigil explained that the specific goals of the project are: to document existing conditions and problems; to predict future conditions; to identify needed facilities; and to evaluate costs and financing options. He also explained that the scope of the work will include: a facilities inventory; hydrology; hydraulics; a water quality assessment; operation and maintenance; an evaluation of alternatives; a capital improvement plan; and a financing plan. The meeting concluded with a brief discussion of the project schedule and a question and answer period.

Although no major concerns were raised, citizens asked questions regarding the costs of proposed facilities. They told DEA representatives that basements in the Old Town area of Sherwood had flooding problems. Mr. Vigil reemphasized the need for community involvement in order to make the planning document as useful as possible to the citizens of Sherwood.

PUBLIC MEETING - NUMBER TWO

The second public meeting was held on October 28, 1992, as part of the regular City Council meeting. The City Council, City Manager, several citizens, and two representatives from DEA attended. Mayor Rick A. Hohnbaum called the meeting to order, and after other topics of discussion, the Mayor introduced the City Engineers from DEA, Ken Vigil and Joe Richards.

Mr. Vigil discussed the overall goals, focus, and need for the stormwater master plan. Before the meeting, the City Council and staff received copies of the report outline and inventory mapping. He referred to the information provided to the City at many times throughout his presentation. He asked Mr. Richards to give a more in-depth discussion on some of the technical aspects of the report, namely, the methodology for computing stormwater run-off.

Mr. Richards explained that one of the methods used was developed by SCS and described in Technical Release 55 (TR55) entitled, "Urban Hydrology of Small Watersheds, 2nd Edition". This method was selected because it is widely accepted; it is based on cover types, land use, and soil characteristics; it is not data intensive; and it provides reasonable estimates of peak stormwater run-off rates. The other method, developed by the COE commonly referred to as Hydrology Engineering Center Model 1 (HEC-1), was utilized to model the large portions of Cedar and Rock Creeks which extend beyond Sherwood's UGB. After discussing the applications of these two programs to the hydrologic conditions in Sherwood, he turned the podium back over to Mr. Vigil who concluded his overview and opened the floor for discussion. A general discussion followed.

PUBLIC MEETING - NUMBER THREE

The third public meeting was held on February 24, 1993, again in conjunction with the regular City Council meeting. At the meeting, Ken Vigil gave an update to the City Council and staff, and the public attending the Council meeting, of progress made on the stormwater master plan. He explained that water quality sampling had been completed and the results showed no surprises. No significant problems with stormwater quality were found as a result of site-specific sampling and analysis. Some concerns still exist, however, about water quality near the Frontier Leather property. Mr. Vigil was asked by Jim Rapp to coordinate with DEQ and the U.S. Department of Fish and Wildlife Service (USFWS) on their analysis of contamination at the property.

The Council and staff discussed the difficulties associated with completing the plan in light of changing regulatory emphasis in the Tualatin River Basin. For example, the technical basis for the rules which require stormwater treatment facilities is currently under question. Recent findings suggest that it may not be possible to reduce the phosphorus concentration in the Tualatin River by treating stormwater (one of the primary purposes of the original treatment rules). Furthermore, concerns have been raised by the Oregon Department of Water Resources about the need to acquire water rights for stormwater ponds to account for the water use associated with the ponds.

The Council and staff also discussed the merits of constructing local stormwater treatment facilities. Mayor Walter Hitchcock made the point that the stormwater master plan should include a far-sighted approach which anticipates more stringent future regulations for stormwater treatment. The master plan should place the City in a favorable position for meeting future regulations by taking action now. Furthermore, he felt that stormwater treatment was particularly important for protecting portions of the future national wildlife refuge planned for the Rock Creek Basin.

Mr. Vigil closed the meeting by stating that specific capital improvements, including local stormwater treatment facilities, and their associated costs were being formulated now and he would report on them during a future presentation.

PUBLIC MEETING - NUMBER FOUR

The fourth public meeting was held on April 14, 1993, in conjunction with the regularly scheduled City Council meeting. Two items relating to stormwater were placed on the "Presentations" section of the City Council agenda. The first item was a formal presentation made by John Jackson and Bill Gaffi of the Unified Sewerage Agency (USA) about the history and latest developments in surface water management within USA's jurisdictional area. The second item was a presentation by Mr. Vigil of DEA on the stormwater master plan.

Mr. Jackson and Mr. Gaffi reported that the initial focus of USA was to develop an overall surface water management plan for the entire service area. Attention was also focused on establishing program funding; public involvement and awareness; development review; maintenance; capital construction; water quality studies; and subbasin planning. More recent activities have been directed at resolving regulatory, technical, and fiscal uncertainties.

Mayor Walt Hitchcock asked Mr. Jackson if he had read the City's draft stormwater master plan and if he considered it to be consistent with USA's broader efforts. Mr. Jackson replied that he received a copy of the draft document and reviewed it for general content and scope. He reported that, based on his preliminary review, he felt that the document was consistent with USA's subbasin planning efforts. In fact, some parts of the City's plan (such as the facilities inventory) are broader in scope than USA's subbasin plans, according to Mr. Jackson.

Immediately after the presentation by USA staff, Mr. Vigil made his presentation of the City's draft stormwater master plan. He reported that the plan was approximately 90 percent complete. He gave a brief summary of the scope of the plan and then discussed the recommended capital improvement plan in more detail.

Following Mr. Vigil's presentation, Mayor Hitchcock asked City Manager, Jim Rapp, what the next step in the process of adopting the stormwater master plan was. Mr. Rapp responded by saying that a formal public hearing should be scheduled next. A motion was made by the City Council to hold a public hearing in two weeks and the motion passed unanimously.

PUBLIC HEARING

A hearing to accept public input on the stormwater master plan was held on April 28, 1993. The hearing was well attended by past and present members of the City's Planning Commission, but not by the public in general.

Joe Richards of DEA gave a brief presentation to the audience which focused on the general purpose and scope of the master plan. Following Mr. Richards' presentation, Mayor Walt Hitchcock opened the hearing for public comment and testimony.

Only one citizen gave testimony at the hearing. He reported that he was concerned about plans to replace the open ditch on Oregon Street with drainage pipe. His main concern was that it be done in such a way that adjacent properties would continue to have adequate drainage and not be flooded. Apparently he had witnessed a problem with flooding in the past when a ditch was replaced with drainage pipe. After his testimony, Mr. Tad Milburn, the City's Public Works Director, assured the citizen that the drainage pipe could be added without causing flooding of adjacent properties.

The hearing was closed by Mayor Hitchcock who concluded by stating that the plan would put the City in a favorable position to meet future stormwater rules and regulations. Adoption of the city-wide stormwater master plan was scheduled for May 12, 1993.

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APPENDIX A

Rules/Regulations/Ordinances

- **Stormwater Management Resolution No. 92-520**
- **USA On-site Detention and Treatment Rules**

City of Sherwood, Oregon
Resolution No. 92-520

A RESOLUTION ADOPTING A STATEMENT OF PRINCIPLES FOR STORM WATER MANAGEMENT IN THE CITY, INITIATING A COMPREHENSIVE UPDATE TO THE CITY STORM WATER MASTER PLAN, AND ESTABLISHING AN EFFECTIVE DATE.

WHEREAS, in recent years the management of storm water quantity and quality has become a vastly more complex and important aspect of municipal concern and responsibility, and

WHEREAS, the City's current storm water master plan was adopted at a time (1981) when storm water was generally managed in a much different way from current practices, and

WHEREAS, the City has been a full participant in regional efforts, through the Unified Sewerage Agency (USA), to produce plans, policies, and practices consistent with current best management practices, and State and Federal regulations, and

WHEREAS, USA's planning effort has, of necessity, been divided into sub-basins of the Tualatin River, and the Sherwood area may not become part of an active sub-basin planning effort until 1996 or later, and

WHEREAS, intense development activity within the City dictates that an update to the storm water master plans for the Rock Creek and Cedar Creek sub-basins within the City needs to occur before 1996.

NOW, THEREFORE, THE CITY RESOLVES AS FOLLOWS:

Section 1. Management Principles. As an interim guideline to City staff, City boards and commissions, the development community, and property owners within the City, the following statement of principles for storm water management is hereby adopted:

a. No property should suffer increased runoff rates above present levels as a result of upstream development, unless a sub-basin stormwater management plan has been approved.

b. All storm water discharged into a stream or wetland shall be substantially treated and all water emanating from the City and discharging into the proposed Tualatin River National Wildlife Refuge shall be of a quality to enhance the overall functioning of the Refuge.

c. All significant wetlands and associated riparian zones within the City shall be preserved. Lesser wetlands and associated riparian areas, if disturbed, shall be mitigated in a predesignated location in accordance with a City wetlands inventory approved by all appropriate State and Federal agencies.

d. A storm water management master plan shall be prepared for all areas of the City and the appropriate fee and charges shall be adopted to ensure its implementation in a timely manner.

e. All streams or ponds, and associated riparian areas, shall be protected from the impacts of development and/or returned to natural conditions, to the greatest extent practicable, and maintained in a manner that allows maximum public enjoyment while preserving the functioning of the natural ecology.

f. The City shall, in cooperation with the Sherwood School District and other educational bodies, become a catalyst for the educational use and research of City waters, wetlands, and natural areas.

g. The City shall take a lead role in working with other jurisdictions, Federal and State resource agencies, and impacted land owners in implementing the preceding goals through intervention up and down stream of all City water courses, including those flowing to areas outside of the Urban Growth Boundary.

Section 2. Master Plan Update. City staff is hereby directed to obtain funding and/or budget for an immediate comprehensive update to the City stormwater management master plan. As political boundaries do not necessarily conform to watersheds, and as a planning effort including the entire Rock Creek and Cedar Creek drainages is clearly well beyond the City's financial resources and jurisdictional authority, it is recognized that a City plan will not answer all stormwater questions, and that future regional, cooperative efforts will be necessary to complete the full stormwater picture.

Section 3. Other Planning Efforts. USA is hereby strongly encouraged to make every effort within its authority to accelerate its planning activities in order to provide for regional solutions in all areas of its jurisdiction. In the case of the Sherwood area in particular, USA is strongly urged to bring Clackamas County into a stormwater management effort for the upper reaches of the Ceder Creek and Rock Creek drainages. City staff is hereby directed to complete current City stormwater planning efforts as expeditiously as possible, while taking care to maximize public involvement, so as to achieve the legal authority to spend current City capital resources on plan implementation.

Section 4. Finances. In addition to current City capital resources, City staff is hereby directed, as planning documents and development actions are approved, to investigate and propose additional mechanisms for funding the planning, engineering, construction, and management of storm water facilities. Such mechanisms could include but are not limited to: a City surcharge on the USA-wide monthly stormwater "user" charge; establishment of a new City stormwater system development charge (SDC) or a surcharge on the present USA-wide SDC; utilization of City bonding capacity through the formation of local improvement districts, or the issuance of revenue or general obligation bonds; joint ventures with interested regional, State, and Federal agencies such as USA, the Oregon Department of Environmental Quality, and the U. S. Fish and Wildlife Service; the application of further development exactions and/or securing the cooperative participation of the development community in funding stormwater management solutions.

Section 5. Resolution Distributed. The City Recorder is hereby ordered to immediately distribute copies of this Resolution to the appropriate City staff and consultants; to such agencies as USA, ODEQ, DSL, and the Army Corps of Engineers; and to the Sherwood development community.

Section 6. Effective Date. This Resolution shall become effective upon approval and adoption.

Duly passed by the City Council on April 8, 1992.

Rick A. Hohnbaum, Mayor

Attest:

Polly Blankenbaker,
City Recorder

UNIFIED SEWERAGE AGENCY

CHAPTER 6

ADDITIONAL SURFACE WATER MANAGEMENT STANDARDS

WATER QUANTITY STANDARDS

6.01 On-site Facilities Required

6.02 Criteria for Requiring Facilities to be Constructed

6.03 Criteria for Requiring On-Site Detention to be Constructed

6.04 On-Site Detention Design Criteria

6.05 On-Site Detention Design Method

6.06 Floodplain Design Standards

6.07 Floodway design Standards

WATER QUALITY STANDARDS

6.08 Sensitive Areas

6.09 Placement of Water Quality Facilities

Chapter 6 -- ADDITIONAL SURFACE WATER MANAGEMENT STANDARDS

WATER QUANTITY STANDARDS

6.01 Downstream Protection Requirement

Each new development is responsible for mitigating the impacts of that development upon the public storm water quantity system. The development may satisfy this requirement through the use of any of the following techniques, subject to the limitations and requirements in Chapters 6.02, and 6.03:

a. Construction of Permanent on-site stormwater quantity detention facilities designed in accordance with this Chapter; or

b. Enlargement of the downstream conveyance system in accordance with this Chapter and Chapter 3; or

c. The payment of a Storm and Surface Water Management System Development Charge, as provided in Ordinance 23, which includes a water quantity component designated to meet these requirements.

6.02 Review of Downstream System

For new development other than the construction of a single family house or duplex, plans shall document review by the design engineer of the downstream capacity of any existing storm drainage facilities impacted by the proposed development. That review shall extend downstream to a point where the impacts to the water surface elevation from the development will be insignificant, or to a point where the conveyance system has adequate capacity, as determined by the procedures in Section 3.03. If the increase in surface waters leaving a development will cause or contribute to documented significant damage from flooding to existing buildings or dwellings, then the identified capacity deficiency shall be corrected prior to development, or the development must construct on-site detention as defined in Section 6.04.

6.03 Criteria for Requiring On-Site Detention to be Constructed

The Agency and/or City shall determine whether the on-site facility shall be constructed. If the on-site facility is constructed, the development shall be eligible for a credit against SWM SDC fees, as provided in Agency rules.

On-site facilities shall be constructed when any of the following conditions exist:

a. There is an identified downstream deficiency, as defined in Section 6.02, and detention rather than conveyance system enlargement is determined to be the more effective solution.

b. There is an identified regional detention site within the boundary of the development.

c. There is a site within the boundary of the development which would qualify as a regional detention site under criteria or capital plan adopted by the Agency.

6.04 On-Site Detention Design Criteria

Unless designed to meet the requirements of an identified downstream deficiency as defined in Section 6.02, stormwater quantity on-site detention facilities shall be designed to capture run-off so the run-off rates from the site after development do not exceed predevelopment conditions, based upon a 25-year, 24 hour return storm.

When designed to meet the requirements of an identified downstream deficiency as defined in Section 6.02, stormwater quantity on-site detention facilities shall be designed such that the peak run-off rates will not exceed predevelopment rates for the 2 through 100 year storms, as required by the determined downstream deficiency.

Construction of on-site detention shall not be allowed as an option if such a detention facility would have an adverse effect upon receiving waters in the basin or subbasin in the event of flooding, or would increase the likelihood or severity of flooding problems downstream of the site.

6.05 On-Site Detention Design Method

The procedure for determining the detention quantities is set forth in Section 4.4 Retention/Detention Facility Analysis and Design, King County, Washington, Surface Water Design Manual (ibid) except subchapters 4.4.5 Tanks, 4.4.6 Vaults and Figure 4.4.4G Permanent Surface Water Control Pond Sign. This reference shall be used for procedure only. The design criteria shall be as noted herein. Engineers desiring to utilize a procedure other than that set forth herein shall obtain Agency and/or City approval prior to submitting calculations utilizing the proposed procedure.

For single family and duplex residential subdivisions, stormwater quantity detention facilities shall be sized for the impervious areas to be created by the subdivision, including all residences on individual lots at a rate of 2640 square feet of impervious surface area per dwelling unit, plus all roads which are assessed a SWM monthly fee under Agency rules. Such facilities shall be constructed as a part of the subdivision public improvements. Construction of a single family or duplex residence on an existing lot of record is not required to construct stormwater quantity detention facilities.

All developments other than single family and duplex, whether residential, multi-family, commercial, industrial, or other uses, the sizing of stormwater quantity detention facilities shall be based on the impervious area to be created by the development, including structures and all roads and impervious areas which are assessed a SWM monthly fee under Agency rules. Impervious surfaces shall be determined based upon building permits, construction plans, site visits or other appropriate methods deemed reliable by Agency and/or City.

6.06 Floodplain Design Standards

6.06.1 Balanced Cut and Fill Standard

All fill placed in a floodplain shall be balanced with an equal amount of removal of soil material. No net fill in any floodplain is allowed with two exceptions. The first is when an engineering study has been conducted and approved by the Agency showing that the increase in water surface elevation resulting from the fill will not cause or contribute to significant damage from flooding to existing buildings or dwellings on properties upstream and downstream. A second exception will be when an area has received special protection from floodplain improvement projects which either lower the floodplain, or otherwise protect affected properties, are approved by the Agency, where the exceptions comply with adopted master plans, if any, and where all required permits and approvals have been obtained in compliance with other local, state, and federal laws regarding fill in floodplains, including FEMA rules.

6.06.2 Excavation Restricted

Large areas may not be excavated in order to gain a small amount of fill in a floodplain. Excavation areas shall not exceed the fill areas by more than 50 percent of the square footage, unless approved by the Agency.

6.06.3 Excavation and Fill Volume Calculation

Any excavation dug below the winter "low water" elevation shall not count towards compensating for fill, since these areas would be full of water in the winter, and not available to hold storm water following a rain. Winter "low water" elevation is defined as the water surface elevation during the winter when it has not rained for at least three days, and the flows resulting from storms have receded. This elevation may be determined from records, studies, or field observation. Any fill placed above the 100 year floodplain will not count towards the fill volume.

6.06.4 Excavation Grade Design Standard

The excavated area must be designed to drain if it is an area identified to be dry in the summer; for example, if it is to be used for a park, or if it is to be mowed in the summer. Excavated areas identified as to remain wet in the summer, such as a constructed wetland, shall be designed not to drain. For areas that are to drain, the lowest elevation should be at least 6 inches above the winter "low water" elevation, and sloped at a minimum of 2 percent towards the drainage way. One percent slopes will be allowed in small areas.

6.06.5 Excavation Location

Excavation to balance a fill does not need to be on the same property as the fill, but shall be in the same drainage basin, within points of constriction on the conveyance system, if any, as near as practical to the fill site, and shall be constructed as a part of the same development project which placed the fill.

6.07 Floodway Design Standards

6.07.1 Obstruction Prohibited

Nothing may be constructed or placed in a floodway that will impede or constrict the flow of storm water. This includes, but is not limited to earth works, street and bike path crossings, and trees. If an object is placed in the floodway, the floodway must be widened or modified to accommodate the storm flows with no measurable increase in water surface elevation upstream or downstream, or unless the property owners of property where the water surface increase occurs grant written permission by agreement or easement.

The floodway may not be modified such that water velocities are increased such that stream bank erosion will be increased, unless the stream banks are protected to prevent an increase in erosion.

6.07.2 Floodway Modifications

Any proposed work within or modification to a floodway must be certified by an Oregon Registered Professional Engineer as meeting the requirements of Section 6.06.1.

6.07.3 Floodway Identification

For streams, creeks, rivers and other watercourses where the Agency has not identified the floodway, the entire floodplain shall be treated as a floodway, or a study prepared by an Oregon Registered Professional Engineer and approved by the Agency may be used to define the floodway limits for a stream section.

WATER QUALITY STANDARDS

6.08 Sensitive Areas

6.08.1 Definition

Sensitive areas shall include all water feature systems which serve as water quality filtering systems, or otherwise function to improve the water quality of the storm and surface water system, and are limited to:

a. existing or created wetlands;

b. rivers, streams, and creeks carrying flows from 100 acres or more;

c. impoundments (lakes and ponds) with average water in the summer of 1 acre-foot or more, or with a depth of 3 feet or more.

Sensitive areas shall not include a constructed wetland, an undisturbed corridor (a buffer) adjacent to a sensitive area, or a water feature, such as a lake, constructed during an earlier phase of a development for specific purposes not including water quality, such as recreation.

6.08.2 Study

The Agency and/or City shall require the applicant to provide a study identifying areas on the parcel which are or may be sensitive areas when, in the opinion of the Agency or City:

a. an area or areas on a parcel may be classified as a sensitive area;

b. if the parcel has been included in an inventory of sensitive areas adopted by the Agency or City and more site specific identification of the boundaries are needed.

6.08.3 Undisturbed Corridor Required

New development or a division of land adjacent to sensitive areas shall preserve and maintain an undisturbed corridor for a buffer wide enough to protect the water quality functioning of the sensitive area. The undisturbed corridor is a facility required to prevent damage to the sensitive area caused by the development. The undisturbed corridor shall be a minimum of 25 feet wide, measured horizontally, from the defined boundaries of the sensitive area, unless otherwise approved by the Agency or City as meeting the following exception.

Where no reasonable and feasible option exists for encroaching within the minimum 25 foot undisturbed corridor, such as at a road crossing or where topography limits options, then a facility equivalent to the 25 foot corridor shall be provided.

6.08.4 Design Standards for the Undisturbed Corridor

The corridor shall be left in a natural state, or allowed to return to a natural state. No structures, development, gardens, lawns, or other activities shall be allowed which otherwise detract from the water quality protection provided by the corridor, except as allowed below:

a. A road crossing the undisturbed corridor to provide access to the sensitive area or across the sensitive area

b. Utility construction, providing the corridor is restored

c. A gravel walkway or bike path, not exceeding 8 feet in width. If the walkway or bike path is paved, then the corridor must be widened by the width of the path. A paved or gravel path may not be constructed closer than 10 feet from the boundary of the sensitive area, unless approved by the Agency or City.

d. Measures to remove or abate hazards, nuisances, or fire and life safety violations.

The Agency or City may require that the corridor be fenced, signed, delineated, or otherwise physically set apart from parcels that will develop.

6.08.5 Location of Undisturbed Corridor

In any residential development which creates multiple parcels or lots intended for separate ownership, such as a subdivision, the undisturbed corridor shall be contained in a tract, and shall not be a part of any parcel to be used for the construction of a dwelling unit.

The Agency or City may require that the tract shall be dedicated to the Agency, or require an easement conveying storm and surface water management rights to the Agency or City and preventing the owner of the tract from activities and uses inconsistent with the purpose of the tract.

6.08.6 Mitigation

The adverse affects to water quality and quantity of any work in a sensitive area shall be compensated by an amount of mitigation and replacement necessary to replace the water quality functioning of the sensitive area as determined by the Agency or City. No fill, removal, or modification of a sensitive area shall be approved unless there is no reasonable and feasible alternative, as determined by the Agency or City.

6.09 Placement of Water Quality Facilities

Chapter 7 specifies that certain properties shall install water quality facilities for the purpose of removing phosphorous. No such water quality facilities shall be constructed within the defined area of existing or created wetlands unless a mitigation action, approved by the Agency or City, is constructed to replace the area used for the water quality facility.

The water quality facility shall not be placed in the undisturbed corridor required in Section 6.08.3, unless the corridor is widened to compensate for the placement of the water quality facility.

Chapter 7

PERMANENT ON-SITE WATER QUALITY FACILITIES

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CHAPTER 7 - PERMANENT ON-SITE WATER QUALITY FACILITIES

7.01 Purpose of Chapter

The purpose of this Chapter is to require new development and other activities which create impervious surfaces to construct or fund on-site or off-site permanent water quality facilities to reduce the amount of phosphorous entering the storm and surface water system.

7.02 Application of Chapter

The provisions of Chapter 7 shall apply to all activities which create new or additional impervious surfaces, except as provided in Section 7.03.

7.03 Exceptions

7.03.1

Those developments with application dates prior to July 1, 1990. Application date shall be defined as the date on which a complete application for development approval is accepted by the responsible jurisdiction in accordance with the regulations of the local jurisdiction.

7.03.2

Construction of one and two family (duplex) dwellings.

7.03.3

Sewer lines, water lines, utilities or other land development that will not directly increase the amount of storm water run-off or pollution leaving the site once construction has been completed and the site is either restored to or not altered from its approximate original condition.

7.04 Definitions

7.04.1 Stormwater Quality Control Facility

Stormwater Quality Control Facility refers to any structure or drainage way that is designed, constructed, and maintained to collect and filter, retain, or detain surface water run-off during and after a storm event for the purpose of water quality improvement. It may also include, but is not limited to, existing features such as constructed wetlands, water quality swales, and ponds which are maintained as stormwater quality control facilities.

7.04.2 Water Quality Swale

Water Quality Swale is a vegetated natural depression, wide shallow ditch, or constructed facility used to temporarily store, route, or filter run-off for the purpose of improving water quality.

7.04.3 Existing Wetlands

Existing Wetlands are those areas identified and delineated as set forth in the Federal Manual for Identifying the Delineating Jurisdictional Wetlands, January 1989, or as amended, by a qualified wetlands specialist.

7.04.4 Created Wetlands

Created Wetlands are those wetlands developed in an area previously identified as a non-wetland to replace, or mitigate wetland destruction or displacement.

7.04.5 Constructed Wetlands

Constructed Wetlands are those wetlands developed as a water quality or quantity facility, subject to change and maintenance as such. These areas must be clearly defined and/or separated from existing or created wetlands. This separation shall preclude a free and open connection to such other wetlands.

7.05 Permit Required

Except as provided in Section 7.03, no person shall cause any change to improved or unimproved real property that will, or is likely to, increase the rate or quantity of run-off or pollution from the site without first obtaining a permit from the Agency and following the conditions of the permit.

7.06 On-Site Facilities Required

For new development,subject to the exemptions of Section 7.03, no permit for construction, or land development, or plat or site plan shall be approved unless the conditions of the plat, plan, or permit approval require permanent stormwater quality control facilities in accordance with this Chapter.

7.07 Phosphorous Removal Standard

The stormwater quality control facilities shall be designed to remove 65 percent of the phosphorous from the runoff from 100 percent of the newly constructed impervious surfaces. Impervious surfaces shall include pavement, buildings, public and private roadways, and all other surfaces with similar runoff characteristics.

7.08 Design Storm

The stormwater quality control facilities shall be designed to meet the removal efficiency of Section 7.07 for a mean summertime storm event totaling 0.36 inches of precipitation falling in 4 hours with an average return period of 96 hours.

7.09 Design Requirements

The removal efficiency in Section 7.07 specifies only the design requirements and are not intended as a basis for performance evaluation or compliance determination of the stormwater quality control facility installed or constructed pursuant to this Chapter.

7.10 Criteria for Requiring the On-Site Facility to be Constructed

The on-site facility shall be constructed unless, in the judgment of the Agency and City, any of the following conditions exist:

a. The site topography or soils makes it impractical, or ineffective to construct an on-site facility.

b. The site is small compared to the development plan, and the loss of area for the on-site facility would preclude the effective development.

c. There is a more efficient and effective regional site within the subbasin and in the near vicinity.

7.11 Facility Permit Approval

A stormwater quality control facility permit shall be approved only if the following are met:

a. The design manual "Surface Water Quality Facilities Technical Guidance Handbook" may be used in preparing the plan for the water quality facility. The plat, site plan, or permit application includes plans and a certification prepared by an Oregon registered professional engineer that the proposed stormwater quality control facilities have been designed in accordance with criteria expected to achieve removal efficiencies for total phosphorous required by this Chapter, and

b. The plat, site plan, or permit application shall be consistent with the areas used to determine the removal required in Section 7.07, and

c. A financial assurance, or equivalent security acceptable to the Agency or City, is provided by the applicant which assures that the stormwater quality control facilities are constructed according to the plans established in the plat, site plan, or permit approval. The financial assurance may be combined with other financial assurance requirements imposed by the Agency or City, and

d. An operation and maintenance plan documenting how the water quality facility will be maintained, and a statement as to who will be responsible for assuring the long term compliance with the plan. A copy of the operation and maintenance plan shall be forwarded to DEQ no later than one month following construction of the water quality facility.

7.12 System Development Charge

If under Section 7.10, an on-site facility will not be constructed, the System Development Charge shall be paid.

7.13 Enforcement

Failure to comply with any provision of this Chapter shall be deemed a violation of this ordinance. In such event, the Agency and City may take enforcement action pursuant to applicable Agency Ordinance and rules adopted thereunder.

7.14 Permit Fee

The Agency and City shall collect a reasonable fee for the review of plans, administration, enforcement, and field inspection to carry out the rules contained herein.

7.15 Residential Developments

The permanent stormwater quality control facilities for the construction of any single family and duplex subdivision shall be adequately sized for the public improvements of the subdivision and for the future construction of single family and duplex houses on the individual lots at a rate of 2640 square feet of impervious surface per dwelling unit.

7.16 Placement of Water Quality Facilities

No water quality facilities shall be constructed within the defined area of existing or created wetlands unless a mitigation action is approved by the Agency and City, and is constructed to replace the area used for water quality.

APPENDIX B

Facilities Inventory/Capacity Analysis

APPENDIX B

Facilities Inventory/Capacity Analysis

Sub-Basin #	Conduit	Length (ft)	Diameter (in.)	Avg. Slope	Material	Condition	Manning's Coeff.	Min. Capacity (cfs)	Avg. Capacity (cfs)	Max. Capacity (cfs)	Min. Velocity (ft/s)	Avg. Velocity (ft/s)	Max. Velocity (ft/s)
1	1.1	1800	30	1%	RCP	GOOD	0.011	15	49	69	3	10	14
	1.2	200	24	1%	ALUM	GOOD	0.022	4	13	19	1	4	6
	1.3	250	12	1%	RCP	GOOD	0.011	1	4	6	2	5	8
	1.4	375	24	1%	RCP	GOOD	0.011	8	27	38	3	9	12
	1.5	525	18	1%	RCP	GOOD	0.011	4	12	18	2	7	10
	1.6	150	12	1%	RCP	GOOD	0.011	1	4	6	2	5	8
	1.7	75	12	1%	RCP	GOOD	0.011	1	4	6	2	5	8
4	4.1	225	12	1%	RCP	AVERAGE	0.013	1	4	5	1	5	6
	4.2	125	18	1%	RCP	AVERAGE	0.013	3	11	15	2	6	8
	4.3	125	18	1%	RCP	AVERAGE	0.013	3	11	15	2	6	8
	4.4	275	18	1%	RCP	AVERAGE	0.013	3	11	15	2	6	8
	4.5	650	12	1%	RCP	AVERAGE	0.013	1	4	5	1	5	6
	4.6	100	12	1%	RCP	AVERAGE	0.013	1	4	5	1	5	6
	4.7	100	12	1%	RCP	AVERAGE	0.013	1	4	5	1	5	6
8	8.1	200	10	3%	RCP	AVERAGE	0.013	3	4	4	6	7	8
	8.2	250	10	2%	RCP	AVERAGE	0.013	2	3	4	4	6	7
	8.3	200	24	2%	RCP	AVERAGE	0.013	24	32	39	8	10	12
	8.4	200	24	2%	RCP	AVERAGE	0.013	24	32	39	8	10	12
	8.5	400	24	12%	RCP	AVERAGE	0.013	76	79	82	24	25	26
	8.6	75	15	2%	RCP	AVERAGE	0.013	7	9	11	6	7	9
	8.7	300	12	1%	ADS	AVERAGE	0.01	1	5	7	2	6	8

Sub-Basin #	Conduit	Length (ft)	Diameter (in.)	Avg. Slope	Material	Condition	Manning's Coeff.	Min. Capacity (cfs)	Avg. Capacity (cfs)	Max. Capacity (cfs)	Min. Velocity (ft/s)	Avg. Velocity (ft/s)	Max. Velocity (ft/s)
	8.8	150	12	3%	RCP	AVERAGE	0.013	5	6	7	7	8	9
	8.9	300	12	1%	ADS	AVERAGE	0.013	1	4	5	1	5	6
9	9.1	300	15	2%	RCP	AVERAGE	0.013	7	9	11	6	7	9
	9.2	80	10	1%	RCP	AVERAGE	0.013	1	2	3	1	4	6
12	12.1	220	12	10%	RCP	AVERAGE	0.013	11	11	12	14	14	15
	12.2	75	12	2%	RCP	AVERAGE	0.013	4	5	6	5	6	8
	12.3	100	12	3%	RCP	AVERAGE	0.013	5	6	7	7	8	9
	12.4	40	10	3%	RCP	AVERAGE	0.013	3	4	4	6	7	8
	12.5	130	12	3%	RCP	AVERAGE	0.013	5	6	7	7	8	9
	12.6	100	10	2%	RCP	AVERAGE	0.013	2	3	4	4	6	7
	12.7	220	10	10%	RCP	AVERAGE	0.013	7	7	7	12	13	13
	12.8	125	12	9%	RCP	AVERAGE	0.013	10	11	11	13	14	14
	12.9	600	12	8%	RCP	AVERAGE	0.013	10	10	11	12	13	14
	12.10	800	15	10%	RCP	AVERAGE	0.013	20	20	21	16	17	17
	12.11	200	18	2%	RCP	AVERAGE	0.013	11	15	18	6	8	10
	12.12	400	12	12%	RCP	AVERAGE	0.013	12	12	13	15	16	16
	12.13	400	12	2%	RCP	AVERAGE	0.013	4	5	6	5	6	8
	12.14	275	10	1%	CLAY	AVERAGE	0.013	1	2	3	1	4	6
	12.15	350	6	1%	DI	AVERAGE	0.015	0	0	1	1	2	4
	12.16	100	16	9%	RCP	AVERAGE	0.013	22	23	24	16	17	17
	12.17	225	18	9%	RCP	AVERAGE	0.013	30	32	33	17	18	19
	12.18	300	12	10%	RCP	AVERAGE	0.013	11	11	12	14	14	15
	12.19	300	12	10%	RCP	AVERAGE	0.013	11	11	12	14	14	15
	12.2	1000	12	7%	RCP	AVERAGE	0.013	9	9	10	11	12	13

Sub-Basin #	Conduit	Length (ft)	Diameter (in.)	Avg. Slope	Material	Condition	Manning's Coeff.	Min. Capacity (cfs)	Avg. Capacity (cfs)	Max. Capacity (cfs)	Min. Velocity (ft/s)	Avg. Velocity (ft/s)	Max. Velocity (ft/s)
	12.21	600	12	6%	RCP	AVERAGE	0.013	8	9	9	10	11	12
	12.22	250	21	10%	RCP	AVERAGE	0.013	48	50	53	20	21	22
	12.23	550	12	1%	RCP	AVERAGE	0.013	1	4	5	1	5	6
	12.24	750	18	1%	RCP	AVERAGE	0.013	3	11	15	2	6	8
	12.25	150	18	1%	RCP	AVERAGE	0.013	3	11	15	2	6	8
	12.26	900	15	1%	RCP	AVERAGE	0.013	2	6	9	2	5	7
	12.27	450	12	1%	RCP	AVERAGE	0.013	1	4	5	1	5	6
	12.28	550	12	1%	RCP	AVERAGE	0.013	1	4	5	1	5	6
14	14.1	200	10	1%	CLAY	AVERAGE	0.013	1	2	3	1	4	6
	14.2	575	18	1%	RCP	AVERAGE	0.013	3	11	15	2	6	8
	14.3	275	8	1%	RCP	AVERAGE	0.013	0	1	2	1	3	5
	14.4	300	12	1%	RCP	AVERAGE	0.013	1	4	5	1	5	6
	14.5	275	12	1%	RCP	AVERAGE	0.013	1	4	5	1	5	6
	14.6	150	8	1%	RCP	AVERAGE	0.013	0	1	2	1	3	5
15	15.1	250	18	1%	RCP	AVERAGE	0.013	3	11	15	2	6	8
	15.2	250	18	1%	RCP	AVERAGE	0.013	3	11	15	2	6	8
16	16.1	350	8	1%	CLAY	AVERAGE	0.013	0	1	2	1	3	5
	16.2	500	12	1%	RCP	AVERAGE	0.013	1	4	5	1	5	6
	16.3	125	8	1%	RCP	AVERAGE	0.013	0	1	2	1	3	5
	16.4	750	16	2%	RCP	AVERAGE	0.013	8	11	13	6	8	10
17	17.1	150	15	2%	RCP	AVERAGE	0.013	7	9	11	6	7	9
	17.2	100	10	2%	RCP	AVERAGE	0.013	2	3	4	4	6	7
	17.3	400	42	9%	RCP	AVERAGE	0.013	287	302	319	30	31	33
	17.4	150	24	2%	RCP	AVERAGE	0.013	24	32	39	8	10	12

Sub-Basin #	Conduit	Length (ft)	Diameter (in.)	Avg. Slope	Material	Condition	Manning's Coeff.	Min. Capacity (cfs)	Avg. Capacity (cfs)	Max. Capacity (cfs)	Min. Velocity (ft/s)	Avg. Velocity (ft/s)	Max. Velocity (ft/s)
	17.5	370	24	5%	RCP	AVERAGE	0.013	46	51	56	15	16	18
	17.6	170	36	2%	RCP	AVERAGE	0.013	70	95	116	10	13	16
	17.7	130	6	6%	STEEL	AVERAGE	0.012	1	1	2	7	8	8
	17.8	270	36	3%	RCP	AVERAGE	0.013	97	116	134	14	16	19
	17.9	180	30	3%	RCP	AVERAGE	0.013	60	71	82	12	15	17
	17.10	400	30	3%	RCP	AVERAGE	0.013	60	71	82	12	15	17
	17.11	250	12	11%	RCP	AVERAGE	0.013	11	12	12	14	15	16
	17.12	600	8	11%	RCP	AVERAGE	0.013	4	4	4	11	12	12
	17.13	240	27	11%	RCP	AVERAGE	0.013	99	103	108	25	26	27
	17.14	350	27	1%	RCP	AVERAGE	0.013	10	31	44	2	8	11
	17.15	900	8	10%	RCP	AVERAGE	0.013	4	4	4	10	11	11
	17.16	750	8	13%	RCP	AVERAGE	0.013	4	4	5	12	13	13
18	18.1	400	12	5%	RCP	AVERAGE	0.013	7	8	9	9	10	11
	18.2	170	36	1%	RCP	AVERAGE	0.013	21	67	95	3	9	13
19	19.1	120	6	2%	RCP	GOOD	0.011	1	1	1	4	5	6
	19.2	550	12	5%	RCP	GOOD	0.011	9	9	10	11	12	13
	19.3	130	12	5%	RCP	GOOD	0.011	9	9	10	11	12	13
	19.4	300	12	4%	RCP	GOOD	0.011	7	8	9	9	11	12
	19.5	200	21	3%	RCP	GOOD	0.011	27	32	38	11	14	16
	19.6	300	12	5%	ADS	GOOD	0.01	9	10	11	12	13	14
	19.7	150	12	5%	ADS	GOOD	0.01	9	10	11	12	13	14
	19.8	120	18	3%	ADS	GOOD	0.01	20	24	27	11	13	15
	19.9	130	12	5%	ADS	GOOD	0.01	9	10	11	12	13	14
	19.10	500	36	3%	RCP	GOOD	0.011	114	137	158	16	19	22

Sub-Basin #	Conduit	Length (ft)	Diameter (in.)	Avg. Slope	Material	Condition	Manning's Coeff.	Min. Capacity (cfs)	Avg. Capacity (cfs)	Max. Capacity (cfs)	Min. Velocity (ft/s)	Avg. Velocity (ft/s)	Max. Velocity (ft/s)
	19.11	50	15	3%	ADS	GOOD	0.01	12	15	17	10	12	14
	19.12	500	6	5%	ADS	GOOD	0.01	1	2	2	8	8	9
	19.13	650	12	4%	ADS	GOOD	0.01	8	9	10	10	12	13
20	20.1	240	15	5%	ADS	GOOD	0.01	17	19	21	14	15	17
	20.2	150	15	4%	RCP	GOOD	0.011	13	15	17	11	12	14
	20.3	100	15	5%	RCP	GOOD	0.011	15	17	19	13	14	15
	20.4	130	24	2%	ADS	GOOD	0.01	31	42	51	10	13	16
	20.5	200	15	2%	ADS	GOOD	0.01	9	12	15	7	10	12
	20.6	100	12	3%	ADS	GOOD	0.01	7	8	9	9	10	12
	20.7	175	12	1%	RCP	GOOD	0.011	1	4	6	2	5	8
	20.8	150	12	3%	RCP	GOOD	0.011	6	7	8	8	9	11
	20.9	430	10	1%	RCP	GOOD	0.011	1	3	4	2	5	7
	20.10	150	12	10%	RCP	GOOD	0.011	13	13	14	16	17	18
	20.11	150	12	10%	RCP	GOOD	0.011	13	13	14	16	17	18
	20.12	300	12	10%	RCP	GOOD	0.011	13	13	14	16	17	18
	20.13	150	10	10%	RCP	GOOD	0.011	8	8	9	14	15	16
	20.14	170	10	10%	RCP	GOOD	0.011	8	8	9	14	15	16
	20.15	175	12	2%	RCP	GOOD	0.011	4	6	7	6	8	9
	20.16	150	24	2%	RCP	GOOD	0.011	28	38	46	9	12	15
	20.17	350	21	3%	RCP	GOOD	0.011	27	32	38	11	14	16
	20.18	100	21	2%	RCP	GOOD	0.011	20	27	32	8	11	14
	20.19	100	12	4%	RCP	GOOD	0.011	7	8	9	9	11	12
	20.20	400	24	6%	RCP	GOOD	0.011	61	66	71	19	21	23
	20.21	175	27	7%	RCP	GOOD	0.011	91	97	104	23	24	26

Sub-Basin #	Conduit	Length (ft)	Diameter (in.)	Avg. Slope	Material	Condition	Manning's Coeff.	Min. Capacity (cfs)	Avg. Capacity (cfs)	Max. Capacity (cfs)	Min. Velocity (ft/s)	Avg. Velocity (ft/s)	Max. Velocity (ft/s)
	20.22	200	12	2%	RCP	GOOD	0.011	4	6	7	6	8	9
	20.23	150	27	8%	RCP	GOOD	0.011	98	104	110	25	26	28
	20.24	350	27	6%	RCP	GOOD	0.011	83	90	97	21	23	24
	20.25	100	27	9%	RCP	GOOD	0.011	104	110	116	26	28	29
	20.26	180	12	2%	RCP	GOOD	0.011	4	6	7	6	8	9
	20.27	125	10	2%	RCP	GOOD	0.011	3	4	4	5	7	8
	20.28	800	12	8%	RCP	GOOD	0.011	11	12	13	14	15	16
	20.29	75	12	5%	RCP	GOOD	0.011	9	9	10	11	12	13
	20.30	150	36	4%	RCP	GOOD	0.011	139	158	177	20	22	25
	20.31	150	36	4%	RCP	GOOD	0.011	139	158	177	20	22	25
	20.32	200	12	3%	RCP	GOOD	0.011	6	7	8	8	9	11
	20.33	200	12	3%	RCP	GOOD	0.011	6	7	8	8	9	11
	20.34	350	12	4%	RCP	GOOD	0.011	7	8	9	9	11	12
	20.35	90	12	3%	RCP	GOOD	0.011	6	7	8	8	9	11
	20.36	150	12	3%	RCP	GOOD	0.011	6	7	8	8	9	11
	20.37	250	12	3%	RCP	GOOD	0.011	6	7	8	8	9	11
	20.38	200	12	3%	RCP	GOOD	0.011	6	7	8	8	9	11
	20.39	320	12	4%	RCP	GOOD	0.011	7	8	9	9	11	12
	20.40	300	12	4%	RCP	GOOD	0.011	7	8	9	9	11	12
21	21.1	320	12	1%	RCP	GOOD	0.011	1	4	6	2	5	8
	21.2	200	6	1%	ADS	GOOD	0.01	0	1	1	1	4	5
	21.3	275	12	2%	RCP	GOOD	0.011	4	6	7	6	8	9
	21.4	850	12	2%	RCP	GOOD	0.011	4	6	7	6	8	9
	21.5	250	12	4%	RCP	GOOD	0.011	7	8	9	9	11	12

Sub-Basin #	Conduit	Length (ft)	Diameter (in.)	Avg. Slope	Material	Condition	Manning's Coeff.	Min. Capacity (cfs)	Avg. Capacity (cfs)	Max. Capacity (cfs)	Min. Velocity (ft/s)	Avg. Velocity (ft/s)	Max. Velocity (ft/s)
	21.6	300	12	4%	RCP	GOOD	0.011	7	8	9	9	11	12
	21.7	975	24	2%	RCP	GOOD	0.011	28	38	46	9	12	15
	21.8	330	12	1%	RCP	GOOD	0.011	1	4	6	2	5	8
	21.9	275	12	2%	RCP	GOOD	0.011	4	6	7	6	8	9
	21.10	150	12	1%	RCP	GOOD	0.011	1	4	6	2	5	8
	21.11	150	12	4%	RCP	GOOD	0.011	7	8	9	9	11	12
	21.12	100	12	1%	RCP	GOOD	0.011	1	4	6	2	5	8
	21.13	300	12	3%	RCP	GOOD	0.011	6	7	8	8	9	11
	21.14	350	12	3%	RCP	GOOD	0.011	6	7	8	8	9	11
	21.15	600	8	1%	RCP	GOOD	0.011	0	1	2	1	4	6
	21.16	150	12	3%	RCP	GOOD	0.011	6	7	8	8	9	11
	21.17	580	12	2%	RCP	GOOD	0.011	4	6	7	6	8	9
	21.18	150	12	4%	RCP	GOOD	0.011	7	8	9	9	11	12
	21.19	600	36	1%	RCP	GOOD	0.011	25	79	112	4	11	16
	21.20	150	10	1%	RCP	GOOD	0.011	1	3	4	2	5	7
	21.21	1000	12	3%	RCP	GOOD	0.011	6	7	8	8	9	11
	21.22	275	12	3%	RCP	GOOD	0.011	6	7	8	8	9	11
	21.23	400	15	3%	RCP	GOOD	0.011	11	13	15	9	11	12
	21.24	150	12	3%	RCP	GOOD	0.011	6	7	8	8	9	11
	21.25	275	36	1%	RCP	GOOD	0.011	25	79	112	4	11	16
	21.26	350	15	1%	RCP	GOOD	0.011	2	8	11	2	6	9
	21.27	100	12	1%	RCP	GOOD	0.011	1	4	6	2	5	8
	21.28	250	12	2%	RCP	GOOD	0.011	4	6	7	6	8	9
	21.29	300	12	1%	RCP	GOOD	0.011	1	4	6	2	5	8

Sub-Basin #	Conduit	Length (ft)	Diameter (in.)	Avg. Slope	Material	Condition	Manning's Coeff.	Min. Capacity (cfs)	Avg. Capacity (cfs)	Max. Capacity (cfs)	Min. Velocity (ft/s)	Avg. Velocity (ft/s)	Max. Velocity (ft/s)
	21.30	325	12	1%	RCP	GOOD	0.011	1	4	6	2	5	8
	21.31	225	8	8%	RCP	GOOD	0.011	4	4	4	11	12	12
	21.32	125	12	8%	RCP	GOOD	0.011	11	12	13	14	15	16
	21.33	750	30	1%	RCP	GOOD	0.011	15	49	69	3	10	14
	21.34	1050	8	9%	RCP	GOOD	0.011	4	4	5	12	12	13
23	23.1	200	12	1%	RCP	GOOD	0.011	1	4	6	2	5	8
	23.2	800	12	1%	RCP	GOOD	0.011	1	4	6	2	5	8
	23.3	100	12	1%	RCP	GOOD	0.011	1	4	6	2	5	8
24	24.1	100	18	2%	RCP	AVERAGE	0.013	11	15	18	6	8	10
	24.2	350	12	1%	RCP	AVERAGE	0.013	1	4	5	1	5	6

ABBREVIATIONS:

ADS - Advanced Drainage Systems
ALUM - Aluminum
Avg. - Average
cfs - cubic feet per second
Coeff. - Coefficient
DI - Ductile Iron
ft - feet
ft/s - feet per second
Max. - Maximum
Min. - Minimum
RCP - Reinforced Concrete Pipe

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APPENDIX C

Emergency Spill Response Plan

EMERGENCY OPERATIONS PLAN

HAZARDOUS MATERIALS

ANNEX S

In case of emergency notify:

1. 9-1-1

2. 1-800-452-0311 (Oregon Emergency Response System (OERS)

Disclaimer: Government entities, while complying with the provisions of this plan, shall not be liable for death, injury, or loss of property except in cases of willful misconduct, gross negligence or bad faith.

Agencies Participating in the Planning Process:

1. Washington County Department of Public Safety (Office of Emergency Management)
2. Washington County Emergency Medical Services Coordinator
3. Washington County Department of Health and Human Services
4. Washington County Department of Land Use and Transportation
5. Washington County Counsels Office
6. Washington County Board of Commissioners
7. Washington County Administrator's Office
8. Washington County Fire Defense Board
9. Forest Grove 9-1-1 Center
10. Fire Com
11. Unified Sewerage Agency of Washington County
12. American Red Cross
13. Washington County Consolidated Communications Agency
14. City of Beaverton Emergency Management

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SECTION I

Purpose, Scope, Limitations, Relationship
To Other Plans, Exceptions

Purpose: The plan describes in detail how Washington County emergency response system will operate during emergencies involving oil or hazardous materials. It is consistent with Oregon's Oil and Hazardous Materials Emergency Response Plan (Annex O) and satisfies requirements of Oregon Revised Statutes Chapters 401, 469 and 597.

Scope: The plan describes the roles and responsibilities of all local responders within Washington County and parts of Clackamas and Multnomah Counties served by Tualatin Valley Fire & Rescue. It identifies who will be in charge of an incident. It provides guidelines for coordinating emergency services. It also describes how Washington County will coordinate with:

- adjacent jurisdictions
- state agencies
- federal agencies
- local private industry
- volunteer organizations

Limitations: Within Washington County, there are several limitations facing agencies involved in hazardous materials response and cleanup. The following is a list of such limitations; it is not meant to be comprehensive, but exemplifies the limitations.

- Fire apparatus exceeds the weight limits on some bridges

- Limited interagency communications capability

- Financial limitations for cleanup related to the scarcity of Superfund money

Relationship to Other Plans:

Federal:
The National Response Plan is hereby incorporated by this reference.

State of Oregon:
The Oregon Emergency Response System (OERS) and the state agency response capabilities are described in Annex O. Washington County recognizes Annex O and hereby incorporates it by reference into this emergency plan.

Cities in Washington County:
have the option of adopting this plan or creating their own. However, it is expected that city plans will complement this plan.

Exceptions: All hazardous materials incidents within Washington County have public health aspects that require appropriate management in order to meet County responsibilities under Oregon Law (ORS 433). In order to minimize County liabilities, there are no exceptions to this plan.

SECTION II

Definitions of Key Terms

Emergency Operations Center (EOC) means site from where local, state and federal agencies coordinate off-scene support to on- scene responders. This includes State, County and City EOCs.

Hazardous Material (Haz-Mat) means any element, compound, mixture, solution or substance which, when spilled or released into the air or into or on any land or waters of the state, may present a substantial danger to the public health, safety, welfare or the environment.

Incident means any event that results in a spill or release of hazardous materials. Action by emergency service personnel will be required to prevent or minimize loss of life or damage to property and/or natural resources.

Incident Commander (IC) means the one individual in charge at any given time of an incident.

Incident Command System (ICS) means the combination of facilities, equipment, personnel, procedures, and communications operating with a command structure.

On-Scene Coordinator (OSC) means the individual on-scene responsible for coordinating the resources at each respective level of government. OSCs may include:

- Local On-Scene Coordinator (LOSC)
- State On-Scene Coordinator (SOSC)
- Federal On-Scene Coordinator (FOSC)

Public Information Officer (PIO) means a designated person who provides information to the public and media.

Responsible Party (RP) means the person or firm who, by law, is financially liable for cleanup of any spill or release.

Unified Command means the method by which local, state and federal agencies will work with the Incident Commander to:

1. Determine their roles and responsibilities for a given incident.

2. Determine their overall objectives for management of an incident.

3. Select a strategy to achieve agreed upon objectives.

4. Deploy resources to achieve agreed upon objectives.

Washington County means the geographical location within the County boundary.

SECTION III

Washington County Emergency Response System

A. Summary

1. The local fire agency (unless otherwise designated) will assume the command during the emergency phases of an incident. All other local responding agencies will provide support to the lead agency during the emergency phases of an incident.

2. State and Federal agencies will be utilized according to the guidance set forth in Annex O of the Oregon State Emergency Operations Plan. Requests for state and Federal assistance shall be made through the Office of Emergency Management unless the situation is life-threatening. For a list of frequently used agencies, see Attachment 1.

3. Oregon Department of Environmental Quality (DEQ) shall assume the lead role for directing the cleanup and site restoration.

4. Private industry is legally responsible for reporting the spill, performing cleanup or hiring a cleanup contractor and disposing of the spilled materials.

5. Some volunteer organizations may be used to provide assistance to responding agencies. Requests for volunteers will be made through the Office of Emergency Management.

B. Notifications:

NOTE- the following emergency notifications do not exempt the Responsible Party from notifying the appropriate government agencies.

1. Local Notifications -

9-1-1 Center

Business/Occupant

Office of Emergency Management

Other agencies as needed: including, but not limited to Water Suppliers, USA, etc.

LUT

OERS

Health Dept.

2. Regional Notifications - 9-1-1 Center will notify the appropriate Haz-Mat team as necessary

3. State Notification - **1-800-452-0311** (24 hrs) activates the Oregon Emergency Response System (OERS), which can provide state assistance to local responders. Most spills that involve oil or hazardous materials must be reported by the spiller to OERS. It is recommended that local governments contact OERS so the state system can be prepared to respond if needed.

4. Federal Notifications - **1-800-424-8802** (24 hrs) activates the National Response Center (NRC), which can provide federal assistance. Depending on the type and quantity of material spilled, the spiller must notify the NRC. OERS will make this notification upon request.

C. Incident Management

1. Emergency Response

a. Local Incident Command - The lead local incident command agency is the local Fire Department/District having jurisdiction. When the incident command agency arrives on scene it shall:

(1) Assume incident command

(2) Establish an appropriate incident command post

(3) Contact the State through OERS for technical assistance

(4) Establish a unified command if more than one level of government is involved

(5) Designate a local on-scene coordinator (LOSC) for local resources

(6) Be in charge of and responsible for all emergency response operations

(7) Designate a Public Information Officer (PIO)

(8) Assure notifications are made

(9) Identify the level of incident if possible

b. Change of Command - Incident command will remain with the Incident Command Agency until emergency operations, including stabilization and control activities, are completed; unless the incident commander requests another agency to assume control.

2. Cleanup and Restoration

- Once the emergency phase of the incident is over, the appropriate state agency will assume control of the cleanup unless other arrangements have been agreed to. They can be reached by calling OERS at **1-800-452-0311.**

D. Emergency Operation Centers (EOC)

- The Washington County EOC is located in the basement of the Public Safety Building in the 100 block of Lincoln Avenue in Hillsboro. It will be activated by the Office of Emergency Management at the direction of the Emergency Management Director.

E. Technical Assistance

- Technical assistance on hazardous materials is available from some of the organizations listed in attachment 1.

F. Public Information

- Public information will be coordinated between on-scene and off-scene operations. A PIO will be designated by the incident commander to issue information about the incident. The PIO will issue information provided by the incident commander and in coordination with the appropriate local, state, federal and private agencies.

SECTION IV

Responsibilities

A. Fire Service

Some communities in Washington County may choose a different Incident Command Agency. If so, that community has the responsibility to create a plan reflecting such change and inform the Office of Emergency Management of such planning efforts.

1. Provide Incident Commander and implement Incident Command System (ICS).

2. Establish a command post and a unified command with other agencies.

3. Provide personnel trained in Haz-Mat emergency response.

4. Make initial product identification and notification per departmental Standard Operating Guidelines (SOG).

5. Undertake initial incident mitigation efforts which may include firefighting, rescue, containment, decontamination and emergency medical care.

6. Provide and control public information.

7. Provide initial site security.

8. Support other agencies and tasks as may be appropriate.

9. Provide and maintain communications.

B. Law Enforcement

1. Maintain perimeter and limit access to spill area.

2. Maintain communications.

3. Provide crowd and traffic control.

4. Detour traffic.

5. Take charge of major evacuation.

6. Coordinate tasks with Incident Command.

7. Execute drug lab activities as per the Guidelines for the Response to Drug Lab Scenes in Washington County or established plans for drug lab response.

C. Emergency Medical

1. Provide emergency care as needed

2. Provide patient transport

3. Provide triage, isolation sectors and assist in decontamination as needed

D. Emergency Management

1. Confirm initial notifications

2. Provide assistance in secondary notifications

3. Provide assistance in procurement of materials, resources, and technical assistance.

4. Activate the EOC as appropriate.

E. Department of Land Use and Transportation

1. Provide assistance to U.S.A. with sewerage control.

2. Provide assistance to U.S.A. and water districts with water control.

3. Provide routing assistance through barricades, traffic light control and routing control.

4. Provide maps, aerial photos, assessment records, and other information as needed.

5. Provide such equipment and material as may be available.

F. Department of Health and Human Services

1. Provide technical support for emergency operations.

2. Ensure protection of public health.

3. Provide support in environmental monitoring.

G. Unified Sewerage Agency

1. Control sewage.

2. Provide maps, diagrams and plans of sewerage systems, as needed.

H. Others

These and other resources are available through the Office of Emergency Management.

1. American Red Cross

   a. Establish and maintain mass care facilities for displaced persons.

   b. Assist in reuniting families who become separated because of the incident.

   c. Assist with other human services within their capabilities.

2. Explorer Post #877

   Assist law enforcement agencies with traffic control and security of the area.

3. Amateur Radio Operator Groups

   Assist with communications via amateur radio systems.

4 Salvation Army

Work with the American Red Cross in supplementing human services and mass care.

H. Industry

1. Private industry is responsible for familiarizing themselves with this plan and working with state and local government to see that their emergency operations plans are consistent with this plan and the Oregon Emergency Operations Plan.

2. Private industry is responsible for responding to emergencies as required by law.

3. Private industry is responsible for cleanup and site restoration when required to do so by law.

4. When requested and if possible, private industry will provide expertise and resources to local government and/or state government to help mitigate the effects of a hazardous materials incident.

5. Private cleanup contractors can provide resources, equipment, and knowledge on the removal and disposal of contamination.

SECTION V

<u>Emergency Procedures</u>

Actual implementation will be based on incident command procedure adopted by individual agencies.

A. DISCOVERY - The first person to arrive on the scene should:

1. Assess the situation - protect yourself from contamination - observe from a safe distance upwind and upground from the material

2. Determine if persons are injured or in danger

3. Get help - call 9-1-1 and tell them you are reporting a hazardous materials incident

4. Advise the public to keep clear or assign someone to do so while you go for help

B. INITIAL RESPONDERS - (Refers to those with "First Responder - Awareness" training as defined by 29CFR1910.120 and enforced by Oregon OSHA.) Others with less training should act in accordance with the "Discovery" phase above.

1. <u>Size-up/Identification</u>

   a. Approach from upwind and upgrade

   b. Observe from a safe distance

   c. Use binoculars if necessary

   d. Examine placards/labels

   e. Interview driver, conductors, facility operator, dock manager, etc.

   f. Examine shipping papers or identification numbers

   g. Refer to DOT Guidebook or Firefighters Handbook of Hazardous Materials

   Note: it is important to utilize 2 or 3 sources for the identification of material and appropriate actions.

2. <u>Isolate area</u>

   a. Avoid contact with materials, fumes, dust, etc.

   b. Establish control line at a safe distance

   c. Eliminate or avoid ignition sources

   d. Determine if larger evacuation is necessary to keep people away from chemicals

3. Provide for Personnel Safety

   a. Use appropriate personal protective equipment

   b. Consciously avoid committing personnel and equipment to an unsafe situation

4. Rescue injured persons - (if it is possible to do so in a safe manner)

   Identify all people who might have been injured or exposed

5. Notification and Technical Assistance

   a. Notification - 9-1-1 (for more information see Section III).

   b. Technical Assistance - (for more information see Attachment 1).

      - **OERS (1-800-452-0311)**
      - **NRC (1-800-424-8802)**
      - **CHEMTREC (1-800-452-9300)**
      - **Emergency Medical Advice:**
        Poison Control Center (1-800-452-7165 or 225-8968)

   c. When working with another agency, be prepared to provide the following information:

      (1) Your name, agency, location, and call-back number

      (2) Type of material involved, characteristics, physical state, physical effects

      (3) Amount of material released, duration of release, total amount that may be released

      (4) Whether significant amounts of substance appear to be entering the atmosphere, nearby waterways, storm drains

(5) Direction, height, color, odor of vapor clouds or plume

(6) Weather conditions, local terrain conditions

(7) Injuries, contamination, exposure

(8) Responsible party

(9) Personnel on scene

6. Establish Incident Command

a. Determine who is the incident commander

b. Set up field command post at same location

c. Advise dispatcher of exact location of command post

d. Establish communications with off-scene help

e. Brief new commander

C. INCIDENT COMMANDER

The Fire Standards and Accreditation Board has adopted standards for incident command training and these standards are hereby adopted by this reference.

1. Establish Incident Command

a. Clearly identify yourself as Commander

b. Make sure command post is at a safe distance

c. Establish unified command, if appropriate, with agencies on scene

d. Identify lead state agency, if any

e. Establish staging areas for equipment, medical treatment

f. Assure notifications are made (see Attachment 1)

g. Determine assistance needed from the State and others

2. Determine the Hazard

a. Check placards, shipping, etc.
b. Use reference books and off-scene help (i.e., OERS, State Fire Marshal, CHEMTREC, etc.)

c. Identify hazardous material, estimate threat to the population and environment

d. Determine windspeed and direction

e. Determine downwind, downstream, and downslope exposures

f. Identify ignition sources

g. Use available detection equipment

3. Provide for Personnel Safety

a. Ensure the use of proper personal protective equipment

b. Evaluate need for further evacuation

c. Document personnel exposure

4. Assign Personnel Responsibilities

- Staging
- Evacuation (see paragraph H below)
- Rescue
- Traffic and crowd control
- Containment
- Fire suppression
- Public Information (see paragraph I below)
- Communications
- Safety
- Emergency Medical
- Documentation

5. Evaluate Control Line and Revise if Necessary

   a. Use tape, rope, fire-hose, etc.

   b. Leave a margin for error

6. Incident Management

   a. Develop incident action plan

   b. Oversee incident operations

   c. Coordinate activities with EOC

7. Decontamination

   a. Assign decontamination area officer and team

   b. Identify people and equipment possibly exposed

   c. Set up decontamination area procedures

D. MEDICAL SERVICES

1. Be aware of dangers

2. Take proper precautions to protect yourself when handling casualties

3. Coordinate actions with the incident commander

4. Identify medical risk to victims and emergency responders

5. Establish medical triage area

6. Determine and establish appropriate treatment upon screening

7. Coordinate Emergency Transport Services

8. Coordinate with hospital and medical personnel

9. Coordinate with Red Cross Mass Care Coordinator and EOC logistics regarding medical services required by evacuees

10. Decontaminate personnel - victims and equipment as needed

11. Help question/examine responding personnel on state of health and treat as required

E. PUBLIC HEALTH

1. Identify yourself to the incident commander and indicate that you represent public health

2. Coordinate with medical services

3. Confirm health hazard

4. Investigate toxic levels of materials involved

5. Confirm evacuation area perimeters

6. Ensure no biological agents involved

7. Work with State Health Division and DEQ to address environmental health/sanitation impacts

F. TRAFFIC CONTROL AND LAW ENFORCEMENT

1. Obtain guidance from the Incident Commander on the need for an exclusion perimeter, and the distances

2. Establish perimeter, using rope, barricades, vehicles, etc.

   Note: avoid flares due to the possible presence of combustible or flammable chemicals

3. Reroute pedestrians and vehicles around perimeter -- keep onlookers, news media and others from excluded area

4. Request additional resources as needed

5. Be prepared, at the request of the Incident Commander, to remove persons hindering emergency operations

6. Reopen evacuated areas at the direction of the Incident Commander

G. PUBLIC WORKS OPERATIONS

1. Coordinate activities with Incident Commander

2. Be prepared to assist with traffic control, providing barricades, etc.

3. Be prepared to provide sand for absorption and diking

4. Coordinate the control of water service.

H. UTILITIES

1. Coordinate activities with Incident Commander

2. Be prepared to cut off power, gas, water, etc. as requested

I. EVACUATION/SHELTER

For further guidance see the Evacuation Annex of the Washington County Emergency Operations Plan.

1. Obtain information on the danger area such as:

   - size of spill
   - plume direction
   - people and facilities in danger area

2. Decide between evacuation and shelter, what will best reduce exposure

3. Begin warning and/or evacuation procedures for those nearest the accident site - work outward from the site

4. Notify those who need to know

   - Law enforcement agencies
   - Emergency Management (city, county, state)
   - Red Cross
   - County Health Department
   - Local TV, radio, cable, and newspaper through the PIO
   - Dispatchers
   - Other Emergency Relief Organizations
   - Transportation companies

J. PUBLIC INFORMATION

1. Initial Actions

   a. Work with Incident Commander on press releases

   b. Contact local media and inform them of the nature of the emergency and other pertinent information

   c. Set up press briefing area as close to the command post as possible, but in such a way that it does not interfere with the command post

   d. Establish both incoming and outgoing telephone communications at the press briefing area if possible

   e. Be available to supply information to the press upon request

2. Long Term Actions

   a. Coordinate press releases with all agencies involved

   b. Coordinate with State and Federal PIOs

   c. Be the direct liaison with all the news media

   d. Do follow-up after emergency is over for evaluation purposes

   e. Offer ongoing contact with media for wrap-up stories

SECTION VI

<u>Exercising and Updating the Plan</u>

A. The Office of Emergency Management will review this plan and make necessary modifications annually.

B. SARA Title III requires an annual exercise of this Hazardous Materials Plan. Such an exercise may be originated by any County department or agency, and can be coordinated with the Washington County Office of Emergency Management, which has the resources available to assist in planning, conducting, and evaluating the exercise.

C. Following each County exercise, the Office of Emergency Management shall facilitate a post-exercise analysis.

SECTION VII

Training

As Washington County does not have the funding to train, equip and maintain its own hazardous materials response team, the County's field employees will be trained to the "First Responder - Awareness" level as defined in 29CFR 1910.120 and administered by Oregon OSHA. Those who meet the criteria for "First Responder Operations" or "First Responder Incident Commander" within the above rules will be trained to these levels. Standards for curricula to meet these requirements have been adopted by the Oregon Fire Standards and Accreditation Board and are hereby adopted by this reference.

SECTION VIII

Off-Site Response Planning

At this time, all facilities within Washington County with Title III threshold planning quantities of hazardous materials are located within rural fire protection districts or incorporated cities with organized fire protection. These cities and fire districts are responsible for off-site response planning for such facilities within their jurisdiction. As needed, the County will provide evacuation and mass care planning portions of the off-site response plans.

If the County becomes aware of such facilities within the County but outside organized fire protection, the County Office of Emergency Management will ensure that an off-site response plan is developed.

ATTACHMENT 1

None of these numbers has been checked since 1989.

A. Resource Information List

NOTE: These numbers are listed as resource numbers only. Initial notification will be made through proper Emergency Management channels.

AGENCY	PHONE	REMARKS
STATE AGENCIES		
OERS	1-800-452-0311	24 hours
OR Dept. of Environmental Quality	1-800-452-4011	
Haz-Mat Section - Portland	229-5759	
OR Dept. of Energy	1-800-221-8035	
Siting & Regulation Div. - Salem	378-6469	
OR State Health Division - Portland	229-5599	
Radiological Fixed Site Incidents		
Communicable Disease Agents		
Radiation Emergency Response Team		
OR State Highway Division - Salem	378-6570	
Local Regional Office	653-3090	
OR State Fire Marshal	378-2885	
Hazardous Materials Section		
OR Military Department - Salem	378-3903	
State Forestry Dept. - Salem	378-2560	
Local Headquarters - Forest Grove	357-2191	
OR Public Utilities Comm. - Salem	378-5849	
OR Dept. of Fish & Wildlife - Portland	229-5683	
FEDERAL AGENCIES		
NRC	1-800-424-8802	24 hours
US Coast Guard Cmd Ctr - Washington, D.C.	1-202-426-1830	
US Coast Guard Seattle (RRT)	1-206-442-5233	
US Coast Guard Portland	240-9300	
Environ. Prot. Agency - Seattle	1-206-442-1196	
US Forest Service - Portland	221-2931	
Nat'l Oceanic & Atmospheric Administration (NOAA) - Seattle	1-206-526-6343	
US Army Corps of Engineers - Portland	221-2193	
Dept. of Health and Human Services (NIOSH) - Seattle	1-206-442-0530	
US Dept. of Energy - Richland	1-509-376-2603	
US Dept of Interior - Portland	231-6157	
US Fish & Wildlife Svc - Portland	231-6154	
FEMA - Seattle	1-206-403-7243	

AGENCY	PHONE	REMARKS
Agency of Toxic Substance & Disease Registry - Atlanta	1-404-241-6200	
US Army Explosive & Ordnance Disposal - Maryland	1-301-677-5770	
US Nuclear Regulatory Comm. - Maryland	1-301-492-7000	
National Weather Service - Portland	281-1911	
Salem	363-7863	
Tape	363-4131	
Center for Disease Control Night Emergency - Atlanta	1-404-633-5313	
Bombing Investigations & Terrorist Bombing (FBI) - D.C.	1-202-324-4664	
Classification of Explosives Military Board - D.C.	1-202-325-0891	
Destruction of Explosives & Destructive Devices - D.C. (AIF)	1-202-566-7087	24 hours
Bureau of Alcohol & Firearms - D.C.	1-202-566-7395	
Explosives Unit Lab (FBI) - D.C.	1-202-324-2696	
Fed. Aviation Admin. Info - D.C.	1-202-426-4817	

INDUSTRY INFORMATION SOURCES (The numbers below need verification)

Industry Chemical Info - CHEMTREC	1-800-424-9300	24 hours
American Petroleum Inst. - D.C.	1-202-682-8134	
Assoc. of American Railroads - Portland	1-800-826-4662	
Burlington Northern RR Dispatch	1-206-625-6246	
Dow Chemical Co. - Midland, MI	1-517-636-4400	
DuPont Company - Wilmington, DE	1-302-774-7500	
Institute of Makers of Explosives - D.C.	1-202-429-9280	
Penwalt "Chlorine Team" - Portland	228-7655	
Southern Pacific Railroad Dispatch	220-4424	
Union Pacific Railroad Dispatch	249-2711	

VOLUNTEER ORGANIZATIONS

Use of volunteer organizations shall be coordinated through the Office of Emergency Management.

American Red Cross - Portland		284-1234	24 hours
Salvation Army - Local	8:30-4:30	640-4311	
Poison Control Center		1-800-452-7165	24 hours
Hazardous Substance Survey	State Fire Marshal	378-2885	8-5/M-F

A SUMMARY OF TYPICAL ROLES OF LOCAL RESPONSE AGENCIES DURING A GENERIC HAZARDOUS MATERIALS INCIDENT

RESPONSE ACTIVITIES AFTER ACCIDENT OCCURS	CITY GOVERNMENT & FIRE DIST.						MED SVC		COUNTY GOVERNMENT											
	POLICE	FIRE	DISPATCH CENTER	EMERG MEDICAL	PUBLIC WORKS	CITY OFFICIAL	AMBULANCE	HOSPITAL	SHERIFF	PUB WKS/ROAD DPT	PUBLIC HEALTH	EMERGENCY MGT	EMERG OPS CTR	COUNTY OFFICIAL	REGIONAL HAZ MAT	RED CROSS	AMATEUR RADIO	PRIVATE INDUSTRY	STATE	FEDERAL
Initial Investigation	P	P	S		S				P	S					S					
Notification	S	S	P						S			P			S				S	P
Problem Recognition	P	P			S				P	S	S				S					
Radio Communications	P	P	P	S	S		S	S	P	S		S	S		P		S		S	
Search and Rescue	S	P		S					P			S							S	
First Aid	S	P		P			P	P	S		S				S					
Hazard Evaluation	S	P							S		S		S		P			S	S	S
Evacuation (decision)	S	P				P			P			S	P	P	S	S			S	S
Evacuation (implement)	P	S			S	S			P	S		S	S	S	S	S			S	
Shelter	S					S			S		S	P				P				
Fire Suppression		P			S					S					P				S	
Spill Containment	S	P			S				S	S					P			S	S	
Site Security (access)	P	P			S				P	S					S					
Crowd Control	P	S							P											
Traffic Control	P	S			S				P	S									S	
Traffic Diversion (decision)	S	S			P				S	P			S						S	
Traffic Diversion (implement)	P				S				P	S									P	
Public Information	S	P				S			P		S	S	P	S		S		S	S	S
Technical - Health Effects								S			P		S		S			S	P	S
Technical - Environ. Effects											S		S		S			S	P	S
Technical - Biol. Agents											S		S		S			S	P	S
Technical - Radiation		S									S		S		S			S	P	S
Technical - Oil & Haz. Chem.											S		S		S			S	P	S
Environmental Monitoring		S									S		S						P	P
Cleanup (decision)		S				S							S	S	S			S	P	P
Cleanup (implement)													S					P	S	S
Disposal (decision)						S								S	S			S	P	P
Investigation (fire)	S	P							S						S				P	S
Investigation (environment)											S		S		S				P	P
Investigation (transport)	S								S						S				P	P
Investigation (radiation)		S											S		S				P	P
Damage Assessment (environment)											S	S			S				P	S
Damage Assessment (structure)		P			P	S				P		S		S		S			S	S
Damage Assessment (human health)	S	S							S		P								P	S
Enforcement	S	S							S									S	P	P
Cost Recovery		S																S	P	P
POTENTIAL INCIDENT COMMANDER	X	X							X											
POTENTIAL ON-SCENE COORD.	X	X							X						X					

P- Agencies with prime responsibility

S- Agencies with support responsibility

_- Agencies with no responsibility under normal circumstances