City of Philomath
Storm Drain Master Plan

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FOREWORD

USING THIS REPORT

Because this report is intended to be used by many people whose needs for detailed information will differ widely, an Executive Summary has been included at the beginning of this report. This executive summary contains a summary and overview which briefly describes the content and main conclusions of the report. Thus, readers may gain a good general understanding of the direction of the report and its contents by reading the Executive Summary. If a reader wishes to explore the subject in greater detail, the appropriate section in the text can be consulted. Each section has also been generally organized so as to move from the general to the specific.

CITY OF PHILOMATH
Storm Drainage System Master Plan

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

INTRODUCTION

This Storm Drainage Master Plan provides recommendations for storm drainage within the City of Philomath. In the past, storm drainage improvements were constructed as they were needed without analyzing overall system needs and impacts. Although this approach has alleviated isolated problems, the majority of the existing system is old and still experiences numerous problems. Continuing development, particularly within the upper reaches of the drainage basins, is further overtaxing the presently undersized drainage system. Lack of funding for storm drainage improvements in the City of Philomath has resulted in many of the main storm drainage lines throughout the City being undersized.

The City's current development standards require findings that adequate capacity is available in the utility systems prior to development occurring. Without a storm drainage master plan which identifies basin-wide improvements required with a schedule guiding their construction, implementation of these policies is difficult. Without a basin-wide understanding of how the drainage system works and how development within the basin impacts its performance, it is difficult at best to determine what improvements to the storm drainage system are required by new development.

PROJECT OBJECTIVES

The primary purpose of the Master Plan is to provide the City with specific engineering recommendations for the control of storm drainage throughout the study area. It is intended that the information contained herein assist the City in the planning and implementation of capital improvements to the storm drainage system, as well as ongoing system maintenance.

The specific objectives of master plan are as follows.

- Identify and delineate the boundaries of the major drainage basins and subbasins within the Planning Area.

- Map the existing storm drainage system based on field data collection and as-built drawings

- Identify current and future storm drain system deficiencies on a prioritized basis, particularly in the following areas:

    - Surcharging, localized flooding, flow routing capacity
    - System reliability
    - Maintenance considerations

- Analyze the major trunk drainage systems under fully developed (buildout) conditions to determine the most cost effective approach to drainage management within the study area.
- Provide an evaluation of the options for correcting these deficiencies with preliminary construction cost estimates for recommended alternatives.
- Provide specific recommendations to the community and City Council for action.

ELEMENTS OF THE MASTER PLAN

Study Area. As outlined in Section 2, the study area is drained by a number of basins that discharge to the Mary's River. The topography within the UGB generally is gently sloping and undulating. The topography within the study area ranges from relatively flat south of Main Street and along Newton Creek, to steeper slopes and hills to the north, east and west of the City. The elevation within the study area ranges from approximately 260 feet along the Mary's River to a high point of 1175 feet at the northern limits of the drainage basin. The majority of the land within the UGB is at or below an elevation of 400 feet, with the City center having an elevation of approximately 280 feet. A significant portion of Philomath is within or affected by the Mary's River Flood Plain (see FEMA flood maps, Appendix B).

Inventory of Existing Drainage System. The study area can be divided into 11 major drainage basins and many minor basins. The major drainage areas identified encompass approximately 3,800 acres, and vary in size from 90 to 840 acres (Table 3-1, Figure 3-1).

The existing storm drainage system is a combination of open channels, storm pipes and culverts in the well developed areas of the City, and roadside ditches, cross country ditches and perennial streams, and cross culverts in the less developed areas. The total estimated length of pipe in the drainage system is approximately 69,590 feet (±13.2 miles) with ±380 catch basins and ±90 storm drain manholes. The remainder of the storm drainage system consists of small perennial streams and constructed open channels, including roadside ditches. A detailed inventory of these channels and ditches was not performed, but the total appears to be in excess of 25 miles (excluding highway ditches). Utility maps showing the general location, size and material type of all pipes in the existing storm drainage system were prepared for use by the City (Appendix A). Table 3-3 contains a summary of the major know problem areas as reported by Public Works.

Drainage System Capacity Evaluation. The purpose of the drainage system capacity evaluation was to identify elements of the existing drainage system that cannot accommodate current and/or projected future storm water flows. The calculation of peak flows and runoff volumes within the drainage basins is essential to any storm drainage master planning effort. Peak flows are used to size ditches, culverts and pipe systems during the design process for new facilities.

For this evaluation, storm flows and hydraulic routing models were developed for the major drainage basins. The methodology used develop and model existing and future peak stormwater flow conditions was the Rational Method. The system capacity evaluation identified facilities that were undersized for existing or projected flows (Section 4).

System Evaluation & Recommended Improvements. Strategies were developed for management of storm drainage within each of the 11 major basins. For 7 of the major basins, the management strategy includes one or more recommended capital improvement projects. A total of 18 projects are recommended for inclusion in the City's Capital Improvement Plan (priority 1 & 2 projects). These projects include replacements of existing culverts and storm drains that are currently undersized or structurally damaged. The total estimated cost to complete construction of these projects is approximately 2.51 million dollars (Section 5-3). The number of projects implemented in a given year will be based on annual reviews and dependent on available funds.

Design Standards. The City does not presently have any detailed design criteria for storm drainage system improvements under City jurisdiction. Based on a review of existing drainage design criteria for Philomath and other communities of similar size, a draft set of recommended Public Works Design Standards (PWDS) for stormwater management and standard details were developed. The format of these PWDS is designed to allow sections for streets, sanitary sewers, and water distribution can be added as these are adopted by the City. The design standards criteria are summarized in Section 6.1, while the full text of the draft standards are included in Appendix C. These draft PWDS are intended to provide a uniform set of standards for public storm drainage improvements. They also are intended to apply to private systems which cannot conform to Uniform Plumbing Codes, particularly minimum slopes. The intent of these standards is to provide guidelines for the construction of public facilities which will provide an adequate service level for the present development as well as for future development.

System Management Practices. In order to ensure that the City's storm drainage system continues to function effectively, and to maintain the full capacity of the existing storm drainage system, a regular program of maintenance is recommended (Section 6.3).

A successful maintenance program should include the following objectives:

- Provide for public safety
- Reduce potential of property damage by obstructed facilities
- Evaluate and upgrade maintenance priorities
- Reduce impact on City's resources
- Maintain capacity and integrity of storm drainage system
- Identify future maintenance needs
- Add projects to the stormwater CIP as appropriate
- Reduce nuisance water on public streets

The most important objectives of the maintenance program should be to provide for public safety and reduce unplanned storm water flow or flooding on private and public property. It also allows access to public roads to be maintained during storm events for emergency and private vehicles. The maintenance section of the master plan provides key recommendations to improve the City's operations and maintenance program. Recommendations include the establishment of an annual storm drainage maintenance and minor repairs and upgrades (Table 6-3), as well as regular inspection/inventory of the drainage system to better characterize and prioritize maintenance needs.

Liability & Funding Issues. A general summary of some drainage-related legal/liability issues was presented as a basis for further investigation by the City into potential liabilities with storm drainage master planning and implementation of improvements (Section 6.4). This summary should not be used in lieu of advice from the City's legal counsel. Historically, the basis for storm drainage litigation in Oregon has been based on case law.

A summary of potential funding sources that municipalities have used in implementing drainage improvements is also presented. In addition to a System Development Charge (SDC), it is recommended that the City consider implementation of a stormwater service charge. A sample ordinance similar to that adopted by other small communities in the Willamette Valley is included in Appendix F.

City of Philomath
Storm Drain Master Plan

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CITY OF PHILOMATH
Storm Drainage System Master Plan

Section 1
INTRODUCTION

SECTION 1
INTRODUCTION

1.1 Background

The City of Philomath has experienced rapid growth in recent years in part because of its proximity to Corvallis, as well as the quality of life provided by the City and the surrounding area of Benton County.

The City of Philomath is located on Highway 20 approximately five miles west of Corvallis in Benton County, Oregon. The current population of Philomath is approximately 3300 (Oregon Blue Book, 1997-98). The City was founded in 1882, and in the past much of the economic activity of Philomath has centered around the forest products industries. With the decline of the forest products industries in western Oregon, future prosperity of Philomath appears to be tied to diversified light industries together with a growing residential community. Many of the residents of Philomath work in Corvallis and other nearby communities.

The storm drainage system in the downtown core area of Philomath has not been upgraded as the City has grown up around it. Storm drainage management within the City of Philomath has received little attention over the years. Without the benefit of a master plan, storm drainage system funding mechanisms or even an overall storm drainage utility map, storm drainage improvements were constructed as they were needed without analyzing overall system needs and impacts. Although this approach has alleviated isolated problems, the majority of the existing system is old and still experiences numerous problems. Continuing development, particularly within the upper reaches of the drainage basins, is further overtaxing the presently undersized drainage system.

Although the City has developed master planning documents for both water and sanitary sewer systems, the City does not currently have a storm drainage master plan document. The City's current development standards require findings that adequate capacity is available in the utility systems prior to development occurring. Without a storm drainage master plan which identifies basin-wide improvements required with a schedule guiding their construction, implementation of these policies is difficult. Without a basin-wide understanding of how the drainage system works and how development within the basin impacts its performance, it is difficult at best to determine what improvements to the storm drainage system are required by new development.

1.2 Authorization

In April of 1997, the City of Philomath authorized Westech Engineering, together with KCM, Inc., to prepare a comprehensive storm drainage master plan for the City. The master plan will guide the City's efforts to manage storm water runoff, and to protect public and private property from damage.

1.3 Project Objectives

The purpose of this study is to evaluate the City's storm drainage system with respect to its existing and future needs, identify improvements and associated costs necessary to meet those needs, and provide the City with a design guide for future growth of the City's storm drainage system. It is intended that the information contained herein assist the City in the planning and implementation of capital improvements to the storm drainage system, as well as ongoing system maintenance.

This evaluation and master plan accomplishes the following specific objectives.

- Identify and delineate the boundaries of the major drainage basins and subbasins within the Planning Area.
- Map the existing storm drainage system based on field data collection and as-built drawings
- Identify current and future storm drain system deficiencies on a prioritized basis, particularly in the following areas:
    - Surcharging, localized flooding, flow routing capacity
    - System reliability
    - Maintenance considerations
- Analyze the major trunk drainage systems under fully developed (buildout) conditions to determine the most cost effective approach to drainage management within the study area.
- Provide an evaluation of the options for correcting these deficiencies with preliminary construction cost estimates for recommended alternatives.
- Provide specific recommendations to the community and City Council for action.

This report does not include wetland inventory or delineations, on-site environmental investigations or geotechnical investigations.

1.4 Prior Studies and Work

The most recent studies, reports and documents utilized in the preparation of this master plan are as follows:

- Local Wetlands Inventory for the City of Philomath, for City of Philomath, Oregon by SRI/Shapiro, Inc., August 1996 (Draft).
- Mill Site Conversion Project, Conceptual Development Plan for Willamette Industries Mill Site, for Rural Development Initiatives, Inc. by KCM, Inc., November 1995.
- Topographic Aerial Maps, City of Philomath, Oregon. Panels 332/1256, 332/1259 & 330/1259, April 1989, 330/1256, April 1975.
- Flood Insurance Study, City of Philomath, Benton County, Oregon, by Federal Emergency Management Agency, December 1981.
- Flood Insurance Study, Benton County, Oregon, Unincorporated Areas, by Federal Emergency Management Agency, August 1986.

CITY OF PHILOMATH
Storm Drainage System Master Plan

Section 2
STUDY AREA

SECTION 2
STUDY AREA

2.1 Study Area

The City of Philomath is located in the center of Benton County, Oregon, approximately 5 miles west of Corvallis. The study area is approximately coincident with the urban growth boundary (UGB) of the City, except on its northern edge where it includes some unincorporated areas of Benton County which drain into the City's storm drainage system. The study area is bounded on the south by the Mary's River. The Corvallis-Newport Highway 20/34 bisects Philomath east to west, and provides the major road transportation to Philomath. Highway 20/34 is designated as Main Street within the City of Philomath. The Southern Pacific Railroad Co. also has a rail line passing through the City.

Philomath's Comprehensive Plan was developed in 1980 near the end of that period of the City's rapid growth. A large urban growth boundary (UGB) was established which encompasses 2,568 acres, approximately 2,000 of which are outside the present City Limits. Eventually the entire area will be part of Philomath and will be served by the City's utility systems.

The planning area for this report includes the land within the urban growth boundary as well as the areas outside the UGB but within the Newton Creek watershed which drain to the City storm drainage system. In addition to the areas within the UGB, the study area encompasses more than 1,300 acres north, east and west of the UGB which drain into and through the City.

The improvements recommended in this plan are based on development of land within the UGB in its present location, as well as the land use zoning and the associated runoff coefficients based on that zoning. It is assumed that no significant development will occur within the study area outside the UGB. Changes in any of these assumptions could change the recommendations contained in the master plan. Should significant changes in any of the above occur, the master plan should be updated accordingly.

2.2 Climate and Rainfall Patterns

The study area is located on the east side of the Coast range, with weather typical of the Willamette valley. The weather is characterized by warm dry summers and cool wet winters. Although there is no National Weather Service recording station in Philomath, there are extensive weather records for OSU Hyslop Field between Corvallis and Albany. While the data from this weather station is not specifically for Philomath, the State Climatologist office has indicated that these values are generally representative for the immediate area around Corvallis, including Philomath. A limited review of the rainfall data collected by the City at the wastewater treatment plant confirms that although there are daily and monthly variations, the annual average rainfall is approximately the same. The localized variations in rainfall result from Philomath's proximity to the Coast range, particularly Mary's Peak.

The study area receives an average of 42 inches of precipitation annually, with the majority of the rainfall occurring during the winter months. Approximately 80 percent of the annual precipitation occurs between November 1 and April 30. Winters are characterized as mild, with very low temperatures being uncommon. Although there are an average of 55 days per year with temperatures below freezing, the average number of days on which the temperature does not rise above freezing during the day is less than 10. One of the region's hazards occurs when below freezing temperatures combine with rain to produce icy conditions. Summers are generally mild with little precipitation.

The rainfall intensity-duration-frequency curve for use in the City of Philomath is the ODOT Zone 8 IDF curve (see draft Public Works Design Standards, Appendix C).

2.3 Topography

Philomath is located on the western edge of the Willamette Valley, near the point the Mary's River leaves the Coast Range. The City center is located on the second bench north of the Mary's River. The natural surface drainage across the study area flows to the south, and the existing storm drainage system intercepts the flows and routes them into the Mary's River.

The topography within the City Limits generally is gently sloping and undulating. The topography within the study area ranges from relatively flat south of Main Street and along Newton Creek, to steeper slopes and hills to the north, east and west of the City. The elevation within the study area ranges from approximately 260 feet along the Mary's River to a high point of 1175 feet at the northern limits of the drainage basin. The majority of the land within the UGB is at or below an elevation of 400 feet, with the City center having an elevation of approximately 280 feet.

2.4 Soils and Geology

The City's Sewer Systems Facilities Plan prepared in 1985 and the Local Wetlands Inventory for the City of Philomath prepared in 1996 contain detailed discussions of the soils and geology within the UGB. These discussions on soil types are based from reports and maps prepared by the Soil Conservation Service (now the Natural Resource Conservation Service) showing the approximate locations of the Benton County soil types.

Although a detailed analysis of the soils and geology is outside the scope of this report, one soil characteristic evaluated by the Soil Conservation Service and these later reports was the surface drainage capacity. Two the five major soil associations within the study area possess poor surface drainage characteristics. These soils occur in much of the eastern part of Philomath, (between and on either side of both channels of Newton Creek) and along Hwy 20. Although poorly drained soils occur in a significant portion of the City within the planning area, including most of the industrial zoned areas, the undeveloped areas north of the City generally consist of moderately well drained soils.

The importance of this to this report is to emphasize that the soil infiltration capacity within the developable portions of the study area is limited at best, particularly during the late winter months after the ground has become saturated. These poor drainage characteristics form the basis for the runoff coefficients used in this study and in the design standards contained in Appendix C. Due to the soil types and drainage characteristics, it is not anticipated that the runoff coefficients of the land north of the City outside the UGB will change significantly even if low density rural development is to occur.

2.5 Land Use

The planning area is made up of land in three categories, namely land inside of Philomath's City limits, land outside of the City limits but inside of the Urban Growth Boundary, and land outside of the Urban Growth Boundary.

Land use zoning in the City of Philomath is comprised primarily of residential uses, although the Comprehensive Plan sets aside large areas for industrial development (approximately 800 acres), of which about 500 acres is presently undeveloped. Lesser amounts of land are designated for commercial, office, and public/open space uses. A copy of the current City zoning map as prepared by Benton County is attached, and identifies the City Limits, Urban Growth Boundary, and land use zones within the UGB.

a. Land Use within City Limits

The majority of the land within the City Limits is currently developed or partially developed. Much of the ongoing and anticipated development within the City is occurring outside the City Limits under deferred or delayed annexation agreements.

b. Land Use outside City Limits but within UGB

The majority of the land inside the UGB but outside the City Limits is undeveloped or underdeveloped. Of the undeveloped land inside the planning area and outside the City Limits, about 35 to 40% appears to be zoned for industrial use and the remainder for residential use. The majority of the industrial zoned land is either undeveloped or being utilized at less than the antipated zone intensity.

The study area includes several large tracts of land currently under agricultural use in the southern portion of the UGB. However, the agricultural parcels are generally too small to support intensive commercial agriculture activities.

c. Land Use outside UGB

Land within the planning area which is outside the UGB is located between the northern boundary of the UGB and the ridges to the north. Most of the land within this area is unimproved pasture land, timbered, or developed as very low density residential uses. The Benton County zoning for this land will preclude any intensive development in this area unless the Philomath or Corvallis UGBs are expanded.

2.6 FEMA Flood Insurance Status

The Mary's River is the primary stream within the study area. It extends approximately 40 miles from its confluence with the Willamette River to its headwaters northwest of Philomath. Newton Creek, the only major tributary in the study area, enters the Mary's River at river mile 10.0. The Mary's River has a streamflow pattern similar to other Willamette Valley streams. It is typified by high flows during the winter and low flows during the summer months. Since 1940, Benton County and the United States Geologic Survey have maintained a gaging station on the Mary's River just downstream of the bridge on Bellfountain Road. Because of this station, excellent streamflow data is available.

The Mary's River flows from west to east along the southwestern edge of Philomath's UGB. The Federal Emergency Management Agency (FEMA) has established a 100 year floodplain designation and insurance ratings for the study area.

In 1968, the U.S. Congress passed the Flood Insurance Act which established a federal program enabling property owners to buy flood insurance at a reasonable cost (FEMA, 1980). In return, communities carry out local floodplain management measures to protect lives and new construction from future flooding. The program is administered by the Federal Insurance Administration within the Federal Emergency Management Agency (FEMA).

A community qualifies for the program in two separate phases -- the Emergency and Regular Programs.

During the initial Emergency phase, limited amounts of flood insurance become available to local property owners. A community's efforts to reduce flood losses are general, in many cases guided only by preliminary flood data. The map FEMA provides the community at this stage is called a Flood Hazard Boundary Map. It outlines the flood-prone areas within the community. Subsidized rates are charged for all structures regardless of their flood risk.

Under the Regular Program, the full limits of flood insurance coverage become available locally. The premiums charged for new construction vary according to exposure to flood damage. A structure's exposure is based upon the elevation at its lowest floor above or below the "Base Flood Elevation". The community's floodplain management efforts become more comprehensive under the Regular Program where new buildings are elevated or flood-proofed above certain flood levels. These levels are derived from FEMA's detailed on-site engineering survey in the community. The community is issued a detailed map called a Flood Insurance Rate Map which shows flood elevations and risk zones used for insurance purposes.

To qualify for the flood insurance program, a community must: (1) require development permits for all proposed construction or other development in the community; and (2) review the permit to assure that sites are reasonably free from flooding. For its flood-prone areas, the community must also require: (1) proper anchoring of structures; (2) use of construction materials and methods that will minimize flood damage; (3) adequate drainage for new subdivisions; (4) the location and design of new or replacement utility systems to prevent flood loss; and (5) that all new construction and substantial improvements to existing structures in FEMA identified flood-prone areas be elevated or flood-proofed to the level of the base flood.

The base flood is a term used to describe the level of flooding the program is geared to protect against. While sometimes referred to as the "100-year flood", it is more accurate to consider it the flood having a 1 percent chance of occurrence in any year, or a 10 percent chance of occurrence during any 10 year period.

The City of Philomath presently participates in the regular phase of the Flood Insurance Program (date of entry into the Regular Program was June 15, 1982). Products of the flood insurance study include flood profiles and maps for the portions of Mary's River and Newton Creek within the City limits (Floodway panel 410011-0001, FIRM panel 410011-0001). Flood profiles and maps for those portions of the Mary's River and Newton Creek which lie outside of the city limits are included in the Flood Insurance Study prepared for Unincorporated Areas of Benton County (Floodway panel 410008-0067, FIRM panel 410008-0086C). Benton County is also a participant of the regular phase of the Flood Insurance Program (August 5, 1986). Copies of these flood maps are included in Appendix B.

For the Mary's River and Newton Creek, the studies define floodplains for the 100-year and 500-year floods and a 100-year, 1-foot floodway (the portion of the stream necessary to convey flow). To continue in the Flood Insurance Program, the City must require that all construction in the floodplain be elevated so the first floor is above the 100-year flood or be flood-proofed. Any construction in the floodway must be prohibited unless an engineering study can demonstrate the construction would not raise the 100-year flood elevation. In this Storm Drainage Master System Plan for Philomath, detailed hydrologic/hydraulic analysis were not performed to either verify or modify the current effective Flood Insurance Study.

It should be noted that the Floodplain and Floodway boundaries shown on the FEMA flood maps and the maps enclosed in this report are based on flood elevations, and as such the actual boundaries may vary slightly from the location shown. Final determinations of whether property is within the floodway or floodplain must be determined based on a topographic survey of the property in question.

CITY OF PHILOMATH
Storm Drainage System Master Plan

Chapter 3
EXISTING DRAINAGE SYSTEM

SECTION 3
EXISTING DRAINAGE SYSTEM

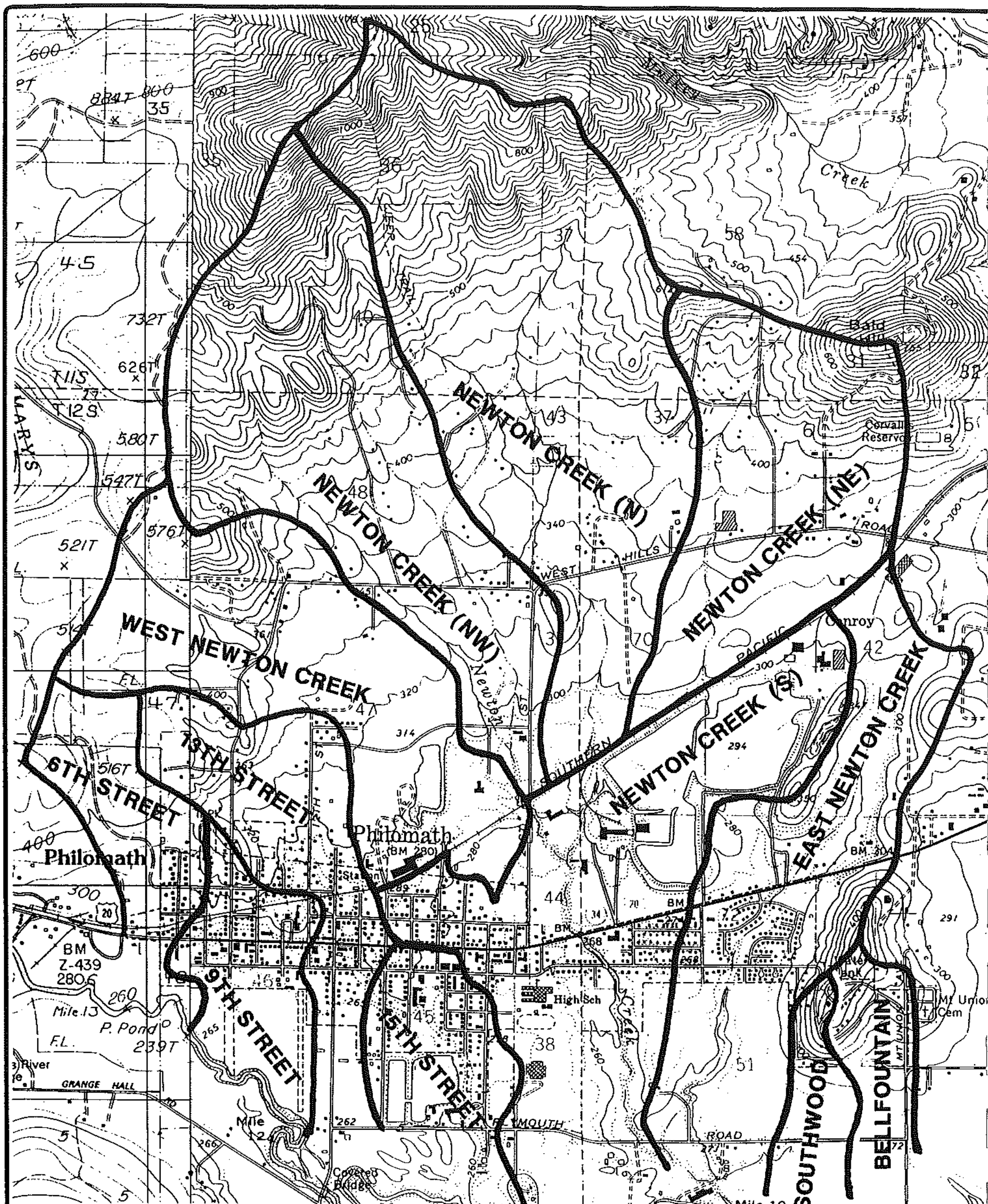
3.1 General

This section provides an overview of the existing drainage system within the study area and summarizes known or reported problems. The study area is divided into a number of major drainage basins as shown on **Figure 3-1**. The basin boundaries were determined based on the existing drainage patterns within the study area. To simplify the application of the storm drainage study for field personnel, the major basins are named based the portion of the storm drainage system to which the basin ultimately flows. For instance, the basin draining to the 13th Street storm drain south of Applegate Street is Basin 13, the basin draining to the Southwood Ditch is Basin SW (Southwood), the basin draining to Newton Creek is Basin NC (Newton Creek), while East Newton Creek is Basin ENC (East Newton Creek). **Table 3-1** lists the approximate areas within each of the major drainage basins shown. Each of these major drainage basins was then divided into subbasins as appropriate.

Table 3-1
MAJOR DRAINAGE BASIN AREAS

Basin Name	Drainage Basin Location	Area (Acres)
6	6th Street (north of Hwy 20)	136
9	9th Street (north of Chapel Rd/Plymouth Dr)	125
13	13th Street (north of Chapel Rd/Plymouth Dr)	238
15	15th Street (north of Chapel Rd/Plymouth Dr)	93
WNC	West Newton Creek	436
NC	Newton Creek (NW)	543
NC	Newton Creek (N)	838
NC	Newton Creek (NE)	391
NC	Newton Creek (S) (north of Chapel Rd/Plymouth Dr)	542
ENC	East Newton Creek (north of Chapel Rd/Plymouth Dr)	394
SW	Southwood (north of Chapel Rd/Plymouth Dr)	41
BF	Bell Fountain (north of Chapel Rd/Plymouth Dr)	56
	Total	3,833

Within the study area, three jurisdictions have responsibility for design and maintenance of the storm drainage system. In addition to the City, who is responsible for the majority of the system, the Oregon Department of Transportation (ODOT) is responsible for facilities in the right-of-ways



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SCALE
HORIZ: 1" = 2000'
VERT: NTS

DATE: OCTOBER 1997

PHILOMATH STORM DRAIN SYSTEM MASTER PLAN

MAJOR DRAINAGE BASINS BOUNDARIES

FIGURE
3-1

JOB NUMBER
960.501.0

along Main Street (Hwy 20/34), while Benton County is responsible for facilities within County right-of-ways outside City Limits.

3.2 Existing System

The **Storm Drainage System Map (Sheet 1 through 4)** show the location and size of the existing drainage system, while **Sheet 5** shows the boundaries of the subbasins within the UGB. Full scale copies of these maps are included in Appendix A.

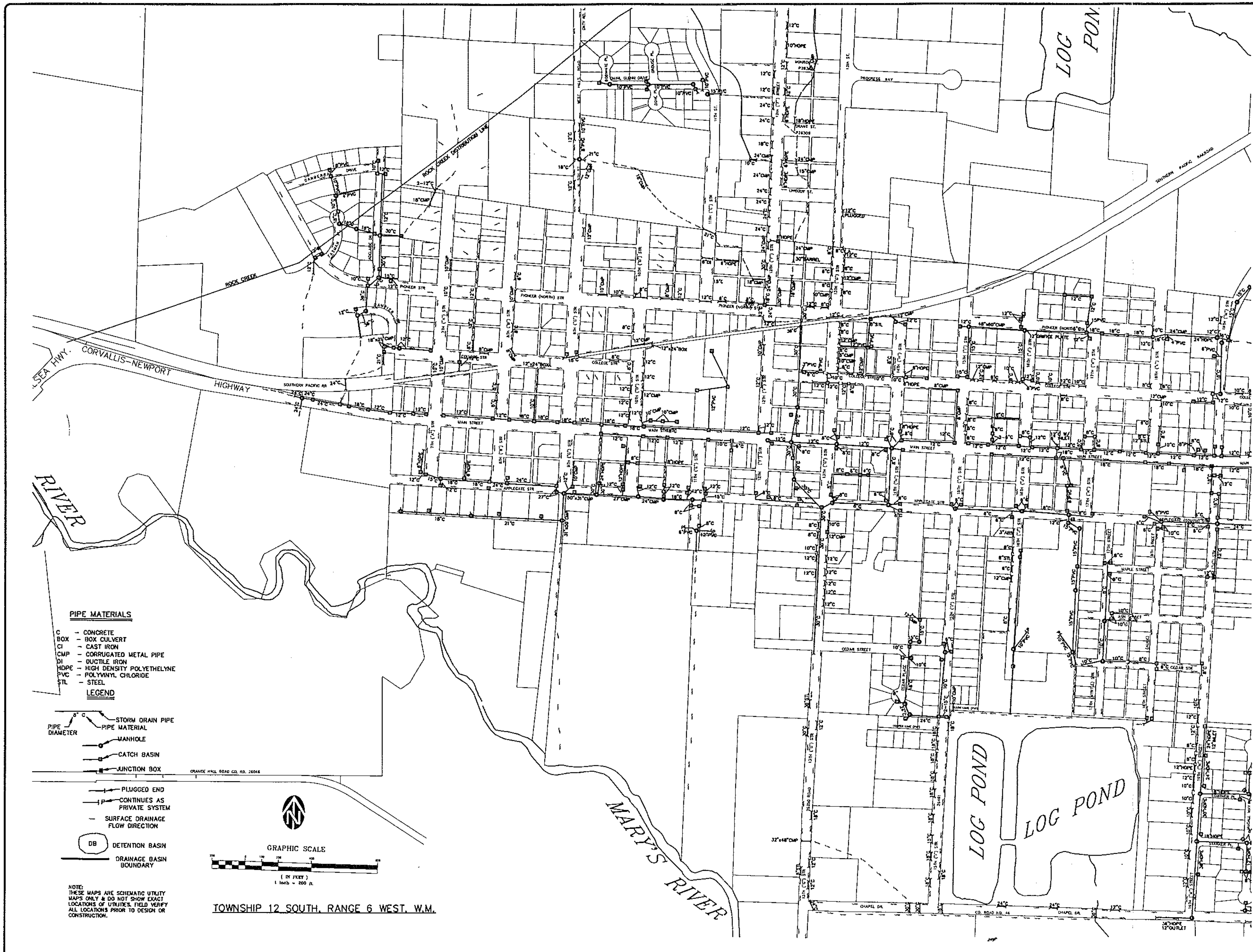
The existing storm drainage system is a combination of open channels, storm pipes and culverts in the well developed areas of the City, and roadside ditches, cross country ditches and perennial streams, and cross culverts in the less developed areas. The total estimated length of pipe in the drainage system is approximately 69,590 feet (±13.2 miles) with ±380 catch basins and ±90 storm drain manholes. The new Nybeck Hill subdivisions are not included in this inventory. The remainder of the storm drainage system consists of small perennial streams and constructed open channels, including roadside ditches. A detailed inventory of these channels and ditches was not performed, but the total appears to be in excess of 25 miles (excluding highway ditches).

The study area is crossed by two major transportation corridors, Highway 20/34 and the Southern Pacific Railroad. These two corridors have modified the natural path of runoff flowing out of drainage basins upstream of these facilities, and the placement and sizing of culverts effects the amount of runoff to downstream drainage areas. The major storm lines (≥18-inch) crossing the railroad within or adjacent to the City are as follows, listed from west to east.

- 24" concrete, ±250 feet west of 7th Street
- 12" x 24" box culvert, ±100 feet west of 9th Street
- 12" x 24" box culvert, east side 10th Street
- 36" concrete, south of Pioneer Street between 12th & 13th
- Twin 36" concrete, Newton Creek on west side of Green Road
- 36" concrete, Green Road
- 36" CMP, ±900 feet east of Green Road
- 72" x 72" concrete box culvert, ±1500 feet east of Green Road
- 36" concrete, ±3100 feet east of Green Road

The major storm lines (≥15-inch) crossing the Highway are as follows, listed from west to east.

- 24" concrete, ±800 feet west of 7th Street
- 18" concrete, between 9th & 10th Street
- 30" concrete, between 12th & 13th Street
- 18" concrete, between 16th & 17th Street
- 24" concrete, between 21st Street & Newton Creek
- Newton Creek bridge
- 24" concrete, between Green & 24th Street
- 18" concrete, Hartz industrial site access road
- Twin 24" concrete, 30" concrete, East Newton Creek



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		REVISIONS	

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VERT:
DSN. D.M.
DRN. D.M.
CKD. J.Y.
DATE: APR 1997

MAP UPDATED: 4-10-98

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CITY OF PHILOMATH, OREGON

STORM DRAINAGE SYSTEM MAP SOUTHWEST QUADRANT

SHEET 1 OF 5

JOB NUMBER
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LOG POND
NEWTON CREEK
EAST NEWTON CREEK
CORVALLIS-NEWPORT HWY.
U.S. HIGHWAY 20
NEWTON CREEK BRIDGE
APPLEGATE STREET
CHAPEL DR.
SOUTHWOOD DRIVE
PLYMOUTH DRIVE
RESERVOIR DRAIN
30"CMP ROAD AS BROADCRESTED WEIR
NOTE: STORM DRAIN CROSSES DIRECTLY UNDER BARN
PIPE MATERIALS
C - CONCRETE
BOX - BOX CULVERT
CI - CAST IRON
CMP - CORRUGATED METAL PIPE
DI - DUCTILE IRON
HDPE - HIGH DENSITY POLYETHELYNE
PVC - POLYVINYL CHLORIDE
STL - STEEL
LEGEND
STORM DRAIN PIPE
PIPE DIAMETER
PIPE MATERIAL
MANHOLE
CATCH BASIN
JUNCTION BOX
PLUGGED END
CONTINUES AS PRIVATE SYSTEM
SURFACE DRAINAGE FLOW DIRECTION
DB DETENTION BASIN
DRAINAGE BASIN BOUNDARY
NOTE:
THESE MAPS ARE SCHEMATIC UTILITY MAPS ONLY & DO NOT SHOW EXACT LOCATIONS OF UTILITIES. FIELD VERIFY ALL LOCATIONS PRIOR TO DESIGN OR CONSTRUCTION.
GRAPHIC SCALE
(IN FEET)
1 inch = 200 ft.
TOWNSHIP 12 SOUTH, RANGE 5 WEST, W.M.
NO. DATE DESCRIPTION REVISIONS BY
SCALE
HORIZ:
VERT:
DSN. D.M.
DRN. D.M.
CKD. J.Y.
DATE: APR 1997
MAP UPDATED: 10-30-97
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CITY OF PHILOMATH, OREGON
STORM DRAINAGE SYSTEM MAP
SOUTHEAST QUADRANT
2 SHEET OF 5
JOB NUMBER
960.100.0

CITY OF PHILOMATH, OREGON

STORM DRAINAGE SYSTEM MAP NORTHWEST QUADRANT

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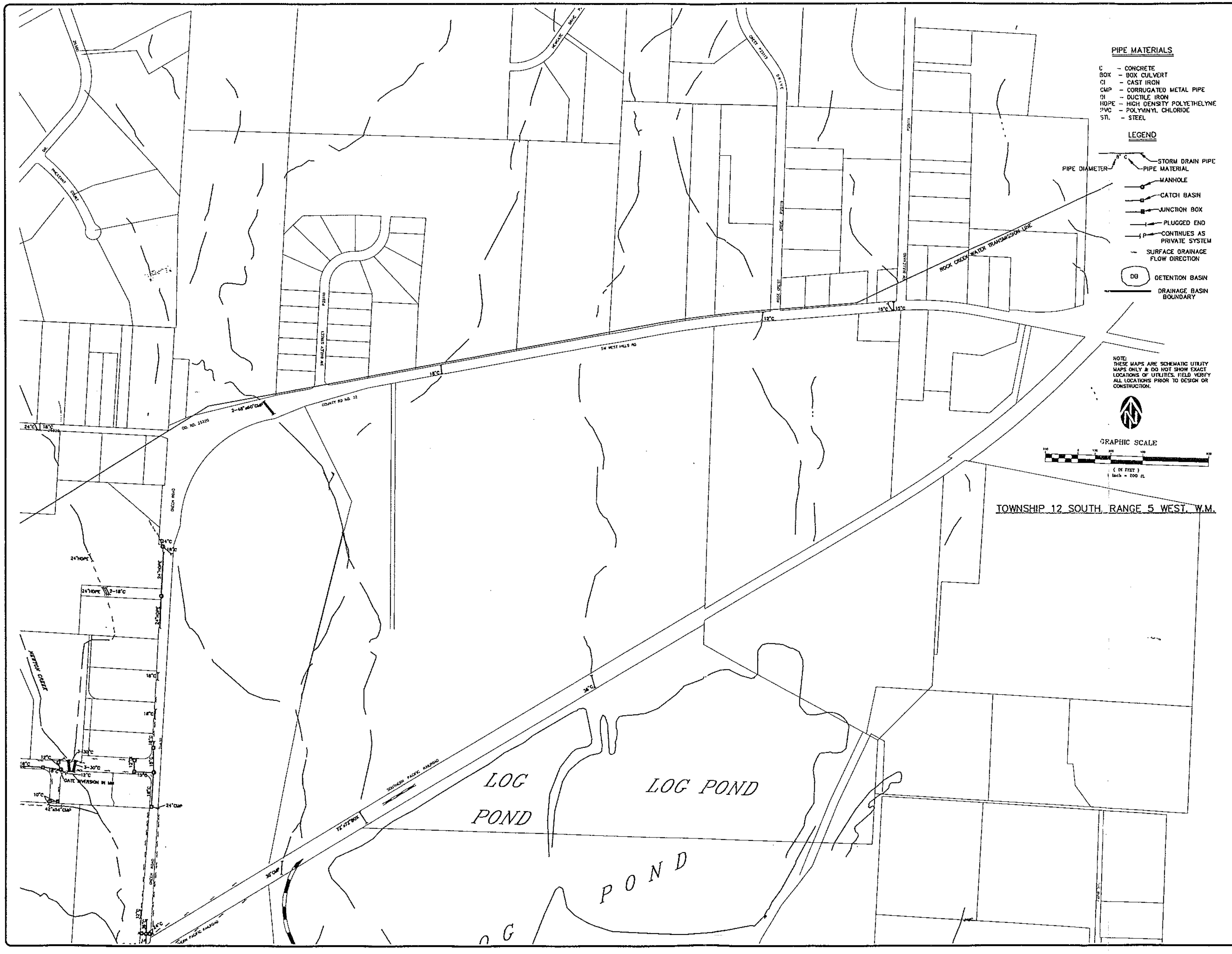
SHEET 3 OF 5

JOB NUMBER 960.100.0



CITY OF PHILOMATH, OREGON

STORM DRAINAGE SYSTEM MAP NORTHEAST QUADRANT

MAP UPDATED: 10-30-97

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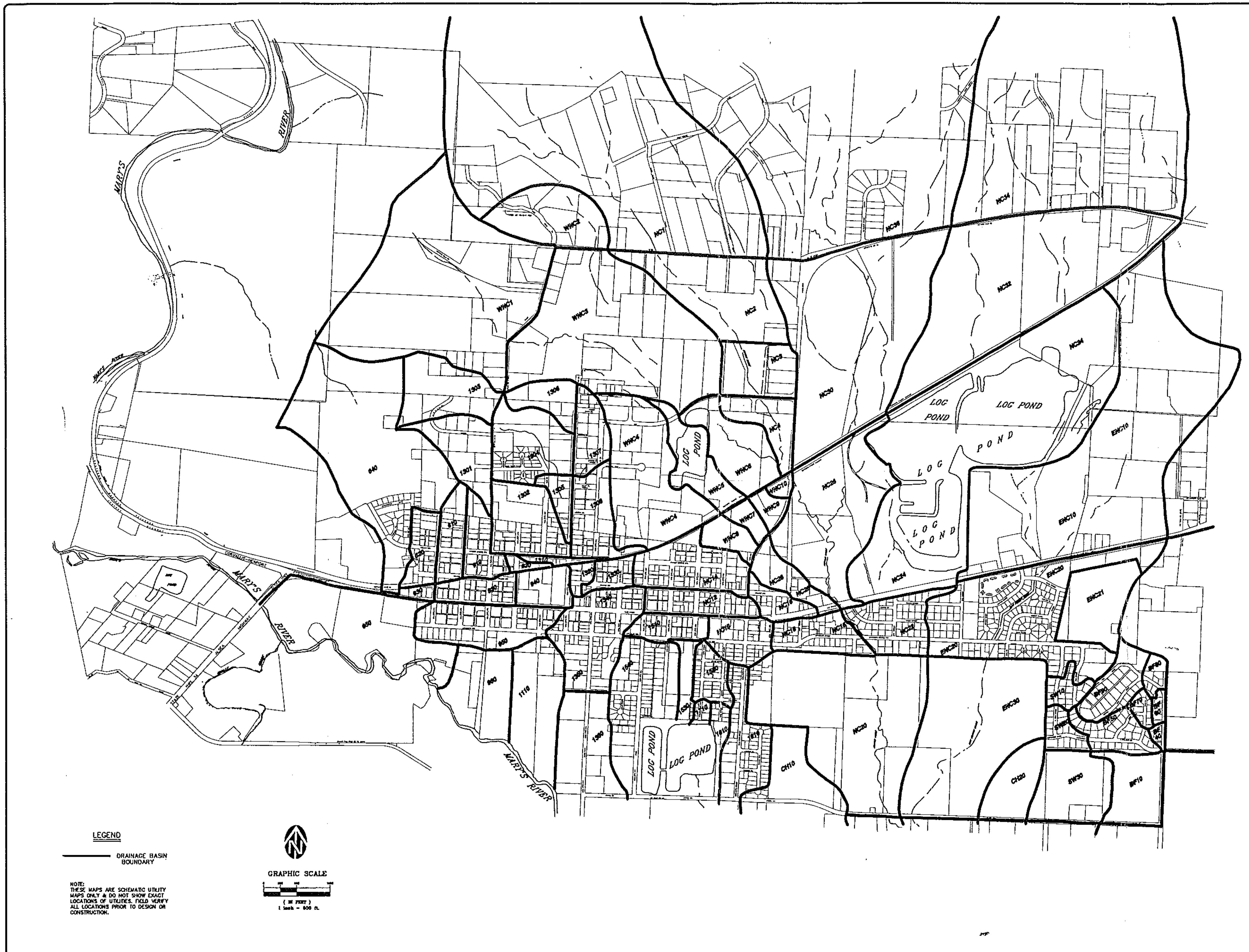
SHEET 4 OF 5

JOB NUMBER 960.100.0



CITY OF PHILOMATH, OREGON

STORM DRAINAGE BASIN MAP

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DATE: APR 1997

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SHEET 5 OF 5

JOB NUMBER 960.501.0

Table 3-2 contains a summary of the estimated quantities of piping by size and material type in the Philomath storm system by material type and diameter.

TABLE 3-2
STORM DRAINAGE SYSTEM,
ESTIMATED PIPING QUANTITIES

Pipe Size	Total Estimated Pipe Quantities (feet)						
	Cast Iron	Concrete	CMP	HDPE	PVC	Steel	Totals
≤ 8"	35	1,675		930	560	35	3,235
8"	60	5,195	680	695	870	75	7,575
10"		6,015	800	980	1,460		8,255
12"	20	12,585	1,160	680	3,510		17,955
15"		3,940	20	220	1,220		6,400
18"		8,260	310	600	500		9,670
21"		1,310					1,310
24"		4,010	970	1,600			6,580
27"		70	250				320
30"		4,080	1,170				5,250
36"		1,230		680		50	1,960
82"			50				50
12 x 24 box		70					70
72 x 72 box		50					50
18" x 21"			80				80
21" x 26"			80				80
24" x 42"			100				100
28" x 42"			60				60
30" x 36"			100				100
30" x 42"			200				200
31" x 50"			500				500
42" x 54"			60				60
48" x 60"			530				530
Totals	115	48,490	7,120	6,385	8,120	160	70,390

Number of Catch Basins = ±381. Number of storm manholes = ±90.

The quantities shown on the table are limited to those within the UGB. As can be seen from this table, there is a variety of pipe materials in the current storm drainage system. The size of the storm drain pipes vary from 8 to 12 inches in diameter for local systems to 18-inch and larger pipes for major collector systems. Pipe materials include cast iron, concrete, corrugated metal (CMP), PVC, High Density Polyethylene (HDPE) and steel. For the purposes of estimating these quantities, the average length of driveway culverts was estimated at 20 feet, the average length of culverts crossing roads was estimated at 50 feet, while the average length of pipe runs crossing streets between catch basins was estimated at 35 feet. Open channels are typically natural stream/runoff channels or roadside ditches.

3.3 Existing Problem Areas

Problems with the City storm drainage system were identified from meetings and discussions with City Public Works staff. City personnel identified a number of locations where significant reoccurring storm drainage problems occur. The types of problems discussed can generally be divided into the following categories; lack of capacity, end of useful life, lack of facility, lack of maintenance, erosion, and on-site problems. A short discussion of each of these categories follows:

a. Lack of Capacity

This type of drainage problem results from open channels or pipes which are too small to handle the peak storm runoff. This type of problem typically results when upstream development increases the peak flow and volume of runoff, or because the existing system was constructed before storm drainage design standards were established. Therefor, although the storm system may have capacity to handle the runoff from smaller magnitude storms, they are unable to convey the runoff during major storm events. In either case, these portions of the existing system are undersized and need to be improved.

Design standards typically require that as the storm channel or pipe gets larger, it must be designed to convey the flow from a more intense storm event due to the increased risk of property damage should the system fail. For instance, local systems are typically sized based on a 10 year frequency storm, while larger storm drains serving a major basin must be designed for a 25 or 50 year frequency storm. If the local system overflows, the likelihood of significant property damage is relatively small, while failure of the major systems can result in significant damage to property.

It should be noted that some capacity problems are localized problems related to the storm drainage system for a particular site. These on-site drainage problems are outside of the scope of this report, and should be considered separately on a case-by-case basis.

b. On-site Problems

Examples of on-site drainage problems include standing water in yards, flooded driveway culverts on small local systems, flooding in private parking lots and problems related to groundwater and springs. In many cases, the on-site drainage problems are a result of conditions on the site (ie. clogged parking lot catch basins or driveway culverts) that are the responsibility of the private property owner. Evaluation of these type of problems is beyond the scope of this report.

c. End of Useful Life

This type of drainage problem is the result of old, damaged, or worn out systems that no longer function as designed. The most common example of this type of problem includes rusted or collapsed pipes or culverts. The correction of these type of problems requires replacement or reconstruction of the existing system.

d. Lack of Facility

Drainage problems in this category are caused by the absence of a drainage system. Examples include areas where there is no catch basin at the low spot in a street, lack of drainage systems for homes set back from the street, or property which is too low to drain to an established drainage system. Any of these cases typically results in ponding water and/or flooding on a regular basis.

e. Lack of Maintenance

Dirt, gravel, sediment, and other debris carried by storm runoff may settle out or become lodged in culverts, pipes and catch basins, resulting in flooding due to the reduced capacity of the system (sedimentation). This type of problem can be prevented or minimized by routine inspection and cleaning.

A second problem in this category results when ditches or other drainage facilities are located along back lot lines or through undeveloped areas without any provisions for maintenance access. Under this scenario, it is difficult and expensive for the City to maintain the storm drainage facilities on a regular basis, as the costs for obtaining access or restoring the area following maintenance may cost as much as the maintenance work itself.

A final concern under this category is when residents or developers dump debris into ditches during the dry season, which results in flooding when the wet season arrives.

f. Erosion

Unless erosion control measures are maintained during construction of new developments, rain washes soil from areas that have been cleared of vegetation and graded for development. Erosion of stream beds and banks may also occur when development increases runoff flows. Deposition of these sediments downstream contributes to the maintenance problems experienced by the system. The irony of erosion problems is that the flooding caused by this sediment typically occurs far downstream of the source of the problem. Although an analysis of this issue is beyond the scope of this report, the City does require erosion control facilities during construction of new developments.

Table 3-3 outlines the major known problem areas reported by Public Works, as well as the category which the problem falls under.

Table 3-3
EXISTING DRAINAGE PROBLEM AREAS REPORTED BY CITY

Location	Problem Category
9th Street ditch south of WTP	Maintenance (access problems)
13th & Chapel Street intersection	Capacity
15th & Chapel Street intersection	Capacity
15th & Willow Lane	Capacity
Cooper Lane west of 15th Street	Lack of facility
Applegate Street just west of 13th Street	Capacity
12th & Pioneer Street	Capacity
Ditch from 11th to 12th Street north of Pioneer	Maintenance (access problems)
Ditch north of Pioneer between 12th & 13th Street	Maintenance (access problems), End of useful life
14th Street & railroad	Lack of facility
Green Street near Newton Creek	Capacity
East Newton Creek through park	Maintenance (access problems, sedimentation)
Applegate intersection with 27th, 28th & 29th Place	Lack of facility
North end Southwood Ditch (west end Southwood Drive)	Maintenance (debris dumping, access problems)
Southwood Ditch south of Chapel Drive	Capacity
Intersection of Upper & Lower Bentonview Drive	Lack of facility

It should be noted that the City is not currently under any specific regulatory water quality requirements for storm water flows. As such, consideration of storm water quality issues are not considered in this study. At such time that the City comes under regulatory requirements for storm water quality, a storm water management program will need to be developed to address these issues.

3.4 Existing Storm Drainage Funding Mechanisms

Based on conversations with the City Manager and Public Works Director, the City currently has no dedicated storm drainage funding mechanism available to finance needed repairs or upgrades to the storm drainage system. Maintenance of the storm drainage system is currently funded from other budgets, such as streets. In the past, the City has financed street and storm drainage improvements in certain areas of town through the LID process.

The City has indicated that they are interested in establishing a dedicated storm drainage funding mechanism. This is discussed further in Section 6.

CITY OF PHILOMATH
Storm Drainage System Master Plan

Section 4
HYDROLOGIC/HYDRAULIC ANALYSIS

CHAPTER 4
DRAINAGE SYSTEM ANALYSIS

4.1 Hydrology Analysis Procedure

a. Modeling Methodology

The purpose of the drainage system capacity evaluation was to identify elements of the existing drainage system that cannot accommodate current and/or projected future storm water flows. The calculation of peak flows and runoff volumes within the drainage basins is essential to any storm drainage master planning effort. Peak flows are used to size ditches, culverts and pipe systems during the design process for new facilities. The evaluation and calculation of peak flows was accomplished using a mathematical simulation computer model. The methodology used develop and model existing and future peak stormwater flow conditions was the Rational Method.

The Rational Method was selected primarily because of the relative ease with which it can be applied, its general acceptance by the engineering community, and its reliable results. For the large undeveloped basins north of the City, the methodology outlined in the "Magnitude and Frequency of Floods in Western Oregon" (reference 5) as contained in the ODOT Hydraulics Manual, was used to verify the design flows generated by the Rational Method. There are several other methods of runoff estimation, such as the unit hydrograph, the Storm Water Management Model (SWMM), and the Hydrologic Engineering Center (HEC) computer models. These methods rely upon measurable rainfall/runoff relationships and are more applicable to larger drainage areas (>1 square mile) where timing and storage of storm runoff may be of greater importance. When properly applied to drainage areas of 200 acres or less, the Rational Method provides reliable results.

The Rational Method is based on the formula: Q=CIA

where: Q = the runoff rate, cubic feet per second
C= the runoff coefficient, determined by land use
A = the contributing drainage area, acres
I = the rainfall intensity, inches per hour

The basic assumptions for application of the Rational Method are as outlined below, and typically result in a conservative but realistic results.

- The computed maximum rate of runoff to the design point is a function of the average rainfall rate during the Time of Concentration (T_c) to that point.

- The maximum rate of rainfall occurs during the time of concentration, and the design rainfall depth during the time of concentration is converted to the average rainfall intensity for the time of concentration.

- The maximum runoff rate occurs when the entire area is contributing flow (ie. at the Time of Concentration).

b. Runoff Coefficients and Land Use

The runoff coefficient "C" represents the ratio of runoff to rainfall. Of all of the variables used in computation of stormwater runoff, the runoff coefficient is the most difficult to estimate because it represents the interaction of many complex factors including surface ponding, infiltration, antecedent moisture (soil saturation at beginning of storm), ground cover conditions, ground slopes, and soil type. To simplify the determination of this coefficient, the use of average values has been adopted as standard practice in the engineering profession.

As part of the evaluation process, two runoff coefficients (existing and future conditions) were determined for each drainage basin area. The assumed future conditions are based on buildout under the land use zoning as set forth in the City of Philomath and Benton County Comprehensive Plans as reflected by current zoning maps. **Table 4-1** shows the runoff coefficients used for this study based on type of development and land use zoning.

TABLE 4-1
RUNOFF COEFFICIENTS

Soil Cover or Land Use Category	Flat Terrain S<2%	Rolling Terrain 2%<S<10%	Steep Terrain S>10%
Cultivated Land	0.30	0.35	0.40
Parks & Cemeteries	0.15	0.20	0.30
Woodlands & Forests	0.10	0.15	0.20
Meadows & Pasture Land	0.25	0.30	0.35
1) Low density residential	0.40	0.45	0.50
2) Medium density residential	0.50	0.55	0.60
3) High density (multi-family) residential	0.70	0.75	0.80
4) Gravel parking lots	0.50	0.55	0.60
5) Mobile home parks	0.60	0.65	0.70
Commercial	0.50 - 0.90		
Light Industrial	0.70		
Heavy Industrial	0.80		
Highly impermeable (roofs and paved areas)	0.90		

The runoff coefficients were used to establish the stormwater runoff under future buildout conditions. Since some areas of the City have not yet been developed, a second, or existing condition runoff coefficient was determined. The existing runoff coefficient is based on recent aerial photos and field observation. Once drainage area boundaries were established, these boundaries were overlain on the aerial photos. A visual estimate of the existing land use, percentage of development and percentage of impervious area was made in order to establish existing drainage conditions.

Where a drainage area is a combination of the runoff characteristics listed, a weighted coefficient for the total drainage area is computed by dividing the summation of the products of the individual areas and their coefficients by the total area:

$$Weighted.C = \frac{\Sigma C_i A_i}{A_T}$$

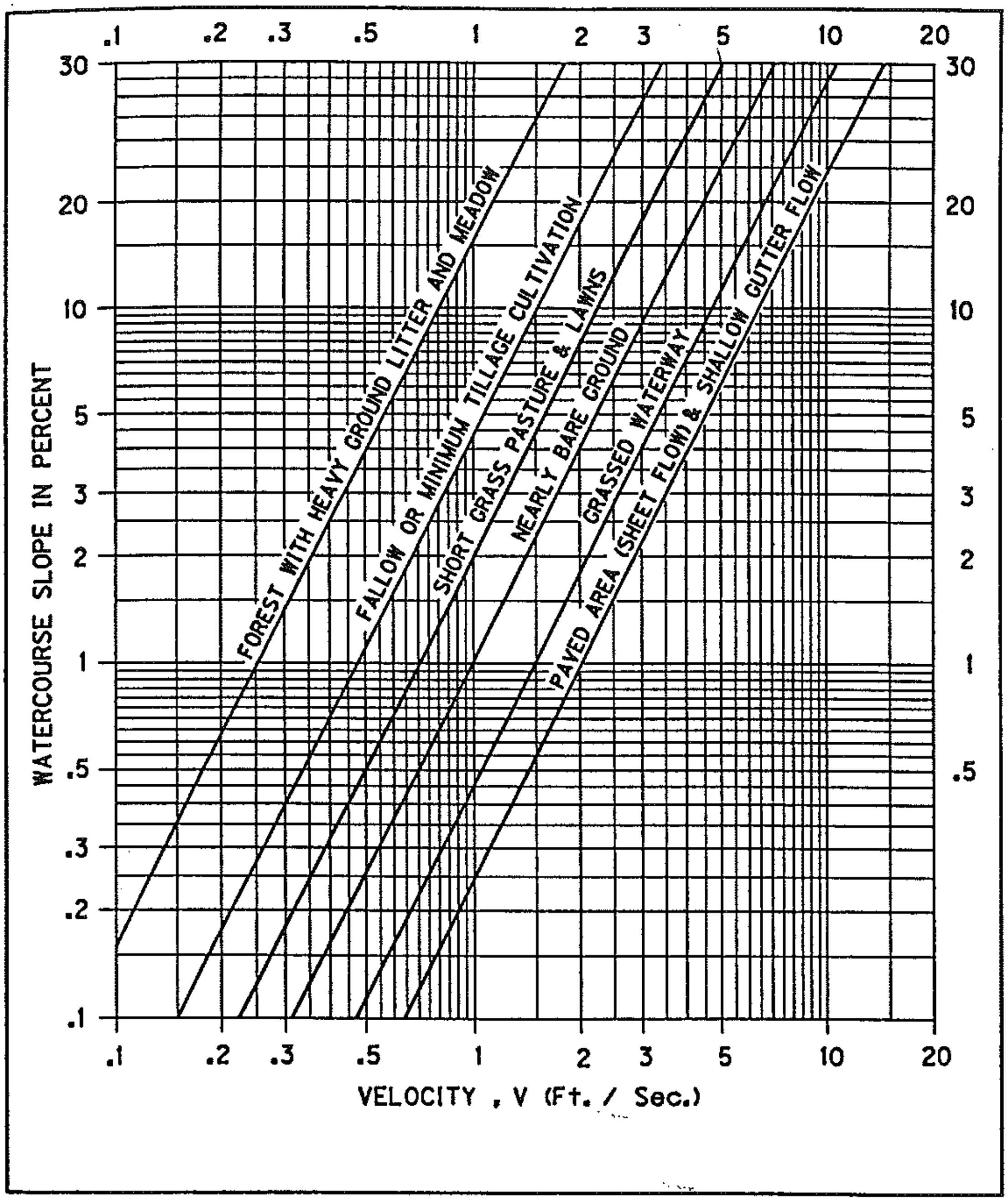
where: C_i = runoff coefficient for each sub-area
A_i = contributing drainage area for each sub-area
A_T = total area

c. Time of Concentration

In order to calculate the peak rate of runoff at any point, it is necessary to know the time of concentration to that point. The Time of Concentration, T_c, is defined as the time it takes for runoff to travel from the hydraulically most distant point in the drainage basin to the point of reference downstream. This time must be known in order to determine the rainfall intensity of a given recurrence interval storm. Most drainage basins will consist of overland flow segments as well as channel or piped flow segments. The travel time is computed for each flow segment and the time of concentration is equal to the sum of the segment travel times.

The time of concentration for the surface flow segments is a function of the surface slope, soil conditions, depression storage, surface cover, antecedent rainfall, and the distance of the surface flow. **Figure 4-1** (taken from the Oregon Department of Transportation, Highway Division, Drainage Design Manual) was used to establish surface velocities for each drainage basin of significant length. The time of concentration in a pipe system is calculated by dividing the known length by a computed velocity.

Common practice is to assume a minimum time of concentration between 10 and 30 minutes. For this planning effort a minimum time of concentration of 10 minutes has been assumed when computing the runoff contribution for each subbasin. If the computed time of concentration was less than 10 minutes, the 10 minute minimum was applied to that area. However, if the computed time of concentration was longer than 10 minutes, the actual computed time was used. This assumption is consistent with previous drainage planning for within the City and the Oregon Department of Transportation, Highway Division, Drainage Design Manual.



(Source: Hydraulics Manual, Oregon Department of Transportation, Highway Division, January 1990)

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PHILOMATH STORM DRAIN SYSTEM MASTER PLAN

SURFACE VELOCITY VERSUS SLOPE

FIGURE 4-1

JOB NUMBER 960.501.0

d. Design Storm Frequency

The selection of the design storm requires the determination of the degree of protection desired from the storm drainage system. A design storm with a low probability of being exceeded, such as the 100-year design storm (1% chance of being exceeded any given year), provides a high degree of safety in the drainage system design. However, the cost of such a system is relatively high compared to a system based on a design storm with a high exceedance probability. On the other hand, a system designed for a 2-year storm (50% chance of being exceeded any given year) will result in a lower cost drainage system whose capacity will be exceeded every few years, with possible property damage, public inconvenience and personal hazard.

For large projects involving construction in or near floodplains, the analysis can be as complex as a benefit-cost comparison where the incremental cost of protection (ie. the cost of conveying that quantity of stormwater which causes a known rise in floodwater elevation) is compared to the expected cost of damage for each additional incremental rise in floodwater elevation. Studies such as these involve determining the average home/property values at given elevations and detailed hydrologic/hydraulic analysis to determine flood elevations for each quantity of excess flow. Since the scope of this study is limited to conveying runoff through the City to the point of discharge south of the City, analysis of impacts within or reliability of the existing established flood plain are not included.

To determine a design storm for drainage planning purposes, the following factors must be considered:

- The cost of the additional level of protection (ie. sizing system to convey a larger storm)
- The size of the drainage basin
- The extent of probable property damage if the system fails
- The availability of storage within the pipe system.

The size of the drainage area has a dramatic impact on the recommended level of protection. As the size of the drainage area increases, so does the total amount of runoff. As previously noted, design standards typically require that as the storm channel or pipe gets larger, it must be designed to convey the flow from a more intense storm event due to the increased risk of property damage should the system fail.

For illustrative purposes, consider that if a small local system overflows, the likelihood of significant property damage is relatively small, while failure of the major systems can result in significant damage to property. Conversely, if the drainage facilities of a large drainage basin (such as that draining Newton Creek, with ±50 times the flow of smaller basins) is undersized by as little as 10%, those excess flows will be five times greater than the entire flow through the small basin, and may produce serious flooding damage.

Finally, in developing the computer model, gravity flow conditions were assumed for most cases. This assumption provides a conservative design since it does not take into account the ability of a pressure head to develop within a pipe under surcharged conditions and thereby increase flow, and allows for temporary storage within the pipe network.

In consideration of these factors, **Table 4-2** outlines the design storm frequencies utilized for this report. This level of protection is consistent with other Cities in the Willamette Valley.

TABLE 4-2
DESIGN STORM FREQUENCY

AREA	FREQUENCY
Residential areas	10-year storm
Commercial and high value districts	10-year storm
Trunk lines (18" pipe and larger)	25-year storm
Minor creeks and drainage ways (not shown as a flood plain on the Flood Insurance Rate Map (FIRM))	50-year storm
Major creeks (shown as a flood plain on the FIRM)	100-year storm

e. Intensity-Duration-Frequency Curve

The intensity-duration-frequency (IDF) curve is used to determine the rainfall intensity "I". Given a time of concentration and a selected design storm frequency, the rainfall intensity is found graphically or from the tabular data in the City Design Standards. The City of Philomath is located in Zone 8 per the Oregon State Highway Department Drainage Design Manual. The rainfall intensity-duration curve for Zone 8 is included in Section 3.1 of the draft Public Works Design Standards (PWDS, Appendix C).

4.2 Hydraulic Analysis

a. Open Channel Flow - Manning's Formula

Most pipes within the storm drainage system were assumed to be flowing full under open channel flow conditions. In most areas of Philomath, the storm system is flat enough that significant surcharge cannot be developed at most inlets and therefore this is a reasonable and conservative assumption. The formula used to evaluate pipes under these circumstances is the Manning Formula, which is expressed as:

$$Q = 1.49/n \times A \times R^{2/3} \times S^{1/2}$$

where:
Q = flow, cubic feet per second
A = cross-sectional area, square feet
R = hydraulic radius, feet
S = slope, feet/feet
n = Manning roughness coefficient

The roughness factor for pipes varies according to the material used and the age of the pipe material. For this planning effort, a minimum "n" value of 0.013 shall be used in Manning's formula for the design of all storm pipes regardless of pipe material. In theory, new PVC sewers have manufacturer's "n" value of as low as 0.009. However, sand and grit as well as slime buildup on the pipe walls over time tend to render a true "n" value of 0.013. Hence, an "n" value of less than 0.013 for smooth wall pipe is not recommended for design purposes. An "n" value of 0.024 for corrugated pipes was used and is recommended for design purposes (PWDS 3.15).

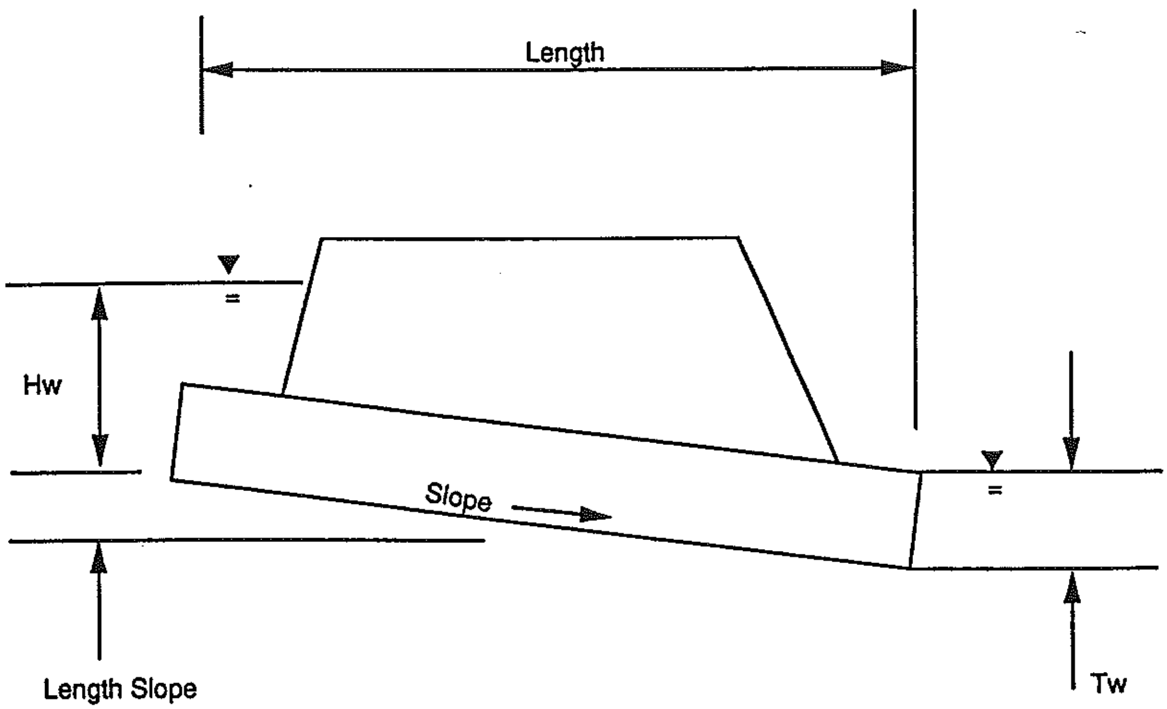
b. Surcharged Culvert Flow

Where conditions allow the build up of a surcharge, or head, and the pipe length is relatively long and the slope is gentle, the pipe is assumed to be a culvert flowing under outlet control conditions. The tailwater (TW) depth is assumed to be at the top of pipe at the outlet. Losses due to velocity, bends and junctions were ignored. This condition is presented graphically in **Figure 4-2.**

Assuming tailwater controlled flow and assuming entrance, exit, bend and junction losses are negligible, then the friction loss (H_f) through the culvert becomes:

$$H_f = HW_{elev} - Tw_{elev}$$

where:
H_f = friction loss through culvert
HW_{elev} = Headwater elevation
Tw_{elev} = Tailwater elevation



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PHILOMATH STORM DRAIN SYSTEM MASTER PLAN

SURCHARGED CULVERT FLOW

FIGURE 4-2

JOB NUMBER 960.501.0

In cases where these elevations were not known, assumptions based on pipe size were made to facilitate completion of the study. The assumed available head is as follows:

Pipe Size	Available Head (HW_{elev} - TW_{elev})
< 18"	1.5 feet
18"-36"	2.0 feet
> 36"	4.0 feet

4.3 Computed Stormwater Flows for Future Conditions (Buildout)

Based on existing land use zoning, a spreadsheet-based computer model was developed following a field inventory of the existing drainage system. A letter designation was applied to each inlet, outlet or junction point. Each pipe segment was assigned a numeric identifier. Subdrainage basins to each individual inlet were determined using existing aerial mapping, and runoff conditions were assessed. Based on previous discussions, time of concentrations were determined to key points within each basin (typically the lower end of the basin). From this information, a rainfall intensity was found for the design storm event. Flows at junctions were summed and carried forward to the next drainage segment. Physical data describing each pipe or channel segment was input and used to calculate capacity based on the assumed flow conditions (ie. open channel or submerged inlet). The cumulative flow within each pipe was subtracted from pipe capacity and is displayed in the last column of the spreadsheet. A negative number, therefore, indicates the amount a pipe is undersized based on conditions that will exist if all areas within the UGB were developed according to zoning restrictions. These calculations are presented in Appendix D, Computations for Future Conditions.

4.4 Computed Stormwater Flows for Existing Conditions

For those areas of the City which have not yet been developed, a similar methodology was utilized to establish the peak flows in the major trunk storm lines under current conditions. These calculations are presented in Appendix E, Computations for Existing Conditions.

CITY OF PHILOMATH
Storm Drainage System Master Plan

Section 5
ALTERNATIVES AND EVALUATION

SECTION 5
SYSTEM EVALUATION AND RECOMMENDED IMPROVEMENTS

5.1 Project Approach Alternatives

Four basic conceptual approaches to stormwater management were considered for application within the City of Philomath: (1) no action; (2) upgrade the existing system to provide capacity; (3) provide regional detention in upper basins; or (4) reroute stormwater between basins. These basic approaches may be implemented singly or in combination to manage present and anticipated future stormwater flows.

a. No Action

The no action approach implies that no improvements to the existing drainage system (excluding maintenance or repairs). Obviously, this approach is recommended for those areas of the system which have sufficient capacity to convey the design flows and are in acceptable condition. Although this approach may be justified in isolated areas within the system on a case-by-case basis where there is insufficient capacity to convey design flows, this approach was effectively eliminated by the City Council as a system-wide policy based on the parameters specified for this storm drain master plan.

Although it is always an option to not improve the system, the result is continued damages and inconveniences where drainage facilities are inadequate or nonexistent. However, to ensure that system improvements are justified, it is necessary to consider the costs and advantages of proposed improvements against the risks entailed by the no action alternative. It should be noted that since resources are limited and the storm system cannot be upgraded all at one time, the phasing plan adopted by the City for the improvements will in effect require that the no action alternative be adopted <u>on a temporary basis</u> for all but the first phase improvements.

It should be noted that since the detailed hydraulic analysis of the system was limited to the trunk storm collection system, the recommendations do not encompass the minor or local portions of the storm drainage system unless there have been reported problems in these areas.

b. Upgrade Existing System

This approach involves constructing replacement or parallel pipes and upgrading existing ditches to provide adequate capacity for the design flow. Upgrading existing ditches may consist of vegetation and debris removal, regrading, shaping, channel enlargement or replacement with a piped system. This is often the most obvious alternative since it provides the greatest assurance that the storm drainage system can convey the design flows through town and that overflows will be kept to a minimum, which in turn limits the City's liability.

c. **Regional Detention**

The concept of regional detention is straight forward. It involves construction of a basin to store excess upstream runoff that would cause flooding problems downstream. This excess water is released later at a rate the downstream drainage structures are capable of handling. The rate of release from the detention site may be based on the capacity of existing downstream drainage structures. Alternatively, the rate of flow release may be a reduction to a lesser design storm flow (ie. the system design storm may have a 10-year recurrence interval, and the detention facility outlet may be sized to release only 5-year storm flows).

An underlying concept relating to detention facilities which must be understood is that when a storm larger than that used to size the detention facility is experienced, or when the outlet orifice is blocked by debris, the downstream system will experience flowrates similar to undetained flowrates. This is the reason that the proposed PWDS recommend that all detention facilities designate an overflow route downstream of detention facilities which will minimize impacts to downstream properties. Since any regional detention facility would by necessity be located in the upper portions of the drainage basins, any overflows or failure of the system could result in flooding all the way through town.

Conversations and meetings with City Public Works personnel raised another issue of concern relating to regional detention facilities. The Mary's River flood plain extends a significant distance into the City (see flood maps, Appendix B). Once the water level rises to the point that it backs up into the storm drainage pipes along Applegate Street, the capacity of the outfall pipes is reduced significantly, and water overflows out of the system along Applegate and Main Street. Under these conditions, the system is no longer limited by the capacity of the pipes, but by the lack of hydraulic grade necessary to move water through the pipes. Due to this characteristic of the system, the expressed preference of Public Works is to move the storm runoff out of town as efficiently as possible prior to the rise of the Mary's River. Metering flows out of a regional detention facility will tend to extend the duration of flows and increase the likelihood of overflows due to high water levels in the river. Obviously, long term intense storm such as those experienced during February or November of 1996 resulted in high runoff while the river levels were high. However, this would be the case with or without regional detention.

Due to wetland, topographic and floodplain constraints, the City staff indicated early on in the process of preparing this storm drainage study that regional detention was not an preferred alternative. Examination of the system and major storm channel/pipe routing supports this conclusion.

Even if regional detention is not feasible, the City should continue with current policy of requiring on-site detention facilities for all developments for which there is inadequate downstream capacity to carry design flows. On-site detention may be accomplished using small detention ponds, underground pipe storage, or parking lot detention.

d. Reroute Stormwater

Under this scenario, stormwater would be diverted or rerouted from one drainage basin or system to another. This approach is practical in cases where an existing storm channel has capacity far in excess of that needed to convey design flows and stormwater diversion is practical from a construction and topographic standpoint. However, the storm drainage systems in the City of Philomath which have some excess capacity are those to which it is not feasible or possible to divert flows to (ie. due to topographic constraints).

Although stormwater diversion may be practical at the local level on a case-by-case basis, topographic constraints and capacity limitations effectively eliminate it from consideration on a basin-wide basis. Additionally, analysis of effect of such diversion on the floodplain levels in the major stream channels is outside the scope of this study.

5.2 Recommended Improvements

Based on the results of the hydrologic and hydraulic analysis discussed in the previous chapter, a number of basins were determined to have pipes or other drainage facilities which do not provide adequate capacity for runoff generated from a design storm under either existing conditions or conditions anticipated at buildout.

The City's goal is to develop a storm drainage system which not only meets existing needs, but which accommodates future development. The types of projects considered to accomplish this goal include, but are not limited to, the following.

- Replace damaged or deteriorated structures which no longer function as designed
- Reconstruct or replace under-capacity culverts and ditches
- Replace or supplement under-capacity storm drain pipes
- Construct new storm drain pipes and/or ditches as required
- Preserve natural drainages and floodplains

Based on the anticipated stormwater flows based on the existing zoning within the UGB, we recommend that the City establish a formal Capital Improvement Program to replace and/or upgrade the major storm drain lines in the existing system to provide capacity to convey the design flows under fully developed conditions. It is recommended that the City implement a program of phased construction of these improvements as funding becomes available.

In total, 18 projects are recommended for inclusion in the City's Storm Drainage Capital Improvements Plan (Priority 1 & 2 projects). These included replacement of culverts under road crossings, reconstruction or replacement of segments of storm drain pipe, and reconstruction of open channels. Since the scope of the detailed modeling provided under this study is limited to the major trunk lines in the storm drainage system, projects to provide additional capacity for a local system are not included unless a reported problem exists in that area. Replacement of private driveway culverts is not included in the scope of this summary unless required as part of upgrading a major storm system.

A conceptual design was developed for each major improvement project to determine the approximate size and features needed to convey the design flows. As part of this process, alternatives such as alignment, feasibility of reusing existing portions of the system, opportunities for upstream detention were identified and evaluated. This involved evaluation of topographic opportunities, available vacant lands, and natural resource constraints with field reconnaissance to confirm the conceptual-level feasibility of each alternative.

Note: City review of the final draft master plan should include a discussion of the feasibility of the proposed improvements to ensure that local conditions of which we are not aware do not conflict with the recommendations.

The improvements described below and shown in **Table 5-1** will result in a storm drainage trunk system with the capacity needed to convey flows from within the planning area assuming development to zoning densities shown. This layout is intended to minimize the amount of new piping which must be installed, as well as to minimize the unnecessary replacement of existing storm drain mainlines.

The proposed trunk drainage system improvements largely follow existing street right-of-ways through the community, or along existing drainage alignments. As such, the alternative alignments are limited. The notable exception is the proposed new trunk line in Basin 13 from the railroad to Applegate Street, which has two possible alignments as outlined below.

The alignment of future lines through the undeveloped land along the east and north sides of town has not yet been determined. The final alignment of storm lines in these areas should be determined as property develops, but should be placed within right-of-ways whenever possible. If the UGB is to be expanded in the future, the storm system should be re-examined to determine where additions are needed and if alternate alignments are justified.

As additional development occurs within the City, it is recommended that the City acquire easements (and maintenance accessways) along the existing drainages or have them replaced with piped systems as appropriate.

a. Basin 6

This basin drains approximately 130 acres on the west side of Philomath. Future land use is comprised primarily of low density residential zoning with a smaller amount of medium density residential lands. The basin is relatively steep in the upper portions and the existing system has adequate grade to convey design storm flows. Criteria for storm frequencies suggest application of the 25-year storm for trunk lines (18-inch pipe and larger). At the downstream end of the basin however, there is deficient capacity at the 24-inch concrete culvert crossing Southern Pacific Railroad, for future buildout land use conditions. In addition, the downstream 24-inch concrete storm drainage pipe system parallel to and crossing Highway 20 is undersized for buildout. Projected future storm flows vary from 10% to 50% over existing capacity.

It is recommended that a parallel storm line be constructed to allow for to the continued use of the existing 24-inch concrete storm pipes. It is assumed that the improvements will include a bore under both the railroad and the highway.

Although the segment between the railroad and the highway is currently in a ditch, it is recommended that the ditch be replaced with a piped system as the land in this basin develops.

b. Basin 9

This basin drains approximately 80 acres in the 9th Street area on the west side of Philomath. The middle portion of the basin is relatively flat with a mix of medium and high density residential zoning, as well as some portions of light industrial. Criteria for storm frequencies suggest application of the 25-year storm for trunk lines (18-inch pipe and larger). Estimated future design flows exceed existing capacity of the piped system by a relatively small amount. Therefor, no capital improvements are recommended for the piped system in this basin.

The major problem in Basin 9 relates to the existing ditch south of Applegate Street, which lack capacity to pass existing peak flows, resulting in backups into Applegate Street. The location of this ditch south of the Water Treatment Plant effectively precludes the City from cleaning and maintaining this ditch, since tracked equipment would be required to access the area. It is our understanding that the City has been exploring the option of installing a road or path south along the 9th Street right-of-way to provide an alternate access to the Mary's River Park. It is recommended that a new drainage ditch be constructed south along the 9th Street alignment west of the existing wetlands and along the proposed road alignment.

c. Basin 13

Basin 13 drains approximately 240 acres and outfalls along 13th Street. Currently much of the upper portion of the basin is undeveloped, but is expected to develop with a mix of low, medium, and high density residential. The existing capacity problems along 12th Street, coupled with the inaccessibility and failure of the ditch between 12th & 13th Street north of Pioneer Street, a new system is needed to provide additional capacity. Criteria for storm frequencies suggest application of the 25-year storm for trunk lines (18-inch pipe and larger). For purposes of discussion and presentation, the improvements to this portion of the system are broken into three segments as follows: North of Pioneer Street, between Pioneer Street and Applegate Street, and south of Applegate Street.

<u>*North of Pioneer Street*</u>. North of Pioneer Street, a new trunk storm line is recommended along 12th Street. This line should be designed to collect not only the flows from Basins

1304 through 1306 (west of 12th Street), but should also be deep enough to intercept the flows from the ditch between 12th & 13th Street. Based on design flows and assumed slopes, it appears that a 36-inch pipe is required from Pioneer to Grant Street, with a 30-inch pipe from Grant to Madison Street. 15-inch pipes are proposed from the existing ditch east of 12th to the new storm line at Lincoln, Grant, Monroe and Madison Streets.

Pioneer Street to Applegate Street. There are two possible alignments south of Pioneer Street. The first possible alignment is along the existing 30-inch line, while the second is along 12th Street to Applegate, and thence east to 13th Street. The existing 30-inch storm line generally follows the alignment of the alley between 12th and 13th Street. To the best of our knowledge, the City does not have any additional easements for the portions of this line which are outside of the public right-of-way. Since the existing storm line appears to wander back and forth across the alley and cross private property, there does not appear to be adequate room to construct a parallel line without the acquisition of significant new easements. Therefor, it is recommended that a new 36-inch pipe be constructed along 12th Street from Pioneer Street to the intersection of 13th and Applegate Street. This line will be in addition to and will not replace the existing 30-inch storm line. The improvements will include a bore under both the railroad and the highway.

South of Applegate Street. It is recommended that the existing 30-inch pipe along 13th Street remain in service. However, a parallel 36-inch pipe must be constructed to provide capacity for the design flows. It is recommended that a new 48-inch pipe be constructed south of the end of the existing 30-inch pipe to the Mary's River. It is recommended that the new pipe extend along 13th Street to a point ±400 feet south of Chapel Drive, and then run southeast to the Mary's River. An easement would need to be acquired across private property prior to construction of this line.

d. Basin 15

Basin 15 drains a relatively small area of approximately 100 acres and outfalls along 15th Street. Currently much of the upper portion of the basin is developed. It appears that some of the flooding problems along 15th Street are due to the backwater effect from the 13th Street drainage which ends up at the intersection of 15th Street and Chapel Drive. The improvements summarized for Basin 13 above (south of Applegate Street) will have the effect of providing additional capacity for the Basin 15 flows along and downstream of Chapel Drive. The existing drainage problems along 15th Street appear to be limited to the area around Willow Lane and Cooper Lane. It is anticipated that cleaning and/or reconstruction of the ditches downstream of this point will alleviate much of the problem. A new piped system sized for design flows should be installed in the future when 15th Street is improved.

e. Newton Creek Basin

This basin drains approximately 1800 acres north of Chapel Drive, and is the largest open natural drainageway in the Philomath area. The creek was analyzed as part of the City of Philomath Flood Insurance Study and a floodplain has been defined from the confluence with the Mary's River upstream to West Hills Road (approximately 2.4 stream miles, see Appendix B).

Principal areas of concern are at the Highway 20 crossing of Newton Creek and a smaller tributary immediately to the east of the main channel (Basin NC 24). The tributary drains approximately 600 acres north of Highway 20. The drainage enters a 24-inch culvert across the highway which ties into a 21-inch closed pipe storm drainage system south of Highway 20 and along Green Street. Criteria for storm frequencies suggest application of the 50-year storm for minor creeks and drainageways. The entire pipe storm drainage system is extremely undersized for a 50-year storm event. It is suggested that a new diversion channel be constructed along the north side of Highway 20 to divert high flows west to Newton Creek and away from the existing 21-inch system. If Highway 20 is improved as was previously proposed by ODOT, the overflow channel should be piped. The design elevation of the overflow channel or pipe shall be set to limit the head (water level) over the highway crossing culvert, and should be based on the capacity of the downstream 21-inch pipe with Newton Creek at 50 year flood levels. Because this work involves a FEMA floodplain, a more detailed analysis of potential impacts on the main channel should be undertaken in conjunction with the design of these improvements.

f. East Newton Creek Basin

This basin drains approximately 390 acres on the east side of Philomath, and East Newton Creek joins with Newton Creek downstream of Chapel Drive. Future land use is comprised primarily of light residential zoning. Four culvert crossings of East Newton Creek were considered for hydraulic analysis. The crossings occur at Highway 20, James Street, Applegate Street and approximately midway between James and Applegate Streets. Criteria for storm frequencies suggest application of the 50-year storm for minor creeks and drainageways. At buildout land use according to zoning, each of the crossings should be improved with an additional culvert of similar size in order to effectively convey the 50-year design storm peak flow. In addition, the existing ditch between James Street and Applegate Street (through the City Park) has overgrown and filled in, significantly reducing capacity. This ditch should be excavated out to provide capacity for design flows in conjunction with the culvert replacement.

In addition to East Newton Creek through the park, there are three reported local problem areas within this basin due to the lack of catch basins at low points in the intersection of Applegate and 27th, 28th, and 29th Place. Catch basins and storm pipes should be installed to drain these intersections to avoid premature failure of the road.

g. Southwood Basin

The Southwood Basin drains approximately 40 acres and outfalls to the Southwood Ditch and Chapel Drive. Currently much of the upper portion of the basin is developed. The only recommended improvements within this basin are those required to correct reported problems.

h. Bell Fountain Basin

The Bell Fountain Basin drains approximately 56 acres and outfalls to the intersection of Bell Fountain Road and Chapel Drive. Currently much of the upper portion of the basin is developed. The only recommended improvements within this basin are those required to correct reported problems.

TABLE 5-1
RECOMMENDED MAJOR STORM DRAINAGE IMPROVEMENTS

Sub-Basin	Location	Map Quad	Existing Facility	Recommended Improvement	Length (feet)
Basin 6					
640	Railroad crossing	SW	24" pipe	parallel 24" pipe railroad bore	80 60
	Ditch from RR to Hwy 20	SW	ditch	36" pipe	90
	North side Hwy 20	SW	24" pipe	parallel 24" pipe	275
	Highway crossing	SW	24" pipe	parallel 24" pipe highway bore	65 65
Basin 9					
960	9th Street ditch south of WTP	SW	ditch	Reroute ditch	1250
Basin 13					
1304	12th Str, Grant to Madison Str	SW/SE	ditch/culverts	30" pipe	800
1305	12th Str, Pioneer to Grant Str	SW	ditch/culverts	36" pipe	1100
1306 1307	Lincoln, Grant & Monroe Str	SW	none	15" pipe	650
1302	Ditch from 11th to 12th Street north of Pioneer	SW	ditch	±24" pipe	550
1320 1340 1350	12th Str, Pioneer to Applegate Railroad Crossing Highway Crossing	SW	no trunk lines	36" pipe railroad bore highway bore	1600 60 80

TABLE 5-1 RECOMMENDED MAJOR STORM DRAINAGE IMPROVEMENTS					
Sub-Basin	Location	Map Quad	Existing Facility	Recommended Improvement	Length (feet)
1350	13th Street, Applegate to end of existing 30" pipe	SW	30" pipe	parallel 36" pipe	920
1360	13th Street, end of existing 30" pipe to Mary's River	SW	ditch/culverts	48" pipe	2300
Basin 15					
1540	South of Willow Lane	SW	ditch/culverts	pipe, size based on street design grade	1150
Newton Creek Basin					
NC24	North side of Hwy 20, 24" to Newton Creek	SE	none	bypass ditch	500
East Newton Creek Basin					
ENC 20	Highway 20 crossing	SE	30" pipe (2) 24" pipes	parallel 30" pipe highway bore	80 80
	James Street crossing	SE	(2) 30" x 36" pipes	33" pipe	60
	East Newton Creek Park	SE	(2) 24" x 42" pipes	33" pipe	30
	Applegate Street crossing	SE	(2) 30" x 42" pipes	36" pipe	80
	Ditch through East Newton Creek Park	SE	ditch	excavate & clean ditch	1200
	Intersection of Applegate & 27th, 28th & 29th Street	SE	none	Catch basin & cross pipe	120
Bell Fountain Basin					
BF80	Intersection of Upper & Lower Bentonview Drive	SE	none	12" pipe	200

5.3 Recommended Capital Improvement Priorities

As summarized in the previous sections, the storm drainage system in Philomath has a number of deficiencies during moderate and major storm events. Some of these deficiencies are more critical than others. In order to assist the City in the planning and scheduling the construction of needed improvements, the improvements recommended in previous sections are grouped as Priority 1, Priority 2 and Priority 3 as outlined below.

In order that the recommended improvements resolve existing problems and meet the requirements of future growth to the system, this prioritization is necessary, since the City obviously cannot afford all of the recommended storm drainage system improvements at once, and because some improvements are not critical at the present time, but will be needed later as develop occurs. Additional pipelines may be needed to serve future developments. In such cases, if current City policies are maintained, a portion or all of the cost for installing such pipelines will be borne by the developers as required by the particular development conditions.

- **Priority 1** (Near Term Improvements) - These are those projects representing existing system deficiencies (currently needed to meet existing and near future projected stormwater runoff flows) or problem areas needing immediate attention. Priority 1 improvements are further broken into Class A and Class B Priorities, with Class A being the most critical. It is recommended that Priority 1 improvements be accomplished as soon as practical considering financing, construction time requirements and timing associated with other related projects.

- **Priority 2** (Vital Future Improvements) - These are improvements which will be needed in the future to meet projected development conditions and design flows. Although not necessary at this time, they should be considered as improvement projects which will be upgraded to Priority 1 in the future.

- **Priority 3** (Long Term Improvements/Possible Future Need) - These improvements are needed to improve system reliability and convey future design flows if land develops to zone intensities. While important, they are not considered to be critical at the present time, or are deemed less desirable due to cost/benefit or impact standpoint. These improvements should be incorporated into street or other utility improvement projects which may allow for concurrent construction.

Each of the projects was examined and assigned a priority for implementation according to the criteria described below. **Table 5-2** shows the list of projects considered in this evaluation and summarizes the results of the evaluation.

The preliminary project cost estimates for the projects in each of these categories are approximately as follows:

Priority 1A	$1,547,700
Priority 1B	$108,800
Priority 2	$852,350
Priority 3	$239,375

a. Project Evaluation Criteria

Five criteria were used by the City to evaluate individual projects and alternative capital improve programs for the major basins. Each of the projects and alternative capital improvement programs was examined and rated according to the following criteria.

- Pipe Size and Flow Increase. Comparisons were made between the diameter of the existing structure and the proposed replacement, and the hydraulic capacity of the existing facility and the peak flow for the design storm event. The relative increase in diameter and flow were assigned values of high, medium and low.

- Flood Hazard. Maps were reviewed to evaluate the potential for flooding moderately to heavily used streets and private property if a project was not implemented. The relative severity of the consequences of potential flooding at a site was assigned values of high, medium, and low.

- City Priority. Certain projects were identified by City engineering and maintenance personnel to be high priority for implementation.

- Reported Problem. The number of times the City had received a citizen report on a specific problem was considered in assigning priorities to projects.

- Capital Costs. Capital costs include all the costs of implementing a project, such as surveying, design, permitting, construction, legal fees and administration. Costs for acquisition of land were not included.

- Structural Damage. Projects to replace damaged components of the major drainage system that no longer function as designed (e.g., rusted, crushed culvert) were assigned a high priority.

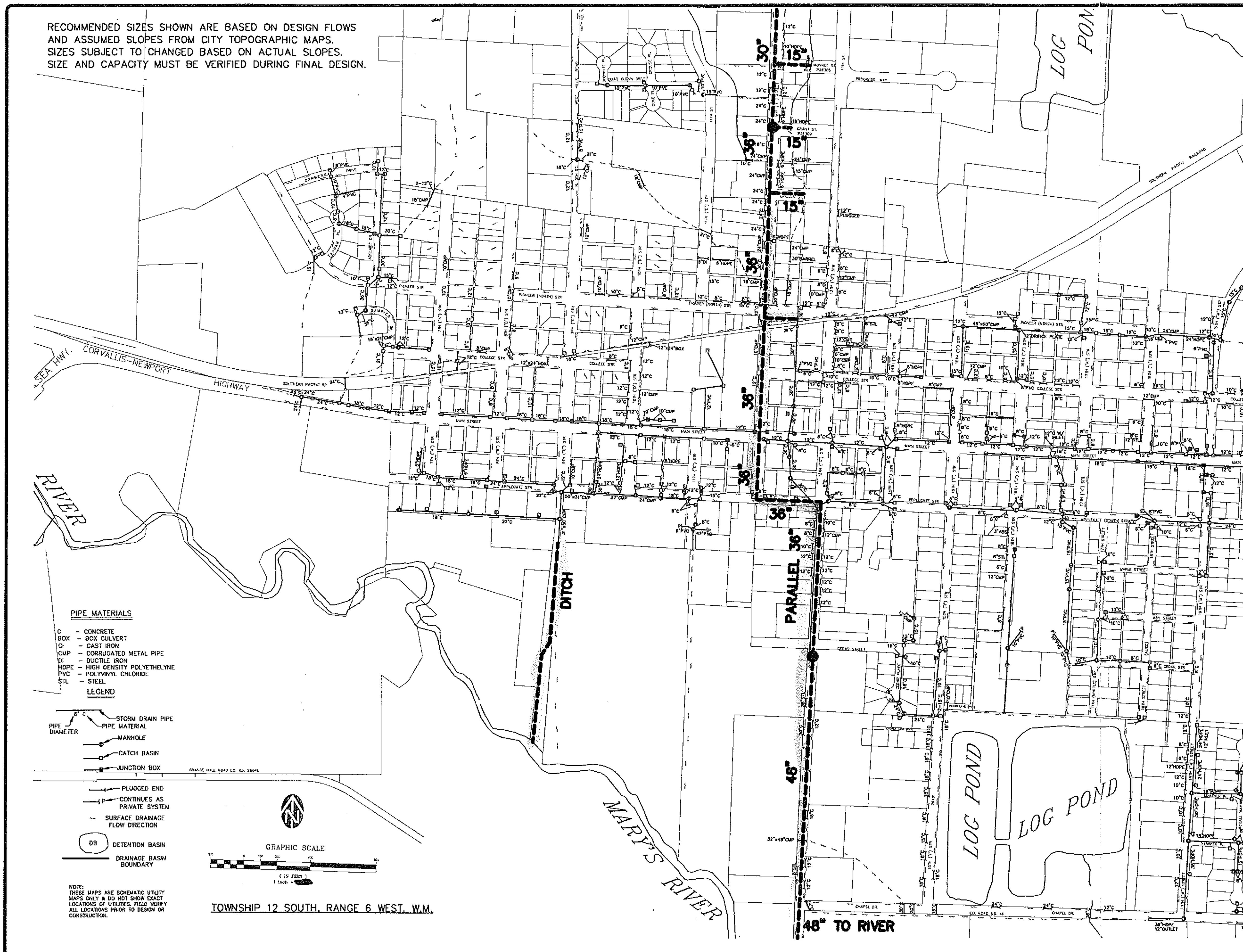
b. Ranking of Recommended Improvements

Many of the problems evident in the existing storm drainage system are the result of major trunk storm facilities which are inadequately sized for the storm flows draining to them. **Table 5-2** outlines and prioritizes the proposed major improvements relating to the storm drain system. As previously discussed, this table does not represent an exhaustive listing of all necessary improvements. **Figure 5-1** through **Figure 5-3** show the approximate locations of the proposed Priority 1 improvements to the storm drainage system.

TABLE 5-2
RECOMMENDED CAPITAL IMPROVEMENT PRIORITIES

Location	Size (inch)	Length (feet)	Estimated Project Budget*	Priority
Basin 6				
Railroad crossing Railroad bore	24 36	80 60	$14,040 $18,000	2
Ditch from RR to Hwy 20	36	90	$23,690	2
North side Hwy 20	24	275	$48,260	2
Highway crossing Highway bore	24 36	65 65	$11,410 $19,500	2
Basin 9				
9th Street ditch south of WTP	ditch	1250	$30,000	1B
Basin 13				
12th Str, Grant to Madison Str	30	800	$175,500	2
12th Str, Pioneer to Grant Str to lincoln st	36	1100	$289,575	2
Lincoln, Grant & Monroe Str	15	650	$71,300	2
Ditch from 11th to 12th Street north of Pioneer	24	550	$96,525	2
12th Str, Pioneer to Applegate Railroad bore Highway bore	36 50 50	1600 60 80	$421,200 $33,000 $44,000	1A
13th Street, Applegate to end of existing 30" pipe	36	920	$242,190	1A
13th Street, end of existing 30" pipe to Mary's River	48	2300	$807,300	1A
Basin 15				
South of Willow Lane	assume 24"	1150	$201,825	3
Newton Creek Basin				
North side of Hwy 20, 24" to Newton Creek	ditch	500	$35,000	2

TABLE 5-2 RECOMMENDED CAPITAL IMPROVEMENT PRIORITIES				
Location	Size (inch)	Length (feet)	Estimated Project Budget*	Priority
East Newton Creek Basin				
Highway crossing Highway bore	30	80 80	$17,550 $32,000	2
James Street crossing	33	60	$14,480	1B
East Newton Creek Park	33	30	$7,240	1B
Applegate Street crossing	36	80	$21,060	1B
Ditch through East Newton Creek Park	ditch	1200	$36,000	1B
Intersection of Applegate & 27th, 28th & 29th Street	12	120	$20,000	3
Bell Fountain Basin				
Intersection of Upper & Lower Bentonview Drive	12	200	$17,550	3
*Costs are 1997 dollars and assume dry weather construction. ENR 20 Cities Index = 5838.				



NO.	DATE	DESCRIPTION REVISIONS	BY

SCALE
HORIZ:
VERT:
DSN. D.M.
DRN. D.M.
CKD. J.Y.
DATE: APR 1997

MAP UPDATED: 11-5-97

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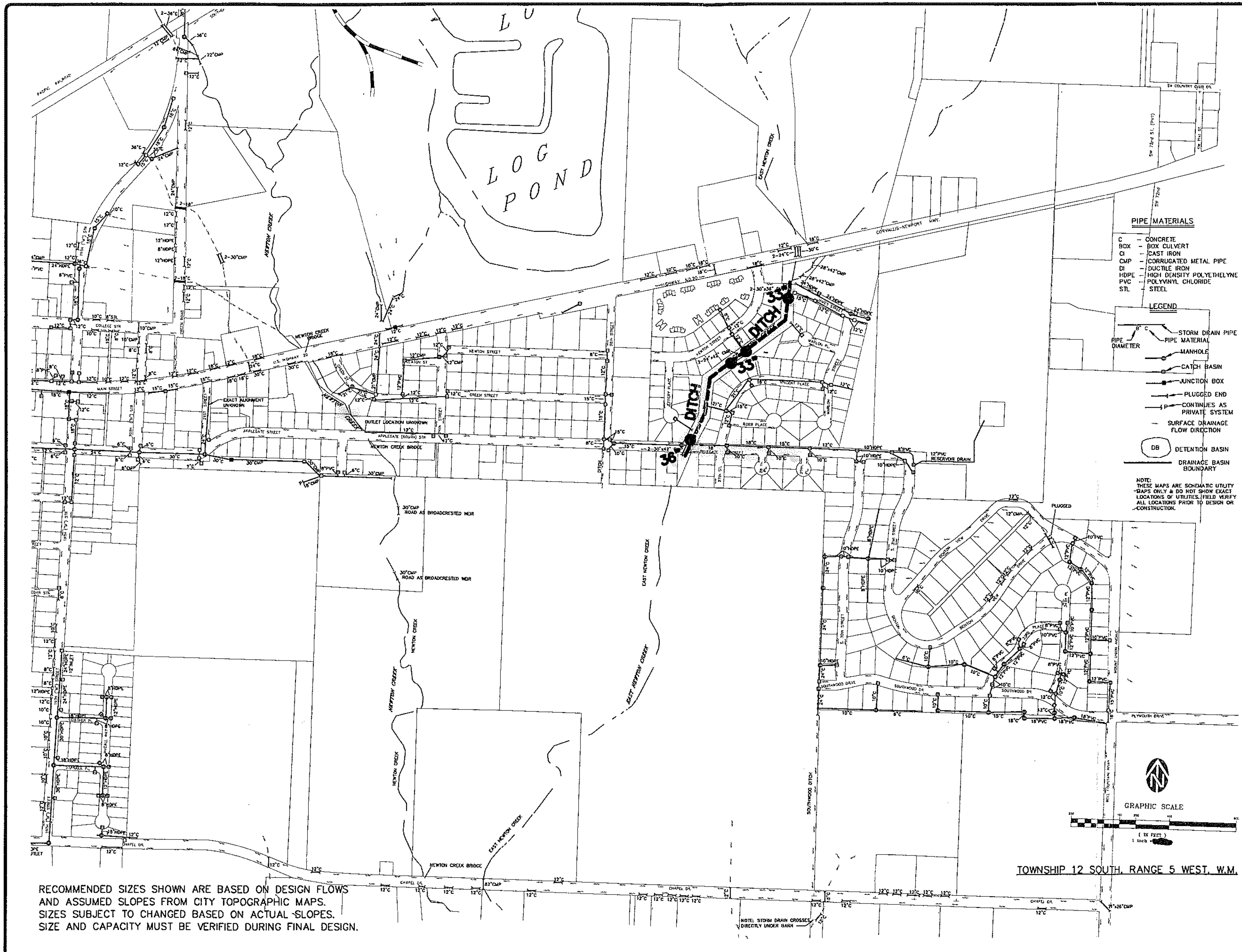
CITY OF PHILOMATH, OREGON

PRIORITY 1 IMPROVEMENTS SOUTHWEST QUADRANT

FIGURE
5-1

JOB NUMBER
960.501.0



CITY OF PHILOMATH, OREGON

PRIORITY 1 IMPROVEMENTS
SOUTHEAST QUADRANT

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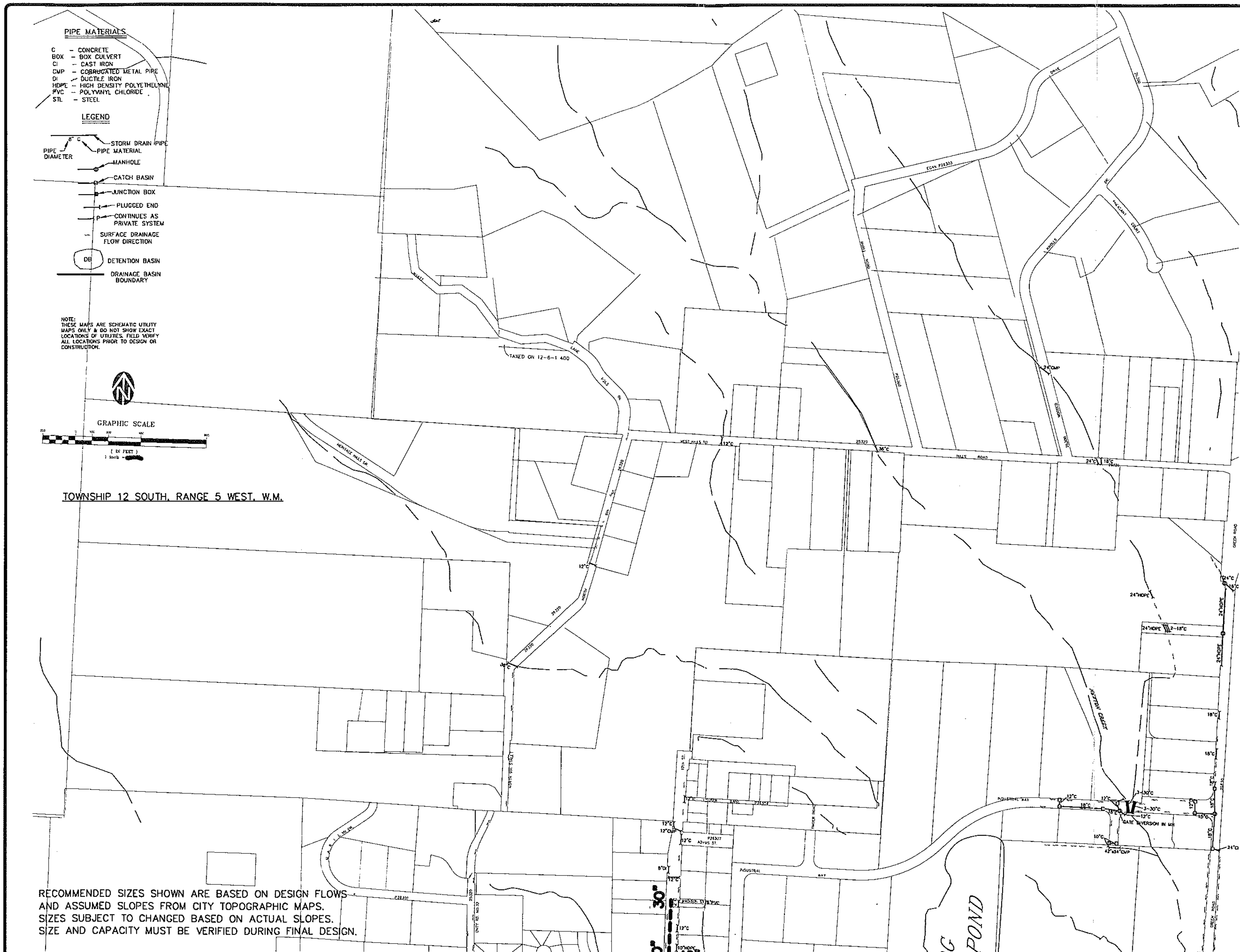
SCALE
HORIZ:
VERT:
DSN. D.M.
DRN. D.M.
CKD. J.Y.
DATE: APR 1997

NO.	DATE	DESCRIPTION	BY
		REVISIONS	

FIGURE 5-2
JOB NUMBER 960.501.0



MAP UPDATED: 11-5-97

CITY OF PHILOMATH, OREGON

PRIORITY 1 IMPROVEMENTS NORTHWEST QUADRANT

FIGURE 5-3

JOB NUMBER 960.501.0

DATE: APR 1997

5.4 Basis of Preliminary Cost Estimates

Preliminary construction costs for improvements recommended in this study are based on the following assumptions. The cost estimates reflect projects bid in early 1998. These estimates are based on construction costs for similar projects and manufacturers information. The costs do not reflect a detailed investigation of existing utilities and soils. It is important to note that the cost estimates are budget level estimates, not engineering estimates, and are intended to be within the range of plus or minus 25% of the actual project cost. The elements which comprise these budget estimates are:

- Construction Cost (materials and installation) - $4.50 per inch-diameter per foot
- Construction Contingencies - 25% of estimated construction cost
- Engineering & Administration Costs (surveying, engineering design, permitting, administration, legal, financing and construction administration) - 30% of estimated construction cost plus contingency

Example: 150 lineal feet of new 36-inch storm pipe

Est. Construction Cost =	150 feet x 36 inches x $4.50 =	$24,300
Contingencies =	$24,300 x 25% =	$6,075
Engineering & Admin =	($24,300 + $6,075) x 30% =	$9,112
Total Est. Project Cost =		$39,487

Once the Master Plan is adopted by the City, the projects listed can be selected for completion through the City's budgeting process. The steps for completion are:

- Project identification and budget level cost estimate (Master Plan)
- Project selection and project budget approval
- Retain consulting engineer to design project
- Preparation of plans, specifications and engineering cost estimates
- Bidding and contract award
- Construction

These construction costs are preliminary estimates, but they should help the City in the process of planning and allocating resources in the most cost effective manner. All costs are estimates of probable costs and do not reflect changes that could include increasing labor costs, material, and phased construction dates. Unit costs used for installation of storm drains and culverts include excavation and export of material, bedding and backfill, cutting of asphalt, repaving of streets, pipe placement, upstream and downstream channel protection, catch basins and manholes.

Section 6

DESIGN STANDARDS & MANAGEMENT PRACTICES

SECTION 6
DESIGN STANDARDS & MANAGEMENT PRACTICES

6.1 Introduction

The purpose of this section is to present background and guidance for nonstructural issues related to management of storm drainage systems. Specifically, this section addresses design standards, maintenance issues, legal/liability issues and funding issues related to storm drainage in the City of Philomath.

6.2 Design Standards

The City does not presently have any detailed design criteria for storm drainage system improvements under City jurisdiction. Based on a review of existing drainage design criteria for Philomath and other communities of similar size, the following sections present suggested design criteria and approaches for use by the City. A draft copy of recommended Public Works Design Standards (PWDS), including a section for stormwater management and standard details, is included in Appendix C. The format of these PWDS is designed to allow sections for streets, sanitary sewers, and water distribution can be added as these are adopted by the City.

These draft PWDS are intended to provide a uniform set of standards for public storm drainage improvements. They also are intended to apply to private systems which cannot conform to Uniform Plumbing Codes, particularly minimum slopes. The intent of these standards is to provide guidelines for the construction of public facilities which will provide an adequate service level for the present development as well as for future development.

The PWDS cannot provide for all situations. They are intended to assist but not to substitute for competent work by design professionals. The Standards are also not intended to limit unreasonably any innovative or creative effort which could result in better quality, better cost savings, or both. Any proposed departure from the Standards will be judged on the likelihood that such variance will produce a compensating or comparable result, in every way adequate for the user and City resident.

The objective is to develop Standards which will:

- be consistent with current City Ordinances.
- provide design guidance criteria to the private sector for the design of public improvements within the City of Philomath.
- be of adequate design to safely manage all volumes of water generated upstream and on the site to an approved point of disposal;
- provide points of disposal for stormwater generated by future upstream developments;

- prevent the uncontrolled or irresponsible discharge of stormwater onto adjoining public or private property;

- prevent the capacity of downstream channels and storm drainage facilities from being exceeded;

- have sufficient structural strength to resist erosion and all external loads which may be imposed;

- maximize the use of the City's natural drainage system;

- be designed in a manner to allow economical future maintenance;

- require the use of design and materials to provide a system with a minimum practical design life of not less than 50 years.

It is recommended that the City adopt the PWDS by ordinance or resolution so as to provide guidelines for drainage improvements within the City's UGB. The following is a short discussion of some of the major components of the recommended PWDS.

a. Design Storm Recurrence Interval

The magnitude of the recommended design storm is a function of the level of protection desired and the relative costs of facilities that could be damaged. The level of required hydrologic and hydraulic analysis is also directly related to the size of the drainage area (and related stormwater flowrates) and the selected design storm. As previously noted, **Table 4-2** and PWDS 3.10 outlines the recommended design storms for different components of the storm drainage system.

Section 4.1(d) contains a detailed discussion of recommended design storm frequencies. For sizing of local storm drains serving residential or commercial areas, it is suggested that a 10-year design storm be used. For trunk lines 18-inches or larger and for highway crossings, a 25-year design storm should be used. For perennial streams and major drainage channels not shown as a flood plain on FEMA maps, a 50-year design storm should be used. Major drainage channels shown as flood plains on FEMA maps should be sized to pass a 100-year storm.

As outlined in PWDS 3.18, it is recommended that peak storm water runoff shall be controlled by detention facilities for the following:

- All commercial, industrial and multi-family developments
- Parking lots with 10,000 square feet or more of impervious area
- All other developments where such control is needed to prevent the capacity of the downstream system from being exceeded.

It is recommended that detention facilities have storage capacities to detain the greater of the difference between a 5-year frequency storm with pre-development conditions and a 25-year frequency storm under developed conditions, or the difference between the *remaining available downstream capacity for the site being developed* under design storm conditions and a 25 year frequency storm under developed conditions.

b. Hydrologic Design Calculations

As mentioned in previous sections (Design Storm Recurrence Interval), size of drainage facility (ie. contributing area) should dictate both the design storm recurrence interval and the required level of hydrologic and hydraulic analysis. For drainage areas less than or equal to 200 acres in size, the Rational Method can be applied with sufficient accuracy. For drainage areas greater than 200 acres but less than 640 acres, U.S. Geological Survey (USGS) regional regression relationships should be used. For drainage areas greater than 640 acres (1 square mile), unit hydrograph analysis or other methods approved by the City Engineer should be used.

c. Sheet Flow Escape Routes

In addition to the above described criteria, sheet flow escape routes should be investigated to demonstrate that flows from storms of greater than design magnitude will not cause excessive damage to downstream properties, or when the downstream drainage system becomes clogged. For example, during design of improvements or development review, site grading should be checked and modified as feasible to ensure that flows in excess of design capacity have a route for escape without endangering property or jeopardizing public safety.

d. Minimum Flow Velocity

The recommended minimum flow velocity for improvements to the drainage system is 3 feet per second. This velocity should be adequate for removing the majority of sand, sediment and debris normally entering the drainage system. This, in conjunction with the sumps in catch basins, will help ensure that pipes will remain relatively self-cleaning and thereby not require frequent maintenance on a long-term basis.

e. Catch Basins

It is suggested that the City continue using sumps in all catch basins to trap and remove heavy sediments and debris. This will facilitate maintenance of the system, ensure that pipe capacity is not reduced by inflowing gravel, rocks and other settleable debris. Most of the surface water pollutants are held within the solids that enter the drainage system, and catch basins will allow for easy removal.

f. Dry Wells

Dry wells, or stormwater sumps, are an alternative means of stormwater disposal which discharge to the ground. However, due to the high groundwater table experienced in most parts of Philomath during the winter months, dry wells are not an effective means of stormwater disposal. Also, long-term discharge to the ground could pose geotechnical and slope stability hazards.

g. Open/Natural Drainage

As part of the development review and approval process, it is suggested that the City require minimum utility and access easement widths for open channels located outside of public right-of-ways as follows (PWDS 3.12(d):

- <u>Channel width less than 14 feet at top of banks</u>: Channel width plus 12 feet on one side and 2 feet on the other.

- <u>Channel width greater than 14 feet at top of banks</u>: Channel width plus 12 feet on both sides.

To the greatest extent practicable, open drainage channels should be kept clean and open to ensure that design flow capacity is maintained.

h. Minimum Storm Drain Pipe Size

To minimize long-term maintenance and allow for reliable system capacity, it is suggested that the City require a minimum pipe diameter of 10 inches for all new piped storm drain improvements. All pipes should shall begin at a structure and terminate at an approved point of disposal (discharge).

i. Pipe Material

The type of storm drain pipe material acceptable depends upon a number of criteria, including potential traffic loading, depth of cover and pipe size. An additional consideration relates to anticipated environmental exposure conditions. For instance, since exposure of PVC pipe sunlight (UV radiation) will result in the pipe becoming brittle, PVC pipe should not be used for storm lines which discharge to surface water channels.

PWDS 3.8(b) contains a table outlining recommended pipe material by pipe size and cover depth. Note that uniform pipe material should be used on each pipe run between structures.

j. Runoff Coefficients

Rational Method runoff coefficients are based on land use types and were outlined previously in Section 4, as well as PWDS 3.10(c).

k. Minimum Time of Concentration

As outlined in Section 4, the recommended minimum time of concentration for use with the Rational Method is 10 minutes (PWDS 3.10).

l. Rainfall Intensity-Duration-Frequency (IDF) Relationship

As outlined in Section 4, the recommended IDF relationship for the City of Philomath is taken from Oregon Department of Transportation (ODOT) Highway Division, Hydraulics Manual (Zone 8). The curves and tabular data is presented in PWDS 3.10.

m. Manning's Roughness Coefficient

As discussed in Section 4, it is recommended that design roughness coefficients reflect the condition of the pipe at the end of the design period rather than the pipe condition when new (PWDS 3.15). Since flows typically increase over time as additional development occurs, and the roughness of the pipe also increases over time, it is prudent to design pipes for future conditions based on roughness coefficients under future conditions.

Roughness coefficients for open channels should be determined based on the size of the channel and its ability to be maintained. While large channels (such as Newton Creek and tributaries) tend to have self cleaning beds due to the stormwater volumes, smaller channels tend to silt in and become overgrown with weeds and trees, thereby reducing capacity. East Newton Creek through the City Park is a good example of this type of situation. For new open channels capable of being maintained, a minimum "n" value of 0.04 is recommended. Channels without maintenance access should be designed with a higher coefficient.

6.3 Storm System Management Practices

In order to ensure that the City's storm drainage system continues to function effectively, and to maintain the full capacity of the existing storm drainage system, a regular program of maintenance is recommended.

A successful maintenance program should include the following objectives:

- Provide for public safety
- Reduce potential of property damage by obstructed facilities
- Evaluate and upgrade maintenance priorities
- Reduce impact on City's resources
- Maintain capacity and integrity of storm drainage system
- Identify future maintenance needs
- Add projects to the stormwater CIP as appropriate
- Reduce nuisance water on public streets

The most important objectives of the maintenance program should be to provide for public safety and reduce unplanned storm water flow or flooding on private and public property. It also allows access to public roads to be maintained during storm events for emergency and private vehicles.

Priorities should be established and re-evaluated yearly to ensure that resources are allocated reasonably and fairly. In this manner, limited City resources are not used for resolving minor storm drainage systems when major facilities are in need of repair or improvement. As repairs are made and yearly evaluations are performed, new problem areas and other maintenance requirements can be identified and prioritized. Another benefit is that City residents visibly see that their concerns are being addressed by the City.

For purposes of evaluating the storm drainage maintenance requirements for the City, typical maintenance requirements were developed for each type of structure in the system along with typical maintenance requirements for different conditions. **Table 6-1** outlines typical maintenance requirements for pipes and culverts, while **Table 6-2** outlines those for catch basins.

Table 6-1
RECOMMENDED MAINTENANCE STANDARDS FOR PIPES & CULVERTS

Maintenance Category	Condition Requiring Maintenance	Recommended Maintenance
Sediment and debris	Accumulated sediment exceeds 20% of the pipe diameter	Clean pipe of all sediment and debris
Vegetation	Vegetation that reduces free movement of water through pipes	Remove all vegetation so water flows freely through pipes
Damaged pipe	Protective coating is damaged and rust causing more than 50% of deterioration to any part of pipe	Repair or replace pipe
	Any dent that decreases the end area of pipe by more than 20%	Repair or replace pipe
Debris barrier plugged	Trash or debris plugging more than 20% of the barrier openings	Clear barrier of all debris
Damaged/missing bars	Bars are missing or entire barrier missing	Replace bars per design
	Bars are missing or entire barrier missing	Replace bars per design
	Bars are loose and rust is causing 50% deterioration to any part of barrier	Repair or replace barrier to design

Table 6-2 RECOMMENDED MAINTENANCE STANDARDS FOR CATCH BASINS		
Maintenance Category	Condition Requiring Maintenance	Recommended Maintenance
Trash and debris (including sediment)	Trash or debris of more than 1/2 ft3 located in front of the catch basin opening or blocking capacity of basin by >10 percent	Clean trash or debris from in front of catch basin opening
	Sediment, trash or debris in the basin greater than 1/3 to 1/2 the depth of the sump	Remove sediment, trash and debris from catch basin
	Sediment, trash or debris in any inlet or outlet pipe blocking more than 1/3 the diameter	Remove sediment, trash and debris from catch basin
Structural damage or deterioration of curb or frame	Deterioration of curb at inlet location	Replace curb across inlet location
	Damage to diamond plate covers in sidewalk	Repair or replace cover
Cracks in basin walls or bottom	Cracks wider than ½ inch or longer than 3 ft, any evidence of soil particles entering catch basin through cracks, or structure is unsound	Basin repaired or replaced
	Cracks wider than ½ in and longer than 1 ft at the joint of any pipe or any evidence of soil particles entering catch basin through crack	Repair/grout cracks
Settlement/misalignment	Basin has settled more than 1 in or has rotated more than 2 in out of alignment	Basin reset or replaced
Fire or chemical hazard	Chemicals such as natural gas, oil, and gasoline in storm drain system	Remove flammable or hazardous chemicals
Vegetation	Vegetation growing across and blocking more than 10 percent of basin	Remove vegetation blocking basin
	Vegetation growing in inlet/outlet or roots at pipe joints	Remove vegetation and roots

Based on these typical maintenance requirements, a sample maintenance budget worksheet was developed using assumed production rates and unit costs for the various maintenance functions. The level of service and assumed unit costs for the various maintenance functions are presented in **Table 6-3**. This should not be regarded as a final budget number, but is intended only to provide a sample for use in developing a realistic budget as the City implements funding programs for storm system maintenance. In summary, the maintenance budget should allow for cleaning of all catch basins bi-annually, all pipes on a 5-year cycle, and other maintenance, repair, replacement, and system inventory requirements as shown.

To develop a storm system maintenance program for the City, the following recommendations should be implemented:

- Once funding mechanisms are in place, allocate an amount determined by Public Works as the Storm System Maintenance Budget for repairs of "minor" storm drainage facilities. **Table 6-3** can be used a starting point for developing this budget.

- Implement routine inspections of system elements (i.e., catch basins, culverts, etc.) to observe debris accumulation and structural conditions, and to evaluate the required procedures, materials, equipment, personnel, urgency, time, and cost for maintenance activities.

- Develop a storm drainage database to inventory system elements, record maintenance actions and inspection logs, and monitor public concerns (complaints of local problem areas).

- Regularly evaluate database to determine maintenance patterns and refine manpower and budgetary requirements.

- Obtain access easements to existing public facilities from private owners.

- Inspect and evaluate detention ponds (schedule maintenance when capacity is reduced by one-third due to sedimentation).

- Develop a program to require maintenance for private water quality facilities.

- Provide an emergency fund to deal with catastrophic events effecting storm drainage facilities.

Table 6-3
Sample Maintenance Budget Worksheet

Item No.	Category	Number to be Maintained	Frequency (times/yr)	Standard #/Length per day	Crew Size	Total days per year	Labor Cost/ Crew day	Equipment Cost (% Labor)	Preliminary Maintenance Costs: Labor Cost	Material Cost	Equipment Cost	Total Cost	Percent of Total Budget
1	Clean Catch Basins	376	0.5	15	1	12.5	$160	50%	$2,005	$0	$1,003	$3,008	10%
2	Clean Major Culverts/Pipe Inlets	30	1	15	1	2.0	$160	50%	$320	$0	$160	$480	2%
3	Clean Trash Racks	4	6	15	1	1.6	$160	50%	$256	$0	$128	$384	1%
4	Clean Storm Lines	69,590	0.2	1000	2	27.8	$160	100%	$4,454	$0	$4,454	$8,908	29%
5	Clean Pollution Control MH	0	0.5	5	1	0.0	$160	50%	$0	$0	$0	$0	0%
6	Clean/Regrade Ditches	20,000	0.5	1000	2	20.0	$160	100%	$3,200	$0	$3,200	$6,400	21%
7	Repair Major Culverts	10	0.2	1	2	4.0	$160	40%	$640	$0	$256	$896	3%
8	Repair Storm Lines	200	1	50	2	8.0	$160	100%	$1,280	$0	$1,280	$2,560	8%
9	Repair/replace Catch Basins	75	0.1	2	2	7.5	$160	50%	$1,200	$0	$600	$1,800	6%
10	Complaint Response	12	1	1	1	12.0	$160	0%	$1,920	$0	$0	$1,920	6%
11	Detention Basin Maintenance	3	2	1	1	6.0	$160	50%	$960	$0	$480	$1,440	5%
12	System Inventory Reconnaissance	1	6	1	1	6.0	$160	0%	$960	$0	$0	$960	3%
				Total crew days/yr		107.5							
						Sub-total: All Maintenance Categories			$17,195	$0	$11,561	$28,756	
									Administration & Overhead @ 8%			$2,300	
									Grand Total			$31,056	

6.4 Legal/Liability Issues

This section presents a general background on drainage-related legal/liability issues and should not be used in lieu of advice from the City's legal counsel. Therefore, the following items present a basis for further investigation by the City into potential liabilities with storm drainage master planning and implementation of improvements. Historically, the basis for stormwater litigation has been a tort action, as follows:

- In the State of Oregon, the civil law doctrine of drainage applies. Under this doctrine, adjoining landowners are entitled to have the normal course of natural drainage maintained. The lower owner must accept water which naturally comes to his land from above, but he is entitled not to have the normal drainage changed or substantially increased. The lower landowner may not obstruct the runoff from the upper land, if the upper landowner is properly discharging the water (Reference 4).

- A municipality undertaking a public drainage improvement is treated like a private party (Harbison v. City of Hillsboro) and is liable for damage resulting from negligence or an omission of duty (Reference 8).

- Municipalities are generally under no legal duty to construct drainage improvements unless public improvements require drainage facilities (Denver v. Mason) (Reference 9).

- Municipalities are not liable for damages due to overflow of its drainage system in cases of extraordinary/unforeseeable rains or floods. (McQuillan) (Reference 10).

- Municipalities will likely be liable in cases where they take responsibility for collection of surface waters which are then released onto private property which has not historically received runoff, where dams/diversions cause an overflow onto another's land, or where there is failure to exercise reasonable care in the maintenance and repair of drainage improvements (Reference 10).

While instances of public water traversing private property are prevalent throughout the City, a policy of purchasing right-of-way or easements, constructing structural drainage improvements and providing long-term maintenance for the existing major drainage channels (such as Newton Creek and upstream tributaries) is likely not cost-effective for the City unless it can be accomplished in conjunction with development of the surrounding land. This situation is true for many Oregon communities. It is suggested that a more cost-effective approach is to apply Oregon's civil law doctrine of drainage on a case-by-case basis to situations as they arise.

6.5 Funding Issues

This section describes the range of alternative funding sources that municipalities have used in implementing drainage improvements.

a. State/Federal Grants and Loans

Various grant/loan programs are available at both the federal and state level. However, no single grant/loan program is available on a consistent, on-going basis for funding of local stormwater management. With communities competing on both a state-wide and even nation-wide basis, and with constraints on how grant/loan money is to be used, these sources can only serve to supplement an existing local funding program for stormwater management.

b. Debt Financing

General obligation bonds and revenue bonds are two commonly used forms of debt financing for public infrastructure improvements. General obligation bonds, primarily used for major capital improvements, are subject to voter approval and are backed by the full credit of the government issuing them. Revenue bonds, on the other hand, may be sold and secured only by those specific revenue sources which are earmarked for their payment.

c. System Development Charges

These charges are imposed on new development as a way of recovering costs for that portion of existing system capacity solely attributable to new development or for that portion of required system up-sizing. System development charges can begin to answer questions of who should pay for required up-sizing of the stormwater system due to new development, or how historical payers into the system can recover their costs in oversizing facilities that enable future growth.

d. Fee-In-Lieu of On-Site Detention

These fees afford a land developer the option of either constructing an on-site stormwater detention facility in accordance with established design criteria, or paying a fee into a fund dedicated to the construction of an off-site or regional stormwater detention facility serving multiple properties. These fees tend to promote siting and construction of regional versus on-site detention facilities. However, cash flow necessary for a regional stormwater detention facility may not necessarily coincide with the required construction timing.

e. Local Improvement Districts and Special Assessments

The concept of deriving funding from local improvement or special assessment districts is founded on quantifying benefits. For water, sewer or street improvements, these benefits can often be easily identified and thus quantified. However, drainage differs in the respect that upstream or hillside properties that are major contributors of runoff may not be specific recipients of benefits.

f. Plan Review and Inspection Fees

These fees are intended to recover the expense of examining development plans to ensure consistency with comprehensive land use and stormwater master plans, and to ensure that construction standards and regulations are met at the construction site. These fees are not intended to be a primary revenue generating source.

g. Stormwater Service Charges

Another method gaining popularity for financing stormwater management is the utility-based service charge. Historically, the concept of considering stormwater as a public utility attracted very few communities. However, as other more conventional funding sources became difficult to obtain, and as federal requirements increase, the service charge concept has generated greater appeal. Service charges for stormwater management reflect a rationale that those who contribute to stormwater problems should logically contribute to the costs of providing mitigative services.

h. Ad Valorem Taxes

Ad valorem taxes are taxes levied on a property as a direct result of "value added" to the subject property. However, with stormwater there is no clear correlation between property value and contribution of runoff. Ad valorem taxes could provide a significant source of revenue, however with the apparent lack of equity, should not be considered a primary source for funding stormwater programs.

In addition to a System Development Charge (SDC), it is recommended that the City consider implementation of a stormwater service charge. A sample ordinance similar to that adopted by other small communities in the Willamette Valley is included in Appendix F.

CITY OF PHILOMATH
Storm Drainage System Master Plan

REFERENCES

REFERENCES

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6. Local Wetlands Inventory for the City of Philomath, for City of Philomath, Oregon by SRI/Shapiro, Inc., August 1996 (Draft).

7. Mill Site Conversion Project, Conceptual Development Plan for Willamette Industries Mill Site, for Rural Development Initiatives, Inc. by KCM, Inc., November 1995.

8. Drainage Management Study and Financial Program, City of Gresham, Oregon, prepared by KCM, December 1981.

9. Kelly Creek Basin, Storm Drain Master Plan, City of Gresham, Oregon, prepared by URS, September 1988.

10. Comprehensive Storm Drainage Master Plan, City of Hillsboro, prepared by URS, July 1988.

CITY OF PHILOMATH
Storm Drainage System Master Plan

Philomath Storm Drainage Utility Maps

APPENDIX A

Jul 22, 2011 – 6:05pm
R:\Maps\City Utility Maps\Philomath\MAPS\Philomath Map (ACAD 04) 6-16-11.dwg (SD-SW tab)

CITY OF PHILOMATH, OREGON	
STORM DRAINAGE SYSTEM MAP SW QUADRANT	

SHEET 1 OF 4
JOB NUMBER 960.100.0

WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS AND PLANNERS
3841 Fairview Industrial Dr. S.E., Suite 100, Salem, OR 97302
Phone: (503) 585-2474 Fax: (503) 585-3986
E-mail: westech@westech-eng.com

MAP UPDATED: 6-21-11

SCALE
HORIZ: 1" = 200'
VERT:

DSN. DM
DRN. DM
CKD. JY
DATE: APRIL 1997

NO.	DATE	DESCRIPTION	BY
1			

REVISIONS

Jul 22, 2011 - 6:06pm
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CITY OF PHILOMATH, OREGON

STORM DRAINAGE SYSTEM MAP
NE QUADRANT

WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS AND PLANNERS
3841 Fairview Industrial Dr. S.E., Suite 100, Salem, OR 97302
Phone: (503) 585-2474 Fax: (503) 585-3986
E-mail: westech@westech-eng.com

MAP UPDATED: 6-21-11

SCALE
HORIZ: 1" = 200'
VERT:

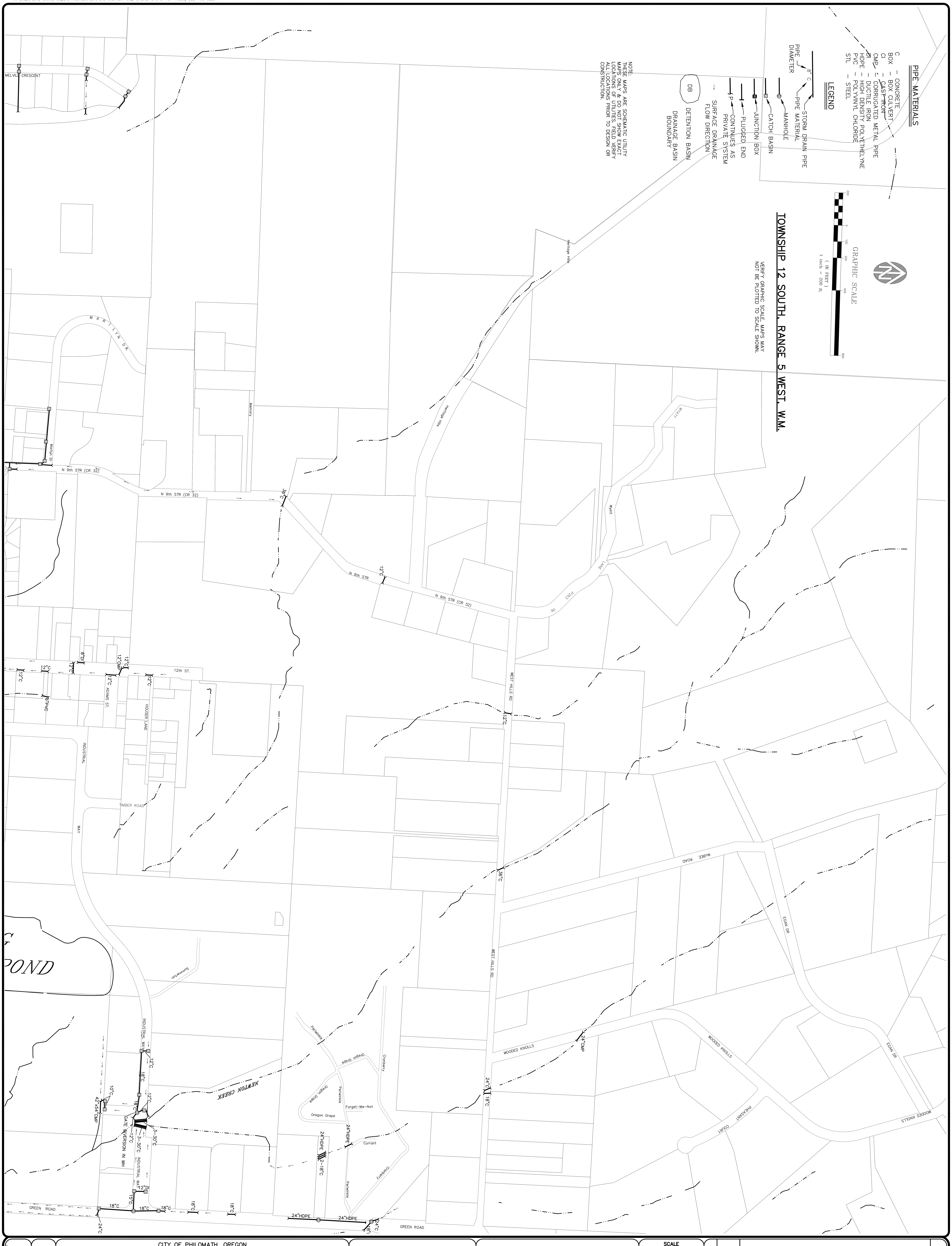
DSN. DM
DRN. DM
CKD. JY
DATE: APRIL 1997

NO.	DATE	DESCRIPTION	BY
1			

REVISIONS

SHEET 4 OF 4
JOB NUMBER 960.100.0

Jul 22, 2011 – 6:05pm
R:\Maps\City Utility Maps\Philomath\MAPS\Philomath Map (ACAD 04) 6-16-11.dwg (SD-NW tab)



CITY OF PHILOMATH, OREGON	WESTECH ENGINEERING, INC. CONSULTING ENGINEERS AND PLANNERS	MAP UPDATED: 6-21-11
STORM DRAINAGE SYSTEM MAP NW QUADRANT	3841 Fairview Industrial Dr. S.E., Suite 100, Salem, OR 97302 Phone: (503) 585-2474 Fax: (503) 585-3986 E-mail: westech@westech-eng.com	

SHEET 3 OF 4
JOB NUMBER 960.100.0

SCALE	
HORIZ:	1" = 200'
VERT:	
DSN.	DM
DRN.	DM
CKD.	JY
DATE:	APRIL 1997

NO.	DATE	DESCRIPTION	BY
1			

REVISIONS

Jul 22, 2011 – 6:05pm
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CITY OF PHILOMATH, OREGON

STORM DRAINAGE SYSTEM MAP
SE QUADRANT

SHEET 2 OF 4
JOB NUMBER 960.100.0

WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS AND PLANNERS
3841 Fairview Industrial Dr. S.E., Suite 100, Salem, OR 97302
Phone: (503) 585-2474 Fax: (503) 585-3986
E-mail: westech@westech-eng.com

MAP UPDATED: 6-21-11

SCALE	
HORIZ: 1" = 200'	
VERT:	
DSN.	DM
DRN.	DM
CKD.	JY
DATE:	APRIL 1997

NO.	DATE	DESCRIPTION	BY
1			

REVISIONS

CITY OF PHILOMATH
Storm Drainage System Master Plan

FEMA Flood Maps

APPENDIX B

CITY OF PHILOMATH
Storm Drainage System Master Plan

Computations for Future Conditions

APPENDIX D

APPENDIX D - FUTURE LAND USE BREAKDOWN					Future Land Use, Percent																						
Philomath Storm Drainage Master Plan					Philomath - City Zoning Districts													Benton County Zoning Districts									
					Commercial				Residential						Industrial			Commercial		Residential			Industrial				Unzoned
Map	Quadrant	Location	Basin ID		C1	C2	C3	C4	R1	R2	R3	P	O	O/R	LI	HI	SPD	C	C2	UR-5			IP	LI	HI	Runoff	UZ
		Description		Acres																LDR	MDR	HDR				Coeff.	
					0.90	0.80	0.85	0.70	0.40	0.55	0.75	0.20	0.75	0.65	0.70	0.80	0.70	0.75	0.90	0.40	0.55	0.75	0.75	0.70	0.80	Cw	0.10
1 of 4	Southwest	Adelaide	6 - 10	12.39					65	30										5						0.445	
1 of 4	Southwest		6 - 20	11.78					65	30										5						0.445	
1 of 4	Southwest		6 - 30	2.55							50									50						0.575	
1 of 4	Southwest		6 - 40	109.62																80						0.340	20
1 of 4	Southwest	9th Street	9 - 10	12.71					55	40										5						0.460	
1 of 4	Southwest		9 - 20	2.37						100																0.550	
1 of 4	Southwest		9 - 30	10.88							100															0.750	
1 of 4	Southwest		9 - 40	10.94													100									0.700	
1 of 4	Southwest		9 - 50	28.88		20									80											0.720	
1 of 4	Southwest		9 - 60	26.28								50				25				25						0.400	
1 of 4	Southwest	11th Street	11 - 10	32.97								50								50						0.300	
3 of 4	Northwest	13th Street	13 - 1	19.80					35											65						0.400	
1 of 4	Southwest		13 - 2	33.17						60										15		25				0.578	
3 of 4	Northwest		13 - 3	33.21																	100					0.550	
3 of 4	Northwest		13 - 4	21.11																		100				0.750	
1 of 4	Southwest		13 - 5	6.47					10													90				0.715	
3 of 4	Northwest		13 - 6	12.25																		100				0.750	
3 of 4	Northwest		13 - 7	13.37																	10	75		15		0.723	
1 of 4	Southwest		13 - 8	20.78					20		10					10						35		25		0.673	
1 of 4	Southwest		13 - 10	2.80						100																0.550	
1 of 4	Southwest		13 - 20	3.34							20			80												0.670	
1 of 4	Southwest		13 - 30	6.85							30			70												0.680	
1 of 4	Southwest		13 - 40	17.75					40	30		5		25												0.498	
1 of 4	Southwest		13 - 50	16.91						85					15											0.573	
1 of 4	Southwest		13 - 60	30.08																100						0.400	
1 of 4	Southwest	15th Street	15 - 10	10.45	10	30								60												0.720	
1 of 4	Southwest		15 - 20	9.82						100																0.550	
1 of 4	Southwest		15 - 30	7.12								100														0.200	
1 of 4	Southwest		15 - 40	38.34					10	50		15								25						0.445	
1 of 4	Southwest	17th Street	17 - 10	1.96						100																0.550	
1 of 4	Southwest	18th Street	18 - 10	2.20						100																0.550	
1 of 4	Southwest	19th Street	19 - 10	22.79						30										70						0.445	

APPENDIX D - FUTURE LAND USE BREAKDOWN					Future Land Use, Percent																						
Philomath Storm Drainage Master Plan					Philomath - City Zoning Districts													Benton County Zoning Districts									
					Commercial				Residential						Industrial			Commercial		Residential			Industrial				Unzoned
Map	Quadrant	Location	Basin ID		C1	C2	C3	C4	R1	R2	R3	P	O	O/R	LI	HI	SPD	C	C2	UR-5			IP	LI	HI	Runoff	UZ
		Description		Acres																LDR	MDR	HDR				Coeff.	
					0.90	0.80	0.85	0.70	0.40	0.55	0.75	0.20	0.75	0.65	0.70	0.80	0.70	0.75	0.90	0.40	0.55	0.75	0.75	0.70	0.80	Cw	0.10
3 of 4	NW/USGS	Newton	NC - 1	458.31																15						0.145	85
3 of 4	Northwest	Creek	NC - 2	48.05																40	60					0.490	
3 of 4	Northwest		NC - 3	21.37											25									75		0.700	
3 of 4	Northwest		NC - 4	15.50												35									65	0.800	
1 of 4	Southwest		NC - 10	14.58			25	35		40																0.678	
1 of 4	Southwest		NC - 12	14.34		35								65												0.703	
1 of 4	Southwest		NC - 14	27.14		50								50												0.725	
1 of 4	Southwest		NC - 16	8.92			20	30						50												0.705	
2 of 4	Southeast		NC - 18	17.01					90		10															0.435	
2 of 4	Southeast		NC - 20	107.73						5		45								50						0.318	
2 of 4	Southeast		NC - 22	21.80			10		60	30																0.490	
2/4 of 4	SE/NE		NC - 24	203.18								70											30			0.365	
2 of 4	Southeast		NC - 26	66.42																			90	10		0.745	
1 of 4	Southwest		NC - 28	12.80				50										20					30			0.725	
4 of 4	Northeast		NC - 30	132.01																			100			0.750	
4 of 4	Northeast		NC - 32	135.61																			100			0.750	
4 of 4	NE/USGS		NC - 34	255.51																25						0.175	75
4 of 4	NE/USGS		NC - 36	706.01																25						0.175	75
3 of 4	NW/USGS	West	WNC - 1	155.85																30						0.190	70
3 of 4	NW/USGS	Fork	WNC - 2	33.69																100						0.400	
3 of 4	NW/USGS	Newton	WNC - 3	121.48																20	60			20		0.550	
1 of 4	Southwest	Creek	WNC - 4	56.71												15								60	25	0.740	
1 of 4	Southwest		WNC - 5	20.25												15									85	0.800	
1 of 4	Southwest		WNC - 6	26.34												80								15	5	0.785	
1 of 4	Southwest		WNC - 7	5.09																100						0.400	
1 of 4	Southwest		WNC - 8	8.57						10										90						0.415	
1 of 4	Southwest		WNC - 9	5.11																100						0.400	
1 of 4	Southwest		WNC - 10	2.41																100						0.400	
2 of 4	Southeast	Bell-	BF - 90	17.12					100																	0.400	
2 of 4	Southeast	Fountain	BF - 80	4.32					100																	0.400	
2 of 4	Southeast		BF - 70	3.63					100																	0.400	
2 of 4	Southeast		BF - 60	2.31					100																	0.400	
2 of 4	Southeast		BF - 50	13.79					100																	0.400	
2 of 4	Southeast		BF - 40	1.66					100																	0.400	
2 of 4	Southeast		BF - 10	20.75																100						0.400	

APPENDIX D - FUTURE LAND USE BREAKDOWN					Future Land Use, Percent																						
Philomath Storm Drainage Master Plan					Philomath - City Zoning Districts													Benton County Zoning Districts									
					Commercial				Residential						Industrial			Commercial		Residential			Industrial				Unzoned
Map	Quadrant	Location	Basin ID		C1	C2	C3	C4	R1	R2	R3	P	O	O/R	LI	HI	SPD	C	C2	UR-5			IP	LI	HI	Runoff	UZ
		Description		Acres																LDR	MDR	HDR				Coeff.	
					0.90	0.80	0.85	0.70	0.40	0.55	0.75	0.20	0.75	0.65	0.70	0.80	0.70	0.75	0.90	0.40	0.55	0.75	0.75	0.70	0.80	Cw	0.10
2 of 4	Southeast	Southwood	SW - 30	26.93																100						0.400	
2 of 4	Southeast	Area	SW - 20	7.57					100																	0.400	
2 of 4	Southeast		SW - 10	6.66					100																	0.400	
1 of 4	Southwest	Chapel	CH - 10	30.09								90								10						0.220	
2 of 4	Southeast	Drive	CH - 20	17.63																100						0.400	
2/4 of 4	SE/NE/USGS	East Fork	ENC - 10	193.11																			40			0.360	60
2 of 4	Southeast	Newton	ENC - 20	103.40			5		65											30						0.423	
2 of 4	Southeast	Creek	ENC - 30	89.15																100						0.400	
				3831.84																							

APPENDIX D - PEAK STORM FLOW COMPUTATIONS, FUTURE LAND USE CONDITIONS
PHILOMATH STORM DRAINAGE MASTER PLAN

Basin ID	Area	C FUTURE	Area x C	Length	Velocity	Time of Concentration	Travel Time	Tc+Tt calc	Tc+Tt use	Intensity, in/hr (ODOT Zone 8) 5	10	25	50	100	Basin ID	Storm Peak Flow, cfs (ODOT Zone 8) 5	10	25	50	100
	acres	unitless	acres	Feet		min	min	min	min											
610	12.4	0.45	5.5	1,500	3	8.3		8.3	10.0	1.60	1.78	2.07	2.33	2.58	610	9	10	11	13	14
620	11.8	0.45	5.2	1,400	3		7.8	7.8	10.0	1.60	1.78	2.07	2.33	2.58	620	8	9	11	12	14
610+620	*24.2*	*0.45*	*10.8*					*16.1*	*15.0*	*1.32*	*1.50*	*1.72*	*1.95*	*2.19*	*610+620*	*14*	*16*	*18*	*21*	*24*
640	109.6	0.34	37.3	3,000	3		16.7	16.7	20.0	1.13	1.30	1.50	1.69	1.90	640	42	48	56	63	71
610,620,640	*133.8*	*0.36*	*48.0*					*32.8*	*35.0*	*0.82*	*0.92*	*1.10*	*1.21*	*1.38*	*610,620,640*	*39*	*44*	*53*	*58*	*66*
630	2.6	0.58	1.5	700	3		3.9	3.9	10.0	1.60	1.78	2.07	2.33	2.58	630	2	3	3	3	4
610,620,640,630	*136.3*	*0.36*	*49.5*					*32.8*	*35.0*	*0.82*	*0.92*	*1.10*	*1.21*	*1.36*	*610,620,640,630*	*41*	*46*	*54*	*60*	*68*
910	12.7	0.46	5.8	1,400	3	7.8		7.8	10.0	1.60	1.78	2.07	2.33	2.58	910	9	10	12	14	15
930	10.9	0.75	8.2	800	3		4.4	4.4	10.0	1.60	1.78	2.07	2.33	2.58	930	13	15	17	19	21
910+930	*23.6*	*0.59*	*14.0*					*12.2*	*12.0*	*1.48*	*1.65*	*1.90*	*2.18*	*2.40*	*910+930*	*21*	*23*	*27*	*31*	*34*
920	2.4	0.55	1.3	500	3	2.8		2.8	10.0	1.60	1.78	2.07	2.33	2.58	920	2	2	3	3	3
940	10.9	0.70	7.7	700	3		3.9	3.9	10.0	1.60	1.78	2.07	2.33	2.58	940	12	14	16	18	20
920+940	*13.3*	*0.67*	*9.0*					*6.7*	*10.0*	*1.60*	*1.78*	*2.07*	*2.33*	*2.58*	*920+940*	*14*	*16*	*19*	*21*	*23*
910,930,920,940	*26.6*	*0.67*	*17.9*					*18.9*	*20.0*	*1.13*	*1.30*	*1.50*	*1.69*	*1.90*	*910,930,920,940*	*20*	*23*	*27*	*30*	*34*
950	28.9	0.72	20.8	900	3		5.0	5.0	10.0	1.60	1.78	2.07	2.33	2.58	950	33	37	43	48	54
910-950	*55.5*	*0.70*	*38.7*					*23.9*	*25.0*	*1.00*	*1.14*	*1.35*	*1.50*	*1.69*	*910-950*	*39*	*44*	*52*	*58*	*65*
960	26.3	0.40	10.5	1,350	3		7.5	7.5	10.0	1.60	1.78	2.07	2.33	2.58	960	17	19	22	24	27
910-960	*81.8*	*0.60*	*49.2*					*31.4*	*30.0*	*0.91*	*1.02*	*1.21*	*1.36*	*1.51*	*910-960*	*45*	*50*	*60*	*67*	*74*
1110	33.0	0.30	9.9	2,100	3	11.7		0.0	12.0	1.48	1.65	1.90	2.18	2.40	1110	15	16	19	22	24
1303	33.2	0.55	18.3	1,500	3	8.3		8.3	10.0	1.60	1.78	2.07	2.33	2.58	1303	29	33	38	43	47
1304	21.1	0.75	15.8	1,550	3		8.6	8.6	10.0	1.60	1.78	2.07	2.33	2.58	1304	25	28	33	37	41
1303+1304	*54.3*	*0.63*	*34.1*					*16.9*	*20.0*	*1.13*	*1.30*	*1.50*	*1.69*	*1.90*	*1303+1304*	*39*	*44*	*51*	*58*	*65*
1305	6.5	0.72	4.6	1,000	3		5.6	5.6	10.0	1.60	1.78	2.07	2.33	2.58	1305	7	8	10	11	12
1303+1304+1305	*60.8*	*0.64*	*38.7*					*22.5*	*25.0*	*1.00*	*1.14*	*1.35*	*1.50*	*1.69*	*1303+1304+1305*	*39*	*44*	*52*	*58*	*65*
1301	19.8	0.40	7.9	1,250	3	6.9		6.9	10.0	1.60	1.78	2.07	2.33	2.58	1301	13	14	16	18	20
1302	33.2	0.58	19.2	1,600	3		8.9	8.9	10.0	1.60	1.78	2.07	2.33	2.58	1302	31	34	40	45	49
1301+1302	*53.0*	*0.51*	*27.1*					*15.8*	*15.0*	*1.32*	*1.50*	*1.72*	*1.95*	*2.19*	*1301+1302*	*36*	*41*	*47*	*53*	*59*
1306	12.3	0.75	9.2	1,200	3	6.7		6.7	10.0	1.60	1.78	2.07	2.33	2.58	1306	15	16	19	21	24
1307	13.4	0.72	9.7	1,000	3		5.6	5.6	10.0	1.60	1.78	2.07	2.33	2.58	1307	15	17	20	23	25
1306+1307	*25.6*	*0.74*	*18.9*					*12.2*	*12.0*	*1.48*	*1.65*	*1.90*	*2.18*	*2.40*	*1306+1307*	*28*	*31*	*36*	*41*	*45*
1308	20.8	0.67	14.0	1,350	3		7.5	7.5	10.0	1.60	1.78	2.07	2.33	2.58	1308	22	25	29	33	36
1306+1307+1308	*46.4*	*0.71*	*32.8*					*19.7*	*20.0*	*1.13*	*1.30*	*1.50*	*1.69*	*1.90*	*1306+1307+1308*	*37*	*43*	*49*	*55*	*62*
1301-1308	*160.2*	*0.62*	*98.7*						*25.0*	*1.00*	*1.14*	*1.35*	*1.50*	*1.69*	*1301-1308*	*99*	*112*	*133*	*148*	*167*
1310	2.8	0.55	1.5	900	3	5.0		5.0	10.0	1.60	1.78	2.07	2.33	2.58	1310	2	3	3	4	4
1301-1310	*163.0*	*0.61*	*100.2*						*25.0*	*1.00*	*1.14*	*1.35*	*1.50*	*1.69*	*1301-1310*	*100*	*114*	*135*	*150*	*169*
1320	3.3	0.67	2.2	300	3		1.7	1.7	10.0	1.60	1.78	2.07	2.33	2.58	1320	4	4	5	5	6
1301-1320	*166.3*	*0.62*	*102.4*					*26.7*	*25.0*	*1.00*	*1.14*	*1.35*	*1.50*	*1.69*	*1301-1320*	*102*	*117*	*138*	*154*	*173*
1330	6.9	0.68	4.7	200	3		1.1	1.1	10.0	1.60	1.78	2.07	2.33	2.58	1330	7	8	10	11	12
1301-1330	*173.2*	*0.62*	*107.1*					*27.8*	*30.0*	*0.91*	*1.02*	*1.21*	*1.36*	*1.51*	*1301-1330*	*97*	*109*	*130*	*146*	*162*
1340	17.8	0.50	8.8	650	3		3.6	3.6	10.0	1.60	1.78	2.07	2.33	2.58	1340	14	16	18	21	23
1301-1340	*190.9*	*0.61*	*115.9*					*31.4*	*30.0*	*0.91*	*1.02*	*1.21*	*1.36*	*1.51*	*1301-1340*	*105*	*118*	*140*	*156*	*175*
1350	16.9	0.57	9.7	800	3		4.4	4.4	10.0	1.60	1.78	2.07	2.33	2.58	1350	16	17	20	23	25
1301-1350	*207.8*	*0.60*	*125.6*					*35.8*	*35.0*	*0.82*	*0.92*	*1.10*	*1.21*	*1.38*	*1301-1350*	*103*	*116*	*138*	*152*	*173*
1360	30.1	0.40	12.0	1,900	3		10.6	10.6	11.0	1.60	1.78	2.07	2.33	2.58	1360	19	21	25	28	31
1301-1360	*237.9*	*0.58*	*137.7*					*46.4*	*45.0*	*0.69*	*0.78*	*0.92*	*1.02*	*1.15*	*1301-1360*	*95*	*107*	*127*	*140*	*158*

APPENDIX D - PEAK STORM FLOW COMPUTATIONS, FUTURE LAND USE CONDITIONS
PHILOMATH STORM DRAINAGE MASTER PLAN

Basin ID	Area acres	C FUTURE unitless	Area x C acres	Length Feet	Velocity	Time of Concentration min	Travel Time min	Tc+Tt calc min	Tc+Tt use min	Intensity, in/hr (ODOT Zone 8) 5	10	25	50	100	Basin ID	Storm Peak Flow, cfs (ODOT Zone 8) 5	10	25	50	100
1510	10.5	0.72	7.5	900	3	5.0		5.0	10.0	1.60	1.78	2.07	2.33	2.58	1510	12	13	16	18	19
1530	7.1	0.20	1.4	1,350	3		7.5	7.5	10.0	1.60	1.78	2.07	2.33	2.58	1530	2	3	3	3	4
1510+1530	*17.6*	*0.51*	*8.9*					*12.5*	*13.0*	*1.41*	*1.60*	*1.85*	*2.10*	*2.31*	*1510+1530*	*13*	*14*	*17*	*19*	*21*
1520	9.8	0.55	5.4	900	3	5.0		5.0	10.0	1.60	1.78	2.07	2.33	2.58	1520	9	10	11	13	14
1510, 1530, 1520	*27.4*	*0.52*	*14.3*					*12.5*	*13.0*	*1.41*	*1.60*	*1.85*	*2.10*	*2.31*	*1510, 1530, 1520*	*20*	*23*	*27*	*30*	*33*
1710	2.0	0.55	1.1	450	3	2.5		2.5	10.0	1.60	1.78	2.07	2.33	2.58	1710	2	2	2	3	3
1510-1710	*29.4*	*0.53*	*15.4*					*12.5*	*13.0*	*1.41*	*1.60*	*1.85*	*2.10*	*2.31*	*1510-1710*	*22*	*25*	*29*	*32*	*36*
1540	38.3	0.45	17.1	1,800	3		10.0	10.0	10.0	1.60	1.78	2.07	2.33	2.58	1540	27	30	35	40	44
1510-1540	*67.7*	*0.48*	*32.5*					*22.5*	*25.0*	*1.00*	*1.14*	*1.35*	*1.50*	*1.69*	*1510-1540*	*32*	*37*	*44*	*49*	*55*
1810	2.2	0.55	1.21	350	3	1.9		1.9	10.0	1.60	1.78	2.07	2.33	2.58	1810	2	2	3	3	3
1910	22.8	0.45	10.1	2,000	3	11.1		11.1	11.0	1.51	1.70	1.98	2.25	2.48	1910	15	17	20	23	25
NC1	458.3	0.15	66.5	5,500	5	18.3		18.3	20.0	1.13	1.30	1.50	1.69	1.90	NC1	75	86	100	112	126
NC2	48.1	0.49	23.5	1,875	4		7.8	7.8	10.0	1.60	1.78	2.07	2.33	2.58	NC2	38	42	49	55	61
NC1+NC2	*506.4*	*0.18*	*90.0*					*26.1*	*25.0*	*1.00*	*1.14*	*1.35*	*1.50*	*1.69*	*NC1+NC2*	*90*	*103*	*121*	*135*	*152*
NC3	21.4	0.70	15.0	1,000	4		4.2	4.2	10.0	1.60	1.78	2.07	2.33	2.58	NC3	24	27	31	35	39
NC1+NC2+NC3	*527.7*	*0.20*	*105.0*					*30.3*	*30.0*	*0.91*	*1.02*	*1.21*	*1.36*	*1.51*	*NC1+NC2+NC3*	*96*	*107*	*127*	*143*	*158*
NC4	15.5	0.80	12.4	1,250	4		5.2	5.2	10.0	1.60	1.78	2.07	2.33	2.58	NC4	20	22	26	29	32
NC1-NC4	*543.2*	*0.22*	*117.4*					*35.5*	*35.0*	*0.82*	*0.92*	*1.10*	*1.21*	*1.38*	*NC1-NC4*	*96*	*108*	*129*	*142*	*162*
WNC1	155.9	0.19	29.6	2,500	5	8.3		8.3	10.0	1.60	1.78	2.07	2.33	2.58	WNC1	47	53	61	69	76
WNC2	33.7	0.40	13.5	2,000	5	6.7		6.7	10.0	1.60	1.78	2.07	2.33	2.58	WNC2	22	24	28	31	35
WNC3	121.5	0.55	66.8	3,000	4		12.5	12.5	13.0	1.41	1.60	1.85	2.10	2.31	WNC3	94	107	124	140	154
WNC1-WNC3	*311.0*	*0.35*	*109.9*					*20.8*	*20.0*	*1.13*	*1.30*	*1.50*	*1.69*	*1.90*	*WNC1-WNC3*	*124*	*143*	*165*	*186*	*209*
WNC6	26.3	0.79	20.7	1,750	4		7.3	7.3	10.0	1.60	1.78	2.07	2.33	2.58	WNC6	33	37	43	48	53
WNC1,2,3, WNC6	*337.4*	*0.39*	*130.6*					*28.1*	*30.0*	*0.91*	*1.02*	*1.21*	*1.36*	*1.51*	*WNC1,2,3, WNC6*	*119*	*133*	*159*	*178*	*197*
WNC1-6, NC1-4	*880.6*	*0.28*	*247.9*					*35.5*	*35.0*	*0.82*	*0.92*	*1.10*	*1.21*	*1.38*	*WNC1-6, NC1-4*	*203*	*228*	*273*	*300*	*342*
WNC10	2.4	0.40	1.0	100	3	0.6	0.6	0.6	10.0	1.60	1.78	2.07	2.33	2.58	WNC10	2	2	2	2	2
WNC1-6, NC1-4, WNC10	*883.0*	*0.28*	*248.9*					*36.1*	*35.0*	*0.82*	*0.92*	*1.10*	*1.21*	*1.38*	*WNC1-6, NC1-4, WNC10*	*204*	*229*	*274*	*301*	*343*
WNC5	20.3	0.80	16.2	2,000	4	8.3		8.3	10.0	1.60	1.78	2.07	2.33	2.58	WNC5	26	29	34	38	42
WNC7	5.1	0.40	2.0	625	3		3.5	3.5	10.0	1.60	1.78	2.07	2.33	2.58	WNC7	3	4	4	5	5
WNC5+WNC7	*25.3*	*0.72*	*18.2*					*11.8*	*12.0*	*1.48*	*1.65*	*1.90*	*2.18*	*2.40*	*WNC5+WNC7*	*27*	*30*	*35*	*40*	*44*
WNC4	56.7	0.74	42.0	2,250	4	9.4		9.4	10.0	1.60	1.78	2.07	2.33	2.58	WNC4	67	75	87	98	108
WNC8	8.6	0.42	3.6	875	3		4.9	4.9	10.0	1.60	1.78	2.07	2.33	2.58	WNC8	6	6	7	8	9
WNC4+WNC8	*65.3*	*0.70*	*45.5*					*14.2*	*15.0*	*1.32*	*1.50*	*1.72*	*1.95*	*2.19*	*WNC4+WNC8*	*60*	*68*	*78*	*89*	*100*
WNC4, 5, 7, 8	*90.6*	*0.70*	*63.8*					*14.2*	*15.0*	*1.32*	*1.50*	*1.72*	*1.95*	*2.19*	*WNC4, 5, 7, 8*	*84*	*96*	*110*	*124*	*140*
NC14	27.1	0.73	19.7	1,800	3	10.0		10.0	10.0	1.60	1.78	2.07	2.33	2.58	NC14	31	35	41	46	51
WNC4578-NC14	*117.8*	*0.71*	*83.4*					*14.2*	*15.0*	*1.32*	*1.50*	*1.72*	*1.95*	*2.19*	*WNC4578-NC14*	*110*	*125*	*144*	*163*	*183*
NC28	12.8	0.73	9.3	900	3		5.0	5.0	10.0	1.60	1.78	2.07	2.33	2.58	NC28	15	17	19	22	24
WNC4578,NC14,NC28	*130.6*	*0.71*	*92.7*					*19.2*	*20.0*	*1.13*	*1.30*	*1.50*	*1.69*	*1.90*	*WNC4578,NC14,NC28*	*105*	*121*	*139*	*157*	*176*
WNC9	5.1	0.40	2.0	250	3	1.4		1.4	10.0	1.60	1.78	2.07	2.33	2.58	WNC9	3	4	4	5	5
WNC4578,NC14,28,WNC9	*135.7*	*0.70*	*94.8*					*19.2*	*20.0*	*1.13*	*1.30*	*1.50*	*1.69*	*1.90*	*WNC4578,NC14,28,WNC9*	*107*	*123*	*142*	*160*	*180*
NC36	706.0	0.18	123.6	8,000	5	26.7		26.7	25.0	1.00	1.14	1.35	1.50	1.69	NC36	124	141	167	185	209
NC30	132.0	0.75	99.0	3,500	4		14.6	14.6	15.0	1.32	1.50	1.72	1.95	2.19	NC30	131	149	170	193	217
NC36+NC30	*838.0*	*0.27*	*222.6*					*41.3*	*40.0*	*0.75*	*0.84*	*0.98*	*1.11*	*1.24*	*NC36+NC30*	*167*	*187*	*218*	*247*	*276*
NC26	66.4	0.75	49.5	2,625	4		10.9	10.9	11.0	1.51	1.70	1.98	2.25	2.48	NC26	75	84	98	111	123
NC36, 30, 26	*904.4*	*0.30*	*272.0*					*52.2*	*50.0*	*0.64*	*0.73*	*0.85*	*0.95*	*1.08*	*NC36, 30, 26*	*174*	*199*	*231*	*258*	*294*

APPENDIX D - PEAK STORM FLOW COMPUTATIONS, FUTURE LAND USE CONDITIONS
PHILOMATH STORM DRAINAGE MASTER PLAN

Basin ID	Area acres	C FUTURE unitless	Area x C acres	Length Feet	Velocity	Time of Concentration min	Travel Time min	Tc+Tt calc min	Tc+Tt use min	Intensity, in/hr (ODOT Zone 8) 5	10	25	50	100	Basin ID	Storm Peak Flow, cfs (ODOT Zone 8) 5	10	25	50	100
WNC4578,NC14,28,WNC9+															WNC4578,NC14,28,WNC9+					
+NC36, 30, 26	1040.1	0.35	366.8					52.2	50.0	0.64	0.73	0.85	0.95	1.08	+NC36, 30, 26	235	268	312	348	396
NC16	8.9	0.71	6.3	1,200	3	6.7		6.7	10.0	1.60	1.78	2.07	2.33	2.58	NC16	10	11	13	15	16
SUM ALL TO NC16	1049.0	0.36	373.1					52.2	50.0	0.64	0.73	0.85	0.95	1.08	SUM ALL TO NC16	239	272	317	354	403
NC12	14.3	0.70	10.1	1,600	3	8.9		8.9	10.0	1.60	1.78	2.07	2.33	2.58	NC12	16	18	21	23	26
NC10	14.6	0.68	9.9	1,200	3		6.7	6.7	10.0	1.60	1.78	2.07	2.33	2.58	NC10	16	18	20	23	26
NC12+NC10	28.9	0.69	20.0					15.6	15.0	1.32	1.50	1.72	1.95	2.19	NC12+NC10	26	30	34	39	44
NC18	17.0	0.44	7.4	1,600	3		8.9	8.9	10.0	1.60	1.78	2.07	2.33	2.58	NC18	12	13	15	17	19
NC10, 12, 18	45.9	0.60	27.4					24.4	25.0	1.00	1.14	1.35	1.50	1.69	NC10, 12, 18	27	31	37	41	46
NC34	255.5	0.18	44.7	3,500	5	11.7		11.7	12.0	1.48	1.65	1.90	2.18	2.40	NC34	66	74	85	97	107
NC32	135.6	0.75	101.7	2,200	4		9.2	9.2	10.0	1.60	1.78	2.07	2.33	2.58	NC32	163	181	211	237	262
NC34+NC32	391.1	0.37	146.4					20.8	20.0	1.13	1.30	1.50	1.69	1.90	NC34+NC32	165	190	220	247	278
NC24	203.2	0.37	74.2	3,000	4		12.5	12.5	13.0	1.41	1.60	1.85	2.10	2.31	NC24	105	119	137	156	171
NC34, 32, 24	594.3	0.37	220.6					33.3	35.0	0.82	0.92	1.10	1.21	1.38	NC34, 32, 24	181	205	243	267	304
NC22	21.8	0.49	10.7	1,200	3		6.7	6.7	10.0	1.60	1.78	2.07	2.33	2.58	NC22	17	19	22	25	28
NC34, 32, 24, 22	616.1	0.38	231.3					40.0	40.0	0.75	0.84	0.98	1.11	1.24	NC34, 32, 24, 22	173	194	227	257	287
SUM ALL TO N16 +															SUM ALL TO N16 +					
NC 10, 12, 18+															NC 10, 12, 18+					
NC34, 32, 24, 22	1711.1	0.37	631.7					52.2	50.0	0.64	0.73	0.85	0.95	1.08	NC34, 32, 24, 22	404	461	537	600	682
NC20	107.7	0.32	34.3	2,500	4		10.4	10.4	10.0	1.60	1.78	2.07	2.33	2.58	NC20	55	61	71	80	88
SUM ALL TO NC20	1818.8	0.37	666.0					62.6	60.0	0.57	0.64	0.75	0.84	0.94	SUM ALL TO NC20	380	426	499	559	626
ENC21	25.6	0.42	10.8	1,200	3	6.7		6.7	10.0	1.60	1.78	2.07	2.33	2.58	ENC21	17	19	22	25	28
ENC20	77.8	0.42	32.9	1,700	3		9.4	9.4	10.0	1.60	1.78	2.07	2.33	2.58	ENC20	53	59	68	77	85
ENC21+ENC20	103.4	0.42	43.7					16.1	15.0	1.32	1.50	1.72	1.95	2.19	ENC21+ENC20	58	66	75	85	96
ENC10	193.1	0.36	69.5	5,000	4	20.8		20.8	20.0	1.13	1.30	1.50	1.69	1.90	ENC10	79	90	104	117	132
ENC21, 20, 10	296.5	0.38	113.3					30.3	30.0	0.91	1.02	1.21	1.36	1.51	ENC21, 20, 10	103	116	137	154	171
ENC30	89.2	0.40	35.7	2,750	3		15.3	15.3	15.0	1.32	1.50	1.72	1.95	2.19	ENC30	47	53	61	70	78
ENC10,20,21,30	385.7	0.39	148.9					45.6	45.0	0.69	0.78	0.92	1.02	1.15	ENC10,20,21,30	103	116	137	152	171
SW10	6.7	0.40	2.7	800	3	4.4		4.4	10.0	1.60	1.78	2.07	2.33	2.58	SW10	4	5	6	6	7
SW20	7.6	0.40	3.0	650	3		3.6	3.6	10.0	1.60	1.78	2.07	2.33	2.58	SW20	5	5	6	7	8
SW10+SW20	14.2	0.40	5.7					8.1	10.0	1.60	1.78	2.07	2.33	2.58	SW10+SW20	9	10	12	13	15
SW30	26.9	0.40	10.8	1,100	3		6.1	6.1	10.0	1.60	1.78	2.07	2.33	2.58	SW30	17	19	22	25	28
SW10, 20, 30	41.2	0.40	16.5					14.2	15.0	1.32	1.50	1.72	1.95	2.19	SW10, 20, 30	22	25	28	32	36
BF90	17.1	0.40	6.8	1,000	3	5.6		5.6	10.0	1.60	1.78	2.07	2.33	2.58	BF90	11	12	14	16	18
BF80	4.3	0.40	1.7	400	3		2.2	2.2	10.0	1.60	1.78	2.07	2.33	2.58	BF80	3	3	4	4	4
BF90+BF80	21.4	0.40	8.6					7.8	10.0	1.60	1.78	2.07	2.33	2.58	BF90+BF80	14	15	18	20	22
BF60	2.3	0.40	0.9	400	3		2.2	2.2	10.0	1.60	1.78	2.07	2.33	2.58	BF60	1	2	2	2	2
BF90, 80, 60	23.8	0.40	9.5					10.0	10.0	1.60	1.78	2.07	2.33	2.58	BF90, 80, 60	15	17	20	22	25
BF70	3.6	0.40	1.5	500	3	2.8		2.8	10.0	1.60	1.78	2.07	2.33	2.58	BF70	2	3	3	3	4
BF90, 80, 60, 70	27.4	0.40	11.0					10.0	10.0	1.60	1.78	2.07	2.33	2.58	BF90, 80, 60, 70	18	19	23	26	28
BF50	13.8	0.40	5.5	1,600	3	8.9		8.9	10.0	1.60	1.78	2.07	2.33	2.58	BF50	9	10	11	13	14
BF90, 80, 60, 70, 50	41.2	0.40	16.5					10.0	10.0	1.60	1.78	2.07	2.33	2.58	BF90, 80, 60, 70, 50	26	29	34	38	42
BF10	20.8	0.40	8.3	1,100	3		6.1	6.1	10.0	1.60	1.78	2.07	2.33	2.58	BF10	13	15	17	19	21
BF90-50, BF10	61.9	0.40	24.8					16.1	15.0	1.32	1.50	1.72	1.95	2.19	BF90-50, BF10	33	37	43	48	54

HYDRAULIC INFORMATION

BASIN ID (Outfall Name)	NODE FROM	NODE TO	LINE NO.	LOCATION ALONG	LOCATION FROM	LOCATION TO	MATERIAL TYPE	DESCRIPTION	LENGTH (feet)	GROUND ELEV. UPST	GROUND ELEV. DNST	MEASURE DOWN UPST	MEASURE DOWN DNST	INVERT UPST	INVERT DNST	SIZE (in)	SLOPE (ft/ft)	N-VALUE	PIPE FLOWING FULL Q-CAPACITY (cfs)	PIPE FLOWING FULL VELOCITY (ft/sec)	PIPE FLOWING FULL TIME IN PIPE (min)	SURCHARGED FLOW CONDITIONS (outlet control) ROAD ELEV. (FT)	TAILWATER ELEV. (ft)	HEADWATER ELEV. (ft)	LOSS (ft)	VELOCITY (ft/sec)	Q - CAPACITY (cfs)		STORM FLOW (cfs)	EXCESS CAPACITY (cfs)
																													25-YR	
6	A	B	1	ADELAIDE	NORTH OF PIONEER		C	PIPE	200	299.8	287.4	9.7	4.5	290.1	282.9	30	0.036	0.013	78.3	15.8	0.21								11.0	67.3
6	B	C	2	ADELAIDE	NORTH OF PIONEER		C	PIPE	50	287.4	286.1	4.5	6.0	282.9	280.1	30	0.056	0.013	97.4	19.7	0.04								22.0	75.4
6	C	D	3	ADELAIDE	AT PIONEER		C	PIPE	75	286.1	284.2	6.0	4.2	280.1	280.0	30	0.001	0.013	12.3	2.5	0.50								22.0	-9.7
6	D	E	4	BACKLOT	PIONEER TO DAMPIER		C	PIPE	150	284.2	283.0	4.2	4.8	280.0	278.3	36	0.012	0.013	73.0	10.2	0.24								22.0	51.0
6	E	F	5	DAMPIER	DAMPIER		C	PIPE	60	283.0	281.1	4.8	6.5	278.3	274.6	36	0.061	0.013	165.1	23.2	0.04								22.0	143.1
6	F	G	6	BACKLOT	SOUTH OF DAMPIER		C	PIPE	130	281.1	277.5	6.5	5.0	274.6	272.5	36	0.016	0.013	85.1	11.9	0.18								22.0	63.1
6	H	I	8	SPRR	CROSSING		C	CULVERT	80							24		0.013				271.7			3.0	5.8	18.3		33.0	-14.7
6	J	K	10	HWY 20	ALONG HWY 20		C	PIPE	40	271.6	271.0	2.9	2.9	268.7	268.1	24	0.015	0.013	28.2	8.9	0.07								36.0	-7.8
6	K	L	11	HWY 20	ALONG HWY 20		C	PIPE	170	271.0	270.7	2.9	3.1	268.1	267.6	24	0.003	0.013	11.9	3.8	0.75								36.0	-24.1
6	L	M	12	HWY 20	ALONG HWY 20		C	PIPE	65	270.7	270.6	3.1	4.9	267.6	265.7	24	0.030	0.013	39.2	12.4	0.09								36.0	3.2
6	M	N	13	HWY 20	CROSSING		C	PIPE	60	270.6	269.3	4.9	4.9	265.7	264.4	24	0.021	0.013	33.2	10.5	0.10								54.0	-20.8
								L=	1420																					
																													25-YR	
9	A	B	1	9/10 ALLEY	MAIN TO ALLEY		C	PIPE	60	267.8	267.8	3.1	3.3	264.7	264.6	24	0.003	0.013	12.0	3.8	0.26								27.0	-15.0
9	C	D	3	9/10 ALLEY	ALLEY TO APPLEGATE		C	PIPE	220	267.8	266.7	4.5	5.7	263.4	261.0	30	0.011	0.013	42.2	8.5	0.43								30.0	12.2
9	D	E	4	APPLEGATE	9/10 ALLEY TO 9TH		CMP	PIPE (50 X 31)	200	266.7	265.6	5.7	5.3	261.0	260.3	40.5	0.004	0.024	30.7	3.4	0.98								37.0	-6.3
9	E	F	5	9TH	SOUTH OF APPLEGATE		CMP	PIPE (50 X 31)	165	265.6	264.5	5.3	4.9	260.3	259.6	40.5	0.004	0.024	31.9	3.5	0.78								47.0	-15.1
9	F	G	6	9TH	SOUTH OF APPLEGATE		CMP	PIPE (50 X 31)	140	264.5	263.5	4.9	4.8	259.6	258.8	40.5	0.006	0.024	38.3	4.2	0.55								52.0	-13.7
								L=	935																					
																													25-YR	
13	A	B	1	12/13 ALLEY	PIONEER TO N OF MAIN		C	PIPE	620	284.0	275.0	4.5	5.7	279.5	269.3	30	0.016	0.013	52.7	10.6	0.97								135.0	-82.3
13	B	C	2	12/13 ALLEY	N OF MAIN TO S OF MAIN		C	PIPE	320	275.0	273.0	5.7	5.8	269.3	267.2	30	0.007	0.013	33.9	6.8	0.78								135.0	-101.1
13	C	D	3	12/13 ALLEY	NORTH OF APPLEGATE		C	PIPE	370	273.0	267.5	5.8	7.0	267.2	260.5	30	0.018	0.013	55.3	11.2	0.55								135.0	-79.7
13	D	E	4	13TH	APPLEGATE	CEDAR	C	PIPE	900	267.5	262.2	7.0	3.7	260.5	258.5	30	0.002	0.013	19.2	3.9	3.86								135.0	-115.8
								L=	2210																					
																													50-YR	
NC	A	B	1	NC	HIGHWAY 20		C	CULVERT	80							24		0.013				267.8			3.0	5.8	18.3		267.0	-248.7
				TRIB																										
								L=	80																					
ENC	A	B	1	ENC	HIGHWAY 20		C	CULVERT	60							30		0.013				271.7			4.0	7.9	39.2		50-YR	
ENC	A	B	1				C	CULVERT	60							24		0.013				271.7			4.0	6.8	21.6			
ENC	A	B	1				C	CULVERT	60							24		0.013				271.7			4.0	6.8	21.6	82.5	117.0	-34.5
ENC	C	D	2	ENC	JAMES		CMP	CULVERT (30x36)	60							33		0.024				268.6			3.5	6.9	41.1			
ENC	C	D	2		STREET		CMP	CULVERT (30x36)	60							33		0.024				268.6			3.5	6.9	41.1	82.3	135.0	-52.7
ENC	E	F	3	ENC	MIDWAY BETW		CMP	CULVERT (24x42)	60							33		0.024							3.5	6.9	41.1			
ENC	E	F	3		JMS/APPGATE		CMP	CULVERT (24x42)	60							33		0.024							3.5	6.9	41.1	82.3	145.0	-62.7
ENC	G	H	4	ENC	APPLEGATE		CMP	CULVERT (30x36)	100							36		0.024				263.8			4.0	7.0	50.0			
ENC	G	H	4		STREET		CMP	CULVERT (30x36)	100							36		0.024				263.8			4.0	7.0	50.0	100.0	154.0	-54.0
								L=	620																					

CITY OF PHILOMATH
Storm Drainage System Master Plan

Computations for Existing Conditions

APPENDIX E

CITY OF PHILOMATH
Storm Drainage System Master Plan

Computations for Future Conditions

APPENDIX D

APPENDIX D - FUTURE LAND USE BREAKDOWN					Future Land Use, Percent																				
Philomath Storm Drainage Master Plan					Philomath - City Zoning Districts													Benton County Zoning Districts								
					Commercial				Residential						Industrial			Commercial		Residential			Industrial				Unzoned
Map	Quadrant	Location	Basin ID		C1	C2	C3	C4	R1	R2	R3	P	O	O/R	LI	HI	SPD	C	C2	UR-5			IP	LI	HI	Runoff	UZ
		Description		Acres																LDR	MDR	HDR				Coeff.	
					0.90	0.80	0.85	0.70	0.40	0.55	0.75	0.20	0.75	0.65	0.70	0.80	0.70	0.75	0.90	0.40	0.55	0.75	0.75	0.70	0.80	Cw	0.10
1 of 4	Southwest	Adelaide	6 - 10	12.39					65	30										5						0.445	
1 of 4	Southwest		6 - 20	11.78					65	30										5						0.445	
1 of 4	Southwest		6 - 30	2.55							50									50						0.575	
1 of 4	Southwest		6 - 40	109.62																80						0.340	20
1 of 4	Southwest	9th Street	9 - 10	12.71					55	40										5						0.460	
1 of 4	Southwest		9 - 20	2.37						100																0.550	
1 of 4	Southwest		9 - 30	10.88							100															0.750	
1 of 4	Southwest		9 - 40	10.94													100									0.700	
1 of 4	Southwest		9 - 50	28.88		20									80											0.720	
1 of 4	Southwest		9 - 60	26.28								50				25				25						0.400	
1 of 4	Southwest	11th Street	11 - 10	32.97								50								50						0.300	
3 of 4	Northwest	13th Street	13 - 1	19.80					35											65						0.400	
1 of 4	Southwest		13 - 2	33.17						60										15		25				0.578	
3 of 4	Northwest		13 - 3	33.21																	100					0.550	
3 of 4	Northwest		13 - 4	21.11																		100				0.750	
1 of 4	Southwest		13 - 5	6.47					10													90				0.715	
3 of 4	Northwest		13 - 6	12.25																		100				0.750	
3 of 4	Northwest		13 - 7	13.37																	10	75		15		0.723	
1 of 4	Southwest		13 - 8	20.78					20		10					10						35		25		0.673	
1 of 4	Southwest		13 - 10	2.80						100																0.550	
1 of 4	Southwest		13 - 20	3.34							20			80												0.670	
1 of 4	Southwest		13 - 30	6.85							30			70												0.680	
1 of 4	Southwest		13 - 40	17.75					40	30		5		25												0.498	
1 of 4	Southwest		13 - 50	16.91						85					15											0.573	
1 of 4	Southwest		13 - 60	30.08																100						0.400	
1 of 4	Southwest	15th Street	15 - 10	10.45	10	30								60												0.720	
1 of 4	Southwest		15 - 20	9.82						100																0.550	
1 of 4	Southwest		15 - 30	7.12								100														0.200	
1 of 4	Southwest		15 - 40	38.34					10	50		15								25						0.445	
1 of 4	Southwest	17th Street	17 - 10	1.96						100																0.550	
1 of 4	Southwest	18th Street	18 - 10	2.20						100																0.550	
1 of 4	Southwest	19th Street	19 - 10	22.79						30										70						0.445	

APPENDIX D - FUTURE LAND USE BREAKDOWN					Future Land Use, Percent																						
Philomath Storm Drainage Master Plan					Philomath - City Zoning Districts													Benton County Zoning Districts									
					Commercial				Residential						Industrial			Commercial		Residential			Industrial				Unzoned
Map	Quadrant	Location Description	Basin ID	Acres	C1	C2	C3	C4	R1	R2	R3	P	O	O/R	LI	HI	SPD	C	C2	UR-5 LDR	UR-5 MDR	UR-5 HDR	IP	LI	HI	Runoff Coeff. Cw	UZ
					0.90	0.80	0.85	0.70	0.40	0.55	0.75	0.20	0.75	0.65	0.70	0.80	0.70	0.75	0.90	0.40	0.55	0.75	0.75	0.70	0.80		0.10
3 of 4	NW/USGS	Newton	NC - 1	458.31																15						0.145	85
3 of 4	Northwest	Creek	NC - 2	48.05																40	60					0.490	
3 of 4	Northwest		NC - 3	21.37											25									75		0.700	
3 of 4	Northwest		NC - 4	15.50												35									65	0.800	
1 of 4	Southwest		NC - 10	14.58			25	35		40																0.678	
1 of 4	Southwest		NC - 12	14.34		35								65												0.703	
1 of 4	Southwest		NC - 14	27.14		50								50												0.725	
1 of 4	Southwest		NC - 16	8.92			20	30						50												0.705	
2 of 4	Southeast		NC - 18	17.01					90		10															0.435	
2 of 4	Southeast		NC - 20	107.73						5		45								50						0.318	
2 of 4	Southeast		NC - 22	21.80			10		60	30																0.490	
2/4 of 4	SE/NE		NC - 24	203.18								70											30			0.365	
2 of 4	Southeast		NC - 26	66.42																			90	10		0.745	
1 of 4	Southwest		NC - 28	12.80				50										20					30			0.725	
4 of 4	Northeast		NC - 30	132.01																			100			0.750	
4 of 4	Northeast		NC - 32	135.61																			100			0.750	
4 of 4	NE/USGS		NC - 34	255.51																25						0.175	75
4 of 4	NE/USGS		NC - 36	706.01																25						0.175	75
3 of 4	NW/USGS	West	WNC - 1	155.85																30						0.190	70
3 of 4	NW/USGS	Fork	WNC - 2	33.69																100						0.400	
3 of 4	NW/USGS	Newton	WNC - 3	121.48																20	60			20		0.550	
1 of 4	Southwest	Creek	WNC - 4	56.71												15								60	25	0.740	
1 of 4	Southwest		WNC - 5	20.25												15									85	0.800	
1 of 4	Southwest		WNC - 6	26.34												80								15	5	0.785	
1 of 4	Southwest		WNC - 7	5.09																100						0.400	
1 of 4	Southwest		WNC - 8	8.57						10										90						0.415	
1 of 4	Southwest		WNC - 9	5.11																100						0.400	
1 of 4	Southwest		WNC - 10	2.41																100						0.400	
2 of 4	Southeast	Bell-	BF - 90	17.12					100																	0.400	
2 of 4	Southeast	Fountain	BF - 80	4.32					100																	0.400	
2 of 4	Southeast		BF - 70	3.63					100																	0.400	
2 of 4	Southeast		BF - 60	2.31					100																	0.400	
2 of 4	Southeast		BF - 50	13.79					100																	0.400	
2 of 4	Southeast		BF - 40	1.66					100																	0.400	
2 of 4	Southeast		BF - 10	20.75																100						0.400	

APPENDIX D - FUTURE LAND USE BREAKDOWN					Future Land Use, Percent																						
Philomath Storm Drainage Master Plan					Philomath - City Zoning Districts													Benton County Zoning Districts									
					Commercial				Residential						Industrial			Commercial		Residential			Industrial				Unzoned
Map	Quadrant	Location	Basin ID		C1	C2	C3	C4	R1	R2	R3	P	O	O/R	LI	HI	SPD	C	C2	UR-5			IP	LI	HI	Runoff	UZ
		Description		Acres																LDR	MDR	HDR				Coeff.	
					0.90	0.80	0.85	0.70	0.40	0.55	0.75	0.20	0.75	0.65	0.70	0.80	0.70	0.75	0.90	0.40	0.55	0.75	0.75	0.70	0.80	Cw	0.10
2 of 4	Southeast	Southwood	SW - 30	26.93																100						0.400	
2 of 4	Southeast	Area	SW - 20	7.57					100																	0.400	
2 of 4	Southeast		SW - 10	6.66					100																	0.400	
1 of 4	Southwest	Chapel	CH - 10	30.09								90								10						0.220	
2 of 4	Southeast	Drive	CH - 20	17.63																100						0.400	
2/4 of 4	SE/NE/USGS	East Fork	ENC - 10	193.11																			40			0.360	60
2 of 4	Southeast	Newton	ENC - 20	103.40			5		65											30						0.423	
2 of 4	Southeast	Creek	ENC - 30	89.15																100						0.400	
				3831.84																							

APPENDIX D - PEAK STORM FLOW COMPUTATIONS, FUTURE LAND USE CONDITIONS
PHILOMATH STORM DRAINAGE MASTER PLAN

Basin ID	Area	C FUTURE	Area x C	Length	Velocity	Time of Concentration	Travel Time	Tc+Tt calc	Tc+Tt use	Intensity, in/hr (ODOT Zone 8) 5	10	25	50	100	Basin ID	Storm Peak Flow, cfs (ODOT Zone 8) 5	10	25	50	100
	acres	unitless	acres	Feet		min	min	min	min											
610	12.4	0.45	5.5	1,500	3	8.3		8.3	10.0	1.60	1.78	2.07	2.33	2.58	610	9	10	11	13	14
620	11.8	0.45	5.2	1,400	3		7.8	7.8	10.0	1.60	1.78	2.07	2.33	2.58	620	8	9	11	12	14
610+620	24.2	0.45	10.8					16.1	15.0	1.32	1.50	1.72	1.95	2.19	610+620	14	16	18	21	24
640	109.6	0.34	37.3	3,000	3		16.7	16.7	20.0	1.13	1.30	1.50	1.69	1.90	640	42	48	56	63	71
610,620,640	133.8	0.36	48.0					32.8	35.0	0.82	0.92	1.10	1.21	1.38	610,620,640	39	44	53	58	66
630	2.6	0.58	1.5	700	3		3.9	3.9	10.0	1.60	1.78	2.07	2.33	2.58	630	2	3	3	3	4
610,620,640,630	136.3	0.36	49.5					32.8	35.0	0.82	0.92	1.10	1.21	1.36	610,620,640,630	41	46	54	60	68
910	12.7	0.46	5.8	1,400	3	7.8		7.8	10.0	1.60	1.78	2.07	2.33	2.58	910	9	10	12	14	15
930	10.9	0.75	8.2	800	3		4.4	4.4	10.0	1.60	1.78	2.07	2.33	2.58	930	13	15	17	19	21
910+930	23.6	0.59	14.0					12.2	12.0	1.48	1.65	1.90	2.18	2.40	910+930	21	23	27	31	34
920	2.4	0.55	1.3	500	3	2.8		2.8	10.0	1.60	1.78	2.07	2.33	2.58	920	2	2	3	3	3
940	10.9	0.70	7.7	700	3		3.9	3.9	10.0	1.60	1.78	2.07	2.33	2.58	940	12	14	16	18	20
920+940	13.3	0.67	9.0					6.7	10.0	1.60	1.78	2.07	2.33	2.58	920+940	14	16	19	21	23
910,930,920,940	26.6	0.67	17.9					18.9	20.0	1.13	1.30	1.50	1.69	1.90	910,930,920,940	20	23	27	30	34
950	28.9	0.72	20.8	900	3		5.0	5.0	10.0	1.60	1.78	2.07	2.33	2.58	950	33	37	43	48	54
910-950	55.5	0.70	38.7					23.9	25.0	1.00	1.14	1.35	1.50	1.69	910-950	39	44	52	58	65
960	26.3	0.40	10.5	1,350	3		7.5	7.5	10.0	1.60	1.78	2.07	2.33	2.58	960	17	19	22	24	27
910-960	81.8	0.60	49.2					31.4	30.0	0.91	1.02	1.21	1.36	1.51	910-960	45	50	60	67	74
1110	33.0	0.30	9.9	2,100	3	11.7		0.0	12.0	1.48	1.65	1.90	2.18	2.40	1110	15	16	19	22	24
1303	33.2	0.55	18.3	1,500	3	8.3		8.3	10.0	1.60	1.78	2.07	2.33	2.58	1303	29	33	38	43	47
1304	21.1	0.75	15.8	1,550	3		8.6	8.6	10.0	1.60	1.78	2.07	2.33	2.58	1304	25	28	33	37	41
1303+1304	54.3	0.63	34.1					16.9	20.0	1.13	1.30	1.50	1.69	1.90	1303+1304	39	44	51	58	65
1305	6.5	0.72	4.6	1,000	3		5.6	5.6	10.0	1.60	1.78	2.07	2.33	2.58	1305	7	8	10	11	12
1303+1304+1305	60.8	0.64	38.7					22.5	25.0	1.00	1.14	1.35	1.50	1.69	1303+1304+1305	39	44	52	58	65
1301	19.8	0.40	7.9	1,250	3	6.9		6.9	10.0	1.60	1.78	2.07	2.33	2.58	1301	13	14	16	18	20
1302	33.2	0.58	19.2	1,600	3		8.9	8.9	10.0	1.60	1.78	2.07	2.33	2.58	1302	31	34	40	45	49
1301+1302	53.0	0.51	27.1					15.8	15.0	1.32	1.50	1.72	1.95	2.19	1301+1302	36	41	47	53	59
1306	12.3	0.75	9.2	1,200	3	6.7		6.7	10.0	1.60	1.78	2.07	2.33	2.58	1306	15	16	19	21	24
1307	13.4	0.72	9.7	1,000	3		5.6	5.6	10.0	1.60	1.78	2.07	2.33	2.58	1307	15	17	20	23	25
1306+1307	25.6	0.74	18.9					12.2	12.0	1.48	1.65	1.90	2.18	2.40	1306+1307	28	31	36	41	45
1308	20.8	0.67	14.0	1,350	3		7.5	7.5	10.0	1.60	1.78	2.07	2.33	2.58	1308	22	25	29	33	36
1306+1307+1308	46.4	0.71	32.8					19.7	20.0	1.13	1.30	1.50	1.69	1.90	1306+1307+1308	37	43	49	55	62
1301-1308	160.2	0.62	98.7						25.0	1.00	1.14	1.35	1.50	1.69	1301-1308	99	112	133	148	167
1310	2.8	0.55	1.5	900	3	5.0		5.0	10.0	1.60	1.78	2.07	2.33	2.58	1310	2	3	3	4	4
1301-1310	163.0	0.61	100.2						25.0	1.00	1.14	1.35	1.50	1.69	1301-1310	100	114	135	150	169
1320	3.3	0.67	2.2	300	3		1.7	1.7	10.0	1.60	1.78	2.07	2.33	2.58	1320	4	4	5	5	6
1301-1320	166.3	0.62	102.4					26.7	25.0	1.00	1.14	1.35	1.50	1.69	1301-1320	102	117	138	154	173
1330	6.9	0.68	4.7	200	3		1.1	1.1	10.0	1.60	1.78	2.07	2.33	2.58	1330	7	8	10	11	12
1301-1330	173.2	0.62	107.1					27.8	30.0	0.91	1.02	1.21	1.36	1.51	1301-1330	97	109	130	146	162
1340	17.8	0.50	8.8	650	3		3.6	3.6	10.0	1.60	1.78	2.07	2.33	2.58	1340	14	16	18	21	23
1301-1340	190.9	0.61	115.9					31.4	30.0	0.91	1.02	1.21	1.36	1.51	1301-1340	105	118	140	156	175
1350	16.9	0.57	9.7	800	3		4.4	4.4	10.0	1.60	1.78	2.07	2.33	2.58	1350	16	17	20	23	25
1301-1350	207.8	0.60	125.6					35.8	35.0	0.82	0.92	1.10	1.21	1.38	1301-1350	103	116	138	152	173
1360	30.1	0.40	12.0	1,900	3		10.6	10.6	11.0	1.60	1.78	2.07	2.33	2.58	1360	19	21	25	28	31
1301-1360	237.9	0.58	137.7					46.4	45.0	0.69	0.78	0.92	1.02	1.15	1301-1360	95	107	127	140	158

APPENDIX D - PEAK STORM FLOW COMPUTATIONS, FUTURE LAND USE CONDITIONS

PHILOMATH STORM DRAINAGE MASTER PLAN

Basin ID	Area acres	C FUTURE unitless	Area x C acres	Length Feet	Velocity	Time of Concentration min	Travel Time min	Tc+Tt calc min	Tc+Tt use min	Intensity, in/hr (ODOT Zone 8) 5	10	25	50	100	Basin ID	Storm Peak Flow, cfs (ODOT Zone 8) 5	10	25	50	100
1510	10.5	0.72	7.5	900	3	5.0		5.0	10.0	1.60	1.78	2.07	2.33	2.58	1510	12	13	16	18	19
1530	7.1	0.20	1.4	1,350	3		7.5	7.5	10.0	1.60	1.78	2.07	2.33	2.58	1530	2	3	3	3	4
1510+1530	*17.6*	*0.51*	*8.9*					*12.5*	*13.0*	*1.41*	*1.60*	*1.85*	*2.10*	*2.31*	*1510+1530*	*13*	*14*	*17*	*19*	*21*
1520	9.8	0.55	5.4	900	3	5.0		5.0	10.0	1.60	1.78	2.07	2.33	2.58	1520	9	10	11	13	14
1510, 1530, 1520	*27.4*	*0.52*	*14.3*					*12.5*	*13.0*	*1.41*	*1.60*	*1.85*	*2.10*	*2.31*	*1510, 1530, 1520*	*20*	*23*	*27*	*30*	*33*
1710	2.0	0.55	1.1	450	3	2.5		2.5	10.0	1.60	1.78	2.07	2.33	2.58	1710	2	2	2	3	3
1510-1710	*29.4*	*0.53*	*15.4*					*12.5*	*13.0*	*1.41*	*1.60*	*1.85*	*2.10*	*2.31*	*1510-1710*	*22*	*25*	*29*	*32*	*36*
1540	38.3	0.45	17.1	1,800	3		10.0	10.0	10.0	1.60	1.78	2.07	2.33	2.58	1540	27	30	35	40	44
1510-1540	*67.7*	*0.48*	*32.5*					*22.5*	*25.0*	*1.00*	*1.14*	*1.35*	*1.50*	*1.69*	*1510-1540*	*32*	*37*	*44*	*49*	*55*
1810	2.2	0.55	1.21	350	3	1.9		1.9	10.0	1.60	1.78	2.07	2.33	2.58	1810	2	2	3	3	3
1910	22.8	0.45	10.1	2,000	3	11.1		11.1	11.0	1.51	1.70	1.98	2.25	2.48	1910	15	17	20	23	25
NC1	458.3	0.15	66.5	5,500	5	18.3		18.3	20.0	1.13	1.30	1.50	1.69	1.90	NC1	75	86	100	112	126
NC2	48.1	0.49	23.5	1,875	4		7.8	7.8	10.0	1.60	1.78	2.07	2.33	2.58	NC2	38	42	49	55	61
NC1+NC2	*506.4*	*0.18*	*90.0*					*26.1*	*25.0*	*1.00*	*1.14*	*1.35*	*1.50*	*1.69*	*NC1+NC2*	*90*	*103*	*121*	*135*	*152*
NC3	21.4	0.70	15.0	1,000	4		4.2	4.2	10.0	1.60	1.78	2.07	2.33	2.58	NC3	24	27	31	35	39
NC1+NC2+NC3	*527.7*	*0.20*	*105.0*					*30.3*	*30.0*	*0.91*	*1.02*	*1.21*	*1.36*	*1.51*	*NC1+NC2+NC3*	*96*	*107*	*127*	*143*	*158*
NC4	15.5	0.80	12.4	1,250	4		5.2	5.2	10.0	1.60	1.78	2.07	2.33	2.58	NC4	20	22	26	29	32
NC1-NC4	*543.2*	*0.22*	*117.4*					*35.5*	*35.0*	*0.82*	*0.92*	*1.10*	*1.21*	*1.38*	*NC1-NC4*	*96*	*108*	*129*	*142*	*162*
WNC1	155.9	0.19	29.6	2,500	5	8.3		8.3	10.0	1.60	1.78	2.07	2.33	2.58	WNC1	47	53	61	69	76
WNC2	33.7	0.40	13.5	2,000	5	6.7		6.7	10.0	1.60	1.78	2.07	2.33	2.58	WNC2	22	24	28	31	35
WNC3	121.5	0.55	66.8	3,000	4		12.5	12.5	13.0	1.41	1.60	1.85	2.10	2.31	WNC3	94	107	124	140	154
WNC1-WNC3	*311.0*	*0.35*	*109.9*					*20.8*	*20.0*	*1.13*	*1.30*	*1.50*	*1.69*	*1.90*	*WNC1-WNC3*	*124*	*143*	*165*	*186*	*209*
WNC6	26.3	0.79	20.7	1,750	4		7.3	7.3	10.0	1.60	1.78	2.07	2.33	2.58	WNC6	33	37	43	48	53
WNC1,2,3, WNC6	*337.4*	*0.39*	*130.6*					*28.1*	*30.0*	*0.91*	*1.02*	*1.21*	*1.36*	*1.51*	*WNC1,2,3, WNC6*	*119*	*133*	*158*	*178*	*197*
WNC1-6, NC1-4	*880.6*	*0.28*	*247.9*					*35.5*	*35.0*	*0.82*	*0.92*	*1.10*	*1.21*	*1.38*	*WNC1-6, NC1-4*	*203*	*228*	*273*	*300*	*342*
WNC10	2.4	0.40	1.0	100	3	0.6	0.6	0.6	10.0	1.60	1.78	2.07	2.33	2.58	WNC10	2	2	2	2	2
WNC1-6, NC1-4, WNC10	*883.0*	*0.28*	*248.9*					*36.1*	*35.0*	*0.82*	*0.92*	*1.10*	*1.21*	*1.38*	*WNC1-6, NC1-4, WNC10*	*204*	*229*	*274*	*301*	*343*
WNC5	20.3	0.80	16.2	2,000	4	8.3		8.3	10.0	1.60	1.78	2.07	2.33	2.58	WNC5	26	29	34	38	42
WNC7	5.1	0.40	2.0	625	3		3.5	3.5	10.0	1.60	1.78	2.07	2.33	2.58	WNC7	3	4	4	5	5
WNC5+WNC7	*25.3*	*0.72*	*18.2*					*11.8*	*12.0*	*1.48*	*1.65*	*1.90*	*2.18*	*2.40*	*WNC5+WNC7*	*27*	*30*	*35*	*40*	*44*
WNC4	56.7	0.74	42.0	2,250	4	9.4		9.4	10.0	1.60	1.78	2.07	2.33	2.58	WNC4	67	75	87	98	108
WNC8	8.6	0.42	3.6	875	3		4.9	4.9	10.0	1.60	1.78	2.07	2.33	2.58	WNC8	6	6	7	8	9
WNC4+WNC8	*65.3*	*0.70*	*45.5*					*14.2*	*15.0*	*1.32*	*1.50*	*1.72*	*1.95*	*2.19*	*WNC4+WNC8*	*60*	*68*	*78*	*89*	*100*
WNC4, 5, 7, 8	*90.6*	*0.70*	*63.8*					*14.2*	*15.0*	*1.32*	*1.50*	*1.72*	*1.95*	*2.19*	*WNC4, 5, 7, 8*	*84*	*96*	*110*	*124*	*140*
NC14	27.1	0.73	19.7	1,800	3	10.0		10.0	10.0	1.60	1.78	2.07	2.33	2.58	NC14	31	35	41	46	51
WNC4578-NC14	*117.8*	*0.71*	*83.4*					*14.2*	*15.0*	*1.32*	*1.50*	*1.72*	*1.95*	*2.19*	*WNC4578-NC14*	*110*	*125*	*144*	*163*	*183*
NC28	12.8	0.73	9.3	900	3		5.0	5.0	10.0	1.60	1.78	2.07	2.33	2.58	NC28	15	17	19	22	24
WNC4578,NC14,NC28	*130.6*	*0.71*	*92.7*					*19.2*	*20.0*	*1.13*	*1.30*	*1.50*	*1.69*	*1.90*	*WNC4578,NC14,NC28*	*105*	*121*	*139*	*157*	*176*
WNC9	5.1	0.40	2.0	250	3	1.4		1.4	10.0	1.60	1.78	2.07	2.33	2.58	WNC9	3	4	4	5	5
WNC4578,NC14,28,WNC9	*135.7*	*0.70*	*94.8*					*19.2*	*20.0*	*1.13*	*1.30*	*1.50*	*1.69*	*1.90*	*WNC4578,NC14,28,WNC9*	*107*	*123*	*142*	*160*	*180*
NC36	706.0	0.18	123.6	8,000	5	26.7		26.7	25.0	1.00	1.14	1.35	1.50	1.69	NC36	124	141	167	185	209
NC30	132.0	0.75	99.0	3,500	4		14.6	14.6	15.0	1.32	1.50	1.72	1.95	2.19	NC30	131	149	170	193	217
NC36+NC30	*838.0*	*0.27*	*222.6*					*41.3*	*40.0*	*0.75*	*0.84*	*0.98*	*1.11*	*1.24*	*NC36+NC30*	*167*	*187*	*218*	*247*	*276*
NC26	66.4	0.75	49.5	2,625	4		10.9	10.9	11.0	1.51	1.70	1.98	2.25	2.48	NC26	75	84	98	111	123
NC36, 30, 26	*904.4*	*0.30*	*272.0*					*52.2*	*50.0*	*0.64*	*0.73*	*0.85*	*0.95*	*1.08*	*NC36, 30, 26*	*174*	*199*	*231*	*258*	*294*

APPENDIX D - PEAK STORM FLOW COMPUTATIONS, FUTURE LAND USE CONDITIONS
PHILOMATH STORM DRAINAGE MASTER PLAN

Basin ID	Area acres	C FUTURE unitless	Area x C acres	Length Feet	Velocity	Time of Concentration min	Travel Time min	Tc+Tt calc min	Tc+Tt use min	Intensity, in/hr (ODOT Zone 8) 5	10	25	50	100	Basin ID	Storm Peak Flow, cfs (ODOT Zone 8) 5	10	25	50	100
WNC4578,NC14,28,WNC9+															*WNC4578,NC14,28,WNC9+*					
+NC36, 30, 26	*1040.1*	*0.35*	*366.8*					*52.2*	*50.0*	*0.64*	*0.73*	*0.85*	*0.95*	*1.08*	*+NC36, 30, 26*	*235*	*268*	*312*	*348*	*396*
NC16	8.9	0.71	6.3	1,200	3	6.7		6.7	10.0	1.60	1.78	2.07	2.33	2.58	NC16	10	11	13	15	16
SUM ALL TO NC16	*1049.0*	*0.36*	*373.1*					*52.2*	*50.0*	*0.64*	*0.73*	*0.85*	*0.95*	*1.08*	*SUM ALL TO NC16*	*259*	*272*	*317*	*354*	*403*
NC12	14.3	0.70	10.1	1,600	3	8.9		8.9	10.0	1.60	1.78	2.07	2.33	2.58	NC12	16	18	21	23	26
NC10	14.6	0.68	9.9	1,200	3		6.7	6.7	10.0	1.60	1.78	2.07	2.33	2.58	NC10	16	18	20	23	26
NC12+NC10	*28.9*	*0.69*	*20.0*					*15.6*	*15.0*	*1.32*	*1.50*	*1.72*	*1.95*	*2.19*	*NC12+NC10*	*26*	*30*	*34*	*39*	*44*
NC18	17.0	0.44	7.4	1,600	3		8.9	8.9	10.0	1.60	1.78	2.07	2.33	2.58	NC18	12	13	15	17	19
NC10, 12, 18	*45.9*	*0.60*	*27.4*					*24.4*	*25.0*	*1.00*	*1.14*	*1.35*	*1.50*	*1.69*	*NC10, 12, 18*	*27*	*31*	*37*	*41*	*46*
NC34	255.5	0.18	44.7	3,500	5	11.7		11.7	12.0	1.48	1.65	1.90	2.18	2.40	NC34	66	74	85	97	107
NC32	135.6	0.75	101.7	2,200	4		9.2	9.2	10.0	1.60	1.78	2.07	2.33	2.58	NC32	163	181	211	237	262
NC34+NC32	*391.1*	*0.37*	*146.4*					*20.8*	*20.0*	*1.13*	*1.30*	*1.50*	*1.69*	*1.90*	*NC34+NC32*	*165*	*190*	*220*	*247*	*278*
NC24	203.2	0.37	74.2	3,000	4		12.5	12.5	13.0	1.41	1.60	1.85	2.10	2.31	NC24	105	119	137	156	171
NC34, 32, 24	*594.3*	*0.37*	*220.6*					*33.3*	*35.0*	*0.82*	*0.92*	*1.10*	*1.21*	*1.38*	*NC34, 32, 24*	*181*	*203*	*243*	*267*	*304*
NC22	21.8	0.49	10.7	1,200	3		6.7	6.7	10.0	1.60	1.78	2.07	2.33	2.58	NC22	17	19	22	25	28
NC34, 32, 24, 22	*616.1*	*0.38*	*231.3*					*40.0*	*40.0*	*0.75*	*0.84*	*0.98*	*1.11*	*1.24*	*NC34, 32, 24, 22*	*173*	*194*	*227*	*257*	*287*
SUM ALL TO N16 +															*SUM ALL TO N16 +*					
NC 10, 12, 18+															*NC 10, 12, 18+*					
NC34, 32, 24, 22	*1711.1*	*0.37*	*631.7*					*52.2*	*50.0*	*0.64*	*0.73*	*0.85*	*0.95*	*1.08*	*NC34, 32, 24, 22*	*404*	*461*	*537*	*600*	*682*
NC20	107.7	0.32	34.3	2,500	4		10.4	10.4	10.0	1.60	1.78	2.07	2.33	2.58	NC20	55	61	71	80	88
SUM ALL TO NC20	*1818.8*	*0.37*	*666.0*					*62.6*	*60.0*	*0.57*	*0.64*	*0.75*	*0.84*	*0.94*	*SUM ALL TO NC20*	*380*	*426*	*499*	*559*	*626*
ENC21	25.6	0.42	10.8	1,200	3	6.7		6.7	10.0	1.60	1.78	2.07	2.33	2.58	ENC21	17	19	22	25	28
ENC20	77.8	0.42	32.9	1,700	3		9.4	9.4	10.0	1.60	1.78	2.07	2.33	2.58	ENC20	53	59	68	77	85
ENC21+ENC20	*103.4*	*0.42*	*43.7*					*16.1*	*15.0*	*1.32*	*1.50*	*1.72*	*1.95*	*2.19*	*ENC21+ENC20*	*58*	*66*	*75*	*85*	*96*
ENC10	193.1	0.36	69.5	5,000	4	20.8		20.8	20.0	1.13	1.30	1.50	1.69	1.90	ENC10	79	90	104	117	132
ENC21, 20, 10	*296.5*	*0.38*	*113.3*					*30.3*	*30.0*	*0.91*	*1.02*	*1.21*	*1.36*	*1.51*	*ENC21, 20, 10*	*103*	*116*	*137*	*154*	*171*
ENC30	89.2	0.40	35.7	2,750	3		15.3	15.3	15.0	1.32	1.50	1.72	1.95	2.19	ENC30	47	53	61	70	78
ENC10,20,21,30	*385.7*	*0.39*	*148.9*					*45.6*	*45.0*	*0.69*	*0.78*	*0.92*	*1.02*	*1.15*	*ENC10,20,21,30*	*103*	*116*	*137*	*152*	*171*
SW10	6.7	0.40	2.7	800	3	4.4		4.4	10.0	1.60	1.78	2.07	2.33	2.58	SW10	4	5	6	6	7
SW20	7.6	0.40	3.0	650	3		3.6	3.6	10.0	1.60	1.78	2.07	2.33	2.58	SW20	5	5	6	7	8
SW10+SW20	*14.2*	*0.40*	*5.7*					*8.1*	*10.0*	*1.60*	*1.78*	*2.07*	*2.33*	*2.58*	*SW10+SW20*	*9*	*10*	*12*	*13*	*15*
SW30	26.9	0.40	10.8	1,100	3		6.1	6.1	10.0	1.60	1.78	2.07	2.33	2.58	SW30	17	19	22	25	28
SW10, 20, 30	*41.2*	*0.40*	*16.5*					*14.2*	*15.0*	*1.32*	*1.50*	*1.72*	*1.95*	*2.19*	*SW10, 20, 30*	*22*	*25*	*28*	*32*	*36*
BF90	17.1	0.40	6.8	1,000	3	5.6		5.6	10.0	1.60	1.78	2.07	2.33	2.58	BF90	11	12	14	16	18
BF80	4.3	0.40	1.7	400	3		2.2	2.2	10.0	1.60	1.78	2.07	2.33	2.58	BF80	3	3	4	4	4
BF90+BF80	*21.4*	*0.40*	*8.6*					*7.8*	*10.0*	*1.60*	*1.78*	*2.07*	*2.33*	*2.58*	*BF90+BF80*	*14*	*15*	*18*	*20*	*22*
BF60	2.3	0.40	0.9	400	3		2.2	2.2	10.0	1.60	1.78	2.07	2.33	2.58	BF60	1	2	2	2	2
BF90, 80, 60	*23.8*	*0.40*	*9.5*					*10.0*	*10.0*	*1.60*	*1.78*	*2.07*	*2.33*	*2.58*	*BF90, 80, 60*	*15*	*17*	*20*	*22*	*25*
BF70	3.6	0.40	1.5	500	3	2.8		2.8	10.0	1.60	1.78	2.07	2.33	2.58	BF70	2	3	3	3	4
BF90, 80, 60, 70	*27.4*	*0.40*	*11.0*					*10.0*	*10.0*	*1.60*	*1.78*	*2.07*	*2.33*	*2.58*	*BF90, 80, 60, 70*	*18*	*19*	*23*	*26*	*28*
BF50	13.8	0.40	5.5	1,600	3	8.9		8.9	10.0	1.60	1.78	2.07	2.33	2.58	BF50	9	10	11	13	14
BF90, 80, 60, 70, 50	*41.2*	*0.40*	*16.5*					*10.0*	*10.0*	*1.60*	*1.78*	*2.07*	*2.33*	*2.58*	*BF90, 80, 60, 70, 50*	*26*	*29*	*34*	*38*	*42*
BF10	20.8	0.40	8.3	1,100	3		6.1	6.1	10.0	1.60	1.78	2.07	2.33	2.58	BF10	13	15	17	19	21
BF90-50, BF10	*61.9*	*0.40*	*24.8*					*16.1*	*15.0*	*1.32*	*1.50*	*1.72*	*1.95*	*2.19*	*BF90-50, BF10*	*33*	*37*	*43*	*48*	*54*

BASIN ID (Outfall Name)	NODE FROM	NODE TO	LINE NO.	LOCATION ALONG	LOCATION FROM	LOCATION TO	...ARGED FLOW CONDITIONS (outlet control) ...ER (ft)	HEAD-WATER ELEV. (ft)	LOSS (ft)	VEL-OCITY (ft/sec)	Q - CAPACITY (cfs)		STORM FLOW (cfs)	EXCESS CAP-ACITY (cfs)
													25-YR	
6	A	B	1	ADELAIDE	NORTH OF PIONEER								11.0	67.3
6	B	C	2	ADELAIDE	NORTH OF PIONEER								22.0	75.4
6	C	D	3	ADELAIDE	AT PIONEER								22.0	-9.7
6	D	E	4	BACKLOT	PIONEER TO DAMPIER								22.0	51.0
6	E	F	5	DAMPIER	DAMPIER								22.0	143.1
6	F	G	6	BACKLOT	SOUTH OF DAMPIER								22.0	63.1
6	H	I	8	SPRR	CROSSING				3.0	5.8	18.3		33.0	-14.7
6	J	K	10	HWY 20	ALONG HWY 20								36.0	-7.8
6	K	L	11	HWY 20	ALONG HWY 20								36.0	-24.1
6	L	M	12	HWY 20	ALONG HWY 20								36.0	3.2
6	M	N	13	HWY 20	CROSSING								54.0	-20.8
													25-YR	
9	A	B	1	9/10 ALLEY	MAIN TO ALLEY								27.0	-15.0
9	C	D	3	9/10 ALLEY	ALLEY TO APPLEGATE								30.0	12.2
9	D	E	4	APPLEGATE	9/10 ALLEY TO 9TH								37.0	-6.3
9	E	F	5	9TH	SOUTH OF APPLEGATE								47.0	-15.1
9	F	G	6	9TH	SOUTH OF APPLEGATE								52.0	-13.7
													25-YR	
13	A	B	1	12/13 ALLEY	PIONEER TO N OF MAIN								135.0	-82.3
13	B	C	2	12/13 ALLEY	N OF MAIN TO S OF MAIN								135.0	-101.1
13	C	D	3	12/13 ALLEY	NORTH OF APPLEGATE								135.0	-79.7
13	D	E	4	13TH	APPLEGATE	CEDAR							135.0	-115.8
													50-YR	
NC	A	B	1	NC	HIGHWAY 20				3.0	5.8	18.3		267.0	-248.7
				TRIB										
ENC	A	B	1	ENC	HIGHWAY 20				4.0	7.9	39.2		50-YR	
ENC	A	B	1						4.0	6.8	21.6			
ENC	A	B	1						4.0	6.8	21.6	82.5	117.0	-34.5
ENC	C	D	2	ENC	JAMES				3.5	6.9	41.1			
ENC	C	D	2		STREET				3.5	6.9	41.1	82.3	135.0	-52.7
ENC	E	F	3	ENC	MIDWAY BETW				3.5	6.9	41.1			
ENC	E	F	3		JMS/APPGATE				3.5	6.9	41.1	82.3	145.0	-62.7
ENC	G	H	4	ENC	APPLEGATE				4.0	7.0	50.0			
ENC	G	H	4		STREET				4.0	7.0	50.0	100.0	154.0	-54.0

APPENDIX E - EXISTING LAND USE BREAKDOWN					Existing Land Use, Percent																						
Philomath Storm Drainage Master Plan					Philomath - City Zoning Districts													Benton County Zoning Districts									
					Commercial				Residential						Industrial			Commercial		Residential			Industrial				Unzoned
Map	Quadrant	Location	Basin ID		C1	C2	C3	C4	R1	R2	R3	P	O	O/R	LI	HI	SPD	C	C2	UR-5			IP	LI	HI	Runoff	UZ
		Description		Acres																LDR	MDR	HDR				Coeff.	
					0.90	0.80	0.85	0.70	0.40	0.55	0.75	0.20	0.75	0.65	0.70	0.80	0.70	0.75	0.90	0.40	0.55	0.75	0.75	0.70	0.80	Cw	0.10
1 of 4	Southwest	Adelaide	6 - 10	12.39					65.0	30.0										5.0						0.445	
1 of 4	Southwest		6 - 20	11.78					65.0	30.0										5.0						0.445	
1 of 4	Southwest		6 - 30	2.55							37.5									37.5						0.456	
1 of 4	Southwest		6 - 40	109.62																16.0						0.148	20
1 of 4	Southwest	9th Street	9 - 10	12.71					55.0	40.0										5.0						0.460	
1 of 4	Southwest		9 - 20	2.37						100.0																0.550	
1 of 4	Southwest		9 - 30	10.88							100.0															0.750	
1 of 4	Southwest		9 - 40	10.94													100.0									0.700	
1 of 4	Southwest		9 - 50	28.88		20.0									80.0											0.720	
1 of 4	Southwest		9 - 60	26.28								10.0				5.0				5.0						0.160	
1 of 4	Southwest	11th Street	11 - 10	32.97								10.0								10.0						0.140	
3 of 4	Northwest	13th Street	13 - 1	19.80					7.0											13.0						0.160	
1 of 4	Southwest		13 - 2	33.17						30.0										7.5		12.5				0.339	
3 of 4	Northwest		13 - 3	33.21																	10.0					0.145	
3 of 4	Northwest		13 - 4	21.11																		50.0				0.425	
1 of 4	Southwest		13 - 5	6.47					4.0													36.0				0.346	
3 of 4	Northwest		13 - 6	12.25																		10.0				0.165	
3 of 4	Northwest		13 - 7	13.37																	2.0	15.0		3.0		0.225	
1 of 4	Southwest		13 - 8	20.78					8.0		4.0					4.0						14.0		10.0		0.329	
1 of 4	Southwest		13 - 10	2.80						100.0																0.550	
1 of 4	Southwest		13 - 20	3.34							20.0			80.0												0.670	
1 of 4	Southwest		13 - 30	6.85							24.0			56.0												0.564	
1 of 4	Southwest		13 - 40	17.75					40.0	30.0		5.0		25.0												0.498	
1 of 4	Southwest		13 - 50	16.91						42.5					7.5											0.336	
1 of 4	Southwest		13 - 60	30.08																25.0						0.175	
1 of 4	Southwest	15th Street	15 - 10	10.45	10.0	30.0								60.0												0.720	
1 of 4	Southwest		15 - 20	9.82						100.0																0.550	
1 of 4	Southwest		15 - 30	7.12								50.0														0.150	
1 of 4	Southwest		15 - 40	38.34					7.5	37.5		11.3								18.8						0.359	
1 of 4	Southwest	17th Street	17 - 10	1.96						100.0																0.550	
1 of 4	Southwest	18th Street	18 - 10	2.20						100.0																0.550	
1 of 4	Southwest	19th Street	19 - 10	22.79						30.0										70.0						0.445	

APPENDIX E - EXISTING LAND USE BREAKDOWN					Existing Land Use, Percent																						
Philomath Storm Drainage Master Plan					Philomath - City Zoning Districts													Benton County Zoning Districts									
					Commercial				Residential						Industrial			Commercial		Residential			Industrial				Unzoned
Map	Quadrant	Location	Basin ID		C1	C2	C3	C4	R1	R2	R3	P	O	O/R	LI	HI	SPD	C	C2	UR-5			IP	LI	HI	Runoff	UZ
		Description		Acres																LDR	MDR	HDR				Coeff.	
					0.90	0.80	0.85	0.70	0.40	0.55	0.75	0.20	0.75	0.65	0.70	0.80	0.70	0.75	0.90	0.40	0.55	0.75	0.75	0.70	0.80	Cw	0.10
3 of 4	NW/USGS	Newton	NC - 1	458.31																0.0						0.100	85
3 of 4	Northwest	Creek	NC - 2	48.05																0.0	0.0					0.100	
3 of 4	Northwest		NC - 3	21.37											5.0									15.0		0.220	
3 of 4	Northwest		NC - 4	15.50												28.0									52.0	0.660	
1 of 4	Southwest		NC - 10	14.58			25.0	35.0		40.0																0.678	
1 of 4	Southwest		NC - 12	14.34		35.0								65.0												0.703	
1 of 4	Southwest		NC - 14	27.14		50.0								50.0												0.725	
1 of 4	Southwest		NC - 16	8.92			12.0	18.0						30.0												0.463	
2 of 4	Southeast		NC - 18	17.01					54.0		6.0															0.301	
2 of 4	Southeast		NC - 20	107.73						1.0		9.0								10.0						0.144	
2 of 4	Southeast		NC - 22	21.80			10.0		60.0	30.0																0.490	
2/4 of 4	SE/NE		NC - 24	203.18								35.0											15.0			0.233	
2 of 4	Southeast		NC - 26	66.42																			54.0	6.0		0.487	
1 of 4	Southwest		NC - 28	12.80				12.5										5.0					7.5			0.256	
4 of 4	Northeast		NC - 30	132.01																			5.0			0.133	
4 of 4	Northeast		NC - 32	135.61																			5.0			0.133	
4 of 4	NE/USGS		NC - 34	255.51																1.3						0.104	75
4 of 4	NE/USGS		NC - 36	706.01																1.3						0.104	75
3 of 4	NW/USGS	West	WNC - 1	155.85																0.0						0.100	70
3 of 4	NW/USGS	Fork	WNC - 2	33.69																0.0						0.100	
3 of 4	NW/USGS	Newton	WNC - 3	121.48																2.0	6.0			2.0		0.145	
1 of 4	Southwest	Creek	WNC - 4	56.71												9.0								36.0	15.0	0.484	
1 of 4	Southwest		WNC - 5	20.25												4.5									25.5	0.310	
1 of 4	Southwest		WNC - 6	26.34												32.0								6.0	2.0	0.374	
1 of 4	Southwest		WNC - 7	5.09																0.0						0.100	
1 of 4	Southwest		WNC - 8	8.57						1.0										9.0						0.132	
1 of 4	Southwest		WNC - 9	5.11																0.0						0.100	
1 of 4	Southwest		WNC - 10	2.41																0.0						0.100	
2 of 4	Southeast	Bell-	BF - 90	17.12					80.0																	0.340	
2 of 4	Southeast	Fountain	BF - 80	4.32					100.0																	0.400	
2 of 4	Southeast		BF - 70	3.63					100.0																	0.400	
2 of 4	Southeast		BF - 60	2.31					100.0																	0.400	
2 of 4	Southeast		BF - 50	13.79					100.0																	0.400	
2 of 4	Southeast		BF - 40	1.66					100.0																	0.400	
2 of 4	Southeast		BF - 10	20.75																0.0						0.100	

APPENDIX E - EXISTING LAND USE BREAKDOWN					Existing Land Use, Percent																						
Philomath Storm Drainage Master Plan					Philomath - City Zoning Districts													Benton County Zoning Districts									
					Commercial				Residential						Industrial			Commercial		Residential			Industrial				Unzoned
Map	Quadrant	Location	Basin ID		C1	C2	C3	C4	R1	R2	R3	P	O	O/R	LI	HI	SPD	C	C2	UR-5			IP	LI	HI	Runoff	UZ
		Description		Acres																LDR	MDR	HDR				Coeff.	
					0.90	0.80	0.85	0.70	0.40	0.55	0.75	0.20	0.75	0.65	0.70	0.80	0.70	0.75	0.90	0.40	0.55	0.75	0.75	0.70	0.80	Cw	0.10
2 of 4	Southeast	Southwood	SW - 30	26.93																5.0						0.115	
2 of 4	Southeast	Area	SW - 20	7.57					100.0																	0.400	
2 of 4	Southeast		SW - 10	6.66					100.0																	0.400	
1 of 4	Southwest	Chapel	CH - 10	30.09								22.5								2.5						0.130	
2 of 4	Southeast	Drive	CH - 20	17.63																0.0						0.100	
2/4 of 4	SE/NE/USGS	East Fork	ENC - 10	193.11																			8.0			0.152	60
2 of 4	Southeast	Newton	ENC - 20	103.40			4.0		52.0											24.0						0.358	
2 of 4	Southeast	Creek	ENC - 30	89.15																10.0						0.130	
				3831.84																							

APPENDIX E - PEAK STORM FLOW COMPUTATIONS, EXISTING LAND USE CONDITIONS (CHANGE IN RUNOFF C and VELOCITY/TIME)
PHILOMATH STORM DRAINAGE MASTER PLAN

Basin ID	Area acres	C EXIST unitless	Area x C acres	Length Feet	Velocity	Time of Concentration min	Travel Time min	Tc+Tt calc min	Tc+Tt use min	Intensity, in/hr (ODOT Zone 8) 5	10	25	50	100	Basin ID	Storm Peak Flow, cfs (ODOT Zone 8) 5	10	25	50	100
610	12.4	0.45	5.5	1,500	3	8.3		8.3	10.0	1.60	1.78	2.07	2.33	2.58	610	9	10	11	13	14
620	11.8	0.45	5.2	1,400	3		7.8	7.8	10.0	1.60	1.78	2.07	2.33	2.58	620	8	9	11	12	14
610+620	*24.2*	*0.45*	*10.8*					*16.1*	*15.0*	*1.32*	*1.50*	*1.72*	*1.95*	*2.19*	*610+620*	*14*	*16*	*18*	*21*	*24*
640	109.6	0.15	16.2	3,000	2		25.0	25.0	25.0	1.00	1.14	1.35	1.50	1.69	640	16	18	22	24	27
610,620,640	*133.8*	*0.20*	*27.0*					*41.1*	*40.0*	*0.75*	*0.84*	*0.98*	*1.11*	*1.24*	*610,620,640*	*20*	*23*	*26*	*30*	*33*
630	2.6	0.46	1.2	700	2		5.8	5.8	10.0	1.60	1.78	2.07	2.33	2.58	630	2	2	2	3	3
610,620,640,630	*136.3*	*0.21*	*28.1*					*41.1*	*40.0*	*0.75*	*0.84*	*0.98*	*1.11*	*1.24*	*610,620,640,630*	*21*	*24*	*28*	*31*	*35*
910	12.7	0.46	5.8	1,400	3	7.8		7.8	10.0	1.60	1.78	2.07	2.33	2.58	910	9	10	12	14	15
930	10.9	0.75	8.2	800	3		4.4	4.4	10.0	1.60	1.78	2.07	2.33	2.58	930	13	15	17	19	21
910+930	*23.6*	*0.59*	*14.0*					*12.2*	*12.0*	*1.48*	*1.65*	*1.90*	*2.18*	*2.40*	*910+930*	*21*	*23*	*27*	*31*	*34*
920	2.4	0.55	1.3	500	3	2.8		2.8	10.0	1.60	1.78	2.07	2.33	2.58	920	2	2	3	3	3
940	10.9	0.70	7.7	700	3		3.9	3.9	10.0	1.60	1.78	2.07	2.33	2.58	940	12	14	16	18	20
920+940	*13.3*	*0.67*	*9.0*					*6.7*	*10.0*	*1.60*	*1.78*	*2.07*	*2.33*	*2.58*	*920+940*	*14*	*16*	*19*	*21*	*23*
910,930,920,940	*26.6*	*0.67*	*17.9*					*18.9*	*20.0*	*1.13*	*1.30*	*1.50*	*1.69*	*1.90*	*910,930,920,940*	*20*	*23*	*27*	*30*	*34*
950	28.9	0.72	20.8	900	3		5.0	5.0	10.0	1.60	1.78	2.07	2.33	2.58	950	33	37	43	48	54
910-950	*55.5*	*0.70*	*38.7*					*23.9*	*25.0*	*1.00*	*1.14*	*1.35*	*1.50*	*1.69*	*910-950*	*39*	*44*	*52*	*58*	*65*
960	26.3	0.16	4.2	1,350	2		11.3	11.3	11.0	1.51	1.70	1.98	2.25	2.48	960	6	7	8	9	10
910-960	*81.8*	*0.52*	*42.9*					*35.1*	*35.0*	*0.82*	*0.92*	*1.10*	*1.21*	*1.38*	*910-960*	*35*	*39*	*47*	*52*	*59*
1110	33.0	0.14	4.6	2,100	2	17.5		17.5	20.0	1.13	1.30	1.50	1.69	1.90	1110	5	6	7	8	9
1303	33.2	0.15	4.8	1,500	2	12.5		12.5	13.0	1.41	1.60	1.85	2.10	2.31	1303	7	8	9	10	11
1304	21.1	0.43	9.0	1,550	2		12.9	12.9	13.0	1.41	1.60	1.85	2.10	2.31	1304	13	14	17	19	21
1303+1304	*54.3*	*0.25*	*13.8*					*25.4*	*25.0*	*1.00*	*1.14*	*1.35*	*1.50*	*1.69*	*1303+1304*	*14*	*16*	*19*	*21*	*23*
1305	6.5	0.35	2.2	1,000	2		8.3	8.3	10.0	1.60	1.78	2.07	2.33	2.58	1305	4	4	5	5	6
1303+1304+1305	*60.8*	*0.26*	*16.0*					*33.8*	*35.0*	*0.82*	*0.92*	*1.10*	*1.21*	*1.38*	*1303+1304+1305*	*13*	*15*	*18*	*19*	*22*
1301	19.8	0.16	3.2	1,250	2	10.4		10.4	10.0	1.60	1.78	2.07	2.33	2.58	1301	5	6	7	7	8
1302	33.2	0.34	11.2	1,600	2		13.3	13.3	13.0	1.41	1.60	1.85	2.10	2.31	1302	16	18	21	24	26
1301+1302	*53.0*	*0.27*	*14.4*					*23.8*	*25.0*	*1.00*	*1.14*	*1.35*	*1.50*	*1.69*	*1301+1302*	*14*	*16*	*19*	*22*	*24*
1306	12.3	0.17	2.0	1,200	2	10.0		10.0	10.0	1.60	1.78	2.07	2.33	2.58	1306	3	4	4	5	5
1307	13.4	0.23	3.0	1,000	2		8.3	8.3	10.0	1.60	1.78	2.07	2.33	2.58	1307	5	5	6	7	8
1306+1307	*25.6*	*0.20*	*5.0*					*18.3*	*20.0*	*1.13*	*1.30*	*1.50*	*1.69*	*1.90*	*1306+1307*	*6*	*7*	*8*	*8*	*10*
1308	20.8	0.33	6.8	1,350	2		11.3	11.3	11.0	1.51	1.70	1.98	2.25	2.48	1308	10	12	14	15	17
1306+1307+1308	*46.4*	*0.26*	*11.9*					*29.6*	*30.0*	*0.91*	*1.02*	*1.21*	*1.36*	*1.51*	*1306+1307+1308*	*11*	*12*	*14*	*16*	*18*
1301-1308	*160.2*	*0.26*	*42.3*						*35.0*	*0.82*	*0.92*	*1.10*	*1.21*	*1.38*	*1301-1308*	*35*	*39*	*47*	*51*	*58*
1310	2.8	0.55	1.5	900	3	5.0		5.0	10.0	1.60	1.78	2.07	2.33	2.58	1310	2	3	3	4	4
1301-1310	*163.0*	*0.27*	*43.8*						*35.0*	*0.82*	*0.92*	*1.10*	*1.21*	*1.38*	*1301-1310*	*36*	*40*	*48*	*53*	*61*
1320	3.3	0.67	2.2	300	3		1.7	1.7	10.0	1.60	1.78	2.07	2.33	2.58	1320	4	4	5	5	6
1301-1320	*166.3*	*0.28*	*46.1*					*36.7*	*35.0*	*0.82*	*0.92*	*1.10*	*1.21*	*1.38*	*1301-1320*	*38*	*42*	*51*	*56*	*64*
1330	6.9	0.56	3.9	200	2		1.7	1.7	10.0	1.60	1.78	2.07	2.33	2.58	1330	6	7	8	9	10
1301-1330	*173.2*	*0.29*	*49.9*					*38.3*	*40.0*	*0.75*	*0.84*	*0.98*	*1.11*	*1.24*	*1301-1330*	*37*	*42*	*49*	*55*	*62*
1340	17.8	0.50	8.8	650	3		3.6	3.6	10.0	1.60	1.78	2.07	2.33	2.58	1340	14	16	18	21	23
1301-1340	*190.9*	*0.31*	*58.8*					*41.9*	*40.0*	*0.75*	*0.84*	*0.98*	*1.11*	*1.24*	*1301-1340*	*44*	*49*	*58*	*65*	*73*
1350	16.9	0.34	5.7	800	2		6.7	6.7	10.0	1.60	1.78	2.07	2.33	2.58	1350	9	10	12	13	15
1301-1350	*207.3*	*0.31*	*64.5*					*48.6*	*50.0*	*0.64*	*0.73*	*0.85*	*0.95*	*1.08*	*1301-1350*	*41*	*47*	*55*	*61*	*70*
1360	30.1	0.18	5.3	1,900	2		15.8	15.8	15.0	1.60	1.78	2.07	2.33	2.58	1360	8	9	11	12	14
1301-1360	*237.9*	*0.29*	*69.7*					*64.4*	*60.0*	*0.57*	*0.64*	*0.75*	*0.84*	*0.94*	*1301-1360*	*40*	*45*	*52*	*59*	*66*

APPENDIX E - PEAK STORM FLOW COMPUTATIONS, EXISTING LAND USE CONDITIONS (CHANGE IN RUNOFF C and VELOCITY/TIME)

PHILOMATH STORM DRAINAGE MASTER PLAN

Basin ID	Area (acres)	C EXIST (unitless)	Area x C (acres)	Length (Feet)	Velocity	Time of Concentration (min)	Travel Time (min)	Tc+Tt calc (min)	Tc+Tt use (min)	Intensity, in/hr (ODOT Zone 8) 5	10	25	50	100	Basin ID	Storm Peak Flow, cfs (ODOT Zone 8) 5	10	25	50	100
1510	10.5	0.72	7.5	900	3	5.0		5.0	10.0	1.60	1.78	2.07	2.33	2.58	1510	12	13	16	18	19
1530	7.1	0.15	1.1	1,350	2		11.3	11.3	11.0	1.51	1.70	1.98	2.25	2.48	1530	2	2	2	2	3
1510+1530	17.6	0.49	8.6					16.3	15.0	1.32	1.50	1.72	1.95	2.19	1510+1530	11	13	15	17	19
1520	9.8	0.55	5.4	900	3	5.0		5.0	10.0	1.60	1.78	2.07	2.33	2.58	1520	9	10	11	13	14
1510, 1530, 1520	27.4	0.51	14.0					16.3	15.0	1.32	1.50	1.72	1.95	2.19	1510, 1530, 1520	18	21	24	27	31
1710	2.0	0.55	1.1	450	3	2.5		2.5	10.0	1.60	1.78	2.07	2.33	2.58	1710	2	2	2	3	3
1510-1710	29.4	0.51	15.1					16.3	15.0	1.32	1.50	1.72	1.95	2.19	1510-1710	20	23	26	29	33
1540	38.3	0.36	13.8	1,800	2		15.0	15.0	15.0	1.60	1.78	2.07	2.33	2.58	1540	22	25	28	32	36
1510-1540	67.7	0.43	28.8					31.3	30.0	0.91	1.02	1.21	1.36	1.51	1510-1540	26	29	35	39	44
1810	2.2	0.55	1.21	350	3	1.9		1.9	10.0	1.60	1.78	2.07	2.33	2.58	1810	2	2	3	3	3
1910	22.8	0.45	10.1	2,000	3	11.1		11.1	11.0	1.51	1.70	1.98	2.25	2.48	1910	15	17	20	23	25
NC1	458.3	0.10	45.8	5,500	4	22.9		22.9	25.0	1.00	1.14	1.35	1.60	1.69	NC1	46	52	62	73	77
NC2	48.1	0.10	4.8	1,875	3		10.4	10.4	10.0	1.60	1.78	2.07	2.33	2.58	NC2	8	9	10	11	12
NC1+NC2	506.4	0.10	50.6					33.3	35.0	0.82	0.92	1.10	1.21	1.38	NC1+NC2	42	47	56	61	70
NC3	21.4	0.22	4.7	1,000	3		5.6	5.6	10.0	1.60	1.78	2.07	2.33	2.58	NC3	8	8	10	11	12
NC1+NC2+NC3	527.7	0.10	55.3					38.9	40.0	0.75	0.84	0.98	1.11	1.24	NC1+NC2+NC3	42	46	54	61	69
NC4	15.5	0.66	10.2	1,250	3		6.9	6.9	10.0	1.60	1.78	2.07	2.33	2.58	NC4	16	18	21	24	26
NC1-NC4	543.2	0.12	65.6					45.8	45.0	0.69	0.78	0.92	1.02	1.15	NC1-NC4	45	51	60	67	75
WNC1	155.9	0.10	15.6	2,500	4	10.4		10.4	10.0	1.60	1.78	2.07	2.33	2.58	WNC1	25	28	32	36	40
WNC2	33.7	0.10	3.4	2,000	4	8.3		8.3	10.0	1.60	1.78	2.07	2.33	2.58	WNC2	5	6	7	8	9
WNC3	121.5	0.15	17.6	3,000	3		16.7	16.7	15.0	1.32	1.50	1.72	1.95	2.19	WNC3	23	26	30	34	39
WNC1-WNC3	311.0	0.12	36.6					27.1	25.0	1.00	1.14	1.35	1.50	1.69	WNC1-WNC3	37	42	49	55	62
WNC6	26.3	0.37	.9	1,750	3		9.7	9.7	10.0	1.60	1.78	2.07	2.33	2.58	WNC6	16	18	20	23	25
WNC1,2,3, WNC6	337.4	0.14	46.4					36.8	35.0	0.82	0.92	1.10	1.21	1.38	WNC1,2,3, WNC6	38	43	51	56	64
WNC1-6, NC1-4	880.6	0.13	112.0					45.8	45.0	0.69	0.78	0.92	1.02	1.15	WNC1-6, NC1-4	77	87	103	114	129
WNC10	2.4	0.10	0.2	100	2	0.8	0.8	0.8	10.0	1.60	1.78	2.07	2.33	2.58	WNC10	0	0	0	1	1
WNC1-6, NC1-4, WNC10	883.0	0.13	112.2					46.7	45.0	0.69	0.78	0.92	1.02	1.15	WNC1-6, NC1-4, WNC10	77	88	103	114	129
WNC5	20.3	0.31	6.3	2,000	3	11.1		11.1	11.0	1.51	1.70	1.98	2.25	2.48	WNC5	9	11	12	14	16
WNC7	5.1	0.10	0.5	625	2		5.2	5.2	10.0	1.60	1.78	2.07	2.33	2.58	WNC7	1	1	1	1	1
WNC5+WNC7	25.3	0.27	6.8					16.3	15.0	1.32	1.50	1.72	1.95	2.19	WNC5+WNC7	9	10	12	13	15
WNC4	56.7	0.48	27.4	2,250	3	12.5		12.5	13.0	1.41	1.60	1.85	2.10	2.31	WNC4	39	44	51	58	63
WNC8	8.6	0.13	1.1	875	2		7.3	7.3	10.0	1.60	1.78	2.07	2.33	2.58	WNC8	2	2	2	3	3
WNC4+WNC8	65.3	0.44	28.6					19.8	20.0	1.13	1.30	1.50	1.69	1.90	WNC4+WNC8	32	37	43	48	54
WNC4, 5, 7, 8	90.6	0.39	35.4					19.8	20.0	1.13	1.30	1.50	1.69	1.90	WNC4, 5, 7, 8	40	46	53	60	67
NC14	27.1	0.73	19.7	1,800	3	10.0		10.0	10.0	1.60	1.78	2.07	2.33	2.58	NC14	31	35	41	46	51
WNC4578-NC14	117.8	0.47	55.0					19.8	20.0	1.13	1.30	1.50	1.69	1.90	WNC4578-NC14	62	72	83	93	105
NC28	12.8	0.26	3.3	900	2		7.5	7.5	10.0	1.60	1.78	2.07	2.33	2.58	NC28	5	6	7	8	8
WNC4578,NC14,NC28	130.6	0.45	58.3					27.3	25.0	1.00	1.14	1.35	1.50	1.69	WNC4578,NC14,NC28	58	66	79	87	99
WNC9	5.1	0.10	0.5	250	2	2.1		2.1	10.0	1.60	1.78	2.07	2.33	2.58	WNC9	1	1	1	1	1
WNC4578,NC14,28,WNC9	135.7	0.43	58.8					27.3	25.0	1.00	1.14	1.35	1.50	1.69	WNC4578,NC14,28,WNC9	59	67	79	88	99
NC36	706.0	0.10	73.4	8,000	4	33.3		33.3	35.0	0.82	0.92	1.10	1.21	1.38	NC36	60	68	81	89	101
NC30	132.0	0.13	17.6	3,500	3		19.4	19.4	20.0	1.13	1.30	1.50	1.69	1.90	NC30	20	23	26	30	33
NC36+NC30	838.0	0.11	91.0					52.8	55.0	0.60	0.68	0.80	0.89	1.00	NC36+NC30	55	62	73	81	91
NC26	66.4	0.49	32.3	2,625	3		14.6	14.6	15.0	1.32	1.50	1.72	1.95	2.19	NC26	43	49	56	63	71
NC36, 30, 26	904.4	0.14	123.3					67.4	70.0	0.53	0.59	0.68	0.76	0.85	NC36, 30, 26	65	73	84	94	105

APPENDIX E - PEAK STORM FLOW COMPUTATIONS, EXISTING LAND USE CONDITIONS (CHANGE IN RUNOFF C and VELOCITY/TIME)
PHILOMATH STORM DRAINAGE MASTER PLAN

Basin ID	Area acres	C EXIST unitless	Area x C acres	Length Feet	Velocity	Time of Concentration min	Travel Time min	Tc+Tt calc min	Tc+Tt use min	Intensity, in/hr (ODOT Zone 8) 5	10	25	50	100	Basin ID	Storm Peak Flow, cfs (ODOT Zone 8) 5	10	25	50	100
WNC4578,NC14,28,WNC9+															WNC4578,NC14,28,WNC9+					
+NC36, 30, 26	1040.1	0.18	182.2					67.4	70.0	0.53	0.59	0.68	0.76	0.85	+NC36, 30, 26	97	107	124	138	155
NC16	8.9	0.46	4.1	1,200	2	10.0		10.0	10.0	1.60	1.78	2.07	2.33	2.58	NC16	7	7	9	10	11
SUM ALL TO NC16	1049.0	0.18	186.3					67.4	70.0	0.53	0.59	0.68	0.76	0.85	SUM ALL TO NC16	99	110	127	142	158
NC12	14.3	0.70	10.1	1,600	3	8.9		8.9	10.0	1.60	1.78	2.07	2.33	2.58	NC12	16	18	21	23	26
NC10	14.6	0.68	9.9	1,200	3		6.7	6.7	10.0	1.60	1.78	2.07	2.33	2.58	NC10	16	18	20	23	26
NC12+NC10	28.9	0.69	20.0					15.6	15.0	1.32	1.50	1.72	1.95	2.19	NC12+NC10	26	30	34	39	44
NC18	17.0	0.30	5.1	1,600	2		13.3	13.3	13.0	1.41	1.60	1.85	2.10	2.31	NC18	7	8	9	11	12
NC10, 12, 18	45.9	0.55	25.1					28.9	30.0	0.91	1.02	1.21	1.36	1.51	NC10, 12, 18	23	26	30	34	38
NC34	255.5	0.10	26.6	3,500	4	14.6		14.6	15.0	1.32	1.50	1.72	1.95	2.19	NC34	35	40	46	52	58
NC32	135.6	0.13	18.0	2,200	3		12.2	12.2	12.0	1.48	1.65	1.90	2.18	2.40	NC32	27	30	34	39	43
NC34+NC32	391.1	0.11	44.6					26.8	25.0	1.00	1.14	1.35	1.50	1.69	NC34+NC32	45	51	60	67	75
NC24	203.2	0.23	47.3	3,000	3		16.7	16.7	15.0	1.32	1.50	1.72	1.95	2.19	NC24	62	71	81	92	104
NC34, 32, 24	594.3	0.15	92.0					43.5	45.0	0.69	0.78	0.92	1.02	1.15	NC34, 32, 24	63	72	85	94	106
NC22	21.8	0.49	10.7	1,200	3		6.7	6.7	10.0	1.60	1.78	2.07	2.33	2.58	NC22	17	19	22	25	28
NC34, 32, 24, 22	616.1	0.17	102.6					50.1	50.0	0.64	0.73	0.85	0.95	1.08	NC34, 32, 24, 22	66	75	87	98	111
SUM ALL TO N16 +															SUM ALL TO N16 +					
NC 10, 12, 18+															NC 10, 12, 18+					
NC34, 32, 24, 22	1711.1	0.18	314.0					67.4	70.0	0.53	0.59	0.68	0.76	0.85	NC34, 32, 24, 22	166	185	214	239	267
NC20	107.7	0.14	15.5	2,500	3		13.9	13.9	14.0	1.38	1.55	1.79	2.01	2.24	NC20	21	24	28	31	35
SUM ALL TO NC20	1818.8	0.18	329.5					81.3	80.0	0.49	0.54	0.63	0.70	0.78	SUM ALL TO NC20	161	178	208	231	257
ENC21	25.6	0.36	9.2	1,200	2	10.0		10.0	10.0	1.60	1.78	2.07	2.33	2.58	ENC21	15	16	19	21	24
ENC20	77.8	0.36	27.9	1,700	2		14.2	14.2	14.0	1.38	1.55	1.79	2.01	2.24	ENC20	38	43	50	56	62
ENC21+ENC20	103.4	0.36	37.0					24.2	25.0	1.00	1.14	1.35	1.50	1.69	ENC21+ENC20	37	42	50	56	63
ENC10	193.1	0.15	29.4	5,000	3	27.8		27.8	30.0	1.13	1.30	1.50	1.69	1.90	ENC10	33	38	44	50	56
ENC21, 20, 10	296.5	0.22	66.4					41.9	40.0	0.75	0.84	0.98	1.11	1.24	ENC21, 20, 10	50	56	65	74	82
ENC30	89.2	0.13	11.6	2,750	2		22.9	22.9	25.0	1.00	1.14	1.35	1.50	1.69	ENC30	12	13	16	17	20
ENC10,20,21,30	385.7	0.20	78.0					64.9	60.0	0.57	0.64	0.75	0.84	0.94	ENC10,20,21,30	44	50	58	65	73
SW10	6.7	0.40	2.7	800	3	4.4		4.4	10.0	1.60	1.78	2.07	2.33	2.58	SW10	4	5	6	6	7
SW20	7.6	0.40	3.0	650	3		3.6	3.6	10.0	1.60	1.78	2.07	2.33	2.58	SW20	5	5	6	7	8
SW10+SW20	14.2	0.40	5.7					8.1	10.0	1.60	1.78	2.07	2.33	2.58	SW10+SW20	9	10	12	13	15
SW30	26.9	0.12	3.1	1,100	2		9.2	9.2	10.0	1.60	1.78	2.07	2.33	2.58	SW30	5	6	6	7	8
SW10, 20, 30	41.2	0.21	8.8					17.2	15.0	1.32	1.50	1.72	1.95	2.19	SW10, 20, 30	12	13	15	17	19
BF90	17.1	0.34	5.8	1,000	2	8.3		8.3	10.0	1.60	1.78	2.07	2.33	2.58	BF90	9	10	12	14	15
BF80	4.3	0.40	1.7	400	3		2.2	2.2	10.0	1.60	1.78	2.07	2.33	2.58	BF80	3	3	4	4	4
BF90+BF80	21.4	0.35	7.5					10.6	11.0	1.51	1.70	1.98	2.25	2.48	BF90+BF80	11	13	15	17	19
BF60	2.3	0.40	0.9	400	3		2.2	2.2	10.0	1.60	1.78	2.07	2.33	2.58	BF60	1	2	2	2	2
BF90, 80, 60	23.8	0.36	8.5					12.8	13.0	1.41	1.60	1.85	2.10	2.31	BF90, 80, 60	12	14	16	18	20
BF70	3.6	0.40	1.5	500	3	2.8		2.8	10.0	1.60	1.78	2.07	2.33	2.58	BF70	2	3	3	3	4
BF90, 80, 60, 70	27.4	0.36	9.9					12.8	13.0	1.41	1.60	1.85	2.10	2.31	BF90, 80, 60, 70	14	16	18	21	23
BF50	13.8	0.40	5.5	1,600	3	8.9		8.9	10.0	1.60	1.78	2.07	2.33	2.58	BF50	9	10	11	13	14
BF90, 80, 60, 70, 50	41.2	0.38	15.4					12.3	13.0	1.41	1.60	1.85	2.10	2.31	BF90, 80, 60, 70, 50	22	25	29	32	36
BF10	20.8	0.10	2.1	1,100	2		9.2	9.2	10.0	1.60	1.78	2.07	2.33	2.58	BF10	3	4	4	5	5
BF90-50, BF10	61.9	0.28	17.5					21.9	20.0	1.13	1.30	1.50	1.69	1.90	BF90-50, BF10	20	23	26	30	33

CITY OF PHILOMATH
Storm Drainage System Master Plan

Sample Storm Drainage User Fee Ordinances

APPENDIX F

SAMPLE ONLY (DRAFT)

ORDINANCE NO.

AN ORDINANCE OF THE CITY OF PHILOMATH, OREGON, RELATING TO UTILITIES AND STORMWATER MANAGEMENT; AMENDING THE PHILOMATH MUNICIPAL CODE TO ADD A NEW CHAPTER ESTABLISHING A STORMWATER UTILITY; ADOPTING A SYSTEM AND PLAN FOR THAT UTILITY; AND AMENDING THE PHILOMATH MUNICIPAL CODE TO ADD A NEW CHAPTER COMBINING THE STORMWATER UTILITY WITH THE WATERWORKS UTILITY.

WHEREAS, the City Council of the City of Philomath (the "City") has determined that the City's physical growth and urban development has and will continue to increase the volume of stormwater runoff collected in and routed through the City's stormwater facilities and system ("stormwater system"); and

WHEREAS, the City Council finds that stormwater runoff causes property damage and erosion; carries concentrations of nutrients, heavy metals, oil and toxic materials into receiving waters and ground water; degrades the integrity of City streets and the transportation system; and reduces citizen access to emergency services and poses hazards to both lives and property; and

WHEREAS, the existing stormwater system in the City cannot adequately address runoff quantity or quality issues; and

WHEREAS, the City Council has determined that stormwater runoff must be managed in a manner that protects the public health, safety and welfare; and

WHEREAS, the City Council finds that stormwater quality and quantity problems cannot be allowed to escalate as a result of inadequate stormwater design criteria, regulation, public awareness or code enforcement; and

WHEREAS, after public meetings on the subject, the City Council finds that the City's stormwater system must be funded in a manner enabling comprehensive maintenance, operation and regulation of stormwater through revisions to the City's existing surface water service charge; and

WHEREAS, the City Council finds that all developed real property within the City's boundaries, contributes runoff to the City's stormwater system; that all developed real property benefits from the City's maintenance and operation of the stormwater system; and that all developed property should contribute to the funding of the City's program for maintenance, operation and improvement of the stormwater system; and

WHEREAS, a professional stormwater management and engineering consultant, and staff of the City's Public Works Department, have assessed methods for stormwater management, evaluated options for improvements and made appropriate recommendations;

NOW, THEREFORE,
THE CITY COUNCIL OF THE CITY OF PHILOMATH, OREGON DOES HEREBY ORDAIN AS FOLLOWS:

Section 1. A new chapter is added to the PHILOMATH Municipal Code, as follows:

CHAPTER ______

STORMWATER UTILITY

Purpose - Findings. The City finds and declares:

(1) All real property in the City contributes runoff to the common stormwater problem, and all real property in the City benefits from the stormwater utility of the City.

(2) The development of real property, as measured by the square footage of impervious surface area, is an appropriate basis for the determination of an individual parcel's contribution to the problem of stormwater runoff.

Potential Hazard Declared. The City finds and declares that absent effective maintenance, operation, regulation and control, existing stormwater drainage conditions in all drainage basins within the City constitute a potential hazard to the health, safety and general welfare of the City. The City Council further finds that natural and man-made stormwater facilities and conveyances together constitute a stormwater drainage system and that effective regulation and control of stormwater through formation, by the City, of a stormwater utility requires the transfer to the utility of all stormwater facilities and conveyances and related rights belonging to the City.

Stormwater Management Utility Created - Responsibilities. There is hereby created and established pursuant to Chapters ________ and _______ ORS, and Article ___, Section ___ of the Oregon State Constitution, a stormwater utility. All references to "the Utility" in this chapter refer to the stormwater utility. The Utility will have authority and responsibility for planning, design, construction, maintenance, administration and operation of all City stormwater conveyances and facilities.

Property Transferred to Utility. Title and all other incidents of ownership of the following assets are hereby transferred to and vested in the Utility: all properties, interests and physical and intangible rights of every nature owned or held by the City, however acquired, insofar as they relate to or concern stormwater, further including, without limitation, all properties, interests, and rights acquired by adverse possession or by prescription, directly or through another, in and to the drainage or storage, or both, of stormwater, through, under, or over lands, watercourses, sloughs, streams, ponds, lakes, and swamps, all beginning in each instance at a point where stormwater first enter the system of the City and ending in each instance at a point where the stormwater exits from the system of the City, and in width to the full extent of inundation caused by storm or flood conditions.

Utility Administered by Public Works Director. The Utility shall be administered by the Director of Public Works.

Section 2. A new chapter ______ is added to the PHILOMATH Municipal Code, as follows:

Chapter x COMBINED UTILITY

Combined Utility. The City is operating and maintaining a waterworks utility, consisting of a water and sewerage system. Pursuant to the provisions of ORS _________, the stormwater utility is hereby combined with the waterworks utility and, together with all additions, extensions and betterment thereof at any time made, shall hereinafter be called the "waterworks utility."

Waterworks Utility - Rates and Charges - Credit - Priority. In the event that any person, firm or corporation shall tender as payment of water, sewer, or stormwater services an amount insufficient to pay in full all of the charges so billed, credit shall be given first to the stormwater utility charges, second to the charges for sanitary sewer service and lastly to the charges for water service.

In the event that any utility account shall become delinquent, water service may be terminated by the City and discontinued until all delinquent rates or charges for the use of the stormwater service, sanitary sewer service and water service shall have been paid in full. The provisions for collection provided herein shall be in addition to any rights or remedies which the City may have under the laws of the State of Oregon.

Section 3. The Public Works Department shall prepare or cause to be prepared a comprehensive stormwater quantity and quality management plan for consideration by the City Council. This plan shall be presented to Council no later than _____ months after enactment of this stormwater utility ordinance.

Section 4. Any acts made consistent with the authority and prior to the effective date of this ordinance are hereby ratified and confirmed.

Section 5. This ordinance shall take effect and be in force five (5) days after its passage, approval and publication as provided by law.

INTRODUCED: Mayor

PASSED:

APPROVED AS TO FORM: ATTEST:

City Attorney
City Clerk Published: Effective:

ORDINANCE 1994-19

AN ORDINANCE AMENDING ORDINANCE 1983-2. AN ORDINANCE REGULATING THE USE OF PUBLIC AND PRIVATE SEWERS AND DRAINS.

NOW, THEREFORE, BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF SHERIDAN, as follows:

Section 1: Ordinance 83-2 shall be amended to include the following:

ARTICLE X
STORM DRAINAGE CHARGE

A. A storm drainage fee shall be established. The obligation to pay the storm drainage fee arises when a person responsible uses storm drainage services. It is presumed that storm drainage services are used whenever there is an improved premises.

B. Unless another person responsible has agreed in writing to pay, and a copy of that writing is filed with the city, the person paying the city's utility charges shall pay the storm drainage fees. If there is no water service to the property or if water service is discontinued, the storm drainage fees shall be paid by the person having the right to occupy the property.

C. When establishing fees for storm drainage service the Council shall:

1. Establish a monthly rate for a single family unit, which rate shall be applied to residentially used property based upon the number of dwelling units, and which rate shall be the rate for an equivalent residential unit, and

2. Establish a monthly rate for all property not included in subsection C(1) of this section, based on the amount of the property's impervious surface.

a. For each three thousand square feet of impervious surface, as determined by the City Engineer, the said property will be charged the rate for a single family unit. The minimum service charge shall be that established for a single family unit.

b. The storm drainage fees for a mobile home park shall be established at the rate of one single family unit per space.

c. The maximum charge for a multiple-family building or facility shall be limited to the number of multiple family units on the property multiplied by the charge for a single family unit.

D. When required, area measurements may be determined from records of the county assessor or by the City Engineer.

E. A responsible person may apply for a reduction or elimination of the monthly charge for storm drainage service through submission of appropriate evidence to the City Engineer. The applicant must show to the Engineer's satisfaction that:

1. The square footage of impervious surface was miscalculated for the property; or

2. All storm water from the property is being discharged directly into the South Yamhill River and not into the City drainage system.

Any reduction or elimination given shall continue until the property is further developed or until the City Engineer determines the property no longer qualifies for the reduction or elimination granted. Upon further development of the property another application may be made by a person responsible. Any applicant aggrieved by the City Engineer's decision may appeal to the City Manager by filing a written request for review. This must be done no later than ten days after receiving the City Engineer's decision. The City Manager's decision shall be final.

F. The rate of a single family unit shall be established at $3.00 per month.

Section 2: The Council desires and deems it necessary for the preservation of the health, peace and safety of the City of Sheridan that this Ordinance take effect at once, and therefore, an emergency is hereby declared to exist, and this ordinance shall be in full force and effect from and after its passage and approval.

PASSED by the Council of the City of Sheridan this ____ day of ______________________________, 1994, by the following vote:

AYES: ____

NAYS: ____

Approved by the Mayor this _____ day of ____________________, 1994

____
Mayor

ATTEST:

____
City Recorder