SECTION 4
ANALYSIS METHODOLOGY

General

This section describes the methodology used to analyze the existing system and the design criteria used to develop improvement recommendations. The analysis methodology and design criteria are based on the City of Salem stormwater management design standards which the City of Sheridan has adopted. The system analysis and improvement recommendations are presented in Sections 5 and 6, respectively.

The stormwater analysis consists of hydrologic and hydraulic components. The hydrologic component estimates the volume and peak flow rate of stormwater runoff entering the stormwater conveyance system in response to the rainfall associated with a particular design storm. The total volume and peak flow rate of stormwater runoff depends on the duration and intensity of the storm, the topography, soil type and amount of impervious area of the basin. The hydraulic component routes the stormwater that results from the hydrologic component through the conveyance system. The hydraulic component evaluates the conveyance system's capacity to route the design storm and is used to identify areas that may be prone to flooding. The hydraulic analysis depends on geometry (size, shape and slope) and other characteristic data of the pipe and channel system to estimate capacity.

The computer modeling program PCSWMM by Computational Hydraulics, Int., (Version 2005) is used for both the hydrologic and hydraulic analysis. PCSWMM is a well-known stormwater analysis model in common use for over 25 years and uses the Environmental Protection Agency's (EPA's) Stormwater Management Model (SWMM) core processes.

Hydrologic Analysis Methodology

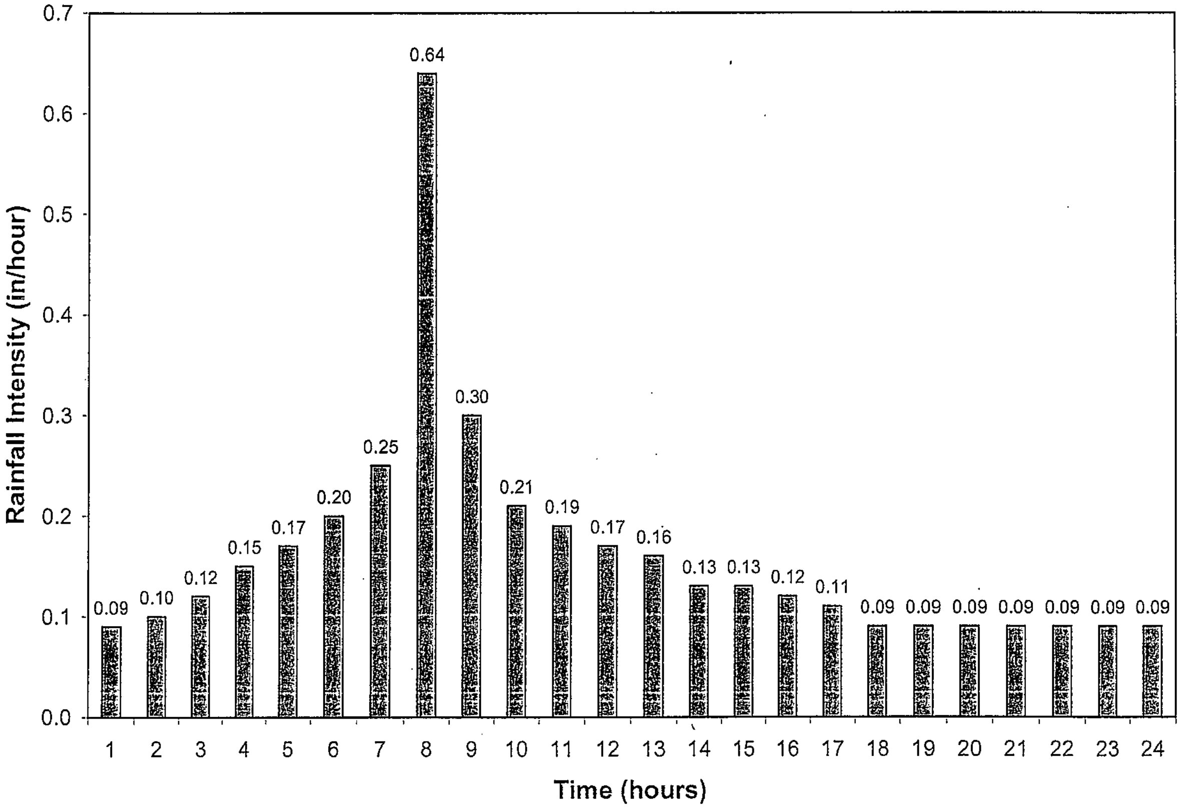
Precipitation

The two precipitation components needed for a hydrologic analysis are:

- The total depth of precipitation for the design storm event
- The rainfall distribution over the duration of the storm event

The Natural Resource Conservation Service (NRCS) has developed a 24-hour duration rainfall distribution appropriate to the City of Sheridan (the Type 1A storm) along with total rainfall depths associated with storm recurrence intervals. The Type 1A 25-year storm is an approved design storm per the adopted City of Salem design standards. The total depth of precipitation for the design storm is 3.9 inches. The storm hyetograph (rainfall intensity versus time) is shown in Figure 4-1.

Figure 4-1
24-Hour NRCS Type 1A 25-Year Design Storm for Sheridan, Oregon



Land Use and Soil Parameters

The dominant soils in the City are Wapato and Cove silt loams, which are both hydrologic soil group D, a high runoff soils group. The soil group D was used to estimate the Horton runoff estimation parameters used in SWMM. The low infiltration capacity of the soils results in appreciable natural runoff volumes.

Impervious area, the area through which no water can penetrate, like rooftops and roadways, is a critical factor in determining the runoff quantity generated in the basin and in predicting the additional runoff from future development. Development generally increases the effective impervious area and hence increase the runoff rates. Since the various land use types have varying amounts of impervious area, land use within each basin is analyzed to estimate the percent impervious area within each basin.

For purposes of estimating imperviousness, each land use type is assigned a percent imperviousness published in the Soil Conservation Service's (SCS's) Technical Release 55 (TR-55) of June of 1986. Table 4-1 shows the percent imperviousness assigned to each land use for this study. The open space land use category is assigned to areas zoned as public lands and when modeling existing conditions in undeveloped areas.

Table 4-1
Percent Imperviousness by Land Use

Zone	Zone Description	Percent Imperviousness[1]
R-1	Low Density Residential District	38%
R-2	Medium Density Residential District[2]	52%
R-3	Mixed Use Residential District	65%
C	Commercial District	85%
I	Industrial District	72%
PF	Public Facilities District[3]	38%
UT	Urban Transitional District[4]	20%

[1] Source: SCS Technical Release 55, Second Edition, June 1986.
[2] Interpolated between 1/4 and 1/8 acre average lot size
[3] Public Facilities District Equivalent to Med Density Residential District
[4] Urban Transitional Districts Equivalent to 1 acre Residential District

Hydraulic Analysis Methodology

Existing Facilities

Conveyance facilities within the planning area include piped systems and open channel systems. All systems were modeled under the 25-year storm event to determine if there is adequate capacity within the system. The existing facilities were considered inadequate if overtopping was predicted in the hydraulic model. All stormwater flows to the South Yamhill River. For analysis purposes, the outfalls at the river are modeled as an un-submerged condition during the 25-year event, which is generally a free discharge condition. Unless otherwise noted, the outfalls are located at or above the 10-year flood elevation.

A detailed survey of the existing system was not performed as part of this project. As a result, there was not sufficient data to define all pipe slopes, invert elevations and open channel geometry. For storm sewer lines parallel to sanitary sewer lines of known slope, the slope of the sanitary pipe was used to represent the storm line as well. All other missing storm line slopes were set at the minimum design slope per City of Salem design standards, which represents a conservative analysis.

Roughness coefficients are used to model the relative roughness of the inside walls of stormwater piping and the surfaces of open channels. The PCSWMM model uses the Manning's "n" factor to represent this roughness. Table 4-2 shows the Manning's "n" roughness coefficients used for the various conduit types in this study, which meet the City standards. For modeling purposes, all unknown pipe types were assigned an "n" value of 0.013.

Table 4-2
Model Roughness Coefficients[1]

Conduit Type	Manning's "n"
Closed Conduits:	
Concrete	0.013
Steel	0.013
PVC/HDPE	0.013
Ductile Iron	0.013
Corrugated Metal Pipe	0.022
Open Channels:	
Rock-Lined	0.030
Natural	0.030-0.050

[1]Source: *Design and Construction of Urban Stormwater Management Systems*, American Society of Civil Engineers, 1992.

Design Standards for Proposed Improvements

The following City design standards were used when modeling the proposed stormwater system improvements:

- Design of the storm conveyance system shall provide a minimum one foot of freeboard between the hydraulic grade line and the top of the structure, or finish grade above the pipe, for the 25-year, post-development peak rate of runoff.
- Design surcharge (hydraulic grade line) in pipe systems for the 25-year design storm event shall not cause flooding in portions of a habitable structure, including below floor crawl spaces, or otherwise create a hazard or danger to the health and safety of the public.
- Open channel systems shall be designed for a minimum of one foot of freeboard from bank full provided no structures are impacted by the design water surface elevation.
- Sewers shall not decrease in size as they move downstream.
- Where topography allows, storm sewers shall have sufficient slope to maintain a minimum flow velocity of 2.5 feet per second when flowing full.
- Storm sewers shall have a minimum diameter of 10 inches.
- When the outlet pipe is larger than the inlet pipe, the inverts shall be designed so that pipe crowns shall have the same elevation.