Oregon
Theodore R. Kulongoski, Governor

Department of Land Conservation and Development
635 Capitol Street NE, Suite 150
Salem, Oregon 97301-2524
Phone: (503) 373-0050
First Floor/Costal Fax: (503) 378-6033
Second Floor/Director's Office: (503) 378-5518
Web Address: http://www.oregon.gov/LCD

NOTICE OF ADOPTED AMENDMENT

December 6, 2007

TO: Subscribers to Notice of Adopted Plan or Land Use Regulation Amendments

FROM: Mara Ulloa, Plan Amendment Program Specialist 12-7-07

SUBJECT: City of Mill City Plan Amendment
DLCD File Number 002-07

The Department of Land Conservation and Development (DLCD) received the attached notice of adoption. Copies of the adopted plan amendment are available for review at DLCD offices in Salem, the applicable field office, and at the local government office. This adoption was adopted by the City on November 23, 2007, and passed the 21-day appeal period from the date of the adoption. Due to the size of amended material submitted, a complete copy has not been attached.

Appeal Procedures*

DLCD DEADLINE TO APPEAL: Acknowledged under ORS 197.625 and ORS 197.830 (9)

This amendment was submitted to DLCD for review prior to adoption with less than the required 45-day notice. Pursuant to ORS 197.625 if no notice of intent to appeal is filed within the 21-day period set out in ORS 197.830 (9), the amendment to the acknowledged comprehensive plan or land use regulation or the new land use regulation shall be considered acknowledged upon the expiration of the 21-day period.

Under ORS 197.830 (9) a notice of intent to appeal a land use decision or limited land use decision shall be filed not later than 21 days after the date the decision sought to be reviewed becomes final.

If you have questions, check with the local government to determine the appeal deadline. Copies of the notice of intent to appeal must be served upon the local government and others who received written notice of the final decision from the local government. The notice of intent to appeal must be served and filed in the form and manner prescribed by LUBA, (OAR Chapter 661, Division 10). Please call LUBA at 503-373-1265, if you have questions about appeal procedures.

*NOTE: **THE APPEAL DEADLINE IS BASED UPON THE DATE THE DECISION WAS ADOPTED BY LOCAL GOVERNMENT. A DECISION MAY HAVE BEEN MAILED TO YOU ON A DIFFERENT DATE THAN IT WAS MAILED TO DLCD. AS A RESULT YOUR APPEAL DEADLINE MAY BE EARLIER THAN THE DATE SPECIFIED ABOVE.**

Cc: Doug White, DLCD Community Services Specialist
Jason Locke, DLCD Regional Representative
David Kinney, City of Mill City
<paa> ya/

FORM 2

DLCD
Notice of Adoption

THIS FORM **MUST BE MAILED** TO DLCD
WITHIN 5 WORKING DAYS AFTER THE FINAL DECISION
PER ORS 197.610, OAR CHAPTER 660 - DIVISION 18

☐ In person ☐ electronic ☐ mailed

DEPT OF
NOV 28 2007
LAND CONSERVATION AND DEVELOPMENT
For DLCD Use Only

Jurisdiction: **Mill City** Local file number: **2007-05-07**
Date of Adoption: **10/23/2007** Date Mailed: **11/21/2007**
Was a Notice of Proposed Amendment (Form 1) mailed to DLCD? **Yes**Date: 6-27-2007

☒ Comprehensive Plan Text Amendment ☐ Comprehensive Plan Map Amendment
☐ Land Use Regulation Amendment ☐ Zoning Map Amendment
☐ New Land Use Regulation ☒ Other: **Storm Sewer Master Plan**

Summarize the adopted amendment. Do not use technical terms. Do not write "See Attached".

Storm Drainage System Master Plan, including an updated subbasin plan for the Kingwood Area subbasin, which encompasses the southern 1/4 of the Mill City UGB.

Does the Adoption differ from proposal? Please select one

Ordinance 347 takes effect on November 22, 2007 - Final adoption includes adoption of the full Storm Drainage System.

Plan Map Changed from: to:
Zone Map Changed from: to:
Location: **Citywide** Acres Involved:
Specify Density: Previous: New:
Applicable statewide planning goals:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☐	☐	☐	☐	☐	☐

Was an Exception Adopted? ☐ YES ☒ NO

Did DLCD receive a Notice of Proposed Amendment...
45-days prior to first evidentiary hearing? ☒ **Yes** ☐ **No**
If no, do the statewide planning goals apply? ☐ **Yes** ☐ **No**
If no, did Emergency Circumstances require immediate adoption? ☐ **Yes** ☐ **No**

DLCD # 002-07 (16498)

DLCD file No. ____________________

Please list all affected State or Federal Agencies, Local Governments or Special Districts:

Linn and Marion Counties, DLCD, DSL, ODFW, Corps of Engineers,

---

Local Contact: **David Kinney, Planning Consultant** Phone: **(503) 897-2302** Extension:

Address: **PO Box 256** Fax Number: **503-897-3499**

City: **Mill City** Zip: **97360-** E-mail Address: **millcity@wbcable.net**

ADOPTION SUBMITTAL REQUIREMENTS

This form **must be mailed** to DLCD **within 5 working days after the final decision**
per ORS 197.610, OAR Chapter 660 - Division 18.

1. Send this Form and **TWO Complete Copies** (documents and maps) of the Adopted Amendment to:

   ATTENTION: PLAN AMENDMENT SPECIALIST
   DEPARTMENT OF LAND CONSERVATION AND DEVELOPMENT
   635 CAPITOL STREET NE, SUITE 150
   SALEM, OREGON 97301-2540

2. Electronic Submittals: At least **one** hard copy must be sent by mail or in person, but you may also submit an electronic copy, by either email or FTP. You may connect to this address to FTP proposals and adoptions: **webserver.lcd.state.or.us**. To obtain our Username and password for FTP, call Mara Ulloa at 503-373-0050 extension 238, or by emailing **mara.ulloa@state.or.us**.

3. Please Note: Adopted materials must be sent to DLCD not later than **FIVE (5) working days** following the date of the final decision on the amendment.

4. Submittal of this Notice of Adoption must include the text of the amendment plus adopted findings and supplementary information.

5. The deadline to appeal will not be extended if you submit this notice of adoption within five working days of the final decision. Appeals to LUBA may be filed within **TWENTY-ONE (21) days** of the date, the Notice of Adoption is sent to DLCD.

6. In addition to sending the Notice of Adoption to DLCD, you must notify persons who participated in the local hearing and requested notice of the final decision.

7. **Need More Copies?** You can now access these forms online at **http://www.lcd.state.or.us/**. Please print on **8-1/2x11 green paper only**. You may also call the DLCD Office at (503) 373-0050; or Fax your request to: (503) 378-5518; or Email your request to **mara.ulloa@state.or.us** - ATTENTION: PLAN AMENDMENT SPECIALIST.

ORDINANCE NO. 347

AN ORDINANCE AMENDING THE MILL CITY COMPREHENSIVE PLAN POLICIES TO ADOPT THE MILL CITY STORM DRAINAGE SYSTEM MASTER PLAN

WHEREAS, Goal 11 "Public Facilities" of the statewide land use goals adopted by the Land Conservation and Development Commission require cities to plan for the development and/or extension of public facilities within the Urban Growth Boundary of every city in Oregon, and

WHEREAS, the City Council and Planning Commission have authorized the city engineer to prepare a storm drainage master plan for the City of Mill City; and

WHEREAS, Westech Engineering, Inc., prepared a Storm Drainage Master Plan for the City of Mill City in November 2002 and the plan included basic storm drainage calculations for the city and a sub-basin plan for the Spring Street sub-basin; and

WHEREAS, in 2007, the City Council authorized the city engineer to add the Snake Creek sub-basin to the plan;

WHEREAS, the City anticipates it will prepare additional sub-basin plans in the future.

WHEREAS, in April 2007 the Planning Commission held a workshop to review the proposed plan and recommended that the City proceed with a public hearing to consider the proposal; and

WHEREAS, on August 14, 2007 the Planning Commission and City Council held a joint public hearing to consider the Storm Drainage System Master Plan, including the proposed Snake Creek sub-basin and heard testimony in favor and against the proposed plan; and

WHEREAS, on September 14, 2007 the Planning Commission concluded that the proposed plan was consistent with Goal 11 and the Mill City Comprehensive Plan and recommended the City enact the Storm Drainage System Master Plan as a technical amendment to the Mill City Comprehensive Plan; and

WHEREAS, on October 9, 2007 the City Council deliberated about the proposal and concurred with the Planning Commission recommendations,

NOW THEREFORE, the City Council of the City of Mill City hereby ordains as follows:

Section 1: The Mill City Comprehensive Plan Goals and Policies shall be amended as follows:

> PUBLIC FACILITIES AND SERVICES – Drainage Policy 15: The City shall adopt a storm drainage system master plan which includes estimated storm drainage calculations for existing and future development areas inside the Mill City UGB. The plan shall include recommended storm drainage system improvements. Engineering standards to implement the plan shall be incorporated into the city's public works standards and specifications.

The Storm Drainage System Master Plan (Westech Engineering, Inc.) is hereby adopted as the storm drainage master plan for the City.

<u>LAND USE POLICIES -- Natural Resources Policy 2.3</u>: As opportunities arise for projects that are within or affect storm drainage projects in the City of Mill City's Urban Growth Boundary and which benefit the citizens of Mill City, the City will cooperate with the property owners, the North Santiam Watershed Council and natural resource agencies to identify funding opportunities and to develop watershed restoration and habitat enhancements within the City of Mill City's Urban Growth Boundary, particularly the Snake Creek and Deford Creek subbasins of the North Santiam River basin.

This Ordinance read for the first time by title only on 9th day of October 2007.

This Ordinance read by title only for the second time on 23rd day of October 2007.

This Ordinance passed on the 23rd day of October 2007 by the city council and executed by the mayor this _____ day of October 2007.

Date: 11-23-07 By: ______________________
TIM KIRSCH, Mayor

Date: 11-26-07 Attest: ______________________
DEBORAH HOGAN, City Administrator

APPROVED AS TO FORM

Date: ______________________ By: ______________________
JAMES L. McGEHEE, City Attorney

H:\Mill City\PC Apps\2007\2007-05-06 Storm Master Plan\347 CP - Storm Master Plan.rtf

STORM DRAINAGE SYSTEM

MASTER PLAN

Adopted October 9, 2007

Prepared for:

MILL CITY, OREGON
P.O. Box 256
252 Cedar Street
Mill City, OR 973

REGISTERED PROFESSIONAL
ENGINEER
19176PE
OREGON
JULY 15, 1997
RAYMOND C. ENGEL
EXPIRES: 12/31/09

Prepared By

Westech Engineering, Inc.
3841 Fairview Industrial Dr SE., Suite 100
Salem, OR 97302
(503) 585-2474

JO 1780.5030.0

CITY OF MILL CITY
STORM DRAINAGE SYSTEM MASTER PLAN

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FOREWORD

USING THIS REPORT

Because this report will 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 MILL CITY
Storm Drainage System Master Plan

Executive Summary

EXECUTIVE SUMMARY

INTRODUCTION

This Storm Drainage System Master Plan assesses the City's existing storm drainage system and provides recommendations for drainage within the City of Mill City. Without the benefit of a storm drainage master plan, storm drainage improvements are often constructed as needed without analyzing overall system needs and impacts. Although this approach alleviates isolated problems, there is no way of making well informed decisions regarding improvements to the system, or assessing the potential impact of future development.

The City's current development standards require findings that adequate capacity is available in the utility systems prior to development occurring. Without a current storm drainage system master plan that identifies area-wide improvements required with a schedule guiding their construction, implementation of these policies is difficult. Without a community wide understanding of how the storm drainage system works and how development within the community 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 management 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.

ELEMENTS OF THE MASTER PLAN

■ ■ Section 2, Study Area and Planning Considerations

Mill City is located in the North Santiam River canyon approximately 30 miles southeast of Salem. The City consists of approximately 504 acres inside the City limits, with an additional 411 acres outside the City limits but within the UGB. This study also evaluates areas upstream and downstream of the City to ensure the influences of these areas are properly address in the analysis.

The City has several land use zones including residential (single and mult-family), commercial, and industrial. The land within the City limits has not fully developed to the degree allowed by the zoning standards. Land in the UGB is generally undeveloped, or developed at levels far below what may be allowed upon annexation. The study evaluates the storm drainage system both according to the current state of development, and assuming the full 915 acres are developed to the full extent allowed by the zoning ordinances.

■ ■ **Section 3, <u>Description of the Existing System</u>**

The City is divided into thirteen main drainage basins designated in the report as Santiam Highway West, 1st Avenue North, Elizabeth Creek, Cedar Creek, West Alder, Alder River, Spring Street, Downtown, 1st Avenue South, Kimmel Park, Cow Creek, Western Industrial, and Snake Creek. Several of the basins listed are quite large, including Santiam Highway West (260 acres), Elizabeth Creek (500 acres), Cedar Creek (370 acres), Cow Creek (800 acres), Western Industrial (690 acres), and Snake Creek (3,600 acres). These basins are at either the north or south end of town, and extend large distances beyond the Urban Growth Boundary, and contain large areas with little or no development. Of the remaining basins, only Spring Street (110 acres) and Kimmel Park (120 acres) are more than 100 acres in size, with the rest ranging from 15 acres for the Alder-River Basin to 87 acres for the 1st Avenue South Basin. All drainage ultimately discharges to the North Santiam River.

When all of the various elements of the current storm drainage system are totaled, the City has nearly 15,000 feet (2.8 miles) of pipe ranging in size from 6-inches in diameter up to 48-inches in diameter. There are also roughly 130 catch basins, 15 manholes, and 7 drywells.

■ ■ **Section 4, <u>Hydrologic/Hydraulic Analysis</u>**

Two methods for calculating the predicted stormwater run-off were employed in this study. One was the Rational Method as prescribed by the ODOT Hydraulics Manual. The other was the Haested Method PondPack Santa Barbara Urban Hydrograph (SBUH) computer modeling program. For both methods, the various drainage basins are divided into sub-basins generally defined by a region's downstream intersection with the basin's major storm drain trunk line.

Calculations were performed for existing and future development conditions using 25-year design storms, which is the storm event specified for the analysis of trunk lines 18-inches in size or larger. Once the run-off calculations were completed, the predicted flows were used to assess the adequacy of the major trunk lines. Ideally, the trunk lines should have the capacity to carry the 25-year storm without surcharging.

■ ■ **Section 5, Storm System Evaluation and Recommendations**

At the time of adoption of this Master Plan (October 2007), only the Spring Street and Snake Creek Basins have been evaluated for both existing and future (fully developed) conditions using both the Rational and Santa Barbara Urban Hydrograph (SBUH) methods. The Rational method is generally not recommended for basins over 300 acres, and thus will be of limited use for the study of the larger basins. Thus, the SBUH results will become of greater interest for these basins due to their size and complexity. The results for both methods are presented in Section 5.

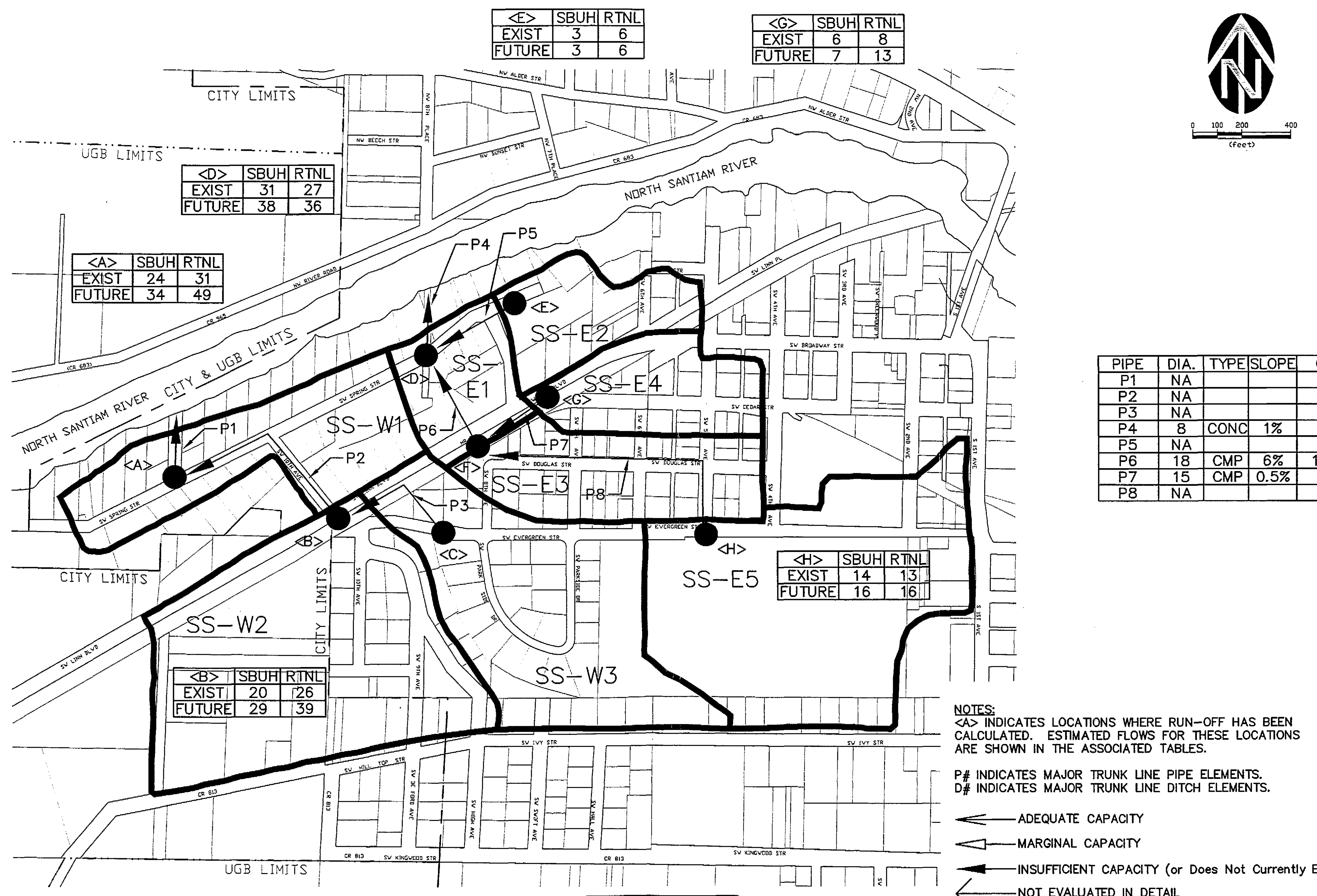
Using the estimated run-off, all major drainage elements (pipes and open channels) were evaluated to determine whether or not they had adequate capacity. System segments that were identified as inadequate were analyzed with regard to the appropriate remedy. Figures 5.4-2 and 5-10.2 provide a complete summary of the proposed improvements required to eliminate the major problem areas within the Spring Street and Snake Creek Basins. Copies of these figures are provided in this Executive Summary for the reader's convenience.

Following the determination of the recommended improvements, each element was evaluated to determine budget level cost estimates for these improvements. These cost estimates are summarized in Tables 5.4-3 and 5.10-3, Capital Improvement Project (CIP) Estimated Costs. Copies of these tables are provided in this Executive Summary for the reader's convenience.

This section also provides a discussion on stormwater detention explaining the purpose of detention, the most important benefits, and pointing out certain costs and disadvantages. In general detention is most beneficial to the storm drainage system immediately downstream of a development site. The benefit to the major trunk lines, while it exists, can be less dramatic. The major drawbacks to detention relate to the cost to development, in either money or lost developable ground, or both. Weighing the benefits and drawbacks of detention within the context of Mill City's specific situation, we recommend that the City continue to support its current stormwater detention standards, particularly in areas where storm drainage systems are listed as marginally adequate. We also discuss the currently regulatory environment regarding drywells and recommend that the City move away from drywells as a method of discharge for the storm drainage system.

■ ■ **Section 6, Design Standards and Management Practices**

This section provides a discussion of the standards and procedures the City has adopted to promote an efficient, effective storm drainage system. Included in this section are general discussions of Storm Drainage System Design Standards, Stormwater Quality Standards, Storm Drainage System Construction Standards, and Management Practices. In addition, we have provided information concerning legal and liability issues, as well as system funding issues.



<A>	SBUH	RTNL
EXIST	24	31
FUTURE	34	49

<B>	SBUH	RTNL
EXIST	20	26
FUTURE	29	39

<C>	SBUH	RTNL
EXIST	12	14
FUTURE	15	17

<D>	SBUH	RTNL
EXIST	31	27
FUTURE	38	36

<E>	SBUH	RTNL
EXIST	3	6
FUTURE	3	6

<F>	SBUH	RTNL
EXIST	25	21
FUTURE	31	29

<G>	SBUH	RTNL
EXIST	6	8
FUTURE	7	13

<H>	SBUH	RTNL
EXIST	14	13
FUTURE	16	16

PIPE	DIA.	TYPE	SLOPE	Q
P1	NA			
P2	NA			
P3	NA			
P4	8	CONC	1%	1
P5	NA			
P6	18	CMP	6%	14
P7	15	CMP	0.5%	2
P8	NA			

NOTES:
<A> INDICATES LOCATIONS WHERE RUN-OFF HAS BEEN CALCULATED. ESTIMATED FLOWS FOR THESE LOCATIONS ARE SHOWN IN THE ASSOCIATED TABLES.

P# INDICATES MAJOR TRUNK LINE PIPE ELEMENTS.
D# INDICATES MAJOR TRUNK LINE DITCH ELEMENTS.

ADEQUATE CAPACITY
MARGINAL CAPACITY
INSUFFICIENT CAPACITY (or Does Not Currently Exist)
NOT EVALUATED IN DETAIL

NO.	DATE	DESCRIPTION	BY
1			

REVISIONS

DSN. RCE
DRN. RCE
CKD. RCE
DATE: AUG' 02

MAP UPDATED: 11-8-02

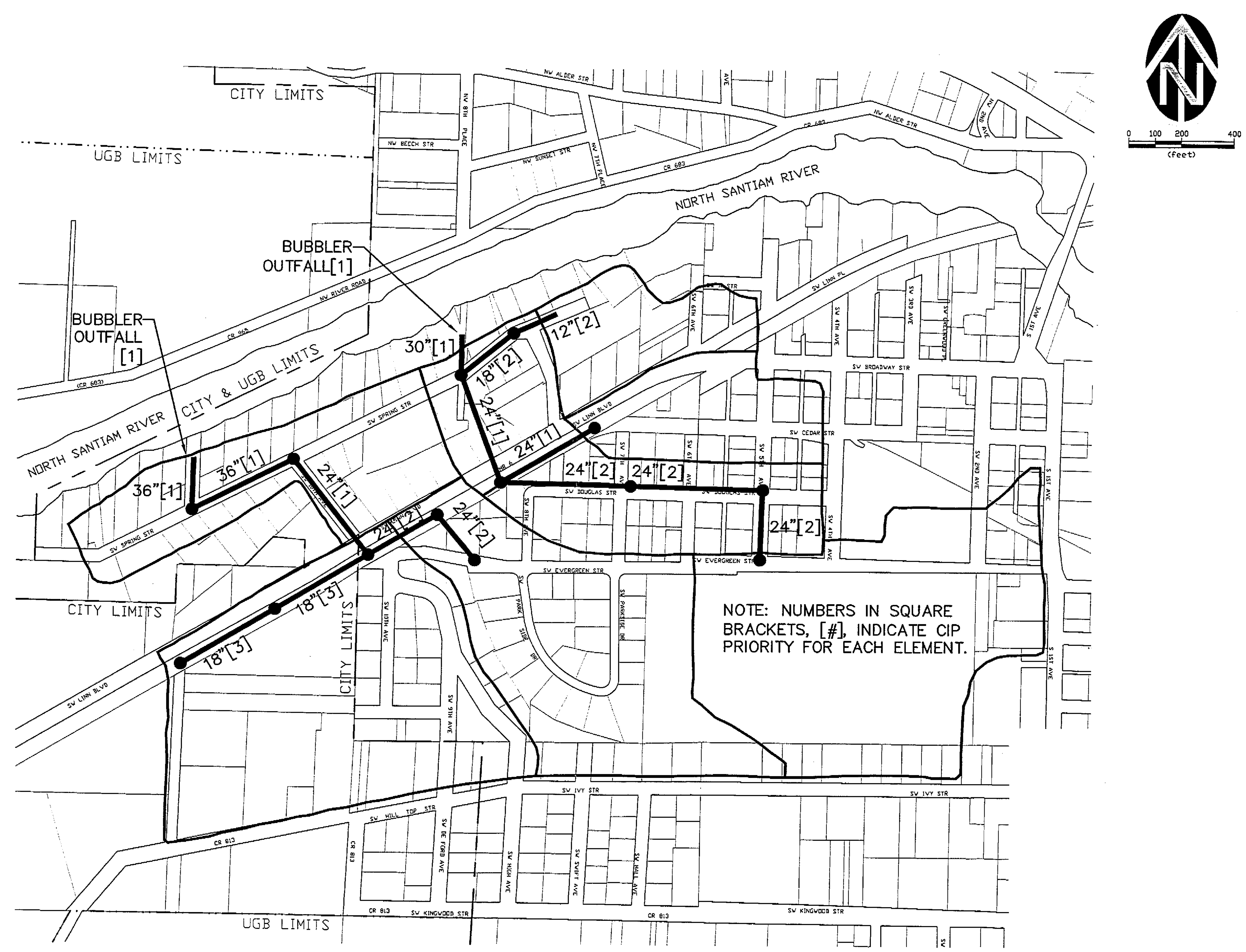
WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS AND PLANNERS
3841 Fairview Industrial Dr. S.E., Suite 100, Salem, OR 97302
Phone: (503) 585-2474 Fax: (503) 585-3986
E-mail: westech@westech-eng.com

CITY OF MILL CITY, OREGON FIGURE 5.4-1
MILL CITY STORM DRAIN MASTER PLAN

SPRING STREET BASIN ESTIMATED FLOWS & CAPACITIES

SHEET 1 OF 1

JOB NUMBER 1780.5010.0



CITY OF MILL CITY, OREGON — FIGURE 5.4-2

MILL CITY STORM DRAIN MASTER PLAN

RECOMMENDED SPRING ST STORM DRAINAGE SYSTEM IMPROVEMENTS

MAP UPDATED: 11-8-02

WESTECH ENGINEERING, INC.

SHEET 1 OF 1

JOB NUMBER 1780.5010.0

TABLE 5.4-3

Spring Street Basin Capital Improvement Project (CIP) Estimated Costs*

PROJECT	Priority	Pipe Size (in)	Paved or Unpaved	Length (ft)	Cost/ft ($)	Manholes	Cost/Ea ($)	Inlets	Cost/Ea ($)	Construction Cost ($)	Contingency (10%)	Engineering (16%)	Legal & Admin (10%)	Project Total ($)	SDC Eligible
PRIORITY 1															
West Basin Bubbler Outfall	1					1	$15,000	0	$0	$15,000	$1,500	$2,400	$1,500	$20,400	No
36-inch Pipe, West Outfall to Spring Street	1	36	Unpaved	200	$110	1	$7,000	2	$1,000	$31,000	$3,100	$4,960	$3,100	$42,160	No
36-inch Pipe along Spring Street	1	36	Paved	400	$120	1	$7,000	2	$1,000	$57,000	$5,700	$9,120	$5,700	$77,520	No
24-inch Pipe along SW 10th Avenue	1	24	Paved	450	$70	1	$10,000	2	$1,000	$43,500	$4,350	$6,960	$4,350	$59,160	No
East Basin Bubbler Outfall	1					1	$15,000	0	$0	$15,000	$1,500	$2,400	$1,500	$20,400	No
30-inch Pipe, East Outfall to Spring Street	1	30	Unpaved	200	$80	1	$5,000	2	$1,000	$23,000	$2,300	$3,680	$2,300	$31,280	No
24-inch Pipe, Spring Street to West Linn Blvd	1	24	Unpaved	450	$60	1	$3,000	2	$1,000	$32,000	$3,200	$5,120	$3,200	$43,520	No
24-inch Pipe along West Linn Blvd	1	24	Paved	450	$70	1	$3,000	2	$1,000	$36,500	$3,650	$5,840	$3,650	$49,640	No
						0	$0	0	$0	$0	$0	$0	$0	$0	
													TOTAL, ALL PRIORITY 1 PROJECTS	**$344,080**	
PRIORITY 2															
24-inch Pipe along West Linn Blvd	2	24	Paved	300	$70	1	$3,000	2	$1,000	$26,000	$2,600	$4,160	$2,600	$35,360	No
24-inch Pipe, West Lin Blvd to SE Evergreen Street	2	24	Unpaved	250	$60	1	$3,000	2	$1,000	$20,000	$2,000	$3,200	$2,000	$27,200	No
18-inch Pipe along Spring Street	2	18	Paved	250	$50	1	$2,000	2	$1,000	$16,500	$1,650	$2,640	$1,650	$22,440	No
12-inch Pipe along Spring Street	2	12	Paved	200	$45	1	$2,000	2	$1,000	$60,000	$6,000	$9,600	$6,000	$81,600	No
24-inch Pipe, SW Douglas, SW Linn Blvd to SW 7th	2	24	Paved	500	$70	2	$3,000	4	$1,000	$100,000	$10,000	$16,000	$10,000	$136,000	No
24-inch Pipe, SW Douglas, SW 7th to SW 5th	2	24	Paved	500	$70	2	$3,000	4	$1,000	$45,000	$4,500	$7,200	$4,500	$61,200	No
24-inch Pipe, SW 5th, SW Douglas to SW Evergreen	2	24	Paved	250	$70	1	$3,000	2	$1,000	$22,500	$2,250	$3,600	$2,250	$30,600	No
													TOTAL, ALL PRIORITY 2 PROJECTS	**$394,400**	
PRIORITY 3															
18-inch Pipe along SW Linn Blvd	3	18	Paved	850	$50	2	$2,000	4	$1,000	$50,500	$5,050	$8,080	$5,050	$68,680	Yes
						0	$0	0	$0	$0	$0	$0	$0	$0	
													TOTAL, ALL PRIORITY 3 PROJECTS	**$68,680**	
													TOTAL, ALL PROJECTS	**$807,160**	

*Note: These estimates are planning level cost estimates and not based on actual designs. They should be considered as preliminary and subject to change.

CITY OF MILL CITY
Storm Drainage System Master Plan

Section 1

INTRODUCTION

SECTION 1
INTRODUCTION

1.1 Background

The City of Mill City, located approximately 30 miles southeast of Salem in the North Santiam River Canyon (Figure 1-1), covers approximately 504 acres within the City Limits, and contains an additional 411 acres between the City Limits and the Urban Growth Boundary. The City has supported a relatively stable population over the past two decades. According to census data, the City's population was 1,537 in 2000 compared with 1,550 in 1990 and 1,565 in 1980. With the comparatively rapid growth of nearby municipalities in the Willamette Valley, Mill City's growth rate is anticipated to increase somewhat in the coming years.

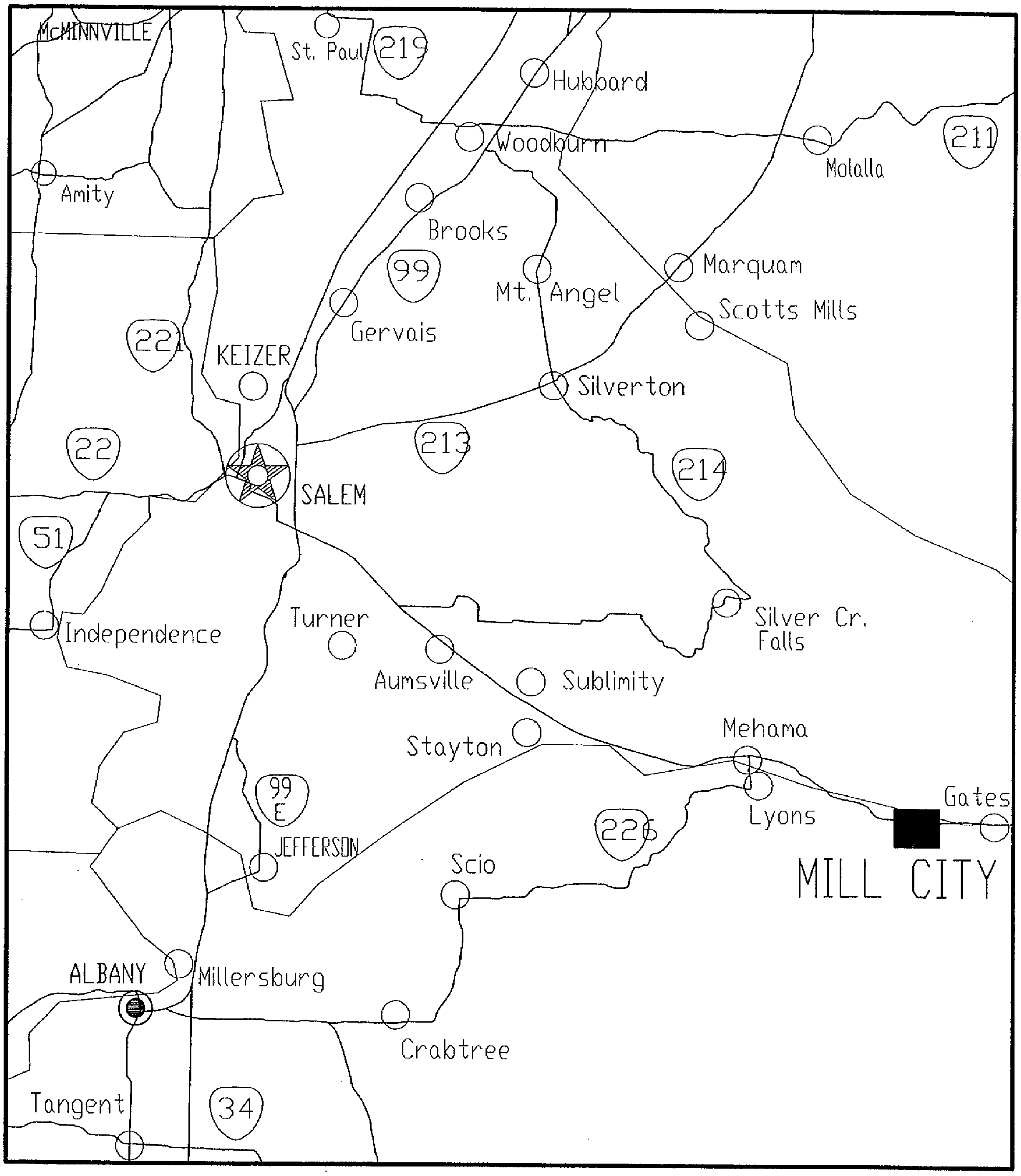
Situated along the North Santiam River (which forms the boundary between Marion and Linn Counties), Mill City's primary transportation link is Highway 22 which runs between Salem and Bend. Originally developed by the Hammond Lumber Company for its employees, Mill City was incorporated in 1947. It is primarily a residential community and is currently without any major commercial or industrial industries inside the city limits.

The City's existing storm drainage system has developed in pieces to address specific local concerns and generally lacks a broad, basin-by-basin perspective on effective storm drainage management. This report is intended to be the first step in developing such a management tool. By establishing a methodology for evaluating storm drainage demands, shortcomings, and identifying recommended improvements, this Storm Drainage Master Plan will serve as a blueprint for future development and general storm drainage infrastructure improvement projects.

The evaluation of the City's drainage basins will begin with the Spring Street basin, as it has been identified as being among the most problematic. Other basins will be evaluated on a case-by-case basis as prioritized by the City.

1.2 Authorization

Because of significant problems with drainage in the Spring Street basin, the City requested Westech Engineering evaluate the drainage and provide recommendations for improvements. During the course of this effort, while in the process of evaluating options for discharging the run-off, it was discovered that relatively new, and not widely known, regulations concerning the use of drywells had been established by the Oregon Department of Environmental Quality. Upon completion of evaluation of the Spring Street basin, including assessment of the impact of the drywell regulations, Westech Engineering requested guidance from the City on the most appropriate form for a report. In the spring of 2002, the City and Westech Engineering concurred that the most effective report would be a document that laid the groundwork for a full Storm Drainage Master plan, with the Spring Street basin complete, and placeholders for other basins to be added from time-to-time as the City so desired. This report fulfills that objective.



SCALE	City of MILL CITY — Figure 1-1	SHEET
HORIZ:	MILL CITY Storm Drainage Master Plan	1
VERT:		OF
DSN. RCE	**Vicinity Map**	1
DRN. RCE		JOB NUMBER
CKD. RCE		1780.5010.0
DATE: JULY '02		

1.3 Project Objectives

The purpose of this study is to evaluate the portion of 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 in this 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 initial report will provide the technical framework for evaluation, and assess the Spring Street basin. Future updates will incorporate the results for other basins on a case-by-case basis as determined by the City of Mill City.

This evaluation and master plan accomplishes the following specific objectives.

- Identify and delineate the boundaries of the major drainage basins within the Planning Area.
- Map the applicable portion of the existing storm drainage system based on field data collection and as-built drawings.
- Identify current and future storm drain system deficiencies within the applicable basins, particularly in the following areas:
    - Localized flooding, flow routing capacity
    - System reliability
    - Maintenance considerations
- Analyze the 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 a 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:

- Soil Survey of Marion County Area, Oregon, by USDA Soil Conservation Service, September 1972.
- Soil Survey of Linn County Area, Oregon, by USDA Soil Conservation Service.
- Flood Insurance Study, Mill City, Marion and Linn Counties, Oregon, by Federal Emergency Management Agency, September, 1978.
- Flood Insurance Study, Marion County, Oregon, Unincorporated Areas, by Federal Emergency Management Agency, January 19, 2000.
- Water System Master Plan, for the City of Mill City, Oregon by Westech Engineering, December 1, 1999.
- Mill City Comprehensive Plan, updated 1990.
- Public Works Design Standards for the City of Mill City, Oregon by Westech Engineering, November 1998.

Section 2

Study Area and Planning Considerations

SECTION 2
STUDY AREA AND PLANNING CONSIDERATIONS

2.1 Study Area

The City of Mill City is located in Marion and Linn Counties approximately 30 miles southeast of Salem on Highway 22. The primary study area is coincident with the Urban Growth Boundary (UGB) established by the City's Comprehensive Plan. However, since the storm drainage system within the UGB is influenced by run-off from upstream of the City, as well as the performance of the downstream drainage system, these areas were also investigated as part of this study. Mill City lies along the North Santiam River, in the bottom of a canyon that rises steeply at the city limits on both north and south sides of town. Highway 22 is the major transportation route serving the City, running east and west north of the river.

Mill City's Comprehensive Plan was last updated in 1990. An Urban Growth Boundary (UGB) has been established which currently encompasses approximately 915 acres. The present breakdown shows approximately 504 acres inside the city limits, and approximately 411 acres inside the UGB but outside the city limits. Eventually the entire area will be will be served by the City's public storm drainage system. This report is based on the assumption that there will be no significant changes to the Urban Growth Boundary or zoning.

This report is based on the assumption that there will be no significant changes to the Urban Growth Boundary during the study period. The improvements recommended in this plan are based on development of land within the UGB in its present location, as well as the existing land use zoning for these areas. It is assumed that no significant development will occur within the study area that will require major changes to the existing zoning. 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 lower slopes of the west side of the Cascade range, with temperatures similar to the Willamette Valley, but with significantly higher rainfall. The weather is characterized by warm, relatively dry summers and cool wet winters. Although there is no National Weather Service recording station within the City, climatic data is available from Detroit Dam, approximately 13 miles to the east. While the data from this weather station is not specifically for Mill City, it is generally representative for this region.

Winters are characterized as relatively mild, with very low temperatures being uncommon. Summers are generally mild with little precipitation. Average high temperatures range from the low to mid-40's in the winter months, and in the upper 70's in the summer. Average low temperatures range from the low to mid-30's in the winter, and are in the mid-60's in the summer. These temperatures are similar to those recorded in Salem, with average high temperatures just a few degrees cooler than Salem's and average low temperatures nearly identical to Salem's throughout the year.

The Detroit Dam weather station receives an average of 87 inches of precipitation annually, with the majority of the rainfall occurring during the winter months. Based on records from 1954-1998, the wettest year was 1996 when more than 138 inches of rainfall was measured. The driest year, 1976, had only 60 inches of rain. Approximately 83% percent of the annual precipitation occurs between November 1 and April 30. Historically, every month except for the months of July (0.9 inches) and August (1.6 inches) receive at least 2 inches of rain.

It should be noted that Mill City's rainfall may be somewhat less than that recorded at Detroit dam. As another point of reference, Salem's rainfall is less than half that recorded at Detroit Dam. However, both due to proximity and topography, Mill City's total should be much closer to Detroit Dam than Salem.

Table 2-1 summarizes the 24-hour rainfall intensity data for the Mill City area.

TABLE 2-1
Storm Event, 24 Hour Rainfall Intensities

Storm Event	24 hour Precipitation (inch)
2-year 24-hour	3.5
5-year 24-hour	4.2
10-year 24-hour	4.5
25-year 24 hour	5.4
50-year 24-hour	6.0
100-year 24-hour	6.5

[1] – From 1973 NOAA Atlas 2, Volume X (Oregon).

The rainfall-intensity-duration curve for use in the City of Mill City for sizing storm drain piping under the rational method is the ODOT Zone 5 curve (see Public Works Design Standards).

2.3 Topography

The City is constructed along the North Santiam River, with approximately 25% of the land within the city limits on the north side of the river, and the remaining 75% to the south. Most of the land on the north side is adjacent Highway 22 which situated on a relatively level bench approximately 50-60' above the river, which rises gradually from east to west through this part of town. The elevation is approximately 830' as you enter town from the west. From there, the highway runs at less than 1% grade until near the eastern edge of town where the elevation is around 880'. The land north of Highway 22 rises quickly up from the road with average slopes over 20% just north of the highway and continuing to rise to elevations between 1600'-1800' just over a mile north of town.

The majority of the land on the south side of town consists of two relatively level plateaus. The first plateau, just south or the river ranges in elevation from 820'-830' near the river up to 830'-840' up to the base of the bluff that divides the two plateaus. The second plateau ranges in elevation from 850'-880' at the top of the bluff up to around 900' at the south edge of town. South of the plateau the terrain again rises relatively quickly with typical slopes in excess of 10% continuing to rise to elevations over 3,000' just over 2 miles south of town.

2.4 Soils and Geology

Although a detailed analysis of the soils and geology is outside the scope of this report, a review of the Soil Survey's for Marion and Linn County was performed. Copies of relevant soil survey information are included as **Appendix A** to this report.

There are three primary soil types indicated in the Marion County section of Mill City. Horeb gravelly silt loam, and Alluvial Land are found along the river. The Horeb gravelly silt loam also is found along Highway 22. North of Highway 22 is McCully very stony clay loam.

Along the south side of the river is a large region of Camas gravelly sandy loam, and a large section of Newberg fine sandly loam. There are sections of Sifton Variant gravelly loam, and Malabon Variant loam. Further south, comprising a large section of the plateaus, are large regions of the Malabon Variant loam and Sifton Variant loam. **Figure 2-1** presents the distribution of the various soil classes within the study area.

2.5 Land Use and Community Planning

Land within the City is divided into several different zones based on the type of use allowed (ie. Residential, Commercial, and Industrial). The Zoning Map (**Figure 2-2**) shows the location of the UGB, City limits and land use zoning designations within the City. **Table 2-2** summarizes the approximate areas contained under each zoning designation.

For the purposes of this study land use was examined under both its current state of development and assuming all land would develop to the full use of the designated zone, both for land within the City Limits and land inside the UGB. Land outside the UGB was assumed to remain in agricultural use.

TABLE 2-2 APPROXIMATE AREAS BY LAND USE CATEGORY	
Zone	Area (acres)
Inside City Limits	
CC Central Commercial	20
CH Highway Commercial	49
I Industrial	5
P Public	62
R-1 Residential Single	130
R-2 Residential Multiple	102
SPD Special Planned District	20
- Public Right of Way	89
- North Santiam River	28
Total	505
Inside UGB (Outside City Limits)	
UGB – Commercial	19
UGB – Industrial	203
UGB – Residential	155
- Public Right of Way	33
Total	410
Total Inside UGB	915

2.6 FEMA Flood Insurance Status

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).

Continued encroachments on floodplains decrease the natural flood-control capacity of these land areas, creates the need for expensive manmade flood-control measures and disaster-relief activities, and endangers both lives and property. Projects obtaining federal funding must demonstrate compliance with federal floodplain management regulations, and avoid to the extent possible:

- The long and short-term adverse impacts associated with the occupancy and modification of floodplains, and
- Direct or indirect support of floodplain development wherever there is a practicable alternative.

The relevant floodplain for most proposed projects is an area that has a 1-percent chance of a flood occurrence in a given year. The flood of this interval is referred to as the 100-year flood or the base flood. The floodplain management guidelines further require Federal agencies to apply the 0.2 percent or 500-year flood occurrence standard to the location of "critical facilities." Facilities considered "critical facilities" are those whose loss would disrupt utility service to large areas for a considerable period of time or would disrupt utility service to critical facilities such as hospitals. Critical facilities include water treatment plants, wastewater treatment facilities, large pump stations, and centralized operations or communication facilities.

The Federal Emergency Management Agency (FEMA) has established 100-year floodplain designation and insurance ratings areas along the Santiam River and its tributaries. 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 500 year flood is a flood having a 0.2 percent chance of occurrence in any given year.

The North Santiam River flows from east to west through the City, with the flood elevation ranging from above 820 feet on the east side down to less than 790 feet on the west side. Through much of town the banks of the river are relatively high, with ground elevations 15-20 feet or more above the 100-year flood. The lowest ground adjacent to the river is in the Santiam Pointe subdivision and along Spring Street, where the development is on the order of 5 feet above the 100 year flood.

The City of Mill City and both Linn and Marion Counties presently participate in the regular phase of the Flood Insurance Program (date of entry into the Regular Program for Mill City was March 1, 1979, for Marion County it was August 15, 1979, and for Linn County it was September 29, 1986). According to the FEMA "National Flood Insurance Program Community Status Book," the City of Mill City is listed as having two maps published for areas within the City Limits. Marion County has one map for the Mill City Area, while Linn County has two maps.

Flood profiles and maps for those portions of the Santiam River on the west side and the North Santiam River on the south side of the study area are included in the Flood Insurance Study as follows.

- FIRM panel 800 of 1150 (map 41047C0800 G) dated 1/19/00 [Marion County]
- FIRM panel 60 of 825 (map 410136 0060 B) dated 19/29/86 [Linn County]

CITY OF MILL CITY
Storm Drainage System Master Plan

Section 3

Description of Existing System

SECTION 3
DESCRIPTION OF EXISTING SYSTEM

3.1 General

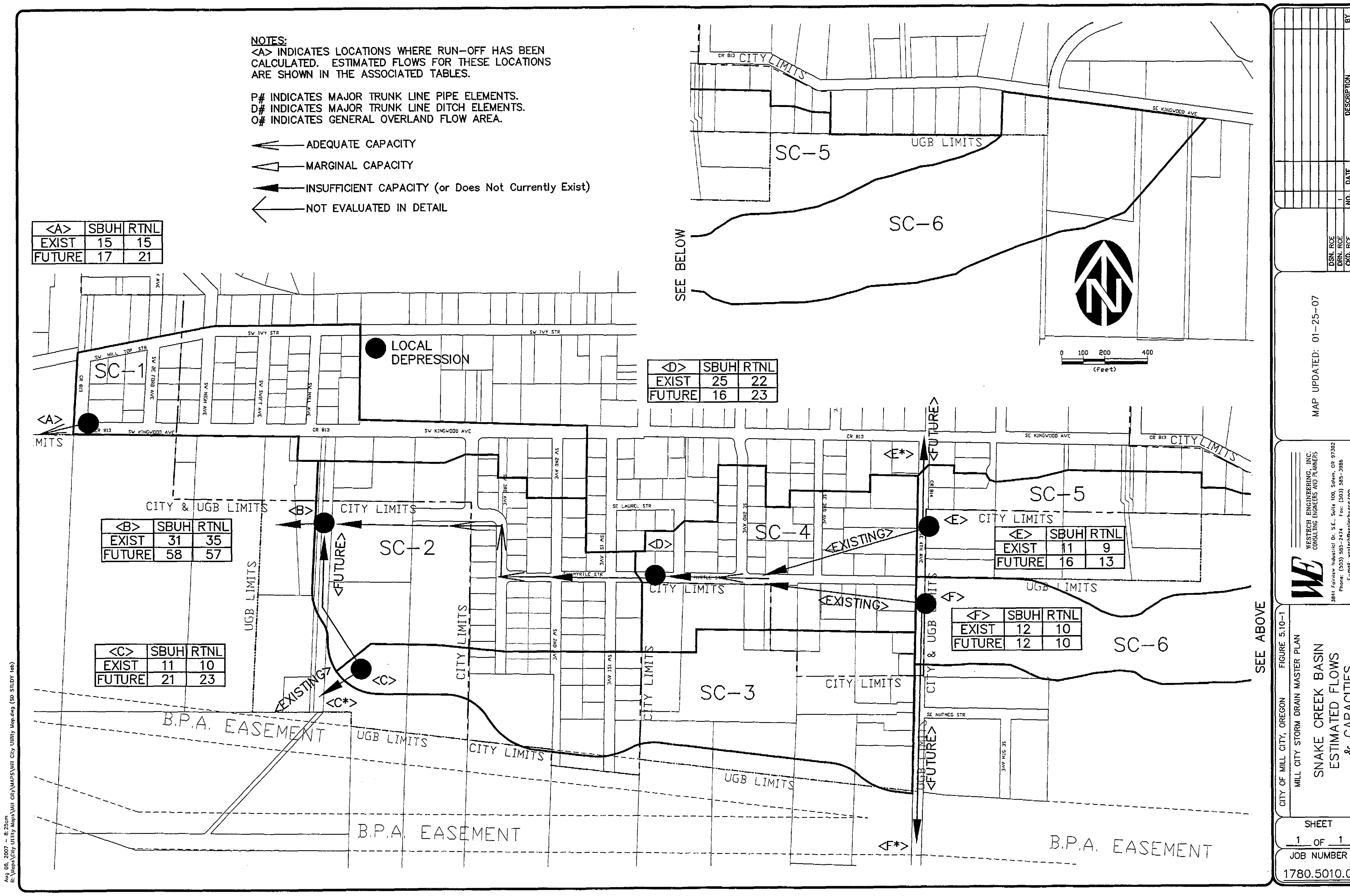
The City's existing storm drainage system collects stormwater from open areas, streets, residences, businesses, industries, and public facilities and conveys the runoff to drainage pipes or open channels that ultimately discharge to the North Santiam River. Flow through the storm drainage collection system is by gravity. There are no public storm drainage pump stations within the City.

This section provides an overview of the existing storm drainage system within the study area and summarizes known or reported problems.

3.2 Stormwater Drainage Basins

As shown on **Figure 3-1**, the study area is divided into a number of drainage basins. The basin boundaries were determined based on the topography, layout of the storm drainage system, and field investigation of actual drainage patterns. The initial boundaries for these basins are approximate, and will be refined as a detailed study is performed on a particular basin. **Table 3-1** lists the approximate areas within each of the major drainage basins shown. The specific basin studies will also subdivide each of these major drainage basins into sub-basins as appropriate to more accurately define their hydrologic characteristics.

Within the study area, several 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 has jurisdiction over facilities in the right-of-ways along Highway 22, while Marion and Linn Counties has jurisdictional oversight over facilities within County right-of-ways. The Counties typically defer review to the City for storm drainage facilities in County right-of-ways within City Limits. The Union Pacific Railroad has jurisdiction oversight for the portion of storm lines crossing the railroad right-of-way.



<A>	SBUH	RTNL
EXIST	15	15
FUTURE	17	21

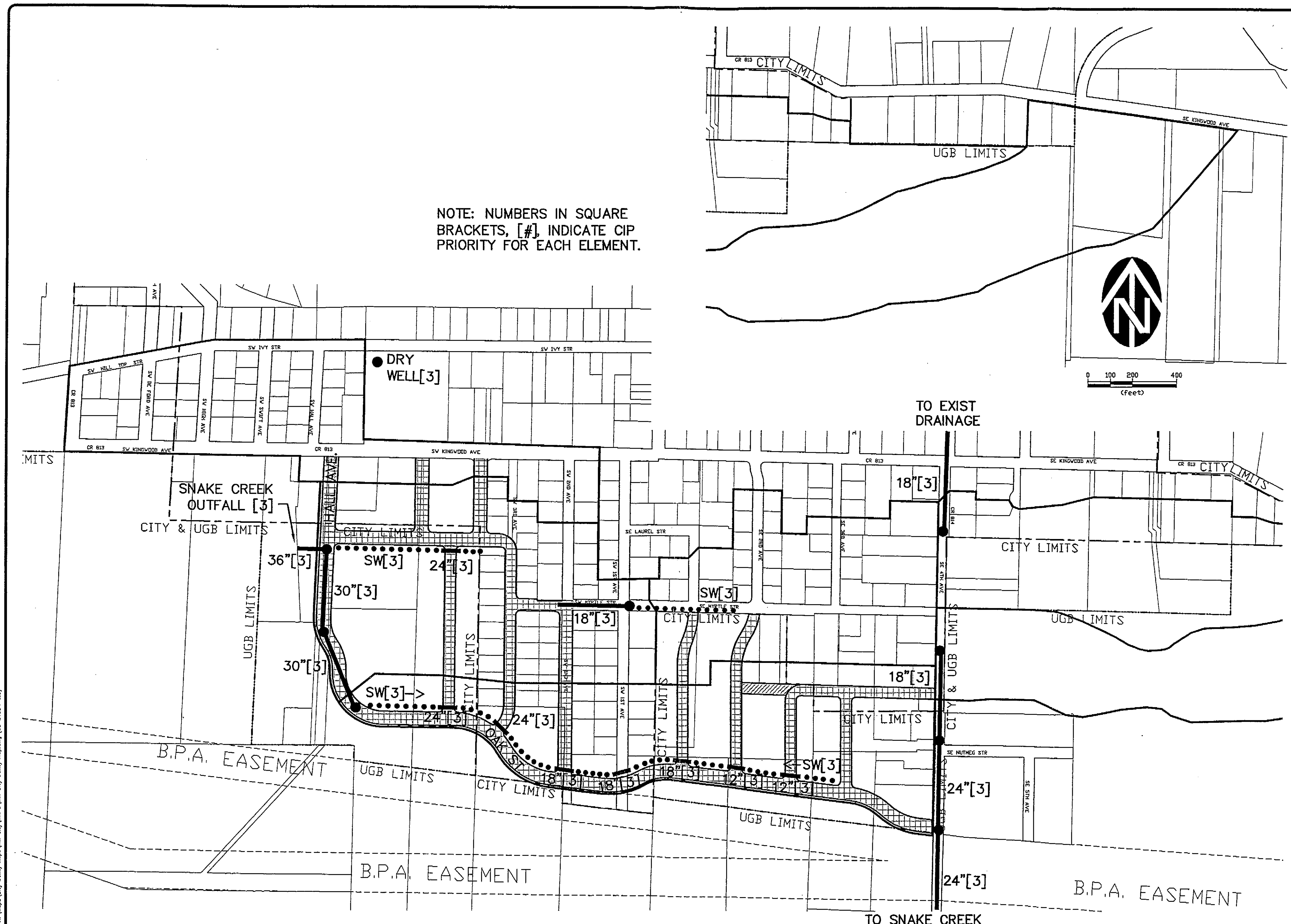
<B>	SBUH	RTNL
EXIST	31	35
FUTURE	58	57

<C>	SBUH	RTNL
EXIST	11	10
FUTURE	21	23

<D>	SBUH	RTNL
EXIST	25	22
FUTURE	16	23

<E>	SBUH	RTNL
EXIST	11	9
FUTURE	16	13

<F>	SBUH	RTNL
EXIST	12	10
FUTURE	12	10



CITY OF MILL CITY, OREGON FIGURE 5.10-2

MILL CITY STORM DRAIN MASTER PLAN

RECOMMENDED SNAKE CREEK STORM DRAINAGE SYSTEM IMPROVEMENTS

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: 01-25-07

DSN. RCE
DRN. RCE
CKD. RCE
DATE: AUG' 02

NO.	DATE	DESCRIPTION	BY
1			

REVISIONS

SHEET 1 OF 1

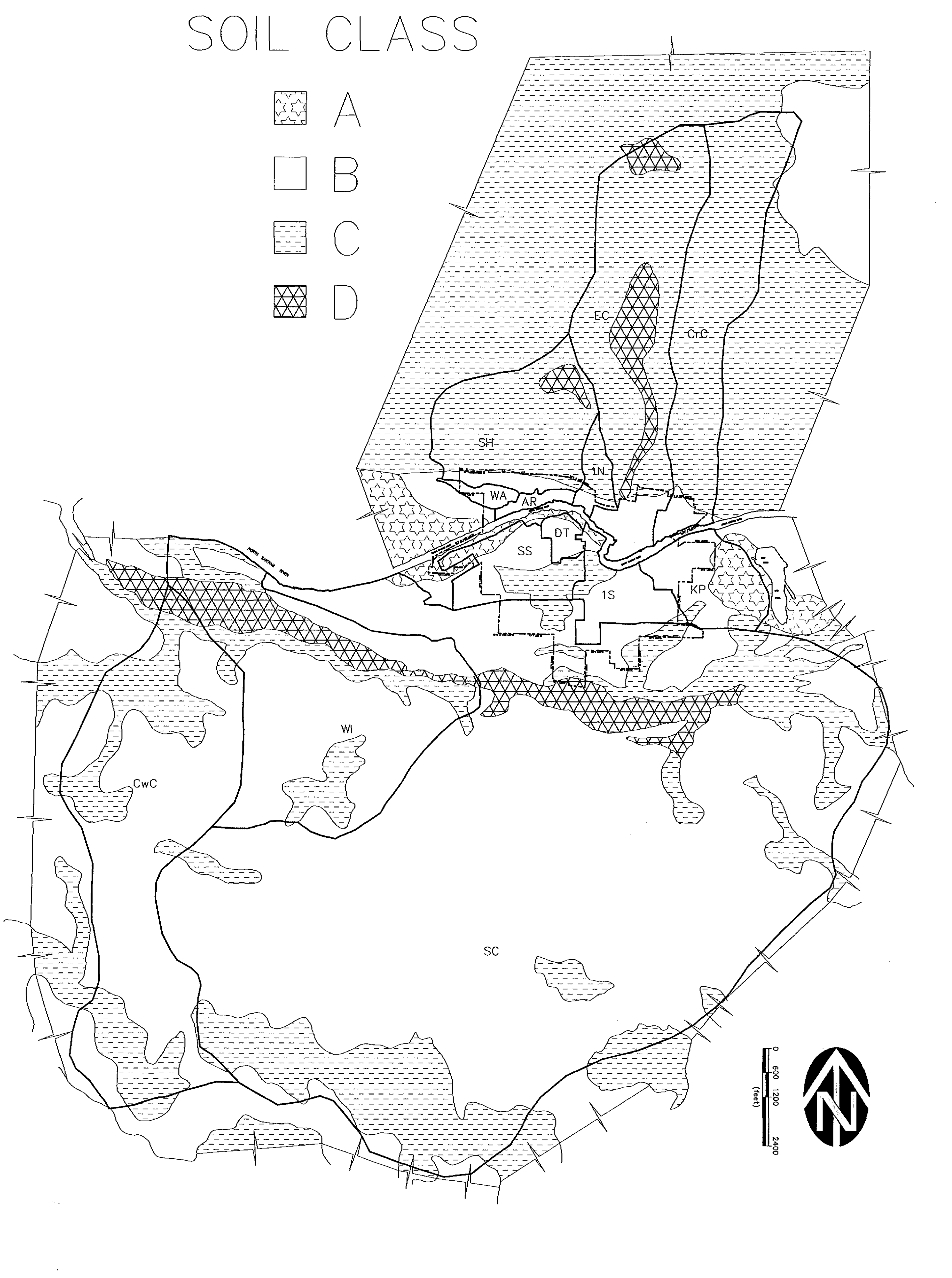
JOB NUMBER 1780.5010.0

TABLE 5.10-3

Snake Creek Basin Capital Improvement Project (CIP) Estimated Costs*

PROJECT	Priority	Pipe Size (in)	Paved or Unpaved	Length (ft)	Cost/ft ($)	Manholes	Cost/Ea ($)	Inlets	Cost/Ea ($)	Construction Cost ($)	Contingency (10%)	Engineering (16%)	Legal & Admin (10%)	Project Total ($)	SDC Eligible
PRIORITY 1															
No Priority 1 Projects Identified	1					0	$0	0	$0	$0	$0	$0	$0	$0	N/A
						0	$0	0	$0	$0	$0	$0	$0	$0	
													TOTAL, ALL PRIORITY 1 PROJECTS	**$0**	
PRIORITY 2															
No Priority 3 Projects Identified	2					0	$0	0	$0	$0	$0	$0	$0	$0	N/A
						0	$0	0	$0	$0	$0	$0	$0	$0	
													TOTAL, ALL PRIORITY 2 PROJECTS	**$0**	
PRIORITY 3															
36-inch Storm Outfall to Snake Creek	3						$10,000	0	$1,500	$0	$0	$0	$0	$0	No
36-inch Pipe, Hall Ave to Discharge	3	36	Unpaved	200	$120	1	$4,000	0	$1,500	$28,000	$2,800	$4,480	$2,800	$38,080	No
SW Laurel Street Roadside Swale	3		Paved	800	$50	1	$3,000	2	$1,500	$46,000	$4,600	$7,360	$4,600	$62,560	No
24-inch Pipe Street Crossing, SW Laurel Street	3	24	Paved	100	$100	0	$3,000	3	$1,500	$60,000	$6,000	$9,600	$6,000	$81,600	No
18-inch Pipe, SW Myrtle, SW 1st to SW 2nd	3	18	Paved	350	$75	1	$3,000	2	$1,500	$100,000	$10,000	$16,000	$10,000	$136,000	No
SW Myrtle Street Roadside Swale, SW 1st to SE 2nd	3		Paved	500	$50	2	$3,000	2	$1,500	$34,000	$3,400	$5,440	$3,400	$46,240	No
30-inch Pipe, SW Hall Ave, SW Laurel to SW Oak	3	30	Paved	800	$115	2	$4,000	4	$1,500	$106,000	$10,600	$16,960	$10,600	$144,160	No
Oak Street Roadside Swale, SW Hall to SE 3rd	3		Paved	1700	$50	0	$3,000	24	$1,500	$121,000	$12,100	$19,360	$12,100	$164,560	No
24-inch Pipe Street Crossings, Oak Street	3	24	Paved	200	$100	0	$3,000	2	$1,500	$23,000	$2,300	$3,680	$2,300	$31,280	No
18-inch Street Crossings, Oak Street	3	18	Paved	300	$75	0	$3,000	3	$1,500	$27,000	$2,700	$4,320	$2,700	$36,720	No
12-inch Street Crossings, Oak Street	3	12	Paved	200	$50	0	$3,000	2	$1,500	$13,000	$1,300	$2,080	$1,300	$17,680	No
18-inch Pipe, SE 4th Ave, North to Existing Drainage	3	18	Paved	1000	$75	3	$3,000	4	$1,500	$90,000	$9,000	$14,400	$9,000	$122,400	No
24-inch Pipe, SE 4th Ave, South to Snake Creek	3	24	Paved	800	$100	2	$3,000	4	$1,500	$92,000	$9,200	$14,720	$9,200	$125,120	No
18-inch Pipe, SE 4th Ave, South to Snake Creek	3	18	Paved	400	$50	1	$3,000	2	$1,500	$26,000	$2,600	$4,160	$2,600	$35,360	No
													TOTAL, ALL PRIORITY 3 PROJECTS	**$1,041,760**	
													TOTAL, ALL PROJECTS	**$1,041,760**	

*Note: These estimates are planning level cost estimates and not based on actual designs. They should be considered as preliminary and subject to change.



CITY OF MILL CITY, OREGON	FIGURE 2-1	SHEET 1 OF 1	JOB NUMBER 1780.5010.0
MILL CITY STORM DRAIN MASTER PLAN			
SOIL CLASS MAP			

WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS AND PLANNERS
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MAP UPDATED: 7-25-02

DSN. RCE
DRN. RCE
CKD. RCE
DATE: JULY '02

NO.	DATE	DESCRIPTION	BY
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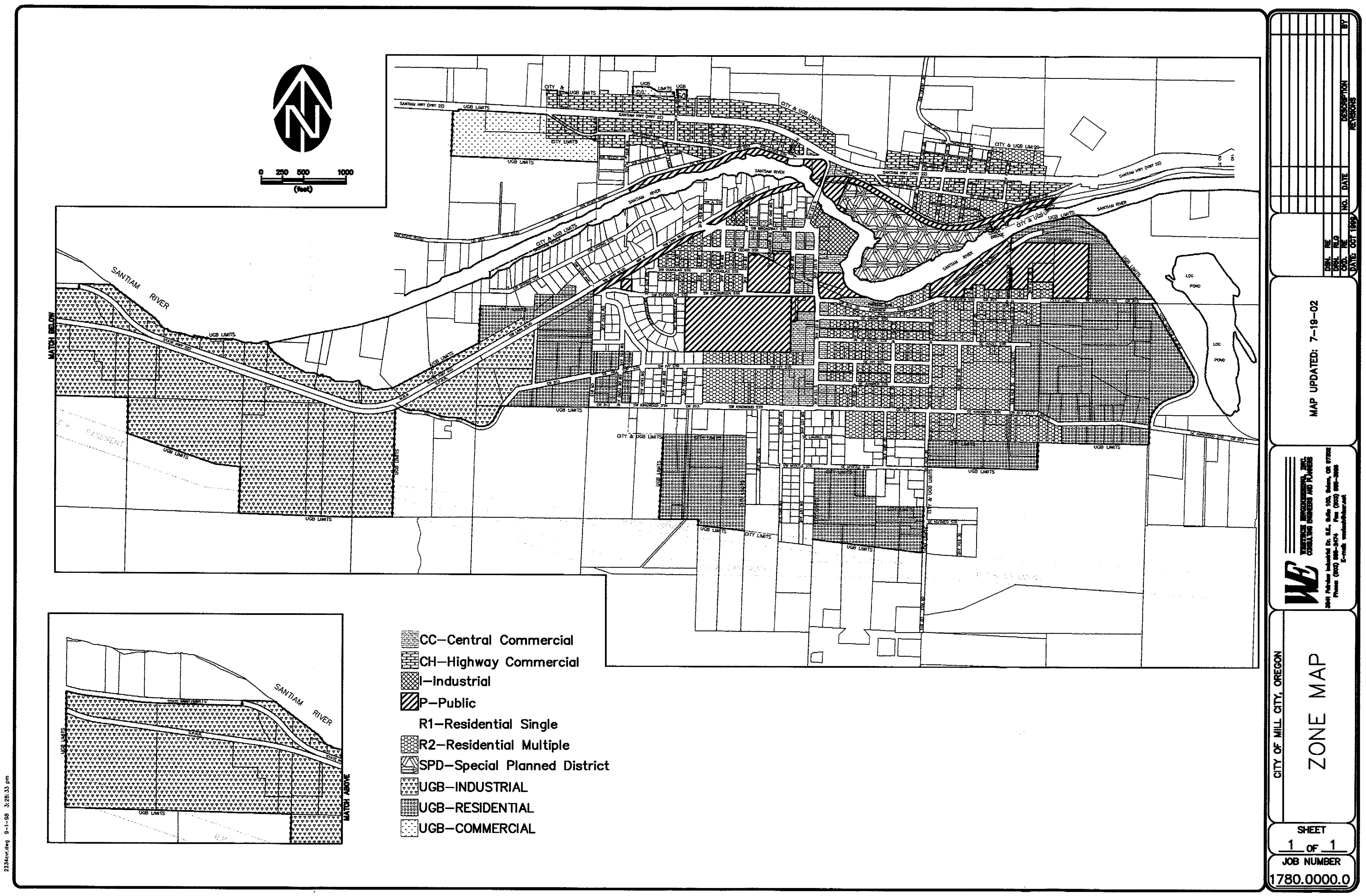
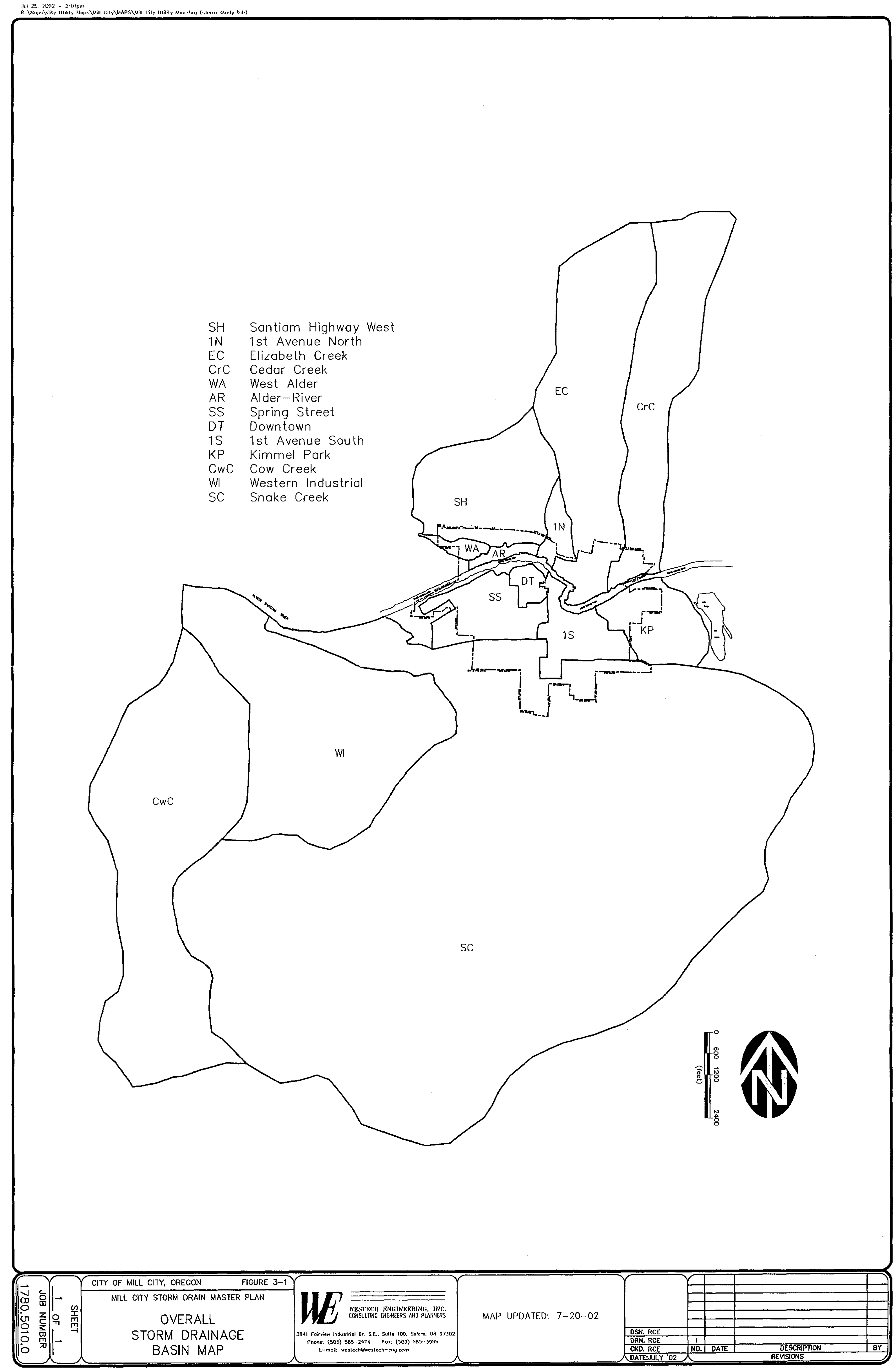

SANTIAM RIVER
UGB LIMITS
CITY & UGB LIMITS
CITY LIMITS
MATCH BELOW
MATCH ABOVE
0 250 500 1000
(feet)
CC–Central Commercial
CH–Highway Commercial
I–Industrial
P–Public
R1–Residential Single
R2–Residential Multiple
SPD–Special Planned District
UGB–INDUSTRIAL
UGB–RESIDENTIAL
UGB–COMMERCIAL
CITY OF MILL CITY, OREGON
ZONE MAP
MAP UPDATED: 7-19-02
SHEET 1 OF 1
JOB NUMBER
1780.0000.0



SH Santiam Highway West
1N 1st Avenue North
EC Elizabeth Creek
CrC Cedar Creek
WA West Alder
AR Alder–River
SS Spring Street
DT Downtown
1S 1st Avenue South
KP Kimmel Park
CwC Cow Creek
WI Western Industrial
SC Snake Creek
0 600 1200 2400
(feet)
CITY OF MILL CITY, OREGON
FIGURE 3-1
MILL CITY STORM DRAIN MASTER PLAN
OVERALL
STORM DRAINAGE
BASIN MAP
WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS AND PLANNERS
MAP UPDATED: 7-20-02
DSN. RCE
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CKD. RCE
DATE JULY '02
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REVISIONS
SHEET
1 OF 1
JOB NUMBER
1780.5010.0

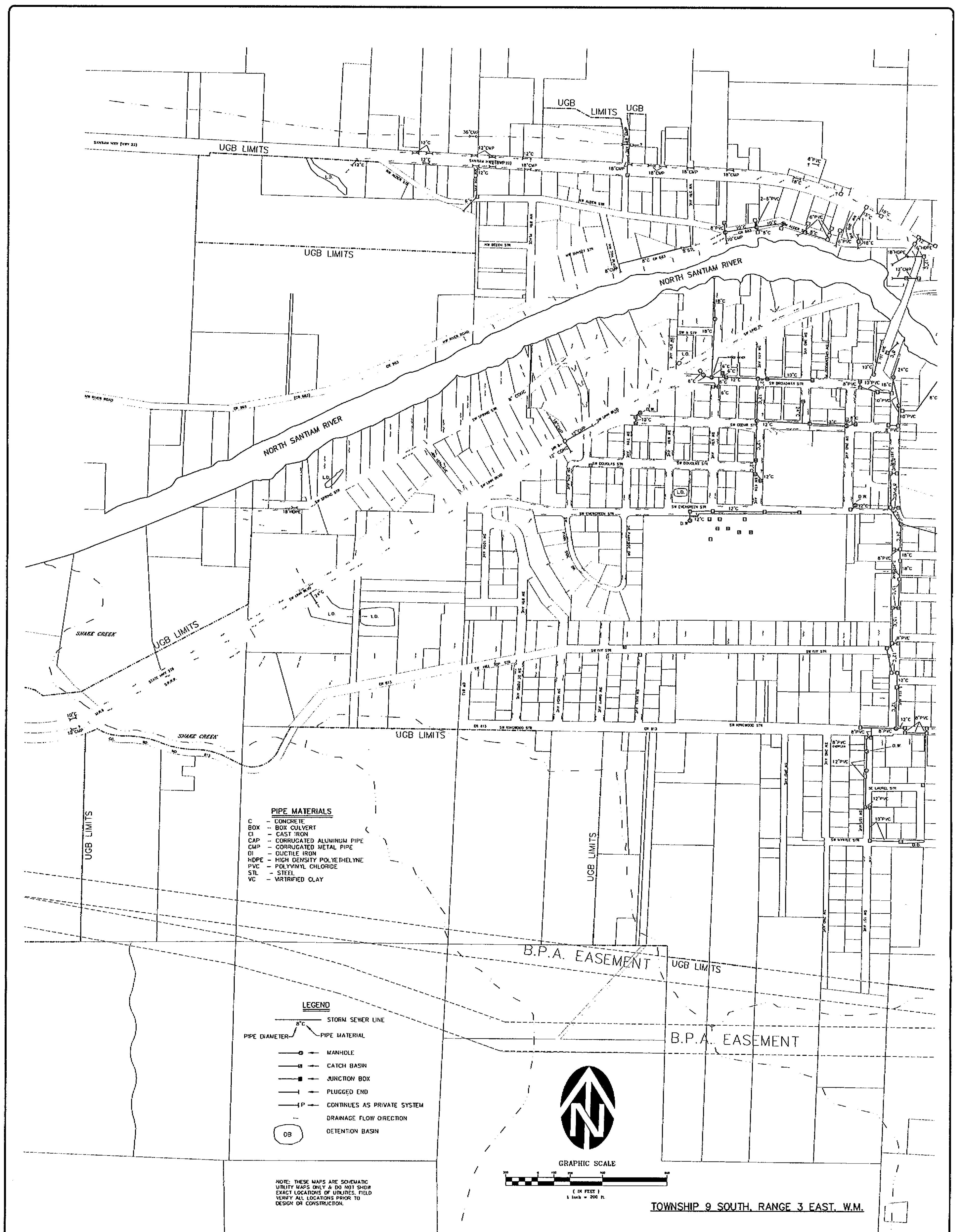
Table 3-1 Major Drainage Basin Areas		
Basin Name	General Drainage Basin Location	Area (Acres)
SH Santiam Highway West	Along of Highway 22 from NW 2nd Avenue west to the west City Limits, and extending roughly 3,000 north of the highway.	260
1N 1st Avenue North	Along Highway 22 from NW 2nd Avenue east to NE Alder, from the river to approximately 2,000 north of the highway.	35
EC Elizabeth Creek	North of the river from NE Alder to NE 5th Avenue, extending approximately 9,000 north of the highway.	500
CC Cedar Creek	North of the river from NE 5th Avenue to the east City Limits, extending approximately 9,000 north of the highway.	370
WA West Alder	Along NW Alder Street from NW 7th west to the west City Limits.	16
AR Alder-River	The area between the river and the highway from the west City Limits to NW 2nd.	15
SS Spring Street	From the river south to SW Ivy Street, from S 1st Avenue west to the West City Limits, except for the downtown area.	110
DT Downtown	From the river south to SW Evergreen Street, from SW 4th and 5th Avenues east to S 1st Avenue.	21
1S 1st Avenue South	From the river south to SE Kingwood Street, from S 1st Avenue east to SE 6th Avenue.	87
KP Kimmel Park	South of the river to SE Kingwood Street from SE 6th Avenue to the log ponds east of town.	120
CwC Cow Creek	The westernmost basin, roughly 3,000 feet wide, from the BPA easement south approximately 12,000 feet to Tom Rock Ridge Road.	800
WI Western Industrial	A funnel shaped basin on the west side running from the river south approximately 6,000 feet and from the west UGB roughly 6,000 feet east.	690
SC Snake Creek	A very large basin south of the City, south of SW Ivy on the east and south of SE Kingwood on the east, extending roughly 12,000 feet south of the City Limits.	3,600

3.3 Existing System

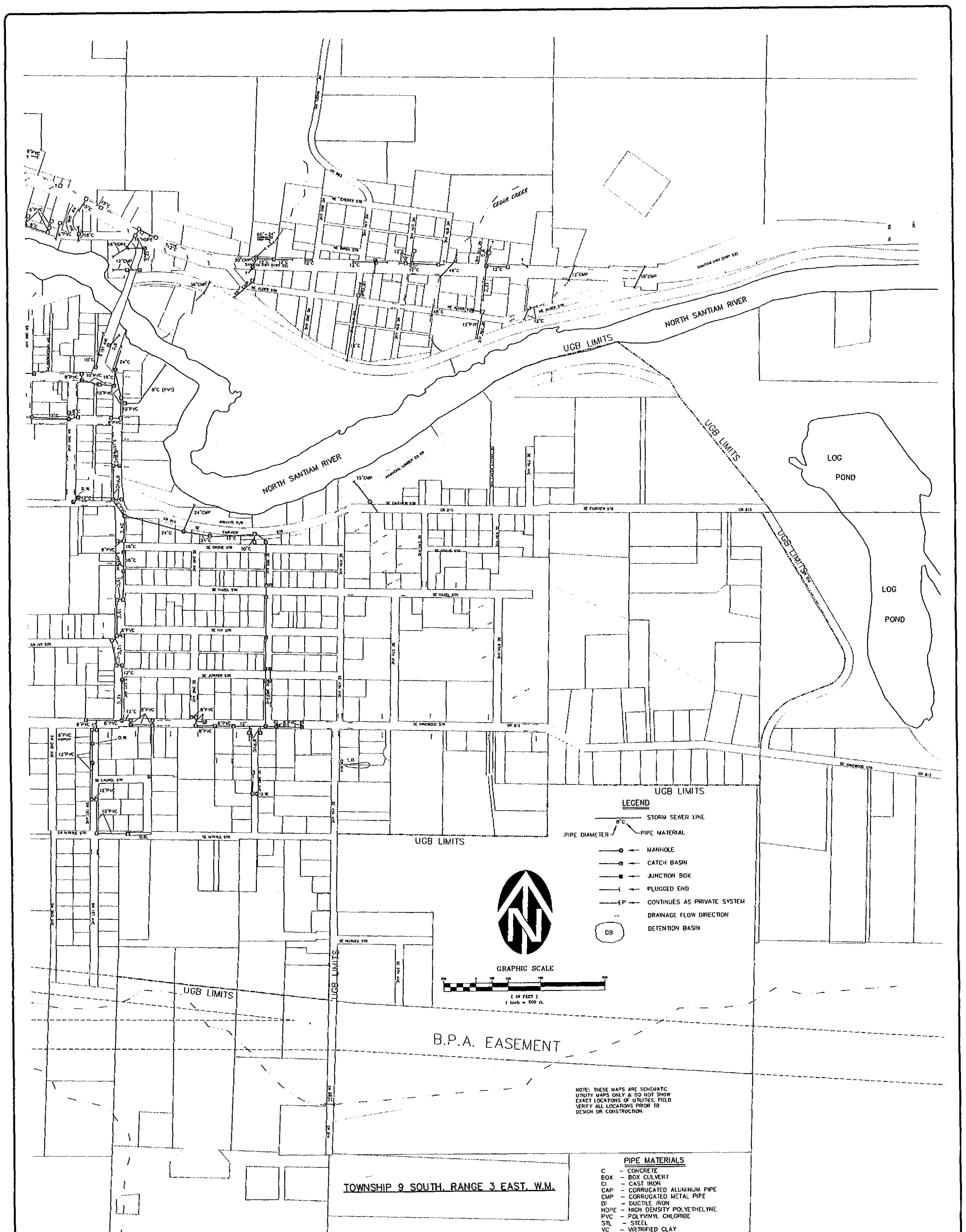
The **Storm Drainage System Map (Figure 3-2)** shows the location and size of the existing known drainage system elements. A full scale copy of this map is included in **Appendix B**.

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 15,000 feet (±2.7 miles) with ±130 catch basins, ±15 storm drain manholes, and 7 drywells. The remainder of the storm drainage system consists of small perennial streams and constructed open channels, including roadside ditches.

As previously noted, the study area is crossed by only one major transportation route, Highway 22. Given the topography and basin configuration, Highway 22 does not appear to present any significant barriers to the storm drainage system. Upon evaluation, certain basins may be found to require upgraded facilities across the highway, but it is unlikely that the highway will pose a major obstacle to such work.



SHEET 1 OF 2 JOB NUMBER 1780.0000.0	CITY OF MILL CITY, OREGON WEST STORM DRAINAGE SYSTEM MAP	WESTECH ENGINEERING, INC. CONSULTING ENGINEERS AND PLANNERS 3841 Fairview Industrial Dr. S.E. Suite 100 Salem, Oregon 97302 PH (503) 585-2474 FAX (503) 585-3986	MAP UPDATED: 7-20-02	SCALE HORIZ: VERT: DSN. C.B. DRN. C.B. CKD. D.M. DATE: OCT 1999	NO. DATE DESCRIPTION BY REVISIONS



JOB NUMBER 1780.0000.0	SHEET 2 OF 2	CITY OF MILL CITY, OREGON EAST STORM DRAINAGE SYSTEM MAP	WESTECH ENGINEERING, INC. CONSULTING ENGINEERS AND PLANNERS 3841 Fairview Industrial Dr. S.E. Suite 100 Salem, Oregon 97302 PH (503) 585-2474 FAX (503) 585-3986	MAP UPDATED: 7-20-02	SCALE HORIZ: VERT: DSN. C.B. DRN. C.B. CKD. D.M. DATE: OCT 1999

NO.	DATE	DESCRIPTION	BY
		REVISIONS	

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

Table 3-2
Storm Drainage System, Estimated Piping Quantities

	Total Estimated Pipe Quantities (feet)					
Pipe Size	Concrete	PVC	HDPE	CMP	Steel	Totals
#6"	200	200				400
8"	1,450	1,000		50	50	2,550
10"	850	750		50		1,650
12"	5,450	500		250		6,200
15"	500			300		800
18"	850		250	700		1,800
24"	800			200		1,000
30"				100		100
36"				100		100
48"	350					350
Totals	10,450	2,450	250	1,750	50	14,950

Number of Catch Basins = ±130   Number of Manholes = ±15   Number of Drywells = ±7

PVC = Poly Vinyl Chloride   HDPE = High Density Polyethylene   CMP = Corrugated Metal Pipe

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 6 to 12 inches in diameter for local systems to 18-inch and larger pipes for major collector systems. Pipe materials include concrete, Poly Vinyl Chloride (PVC), High Density Polyethylene (HDPE), corrugated metal (CMP), and steel.

3.4 Typical Storm Drain System Problems

Before addressing particular problems, it is helpful to define the categories of problems likely to be encountered. We have found that problems 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. Not all categories of problems are present in every system. A short description of each of these categories follows:

a. Lack of Capacity

This type of drainage problem results from open channels or pipes that 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. Therefore, although the storm system may have capacity to handle the runoff from smaller magnitude storms, it is 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 or ditches 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.

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 types 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 types 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, rainfall washes soil from areas that have been cleared of vegetation and graded for development. Erosion of streambeds 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.

3.5 Mill City Storm Drain System Problem Areas

The major problem areas and their associated categories are summarized in **Table 3-3.** This list shows that there is one primary cause for most of the problems in the City's storm drainage system in the Spring Street Basin: lack of facility. There is simply little or no storm drainage system infrastructure in most areas of this basin. The recommended approaches for correcting problems are presented in Section 5. This table will be updated with each revision to this report, with additions based on new basin evaluations and deletions where improvements have been constructed to correct problems noted earlier.

Table 3-3
Existing Drainage Problem Areas
(Based on analysis or City Input)

Location (Basin)	Problem Category
Spring Street Basin	Lack of Facility

3.6 Existing Storm Drainage Funding Mechanisms

According to the City, it does not presently have a dedicated storm drainage system 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. Potential storm drainage system funding mechanisms are discussed in Section 6.

CITY OF MILL CITY
Storm Drainage System Master Plan

Section 4

Hydrologic/Hydraulic Analysis

SECTION 4
HYDROLOGIC/HYDRAULIC 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 City of Mill City's Public Works Design Standards specify the Rational Method for calculating run-off for public storm drainage improvements. However, the validity of the Rational Method is generally limited to basins less than 300 acres. For this study, the calculation of peak flows was accomplished using both the Rational Method, as presented in the ODOT Hydraulics Manual and a mathematical computer simulation model, PondPack Santa Barbara Urban Hydrograph (SBUH), developed by Haested Methods. The fundamental principles for these two methods are described below.

In addition to the typical advantages provided by computer simulations, the SBUH approach was used because the rational method is generally considered to be reliable only for basins under 300 acres. Additional differences between the SBUH method and the rational include the use of a 24-hour storm event model with SBUH compared with the Intensity-Duration-Frequency (IDF) tables used in the rational method that end after 6 hours, and a greater variety of soil types in the SBUH. The IDF curves used with the Rational Method generally represent a more intense, shorter duration storm events that work well with site specific storm system designs. However, the 24-hour storm used by SBUH more closely follows the pattern of storms that should be applied to larger, more extensive drainage systems.

The Rational Method

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 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. For Mill City, the Intensity-Duration-Frequency (IDF) curve for Zone 5 should be used.

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

Santa Barbara Urban Hydrograph (SBUH) Method

The SBUH procedure involves defining sub-basins of the drainage basin of interest according to two basic hydrologic characteristics, the soil type and the time of concentration, then applying a model storm to that basin. The soil type involves the type of soil (as defined by the Soil Conservation Service soil maps), the use related to the parcel (residential, commercial, various types of agricultural activities, etc.), and judgement of relative quality of soil within that use (good, fair, poor). Using these parameters a CN number was selected to represent each of the various areas within the drainage basin, and used as input in the computer model.

The time of concentration is the length of time it takes for rain falling at the most distant point of a drainage area to travel to the discharge point. Typically, rainfall must travel several segments before it reaches the basin discharge point. These can include an overland sheet flow segment, a shallow overland segment, open channel segments, and piped segments.

The model storm used is a 24-hour rainfall event, where the total rainfall is distributed in time related increments based on the appropriately selected region of the country. The type of storm used for this study is the Type IA, that represents typical storm patterns for the West Coast from the coastline to the first major mountain range (Cascades, Sierras, etc.). The total rainfall is dependent on the magnitude of the event as described by the expected frequency: 2-year (3.5-inches), 5-year (4.2-inches), 10-year (4.5-inches), 25-year (5.4-inches), 50-year (6.0-inches), or 100-year (6.5-inches). These totals are mapped in the National Oceanic and Atmospheric Administration (NOAA) *Atlas 2, Precipitation-Frequency Atlas of the Western United States, Volume X – Oregon*.

To this point, the SBUH and the rational methods are similar. The most significant computational difference between SBUH and rational involves the method of adding together the various sub-basins. For the SBUH the computer calculates a time dependent discharge from each sub-basin, and then adds these results together as the flow is "routed" mathematically along the central drainageway. Using this procedure, the run-off from a sub-basin with a short time of concentration can be properly combined with the run-off from a basin with a much longer time of concentration. Information on the various input parameters used for the SBUH method, are presented in **Appendix C**.

Table 4-1 presents a comparison between the SBUH and Rational methods for selected hypothetical conditions, including a 10 acre site, and a time of concentration of 30 minutes. For the SBUH method, Soil Class 'B' was assumed, while for the Rational Method terrain with 2-10% slopes were assumed.

Table 4-1
SBUH/Rational Peak Run-Off Comparison (cfs)
10 acre site, Time of Concentration = 0.5 hours

Zone	Storm *SBUH* Rational	2-year *3.5-inches* 0.40 in/hr	10-year *4.5-inches* 0.60 in/hr	25-year *5.4-inches* 0.69 in/hr	50-year *6.0-inches* 0.78 in/hr
Open	CN = 60	0.4	0.8	1.6	2.2
	C=0.15	1.2	1.7	2.0	2.3
Farm	CN = 73	1.4	2.7	4.0	5.0
	C=0.45	3.5	5.1	5.9	6.8
R1	CN = 75	1.7	3.1	5.4	5.5
	C = 0.55	4.3	6.3	7.3	8.3
R2	CN = 80	2.5	4.1	5.6	6.7
	C = 0.65	5.1	7.4	8.6	9.8
I	CN = 88	4.0	5.8	7.5	8.6
	C = 0.75	5.9	8.6	9.9	11.3
C	CN = 92	4.9	6.7	8.4	9.5
	C = 0.85	6.6	9.7	11.2	12.8

This table clearly shows the conservative nature of the Rational Method. For the storm event applicable to this study, the 25-year event, the Rational run-off estimates are typically 30%-60% higher than the estimates using the Santa Barbara Urban Hydrograph method.

The conservative nature of the Rational Method, as well as its simplicity, underlies the reasoning behind its use as the method required by the City's Public Works Design Standards. New development typically involves smaller areas and shorter times of concentration. The facilities designed to support this development should be able to handle the intense, shorter duration storms and adequately convey the run-off to the trunk line system.

The SBUH becomes relevant as contributing areas get larger and times of concentration get longer. Thus, the SBUH calculations are most meaningful for basins such as the long basins in the north and south parts of the City.

For the purposes of this study both methods of calculation were employed for all basins and the results of all calculations are presented in Section 5. In general, the adequacy of the storm drainage system for smaller basins should be evaluated against the Rational results. For larger basins, the results from both the Rational and SBUH methods should be considered.

b. 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.

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 drainage 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 one 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.

Under certain circumstances, a detailed cost-benefit analysis may be appropriate for determining the appropriate magnitude storm to be used. As an example, a large construction project in or near a floodplain, might warrant a study of the cost of conveying various quantities of stormwater compared to the expected cost of damage for each additional incremental rise in floodwater elevation. However, such an analysis is generally beyond the scope of a report such as this. Instead, standard guidelines relating the magnitude of storm to be considered to the various portions of a storm drainage system are commonly used.

With all these factors in mind, **Table 4-2** outlines the design storm frequencies typically employed in storm system analysis, and thus utilized for this report. This level of protection is consistent with other Cities in the region and the City's Public Works Design Standards.

Table 4-2
Design Storm Frequency

Area	**Frequency**
Residential areas	10-year storm
Commercial areas	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

Based on this Table, the analysis performed for this study used 25-year storm events.

4.2 Hydraulic Analysis

a. General

A typical public storm drainage system generally consists of three main elements; pipes, culverts, and open channels (manmade ditches or natural streams). While other elements exist (such as pumps, dams, ponds, and water quality features), the pipes, culverts, and open ditches serve as the primary means of conveying stormwater through and out of the City.

The following sections provide a brief summary of the standard mathematical analysis used to determine the capacity of a given element. Like a chain, a storm drainage system is only as good as its weakest link. Thus, in completing an analysis of a storm drainage system it becomes necessary, as a minimum, to evaluate all of the major elements to identify any "weak link." For this study the evaluation included all major trunk lines down to those that handle the drainage for at least a full sub-basin. Local collection systems within a sub-basin were not specifically addressed.

b. Pipe Flow - Manning's Formula

The majority of Mill City's storm drainage conveyance system is made up of pipe elements. The drainage is collected by an inlet structure, such as a catch basin, and conveyed from point to point through a series of pipes connected by structures, such as manholes or junction boxes. Most pipes within the storm drainage system were assumed to be flowing full under open channel flow conditions. ("Open Channel" in a pipe system refers to uniform gravity flow in a long pipe segment, not open to the air such as a ditch).

In many areas of Mill City, 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 Manning's Formula, which is expressed as:

$$Q = \frac{1.486}{n} \times A \times R^{2/3} \times S^{1/2}$$

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 smooth wall 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 accumulations on the pipe walls over time tend to render a true, or operational, "n" value of 0.013. Hence, an "n" value of less than 0.013 for smooth wall pipe is not recommended for design purposes. For corrugated pipes an "n" of 0.024 value was used, and is recommended for design purposes.

Using the equation above it becomes a straightforward matter to calculate the capacity of any given pipe segment given a few simple, specific pieces of information. The cross sectional area can be readily computed from the pipe diameter. The hydraulic radius is defined as the cross sectional area divided by the wetted perimeter and is included in the formula because the friction resistance opposing the flow occurs at the wetted perimeter. For this study the interest is in the maximum capacity of the pipe, so all pipes are assumed to be flowing full. The slope is self explanatory, and as the "n" value is discussed above. **Table 4-3** presents the computed capacity of a variety of pipe sizes and slopes assuming the pipes have a Manning's "n" of 0.013 and are flowing full:

Table 4-3 Pipe Capacity, Flowing Full (cfs) Manning's "n" = 0.013							
	Pipe Size (inches)						
Slope (%)	12	18	24	30	36	42	48
0.2	2	5	10	18	30	45	64
0.4	2	7	14	26	42	64	91
0.6	3	8	18	32	52	78	112
0.8	3	9	20	37	60	90	129
1	4	11	23	41	67	101	144
1.2	4	12	25	45	73	111	158
1.4	4	12	27	49	79	119	170
1.6	5	13	29	52	85	128	182
1.8	5	14	30	55	90	135	193
2	5	15	32	58	95	143	204
2.2	5	16	34	61	99	150	214
2.4	6	16	35	64	104	156	223
2.6	6	17	37	66	108	163	232
2.8	6	18	38	69	112	169	241
3	6	18	39	71	116	175	249

c. Culvert Flow

Culverts are distinguished from pipes in that they are open at both ends, rather than connected to structures such as catch basins or manholes. Culverts function under several distinct conditions depending on the depth of flow at their upstream and downstream ends. The desired condition for a properly sized channel and culvert is to have the downstream water surface level below the top of the pipe, and the upstream water surface level at or below the top of the pipe. In this condition the culvert is not having any significant impact on the flow, and is simply conveying the water underground from one section of channel to another.

If the downstream channel water surface level is below the top of the culvert, but the flow from upstream is greater than the full flow capacity of the culvert, the water surface height at the upstream end will rise. This will increase the water pressure at the upstream end, which will then force water through the pipe at a higher rate. This condition is described as inlet control. Under this condition the water surface elevation will stabilize at the point where the water is being forced through the culvert at the same rate that it is arriving from upstream.

If the downstream channel is undersized, the normal depth of flow will rise above the top of the outlet pipe. In order for water to continue to flow through the pipe, the water at the upstream end must rise also. This condition is described as outlet control. Since outlet control also results in a higher than normal upstream water surface elevation, it is generally considered to be an undesirable condition and should be corrected whenever possible.

Both inlet and outlet control capacities are frequently determined using nomographs that allow a simple, graphical solution for a wide range of pre-computed conditions. Sample nomographs for concrete and corrugated metal pipes for both inlet and outlet control are presented in **Appendix D.**

The final condition that may be relevant to culvert flow is that of a pipe flowing full. Just as open channels have a "normal" condition, so do pipes. The physical properties of a pipe define its capacity in the absence of bends, obstructions, changes in size, etc. This is described in more detail in the following section.

d. Open Channel Flow - Manning's Formula

Much of the storm drainage conveyance system in Mill City consists of piped drainage. However, there are also numerous creeks and open ditches in various parts of the City. The following discussion is provided as a resource to aid in the evaluation the existing open channels, as well as any open drainageways that might be proposed in the future.

Any analysis of open ditches should address at least two main issues. The first is the ability of the ditch to carry the anticipated flows. The second, and more subtle consideration, is ensuring that they are properly designed to accept flows from piped systems or other ditches discharging to them. If the water surface in the ditch becomes too high, water in piped systems or adjacent roadside ditches tends to back up and resist the flow of water trying to enter the main ditch. If such a situation occurs frequently, the slow drainage in the piped system can allow sediment to settle out and accumulate, thereby creating further reductions in system capacity as well as maintenance problems.

Under conditions described as "normal flow", the depth of water in an open ditch can be determined using Manning's equation:

$$Q=\frac{1.486}{n}\times[Y\times(B+Z\times Y)]\times\{\frac{[Y\times(B+Z\times Y)]}{[B+2Y\times(1+Z^2)^{1/2}]}\}^{2/3}\times S^{1/2}$$

where:

	Q =	Flow (cfs)
	n =	Manning's coefficient (0.035 used for open channel with a natural bottom, 0.013 used for open channel with a concrete bottom)
	Y =	Flow Depth (feet)
	B =	Channel Bottom Width (feet)
	Z =	Channel Side Slopes (Z horizontal: 1 Vertical)
	S =	Channel Slope (ft/ft)

Normal flow occurs where the ditch or waterway is consistent, with no changes in slope, no bends, or obstructions such as culverts or weirs. While normal flow is a best case situation, it provides a reliable estimate for flow depth at a given flow volume for man-made channels with consistent cross sections and gradual bends.

When an open drainageway encounters a culvert, the effect on the flow is dependent on the flow relative to the size and capacity of the culvert. If culvert capacity is large relative to the flow, it is unlikely that it will have a significant impact on the open channel flow in the ditch. However, if the flow in the ditch approaches or exceeds the capacity of the culvert, the conditions for normal flow can be violated and other methods must be applied to estimate the depth of flow in the ditch.

While the details of the culvert flow were described in the preceding section, the primary effect of an undersized culvert on open channel flow is to raise the water surface elevation on the upstream end of the culvert. This higher water surface elevation impedes normal flow for some distance upstream of the culvert. This upstream region is described by a backwater curve that can be calculated either by hand or computer programs.

For the purposes of this study, backwater analysis was not conducted. It is important that culverts on the main drainage channels not be points of flow restrictions that cause significant backwater conditions.

4.3 Computed Stormwater Flows for Existing and Future Conditions

The baseline for analysis in this study is the existing conditions. Using the 'C' and 'CN' values for current zoning, land uses, and estimated conditions, the various basins were modeled under 25-year storm event conditions. Where the current use does not match the zoning, such as land still being farmed in the R1 zone, the run-off coefficient for the actual use was employed in the study for existing conditions. Where there is a mixture of uses, a run-off coefficient based on a weighted average was computed. The 'C' and 'CN' numbers used in this modeling are shown in **Table 4-4**. With possible CN numbers ranging from 30 or less for well drained, sandy meadows to 98 for paved surfaces, the numbers used in this study vary widely depending on the soil indicated on the soil study maps (see Figure 2-1) and the nature of the development.

The time of concentration was estimated for each basin in three segments; overland sheet flow, shallow overland flow, and piped or open channel flow. For overland sheet flow, the ground slope, soil condition and flow length was estimated based on typical parameters for each area. **Table 4-5** shows representative values for these parameters used in this study.

For future conditions, rather than representing a sub-basin by run-off coefficients and times of concentration based on the current state of development, all zones were assumed to be fully developed according to their respective zoning conditions.

Table 4-6 provides a summary of run-off coefficients and times of concentration for all sub-basins in both existing and future conditions.

The estimated run-off for each sub-basin using the Rational Method is provided in **Appendix C**. The SBUH stormwater hydrographs computed based on the input parameters listed above are included in this report as **Appendix E**. The peak flow values from these calculations are used in Section 5 to evaluate the adequacy of the main trunk lines and culverts.

Table 4-4
Typical Sub-basin 'C' and 'CN' Parameters

	'C' by Terrain			'CN' By Soil Type			
ZONE	Flat	2%-10%	Over 10%	A	B	C	D
CC – Central Commercial	0.80	0.85	0.85	89	92	94	95
CH – Highway Commercial	0.80	0.85	0.85	89	92	94	95
R1 –Residential Single	0.50	0.55	0.60	61	75	83	87
R2 –Residential Multiple	0.60	0.65	0.70	70	80	86	90
P – Public (Buildings & Offices)	0.60	0.65	0.70	70	80	86	90
P – Public (Parks & Playgrounds)	0.20	0.25	0.30	49	69	79	84
I – Industrial	0.55	0.75	0.80	81	88	91	93
SPD – Special Planned District	0.50	0.55	0.60	60	73	81	84
UGB – Commercial	0.80	0.85	0.85	89	92	94	95
UGB – Industrial	0.55	0.75	0.80	81	88	91	93
UGB – Residential Adjacent R1	0.50	0.55	0.60	61	75	83	87
UGB – Residential Adjacent R2	0.60	0.65	0.70	70	80	86	90
Forest/Open Space	0.10	0.15	0.20	36	60	73	79
Farm	0.40	0.45	0.50	61	73	81	84
Right-of-Way (Turnpike) (Curbed)	0.85 0.90	0.85 0.90	0.85 0.90	93 98	93 98	93 98	93 98

Table 4-5
Typical Sub-basin Time of Concentration Parameters
Time in Hours (Minutes)

Overland Sheet Flow			
	100'	150'	200'
n = 0.05			
s = 2%	0.08 (5)	0.11 (6)	0.13 (8)
s = 1%	0.10 (6)	0.14 (8)	0.17 (11)
n = 0.08			
s = 2%	0.11 (7)	0.15 (9)	0.19 (12)
s = 1%	0.15 (9)	0.20 (12)	0.26 (16)
n = 0.15			
s = 2%	0.18 (11)	0.26 (15)	0.32 (19)
s = 1%	0.24 (14)	0.34 (20)	0.42 (25)
n = 0.24			
s = 2%	0.27 (16)	0.37 (22)	0.47 (28)
s = 1%	0.36 (21)	0.49 (29)	0.62 (37)
Manning's coefficients used as follows: 0.05 – Industrial and General Commercial; 0.08 – Residential Multiple and Commercial Residential; 0.15 – Combination Areas; 0.24 – Residential Single and Public (Schools and Parks)			
Shallow Concentrated Flow			
	Paved	Unpaved	
s = 4%	N/A	0.009 (0.5)	
s = 2%	0.010 (0.6)	0.012 (0.7)	
s = 1%	0.014 (0.8)	0.017 (1.0)	
Times shown are per 100 foot of distance traveled.			
Pipe Flow			
6 ft/sec assumed average velocity.			

Table 4-6 Sub-basin Characteristic Summary							
		Rational 'C'		SBUH 'CN'		Time of Concentration (hours)	
Sub-basin	Size (acres)	Existing	Future	Existing	Future	Existing	Future
SS-W1	12.1	0.61	0.62	69	70	0.45	0.40
SS-W2	25.5	0.49	0.58	72	80	0.65	0.38
SS-W3	19.2	0.55	0.56	82	83	0.49	0.37
SS-E1	5.8	0.63	0.64	76	77	0.28	0.26
SS-E2	6.1	0.59	0.59	73	76	0.36	0.36
SS-E3	9.7	0.67	0.71	81	85	0.56	0.20
SS-E4	7.1	0.68	0.74	85	88	0.31	0.13
SS-E5	24.7	0.46	0.54	84	86	0.66	0.60

CITY OF MILL CITY
Storm Drainage System Master Plan

Section 5

Storm System Evaluation & Recommendations

SECTION 5
STORM SYSTEM EVALUATION & RECOMMENDATIONS

5.1 Introduction

In the previous sections, we presented the background information and methodology used in completing the analysis of Mill City's stormwater system. In this section we bring the pieces together to identify shortcoming's in the stormwater system, and then make recommendations to correct those problems. Since this report will be developed over time with different basins being selected by the City for evaluation, The remainder of this section is organized as follows:

- Stormwater Drainage System Capital Improvement Plan (CIP) Elements
- Stormwater drywells
- Spring Street Basin
- Downtown Basin (To Be Developed)
- 1st Avenue South Basin (To Be Developed)
- Kimmel Park Basin (To Be Developed)
- Cow Creek Basin (To Be Developed)
- Western Industrial Basin (To Be Developed)
- Snake Creek Basin
- Santiam Highway West Basin (To Be Developed)
- Elizabeth Creek Basin (To Be Developed)
- 1st Avenue North Basin (To Be Developed)
- Cedar Creek Basin (To Be Developed)
- West Alder Basin (To Be Developed)
- Alder-River (To Be Developed)
- Stormwater Detention

5.2 Stormwater Drainage System Capital Improvement Plan (CIP) Elements

As each storm drainage basin is evaluated and incorporated into this report, it is likely that there will be storm drainage system improvements recommended for construction. For each basin there will be a section of the report provided to compile, prioritize, and provide cost estimates for the various recommended improvements. The priorities assigned to the improvements are based on the following definitions.

- **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. 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.

The construction costs associated with each recommendation are based on the size of pipe required, and whether or not the pipe is in a paved area and therefore requires crushed rock backfill and paved trench surface restoration. The construction costs are intended to represent all construction costs, including mobilization, bonds, permits, insurance and all of the various miscellaneous costs associated with each project. In addition to construction costs, a 10% contingency, 16% for engineering services, and 10% for legal and project administration are listed to provide a comprehensive estimate of all costs associated with the project. All cost estimates are based on 2002 construction costs and assume that right-of-way is available, unless otherwise specifically noted.

5.3 Stormwater Drywells

As noted in the "Authorization" section of this report, the State of Oregon Department of Environmental Quality (DEQ) has significantly increased its regulatory oversight of the use of drywells as a discharge point for storm drainage systems. This increased interest is based on Federal regulations administered by the US Environmental Protection Agency (EPA).

Historically, the City of Mill City, and numerous private developments have employed drywells as the discharge point for storm drainage, primarily because it was a comparatively inexpensive alternative to constructing a piped system to an open discharge point which might be hundreds of feet away. The current drywell regulations required the City to inventory and register existing drywells owned and operated by the City. The City has complied with this requirement. In general, existing drywells can continue to be used.

The regulations also provide a mechanism for getting new drywells approved for construction and use. However, both the language of the regulations and the discussions with DEQ have made it quite apparent that the intent is to effectively prohibit the use of drywells wherever possible. As such, we recommend that the City of Mill City develop all future storm drainage standards and systems excluding the use of drywells.

5.4 Spring Street Basin

a. Basin Evaluation

As discussed in Section 3, the Spring Street Basin is estimated to consist of approximately 110 acres. The geography and general layout lend themselves to splitting the basin into two halves, east and west to provide for development of the ultimate drainage system. There is currently very little developed storm drainage infrastructure, so the improvements will generally require starting from scratch. The estimated run-off using both the Rational and SBUH methods for existing conditions are presented in **Table 5.4-1**, while estimated run-off for future conditions is presented in **Table 5.4-2**.

Table 5.4-1
Sub-basin Run-off Estimates
Spring Street Basin, Existing Conditions

			SBUH		Rational	
Sub-basin	Size (acres)	Tc	'CN'	Q (cfs)	'C'	Q (cfs)
SS-W1	12.1	0.45	69	4	0.61	10
SS-W2	25.5	0.65	72	9	0.49	14
SS-W3	19.2	0.49	82	12	0.55	14
SS-E1	5.8	0.28	76	3	0.63	7
SS-E2	6.1	0.36	73	3	0.59	6
SS-E3	9.7	0.56	81	5	0.67	8
SS-E4	7.1	0.31	85	6	0.68	8
SS-E5	24.7	0.66	84	14	0.46	13

Table 5.4-2
Sub-basin Run-off Estimates
Spring Street Basin, Future Conditions

			SBUH		Rational	
Sub-basin	Size (acres)	Tc	'CN'	Q (cfs)	'C'	Q (cfs)
SS-W1	12.1	0.40	70	5	0.62	11
SS-W2	25.5	0.38	80	16	0.58	23
SS-W3	19.2	0.37	83	15	0.56	17
SS-E1	5.8	0.26	77	4	0.64	7
SS-E2	6.1	0.36	76	3	0.59	6
SS-E3	9.7	0.20	85	9	0.71	15
SS-E4	7.1	0.13	88	7	0.74	13
SS-E5	24.7	0.60	86	16	0.54	16

Figure 5.4-1 summarizes the estimated run-off for both SBUH and Rational methods for both existing and future conditions. Where existing storm drainage infrastructure is lacking, which is true for most of this basin, the ultimate routing of flow was assumed in developing flows at the various locations indicated.

b. Recommended Improvements

Figure 5.4-2 presents the recommended storm drainage system improvements for the Spring Street drainage basin.

For a backbone system for the western portion of the basin we recommend 36-inch diameter pipe from the outfall upstream to the intersection of Spring Street and SW 10th Avenue, and a 24-inch pipe up SW 10th Avenue and across SW Linn Blvd. From this point we recommend a 24-inch pipe extending to the west end of SW Evergreen Street, and a separate line consisting of 18-inch pipe west along SW Linn Blvd.

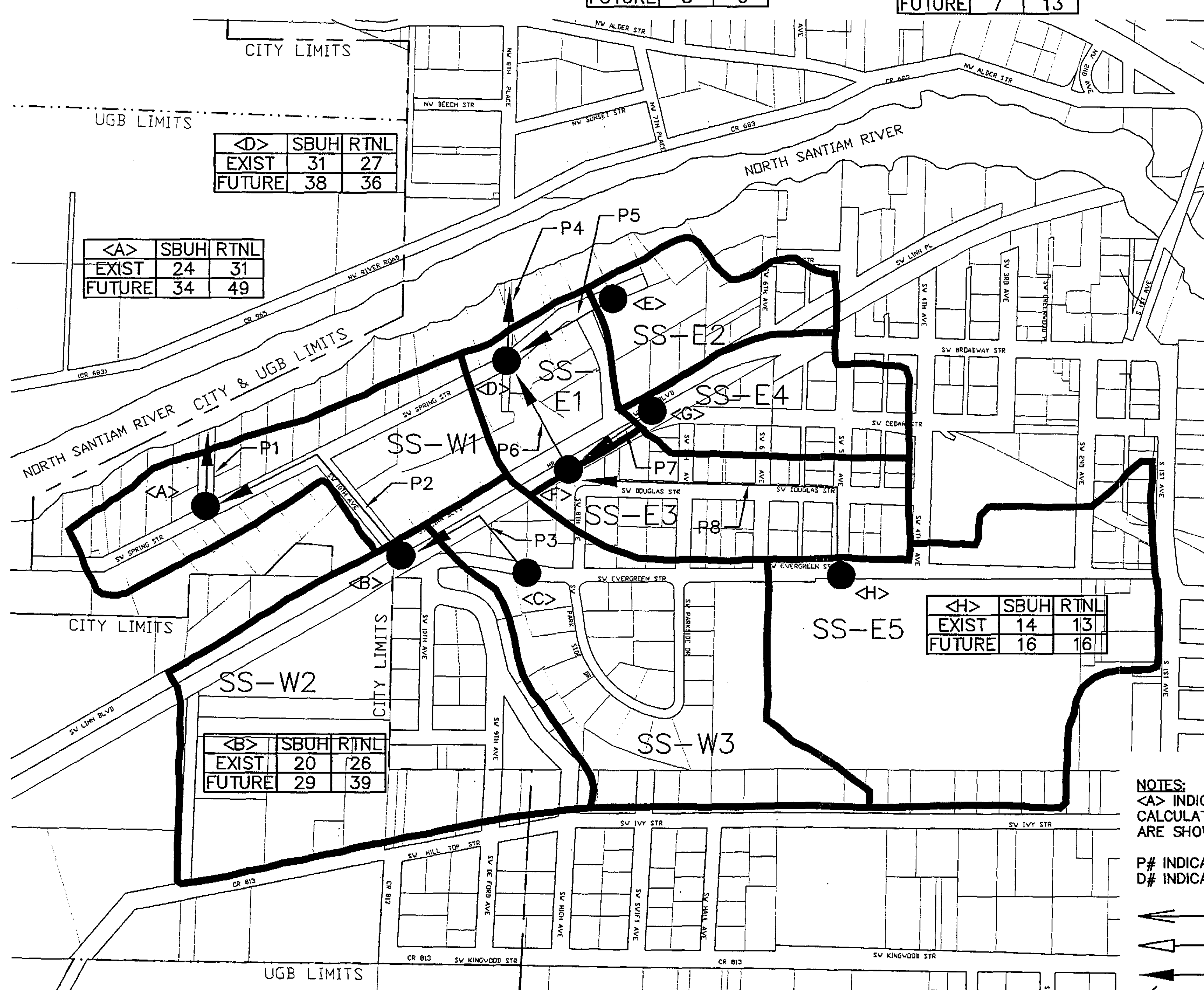
We recommend the backbone for the eastern part of the basin have a 30-inch pipe at the low end from Spring Street to the River. For the leg running east along Spring Street we recommend 18-inch pipe, while we recommend a 24-inch pipe running up the hill from Spring Street to SW Linn Blvd, and then east along SW Linn Blvd. The final leg of this backbone consists of 24-inch pipe that extends east along SW Douglas Street to SW 5th Avenue, then south on SW Fifth Avenue to SW Evergreen Street.

It should be noted that even though the flows for the eastern part of the basin are higher than the western part where we recommend a 36-inch pipe, a 30-inch pipe is proposed for the final leg of the eastern half of the basin. The reason for the difference is that in the western part the pipe size is determined by the run along Spring Street which is quite flat and therefore dictates a larger pipe. While the final pipe in the western half of the basin could theoretically be served by a 30-inch pipe on the final leg, it is generally considered poor design practice to reduce pipe sizes moving downstream as it creates the potential for blockage at the point of constriction.

The outfalls for both the eastern and western portions of the basin are indicated as "Bubbler Outfall". The intent is to stop the piped drainage behind the top of bank and discharge smaller storms through some sort of bubbler system, while larger storms would overflow out the top of a structure. The goal is to provide additional water quality protection by avoiding direct discharge to the river, especially for lower flows.

c. Stormwater Drainage System Capital Improvement Plan (CIP) Elements

The budget level costs for each element of recommended for this basin is provided in **Table 5.4-3**. The explanation of the development of these costs is provided in Section 5.2.



<A>	SBUH	RTNL
EXIST	24	31
FUTURE	34	49

<B>	SBUH	RTNL
EXIST	20	26
FUTURE	29	39

<C>	SBUH	RTNL
EXIST	12	14
FUTURE	15	17

<D>	SBUH	RTNL
EXIST	31	27
FUTURE	38	36

<E>	SBUH	RTNL
EXIST	3	6
FUTURE	3	6

<F>	SBUH	RTNL
EXIST	25	21
FUTURE	31	29

<G>	SBUH	RTNL
EXIST	6	8
FUTURE	7	13

<H>	SBUH	RTNL
EXIST	14	13
FUTURE	16	16

PIPE	DIA.	TYPE	SLOPE	Q
P1	NA			
P2	NA			
P3	NA			
P4	8	CONC	1%	1
P5	NA			
P6	18	CMP	6%	14
P7	15	CMP	0.5%	2
P8	NA			

NOTES:
<A> INDICATES LOCATIONS WHERE RUN-OFF HAS BEEN CALCULATED. ESTIMATED FLOWS FOR THESE LOCATIONS ARE SHOWN IN THE ASSOCIATED TABLES.

P# INDICATES MAJOR TRUNK LINE PIPE ELEMENTS.
D# INDICATES MAJOR TRUNK LINE DITCH ELEMENTS.

- ADEQUATE CAPACITY
- MARGINAL CAPACITY
- INSUFFICIENT CAPACITY (or Does Not Currently Exist)
- NOT EVALUATED IN DETAIL

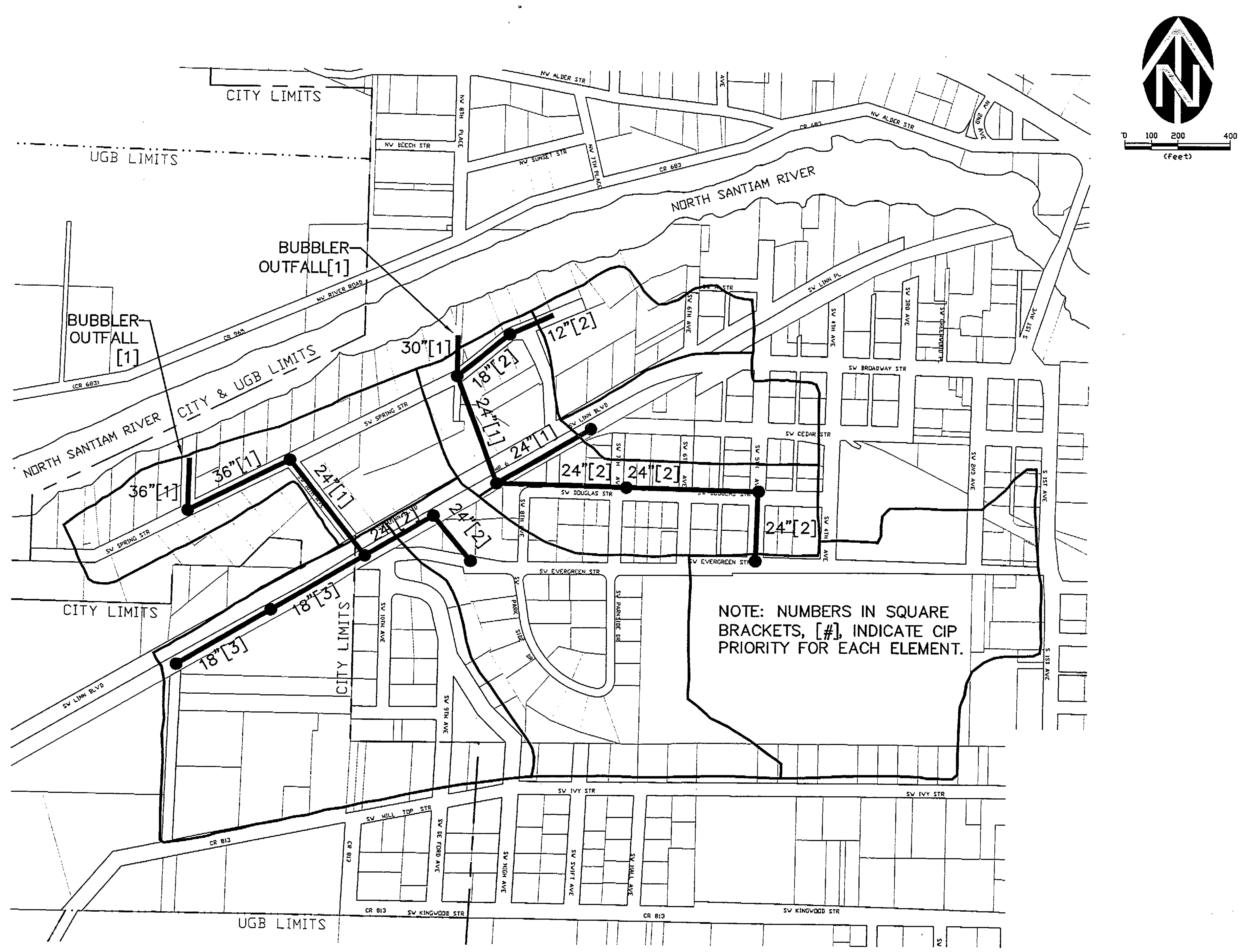
MAP UPDATED: 11-8-02

WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS AND PLANNERS

CITY OF MILL CITY, OREGON — FIGURE 5.4-1
MILL CITY STORM DRAIN MASTER PLAN

SPRING STREET BASIN ESTIMATED FLOWS & CAPACITIES

SHEET 1 OF 1
JOB NUMBER 1780.5010.0



MAP UPDATED: 11-8-02

WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS AND PLANNERS

CITY OF MILL CITY, OREGON — FIGURE 5.4-2

MILL CITY STORM DRAIN MASTER PLAN

RECOMMENDED SPRING ST STORM DRAINAGE SYSTEM IMPROVEMENTS

SHEET 1 OF 1

JOB NUMBER 1780.5010.0

TABLE 5.4-3

Spring Street Basin Capital Improvement Project (CIP) Estimated Costs*

PROJECT	Priority	Pipe Size (in)	Paved or Unpaved	Length (ft)	Cost/ft ($)	Manholes	Cost/Ea ($)	Inlets	Cost/Ea ($)	Construction Cost ($)	Contingency (10%)	Engineering (16%)	Legal & Admin (10%)	Project Total ($)	SDC Eligible
PRIORITY 1															
West Basin Bubbler Outfall	1					1	$15,000	0	$0	$15,000	$1,500	$2,400	$1,500	$20,400	No
36-inch Pipe, West Outfall to Spring Street	1	36	Unpaved	200	$110	1	$7,000	2	$1,000	$31,000	$3,100	$4,960	$3,100	$42,160	No
36-inch Pipe along Spring Street	1	36	Paved	400	$120	1	$7,000	2	$1,000	$57,000	$5,700	$9,120	$5,700	$77,520	No
24-inch Pipe along SW 10th Avenue	1	24	Paved	450	$70	1	$10,000	2	$1,000	$43,500	$4,350	$6,960	$4,350	$59,160	No
East Basin Bubbler Outfall	1					1	$15,000	0	$0	$15,000	$1,500	$2,400	$1,500	$20,400	No
30-inch Pipe, East Outfall to Spring Street	1	30	Unpaved	200	$80	1	$5,000	2	$1,000	$23,000	$2,300	$3,680	$2,300	$31,280	No
24-inch Pipe, Spring Street to West Linn Blvd	1	24	Unpaved	450	$60	1	$3,000	2	$1,000	$32,000	$3,200	$5,120	$3,200	$43,520	No
24-inch Pipe along West Linn Blvd	1	24	Paved	450	$70	1	$3,000	2	$1,000	$36,500	$3,650	$5,840	$3,650	$49,640	No
						0	$0	0	$0	$0	$0	$0	$0	$0	
											TOTAL, ALL PRIORITY 1 PROJECTS			**$344,080**	
PRIORITY 2															
24-inch Pipe along West Linn Blvd	2	24	Paved	300	$70	1	$3,000	2	$1,000	$26,000	$2,600	$4,160	$2,600	$35,360	No
24-inch Pipe, West Lin Blvd to SE Evergreen Street	2	24	Unpaved	250	$60	1	$3,000	2	$1,000	$20,000	$2,000	$3,200	$2,000	$27,200	No
18-inch Pipe along Spring Street	2	18	Paved	250	$50	1	$2,000	2	$1,000	$16,500	$1,650	$2,640	$1,650	$22,440	No
12-inch Pipe along Spring Street	2	12	Paved	200	$45	1	$2,000	2	$1,000	$60,000	$6,000	$9,600	$6,000	$81,600	No
24-inch Pipe, SW Douglas, SW Linn Blvd to SW 7th	2	24	Paved	500	$70	2	$3,000	4	$1,000	$100,000	$10,000	$16,000	$10,000	$136,000	No
24-inch Pipe, SW Douglas, SW 7th to SW 5th	2	24	Paved	500	$70	2	$3,000	4	$1,000	$45,000	$4,500	$7,200	$4,500	$61,200	No
24-inch Pipe, SW 5th, SW Douglas to SW Evergreen	2	24	Paved	250	$70	1	$3,000	2	$1,000	$22,500	$2,250	$3,600	$2,250	$30,600	No
											TOTAL, ALL PRIORITY 2 PROJECTS			**$394,400**	
PRIORITY 3															
18-inch Pipe along SW Linn Blvd	3	18	Paved	850	$50	2	$2,000	4	$1,000	$50,500	$5,050	$8,080	$5,050	$68,680	Yes
						0	$0	0	$0	$0	$0	$0	$0	$0	
											TOTAL, ALL PRIORITY 3 PROJECTS			**$68,680**	
												TOTAL, ALL PROJECTS		**$807,160**	

*Note: These estimates are planning level cost estimates and not based on actual designs. They should be considered as preliminary and subject to change.

5.5 Downtown Basin Evaluation (To Be Developed)

5.6 1st Avenue South Basin Evaluation (To Be Developed)

5.7 Kimmel Park Basin Evaluation (To Be Developed)

5.8 Cow Creek Basin Evaluation (To Be Developed)

5.9 Western Industrial Basin Evaluation (To Be Developed)

5.10 Snake Creek Basin Evaluation

a. Basin Evaluation

The Snake Creek Basin is unique because of its size and location. As noted in Section 3, the full Snake Creek Basin is estimated to cover roughly 3,600 acres (over 5.6 square miles). Most of the basin is located south of the City, with only small amount of its area on the southern edge of town, with Snake Creek as the divider between the larger rural portion and the developable city area. This arrangement lends itself to managing the Snake Creek Basin stormwater in unique ways.

The first item to address is controlling the flow in Snake Creek so that its potential for flooding the developed areas is greatly reduced. As part of the development of the City's Kingwood Area Local Street Plan, a future "Oak Street" was identified as the southern boundary of development. The intent is for Oak Street, along with a new segment of Hall Avenue, to serve as a dike or barrier to Snake Creek flows should the creek overflow its normal banks. To accomplish this Oak Street is to be constructed on embankment raising it higher than the adjacent ground.

Physically separating Snake Creek from the developable portion of town with the Oak Street roadway berm eliminates the need for a detailed analysis of the creek and greatly simplifies the analysis needed for the developable areas. In effect, the master plan analysis only needs to evaluate the developable areas north of the creek, and the analysis can be handled in a normal manner.

The close associate of the developable areas with the creek does lend weight to the desirability of incorporating stormwater quality components into the storm drainage systems within the developable portions of the Snake Creek Basin wherever such can be reasonably accommodated. A relatively large portion of the study area in this basin is currently open, undeveloped space that drains directly to Snake Creek, which remains a largely rural, natural waterway.

Figure 5.10-1 summarizes the estimated run-off for both SBUH and Rational methods for both existing and future conditions for the developable portions of the Snake Creek Basin, with the basin divided up into six sub-basins. The estimated run-off for existing conditions is presented in **Table 5.10-1**, while estimated run-off for future conditions is presented in **Table 5.10-2**. It should be noted that run-off estimates for future conditions do not account for detention as part of development, thus are on the high end of values. Actual future run-off is likely to fall somewhere between the existing and future estimates.

Table 5.10-1 Sub-basin Run-off Estimates Snake Creek Basin, Existing Conditions						
			SBUH		Rational	
Sub-basin	Size (acres)	Tc SB/Rat	'CN'	Q (cfs)	'C'	Q (cfs)
SC-1	21.6	0.57/0.57	81	15	0.57	15
SC-2	27.5	0.56/0.68	71	12	0.43	13
SC-3	28.7	0.79/1.13	71	11	0.42	10
SC-4	19.9	0.52/0.63	74	10	0.47	11
SC-5	23.4	0.72/1.00	73	11	0.45	9
SC-6	34.9	1.08/1.53	71	12	0.42	10

Table 5.10-2 Sub-basin Run-off Estimates Snake Creek Basin, Future Conditions						
			SBUH		Rational	
Sub-basin	Size (acres)	Tc SB/Rat	'CN'	Q (cfs)	'C'	Q (cfs)
SC-1	21.6	0.42/0.38	83	17	0.63	21
SC-2	27.5	0.46/0.42	83	22	0.61	24
SC-3	28.7	0.56/0.50	83	21	0.60	23
SC-4	19.9	0.31/0.25	82	16	0.60	23
SC-5	23.4	0.54/0.73	80	16	0.54	13
SC-6	34.9	1.08/1.53	71	12	0.42	10

In the above tables the time of concentration is given in hours for both the SBUH and the Rational methods. In many cases within developed areas the difference in time computed by the two methods is small. However, where long overland flow distances exist, the Rational Method produces much longer times in these segments. Since there are such segments in most of the Snake Creek sub-basins, it became necessary to compute both.

b. Recommended Improvements

Figure 5.10-2 presents the recommended storm drainage system improvements for the Snake Creek drainage basin. These will be discussed on a sub-basin basis below.

Snake Creek Sub-Basin 1 (SC-1) is already largely developed. The major drainage component is the existing roadside ditch on the south Side of Kingwood Avenue. This is expected to be adequate to handle the little remaining development in this area, thus no specific recommended improvements are shown in this area. While piped storm drainage is needed when the turnpike streets are reconstructed to urban standards, such piping does not represent master plan level concerns.

There is a unique situation immediately east of SC-1 on the south side of Ivy Street. There is a local depression in this area that could collect drainage from several acres, but it has no surface outlet. Apparently the soils in this area are so pervious that little or no run-off is generated. However, upon development a substantial increase in runoff could occur. At such time a viable point of discharge would be needed.

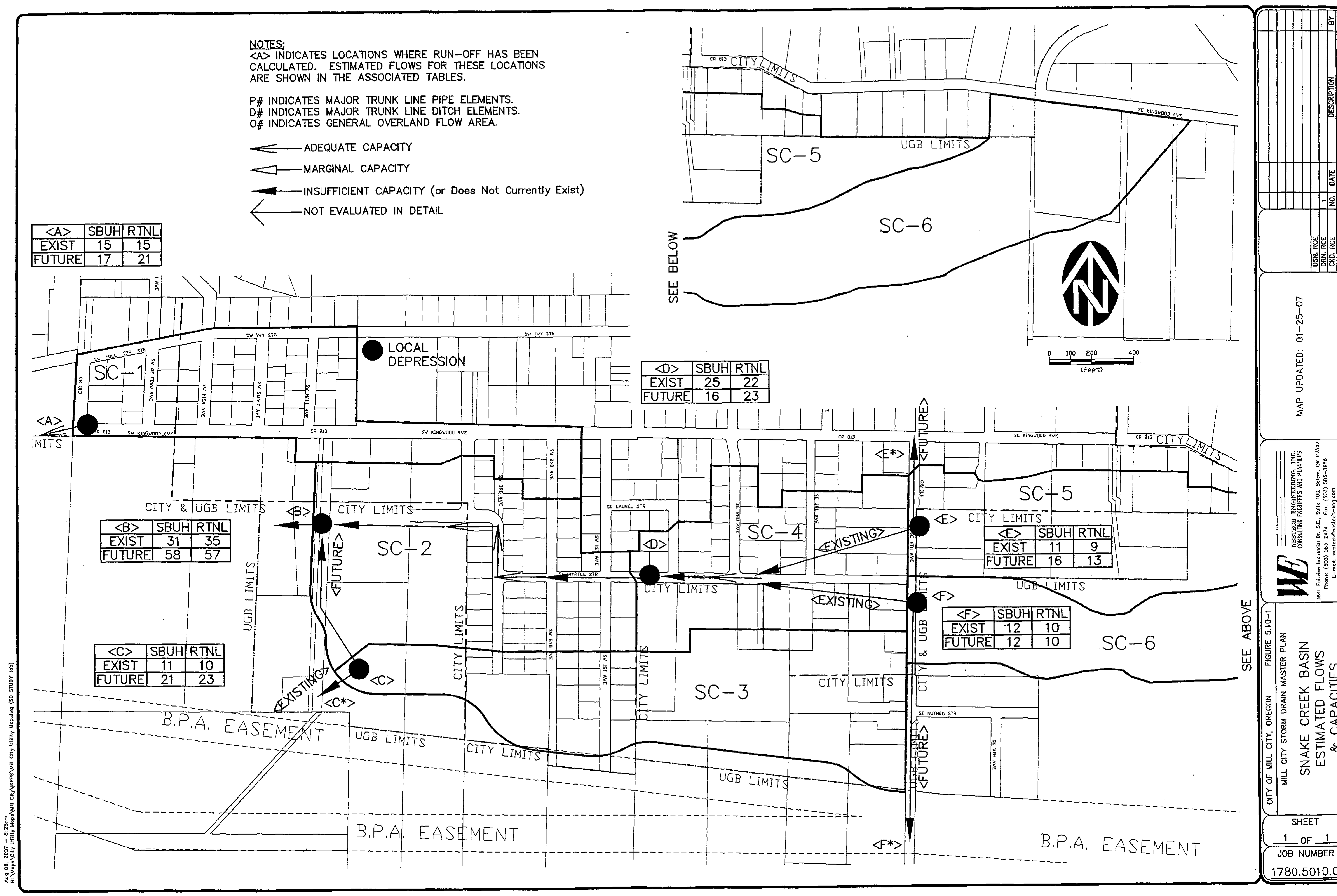
There are at least two options for the discharge. One would be to construct piped drainage west on Ivy Street to either Snake Creek, or to some other point to the north. The second option would be to install a drywell with an approved water quality device upstream of the drywell. At the current time either option appears to be viable, and more detailed study will be needed in the future when a specific action must be determined. The driving force for that action will be either the reconstruction of Ivy Street, or a proposed development of the subject parcel.

The only other Snake Creek Sub-basin with a significant amount of existing development is Sub-basin 4 (SC-4). The remaining four sub-basins (SC-2, SC-3, SC-5, and SC-6) are relatively undeveloped. The proposed improvements for these basins have been developed to address the concerns for providing stormwater quality components on new development that ultimately discharges to Snake Creek.

The first component in this effort is the routing of the flows from SC-5 and SC-6. These two sub-basins are the easternmost in the study area, both lying east of SE 4th Avenue. If routed or piped through the lower sub-basins their flows would result in larger pipes and more difficulties in providing stormwater quality treatment. Therefore, as shown on **Figure 5.10-2**, SC-5 runoff is proposed to be piped north along SE 4th Avenue and SC-6 runoff is proposed to be side south to Snake Creek.

The stormwater management concept presented on **Figure 5.10-2** for the remaining undeveloped portions of sub-basins SC-2, SC-3, and SC-4 is to employ roadside swales to convey stormwater to the west where it will ultimately discharge to Snake Creek. Repeating the point above, Oak Street and the new segment of Hall Avenue form a barrier between Snake Creek and the developable areas. By placing only one discharge point at the lowest end of these areas the potential flooding from Snake Creek is greatly reduced. There should be no pipes or hydraulic connection provided across the roadway barrier other than the single discharge point.

The roadside swales accomplish two functions. First, they provide water quality treatment by capturing pollutants such as oils, grease, and silts. Second, the provide a detention function by slowing and holding run-off, and allowing a greater opportunity for runoff to infiltrate into the soils. The recommended configuration for a typical roadside swale is shown on **Figure 5.10-3**. Roadside swales are shown and anticipated only for the east-west sections of the roadways as shown. Property access is then provided by the north-south streets. Access to properties across the swale should not be necessary and should generally not be allowed.



<A>	SBUH	RTNL
EXIST	15	15
FUTURE	17	21

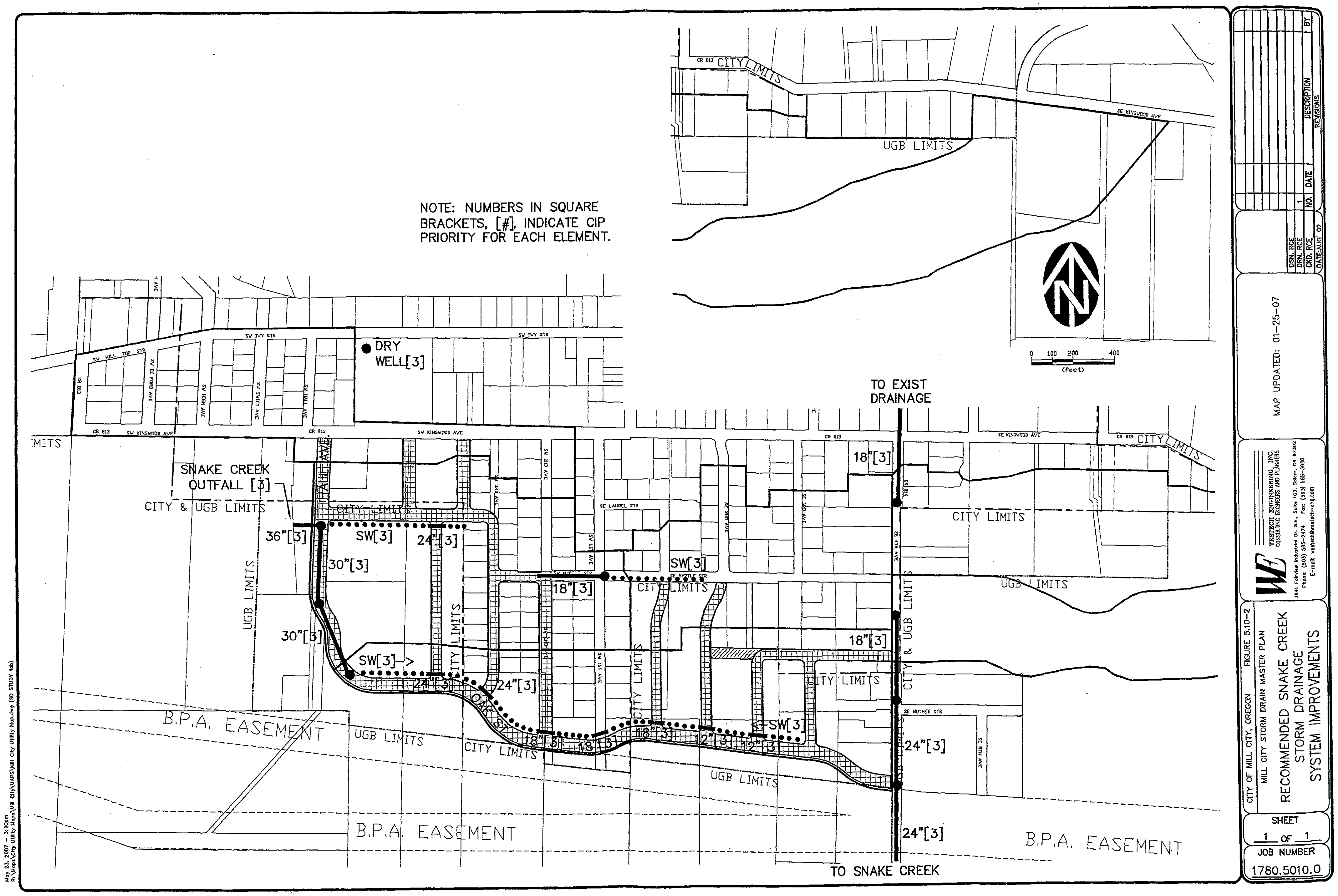
<B>	SBUH	RTNL
EXIST	31	35
FUTURE	58	57

<C>	SBUH	RTNL
EXIST	11	10
FUTURE	21	23

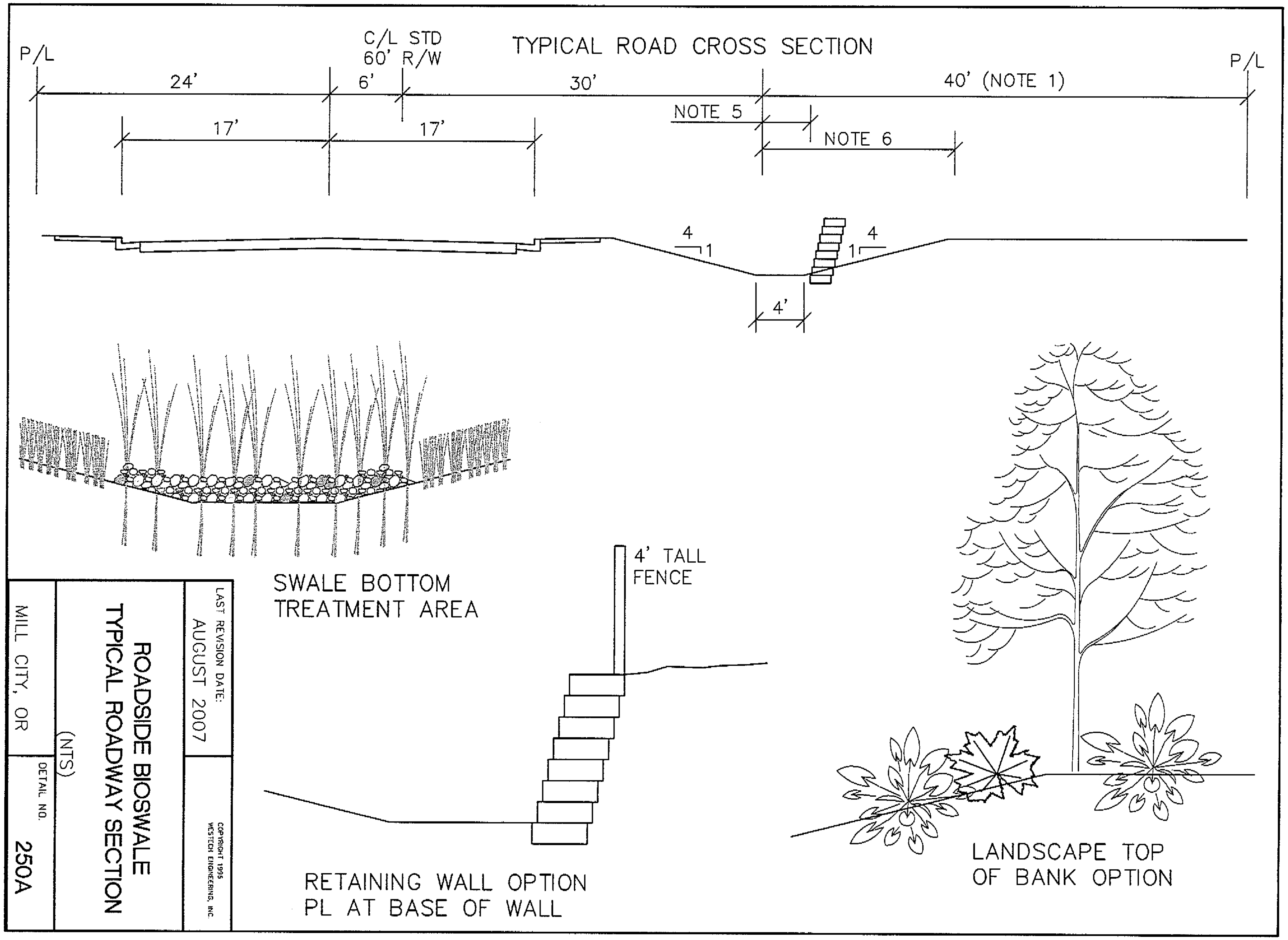
<D>	SBUH	RTNL
EXIST	25	22
FUTURE	16	23

<E>	SBUH	RTNL
EXIST	11	9
FUTURE	16	13

<F>	SBUH	RTNL
EXIST	12	10
FUTURE	12	10



NOTE: NUMBERS IN SQUARE BRACKETS, [#], INDICATE CIP PRIORITY FOR EACH ELEMENT.
DRY WELL[3]
SNAKE CREEK OUTFALL [3]
CITY & UGB LIMITS
36"[3]
SW[3]
24"[3]
30"[3]
30"[3]
SW[3]->
24"[3]
24"[3]
OAK ST
18"[3]
18"[3]
18"[3]
12"[3]
12"[3]
<-SW[3]
SW[3]
18"[3]
18"[3]
18"[3]
TO EXIST DRAINAGE
24"[3]
24"[3]
TO SNAKE CREEK
CITY LIMITS
UGB LIMITS
CITY & UGB LIMITS
B.P.A. EASEMENT
B.P.A. EASEMENT
B.P.A. EASEMENT
MAP UPDATED: 01-25-07
CITY OF MILL CITY, OREGON
FIGURE 5.10-2
MILL CITY STORM DRAIN MASTER PLAN
RECOMMENDED SNAKE CREEK STORM DRAINAGE SYSTEM IMPROVEMENTS
SHEET 1 OF 1
JOB NUMBER
1780.5010.0



LAST REVISION DATE:
AUGUST 2007

ROADSIDE BIOSWALE
TYPICAL ROADWAY SECTION

(NTS)

MILL CITY, OR

DETAIL NO.
250A

Bioswales shall conform to the following requirements:

Water Quality Design Storm: 0.36 inches in 4 hours, with a 96-hour return period
Minimum Channel Slope: 0.5%
Manning "n" Value: 0.24
Maximum Water Quality Flow Depth: 0.5 feet
Minimum Hydraulic Residence Time: 9 minutes

For water quality bioswales that also serve as primary conveyance channels the following requirements shall apply:

Design Conveyance Flows: See "Design Storm Frequency", PWDS, Section 3.10
Minimum Freeboard: 1 foot

For the Snake Creek Basin, the intent is that where roadside swales are used no other stormwater quality treatment or detention will be required. Should a developer wish to do so, alternatives to the swale concept may be considered. The developer should be required to show that equal or better stormwater quality treatment and detention is provided by the proposed alternative, and that the proposed alternative does not adversely affect other sections of the swale system, either existing or potential future sections.

c. Stormwater Drainage System Capital Improvement Plan (CIP) Elements

The budget level costs for each element of recommended for this basin is provided in **Table 5.10-3**. The explanation of the development of these costs is provided in Section 5.2.

NOTES:
1) STANDARD R/W FOR STREET SECTIONS W/ ROADSIDE SWALE SHALL BE 100' WIDE.
2) MINIMUM SWALE DEPTH = 2', TC TO SWALE INVERT.
3) MAXIMUM SWALE DEPTH = 5', TC TO SWALE INVERT.
4) R/W WIDTH MAY BE REDUCED IF CROSS SECTIONS PROVIDED WITH DESIGN TO SHOW AREA TO BE MAINTAINED WITHIN THE R/W.
5) IF WALL OPTION USED, R/W = FAR SIDE OF BOTTOM.
6) IF SLOPE OPTION USED, R/W = TOP OF FAR SLOPE.
7) LINE CHANNEL BOTTOM & 6-INCHES UP SLOPE WITH GEOJUTE PLUS OR APPROVED EQUAL, COVER WITH 2"-3/4" RIVER ROCK 2.5" TO 3" DEEP.
8) PLANT SWALE WITH SEED MIX AS SHOWN THIS DETAIL.
9) PROVIDE ACCESS FROM STREET TO SWALE BOTTOM AT BOTH ENDS WITH RAMP MIN 6 FT WIDE, 6(H):1(V) MAX SLOPE.
10) PROVIDE ENERGY DISSIPATOR/FLOW SPREADER AT STORM DISCHARGE INTO SWALE.
11) SWALES 3-5' DEEP SHALL INCLUDE 8 FT R/W PAST THE TOP OF BANK FOR MOWING ACCESS.

SWALE GRASS SEED OPTIONS
FOR BOTTOM TREATMENT AREA
(SEED AT 8 LBS PER 1,000 SF)

OPTION 1
HOBBS & HOPKINS, PRO-TIME 835

ELKA PERENNIAL RYGRASS	60%
EUREKA HARD FESCUE	15%
YARROW MILLEFOLIUM	8%
SWEET ALYSSUM	3%
SHAMROCK	3%
DUTCH WHITE CLOVER	7%
SALINAS STRAWBERRY CLOVER	4%

OPTION 2
WASH. ST. ECOLOGY PUB 657
MONTLAKE TERRACE MIX

TALL FESCUE	67%
SEASIDE BENTGRASS	16%
MEADOW FOXTAIL	9%
ALSIKE CLOVER	6%
MARSHFIELD BIG TREFOIL	1%
INERT MATTER	1.5%
WEED SEED	0.5%

SWALE GRASS SEED
FOR SIDE SLOPES
(SEED AT 120 LBS PER ACRE)

DWARF TALL FESCUE	40%
DWARF PERENIAL RYE	30%
CREEPING RED FESCUE	25%
COLONIAL BENT GRASS	5%

LAST REVISION DATE: AUGUST 2007

ROADSIDE BIOSWALE NOTES + PLANTING INFORMATION
(NTS)

MILL CITY, OR

DETAIL NO. 250B

TABLE 5.10-3

Snake Creek Basin Capital Improvement Project (CIP) Estimated Costs*

PROJECT	Priority	Pipe Size (in)	Paved or Unpaved	Length (ft)	Cost/ft ($)	Manholes	Cost/Ea ($)	Inlets	Cost/Ea ($)	Construction Cost ($)	Contingency (10%)	Engineering (16%)	Legal & Admin (10%)	Project Total ($)	SDC Eligible
PRIORITY 1															
No Priority 1 Projects Identified	1					0	$0	0	$0	$0	$0	$0	$0	$0	N/A
						0	$0	0	$0	$0	$0	$0	$0	$0	
											TOTAL, ALL PRIORITY 1 PROJECTS			**$0**	
PRIORITY 2															
No Priority 3 Projects Identified	2					0	$0	0	$0	$0	$0	$0	$0	$0	N/A
						0	$0	0	$0	$0	$0	$0	$0	$0	
											TOTAL, ALL PRIORITY 2 PROJECTS			**$0**	
PRIORITY 3															
36-inch Storm Outfall to Snake Creek	3						$10,000	0	$1,500	$0	$0	$0	$0	$0	No
36-inch Pipe, Hall Ave to Discharge	3	36	Unpaved	200	$120	1	$4,000	0	$1,500	$28,000	$2,800	$4,480	$2,800	$38,080	No
SW Laurel Street Roadside Swale	3		Paved	800	$50	1	$3,000	2	$1,500	$46,000	$4,600	$7,360	$4,600	$62,560	No
24-inch Pipe Street Crossing, SW Laurel Street	3	24	Paved	100	$100	0	$3,000	3	$1,500	$60,000	$6,000	$9,600	$6,000	$81,600	No
18-inch Pipe, SW Myrtle, SW 1st to SW 2nd	3	18	Paved	350	$75	1	$3,000	2	$1,500	$100,000	$10,000	$16,000	$10,000	$136,000	No
SW Myrtle Street Roadside Swale, SW 1st to SE 2nd	3		Paved	500	$50	2	$3,000	2	$1,500	$34,000	$3,400	$5,440	$3,400	$46,240	No
30-inch Pipe, SW Hall Ave, SW Laurel to SW Oak	3	30	Paved	800	$115	2	$4,000	4	$1,500	$106,000	$10,600	$16,960	$10,600	$144,160	No
Oak Street Roadside Swale, SW Hall to SE 3rd	3		Paved	1700	$50	0	$3,000	24	$1,500	$121,000	$12,100	$19,360	$12,100	$164,560	No
24-inch Pipe Street Crossings, Oak Street	3	24	Paved	200	$100	0	$3,000	2	$1,500	$23,000	$2,300	$3,680	$2,300	$31,280	No
18-inch Street Crossings, Oak Street	3	18	Paved	300	$75	0	$3,000	3	$1,500	$27,000	$2,700	$4,320	$2,700	$36,720	No
12-inch Street Crossings, Oak Street	3	12	Paved	200	$50	0	$3,000	2	$1,500	$13,000	$1,300	$2,080	$1,300	$17,680	No
18-inch Pipe, SE 4th Ave, North to Existing Drainage	3	18	Paved	1000	$75	3	$3,000	4	$1,500	$90,000	$9,000	$14,400	$9,000	$122,400	No
24-inch Pipe, SE 4th Ave, South to Snake Creek	3	24	Paved	800	$100	2	$3,000	4	$1,500	$92,000	$9,200	$14,720	$9,200	$125,120	No
18-inch Pipe, SE 4th Ave, South to Snake Creek	3	18	Paved	400	$50	1	$3,000	2	$1,500	$26,000	$2,600	$4,160	$2,600	$35,360	No
											TOTAL, ALL PRIORITY 3 PROJECTS			**$1,041,760**	
											TOTAL, ALL PROJECTS			**$1,041,760**	

*Note: These estimates are planning level cost estimates and not based on actual designs. They should be considered as preliminary and subject to change.

TABLE 5.10-3

Snake Creek Basin Capital Improvement Project (CIP) Estimated Costs*

PROJECT	Priority	Pipe Size (in)	Paved or Unpaved	Length (ft)	Cost/ft ($)	Manholes	Cost/Ea ($)	Inlets	Cost/Ea ($)	Construction Cost ($)	Contingency (10%)	Engineering (16%)	Legal & Admin (10%)	Project Total ($)	SDC Eligible
PRIORITY 1															
No Priority 1 Projects Identified	1					0	$0	0	$0	$0	$0	$0	$0	$0	N/A
						0	$0	0	$0	$0	$0	$0	$0	$0	
													TOTAL, ALL PRIORITY 1 PROJECTS	**$0**	
PRIORITY 2															
No Priority 3 Projects Identified	2					0	$0	0	$0	$0	$0	$0	$0	$0	N/A
						0	$0	0	$0	$0	$0	$0	$0	$0	
													TOTAL, ALL PRIORITY 2 PROJECTS	**$0**	
PRIORITY 3															
36-inch Storm Outfall to Snake Creek	3						$10,000	0	$1,500	$0	$0	$0	$0	$0	No
36-inch Pipe, Hall Ave to Discharge	3	36	Unpaved	200	$120	1	$4,000	0	$1,500	$28,000	$2,800	$4,480	$2,800	$38,080	No
SW Laurel Street Roadside Swale	3		Paved	800	$50	1	$3,000	2	$1,500	$46,000	$4,600	$7,360	$4,600	$62,560	No
24-inch Pipe Street Crossing, SW Laurel Street	3	24	Paved	100	$100	0	$3,000	3	$1,500	$60,000	$6,000	$9,600	$6,000	$81,600	No
18-inch Pipe, SW Myrtle, SW 1st to SW 2nd	3	18	Paved	350	$75	1	$3,000	2	$1,500	$100,000	$10,000	$16,000	$10,000	$136,000	No
SW Myrtle Street Roadside Swale, SW 1st to SE 2nd	3		Paved	500	$50	2	$3,000	2	$1,500	$34,000	$3,400	$5,440	$3,400	$46,240	No
30-inch Pipe, SW Hall Ave, SW Laurel to SW Oak	3	30	Paved	800	$115	2	$4,000	4	$1,500	$106,000	$10,600	$16,960	$10,600	$144,160	No
Oak Street Roadside Swale, SW Hall to SE 3rd	3		Paved	1700	$50	0	$3,000	24	$1,500	$121,000	$12,100	$19,360	$12,100	$164,560	No
24-inch Pipe Street Crossings, Oak Street	3	24	Paved	200	$100	0	$3,000	2	$1,500	$23,000	$2,300	$3,680	$2,300	$31,280	No
18-inch Street Crossings, Oak Street	3	18	Paved	300	$75	0	$3,000	3	$1,500	$27,000	$2,700	$4,320	$2,700	$36,720	No
12-inch Street Crossings, Oak Street	3	12	Paved	200	$50	0	$3,000	2	$1,500	$13,000	$1,300	$2,080	$1,300	$17,680	No
18-inch Pipe, SE 4th Ave, North to Existing Drainage	3	18	Paved	1000	$75	3	$3,000	4	$1,500	$90,000	$9,000	$14,400	$9,000	$122,400	No
24-inch Pipe, SE 4th Ave, South to Snake Creek	3	24	Paved	800	$100	2	$3,000	4	$1,500	$92,000	$9,200	$14,720	$9,200	$125,120	No
18-inch Pipe, SE 4th Ave, South to Snake Creek	3	18	Paved	400	$50	1	$3,000	2	$1,500	$26,000	$2,600	$4,160	$2,600	$35,360	No
													TOTAL, ALL PRIORITY 3 PROJECTS	**$1,041,760**	
													TOTAL, ALL PROJECTS	**$1,041,760**	

*Note: These estimates are planning level cost estimates and not based on actual designs. They should be considered as preliminary and subject to change.

5.11 Santiam Highway West Basin Evaluation (To Be Developed)

5.12 Elizabeth Creek Basin Evaluation (To Be Developed)

5.13 1st Avenue North Basin Evaluation (To Be Developed)

5.14 Cedar Creek Basin Evaluation (To Be Developed)

5.15 West Alder Basin Evaluation (To Be Developed)

5.16 Alder-River Evaluation (To Be Developed)

5.17 Stormwater Detention

The primary purpose of stormwater detention is to mitigate the impacts of development on downstream drainage systems. As property develops, the increased impervious area allows the stormwater to travel more quickly resulting in a greater concentration of water in a shorter time period. By capturing the runoff from developed areas in a detention facility, the opportunity is created to release the runoff at a controlled rate, typically related to the flow estimated in the undeveloped condition.

While stormwater detention has potential benefits when properly implemented, it is not without costs. One potential cost is loss of developable land. Some of the simplest and least expensive detention facilities are ponds created on the site. A second method of creating detention capacity is to do so underground in vaults or pipes. While this method is more expensive to construct, it typically allows the development of a greater percentage of the site. Whether constructed above or below ground, there is a cost to the development to provide a detention facility. Once in existence, these facilities become a long-term maintenance responsibility, which incurs additional cost.

The City of Mill City's current detention standard, outlined in the Public Works Design Standards, requires development to control run-off to that generated by a 5-year storm under existing conditions. The detention facility must then be sized to contain the difference between a 25-year storm post-development and the 5-year storm under existing conditions.

The potential benefits of detention may arise from two possible situations. The first relates to the local system immediately downstream of the site. Existing storm drainage systems developed primarily to serve streets or areas with limited development may not have the capacity to handle large increases in run-off, particularly at the very end of the system where pipe sizes tend to be smaller. On-site detention can provide the buffer to minimize the effect of development on the local storm drainage collection system.

The other potential benefit of detention relates to controlling the demand placed on the trunk lines. In certain circumstances where existing trunk lines are at or near capacity, upstream development can add enough demand to the system to cause significant problems, depending on the size of development and remaining capacity in the existing system. Thus, controlling additional, incremental, run-off by detention can eliminate or at least delay the need to increase trunk line capacity which can be an expensive task.

Therefore, for both the interest of the local system adjacent to potential development sites, and the major system trunk lines, we believe it makes good sense for the City of Mill City to employ some sort of detention requirement. The detention requirement currently adopted as part of the City's Public Works Design Standards, and briefly discussed above, limiting run-off to the 5-year, existing conditions value, and requiring detention for the difference between the pre-developed 5-year and post-developed 25-year events is a fairly common standard. We continue to believe that this standard is appropriate for the City of Mill City.

Finally, in addition to on-site detention there is a second method of controlling storm drainage run-off that may or may not be applicable to Mill City. That method is known as regional detention. Rather than providing detention at each development site, detention is created at a centralized location along the main drainage route. Regional detention is most frequently associated with locations along open drainageways that allow for the creation of large temporary ponding areas. A good example would be a park area along a creek where standing water during a large rainstorm would not be considered problematic.

At this time, regional detention does not appear to be a desirable alternative for the Spring Street basin. However, given the number of basins within the overall study are that have open drainageways, it is possible that some type of regional detention may be appropriate elsewhere in the City.

CITY OF MILL CITY
Storm Drainage System Master Plan

Section 6

DESIGN STANDARDS & MANAGEMENT PRACTICES

SECTION 6
DESIGN STANDARDS & MANAGEMENT PRACTICES

6.1 General

This section provides information and recommendations to the City regarding design standards and management practices for the City's storm drainage system. Design standards aid the City in providing direction to developers seeking to extend or improve the drainage system to serve new developments. Another concern of the City's is the operation and maintenance of existing storm drainage facilities. The second part of this section provides suggestions intended to help the City develop procedures and standards for the management of storm drainage facilities.

6.2 Current Mill City Storm Drainage System Design Standards

The City has adopted Public Works Design Standards (PWDS) that are intended to provide guidelines for the design of public facilities that 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.

These standards were drafted with the intent that they:

- Be consistent with current City Ordinances;
- Provide design guidance criteria to the private sector for the design of public improvements within the City of Mill City;
- 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; and

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

Based on the analysis of the City's storm drainage system carried out for this report, the City's current Public Works Design Standards are appropriate as adopted. For specific information regarding current City requirements, the Public Works Design Standards should be obtained from the City of Mill City.

6.3 Storm Drainage System Construction Standards

The City does not presently have construction standards specifically tailored for stormwater system improvements under City jurisdiction, although the Standard Specifications for Public Works Construction as prepared by the Oregon Chapter of the American Public Works Association (APWA) are adopted by reference in the PWDS. Until the City develops Public Works Construction Standards (PWCS) specifically tailored to the City's infrastructure, it is recommended that the City continue to use the APWA standards.

It is recommended that the City develop PWCS specifically tailored to the City stormwater system and the adopted PWDS. These PWCS will provide a uniform set of standards for use by contractors during the construction of stormwater improvements. However, even the best PWCS cannot provide for all situations. They are intended to assist but not to substitute for competent work by experienced professional contractors.

6.4 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 cu ft 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.

6.5 Stormwater Drainage Quality Standards

Mill City incorporated stormwater quality standards into it's Publics Works Design Standards (PWDS). These are found in Section 3.19 of the PWDS, "Stormwater Quality Facilities." The bioswale standards set forth in this document, including slope capacity, and planting, subject to modification as appropriate, will be incorporated into a future revision of the Public Works Design Standards. The bioswale standards are presented in the Snake Creek Basin section of this study because of the suitability for their use in this area. The bioswale standards are applicable citywide, with suitability for a particular application being dependent on the discretion of the City. Until the PWDS update occurs, the bioswale standards in this document shall apply as if part of the PWDS.

In addition, there continues to be a significant amount of concern about stormwater quality practices among the various regulatory agencies. Therefore, we recommend the City continue to monitor the stormwater quality regulatory situation and be prepared to adapt to future changes as they occur.

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	130	0.5	15	1	4.3	$200	50%	$867	$0	$433	$1,300	8%
2	Clean Major Culverts/Pipe Inlets	0	1	15	1	0.0	$200	50%	$0	$0	$0	$0	0%
3	Clean Storm Lines	15,000	0.2	1000	2	6.0	$200	100%	$1,200	$0	$1,200	$2,400	15%
4	Clean/Regrade Major Ditches	0	0.5	1000	2	0.0	$200	100%	$0	$0	$0	$0	0%
5	Clean/Regrade Roadside Ditches	15,000	0.25	2000	1	1.9	$200	200%	$375	$0	$750	$1,125	7%
6	Repair Major Culverts	0	0.2	1	2	0.0	$200	40%	$0	$0	$0	$0	0%
7	Repair Storm Lines	200	0.05	2	2	10.0	$200	100%	$2,000	$0	$2,000	$4,000	26%
8	Repair/replace Catch Basins	130	0.05	2	2	6.5	$200	50%	$1,300	$0	$650	$1,950	13%
9	Complaint Response	12	1	1	1	12.0	$200	0%	$2,400	$0	$0	$2,400	15%
10	System Inventory Reconnaissance	1	6	1	1	6.0	$200	0%	$1,200	$0	$0	$1,200	8%
													93%
				Total crew days/yr		46.7							
				Sub-total: All Maintenance Categories					$9,342	$0	$5,034	$14,375	
							Administration & Overhead @ 8%					$1,150	
								Grand Total				$15,525	

6.6 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 1).

- 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 2).

- Municipalities are generally under no legal duty to construct drainage improvements unless public improvements require drainage facilities (Denver v. Mason) (Reference 3).

- Municipalities are not liable for damages due to overflow of its drainage system in cases of extraordinary/unforeseeable rains or floods. (McQuillan) (Reference 4).

- 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 4).

REFERENCES

1. Hydraulics Manual, Oregon Department of Transportation, Highway Division, prepared by the Hydraulics Unit, January 1990.

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

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

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

6.7 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**.

6.8 Coordination with the North Santiam Watershed Council and Other Agenices

As opportunities arise for projects that are within or affect storm drainage projects in the City of Mill City's Urban Growth Boundary and which benefit the citizens of Mill City, the City will cooperate with the property owners, the North Santiam Watershed Council and natural resource agencies to identify funding opportunities and to develop watershed restoration and habitat enhancements within the Snake Creek and Deford Creek subbasins of the North Santiam River basin.

Because drainage basins in the City discharge into the North Santiam River and its subbasins, the City of Mill City will actively seek opportunites to comment on the design, or to collaborate with property owners, the North Santiam Watershed Council or natural resource agencies in the design of bio-swales, wetlands or watershed enhancement projects in the Snake Creek, DeFord Creek or other subbasins of the North Santiam River basin when the proposed project impacts storm water drainage inside the Mill City Urban Growth Boundary

The City wishes to ensure that watershed enhancement designs and development projects are consistent with this Storm Drainage Master Plan and that they will benefit the property owners and citizens inside the Mill City Urban Growth Boundary. City interests in watershed enhancement projects may include, but are not limited to, design capacity, detention, habitat enhancement, water quality management, acquisition of easements or right-of-way, protective covenants, management practices, potential costs to the city, and any other impacts within the City of Mill City.

CITY OF MILL CITY
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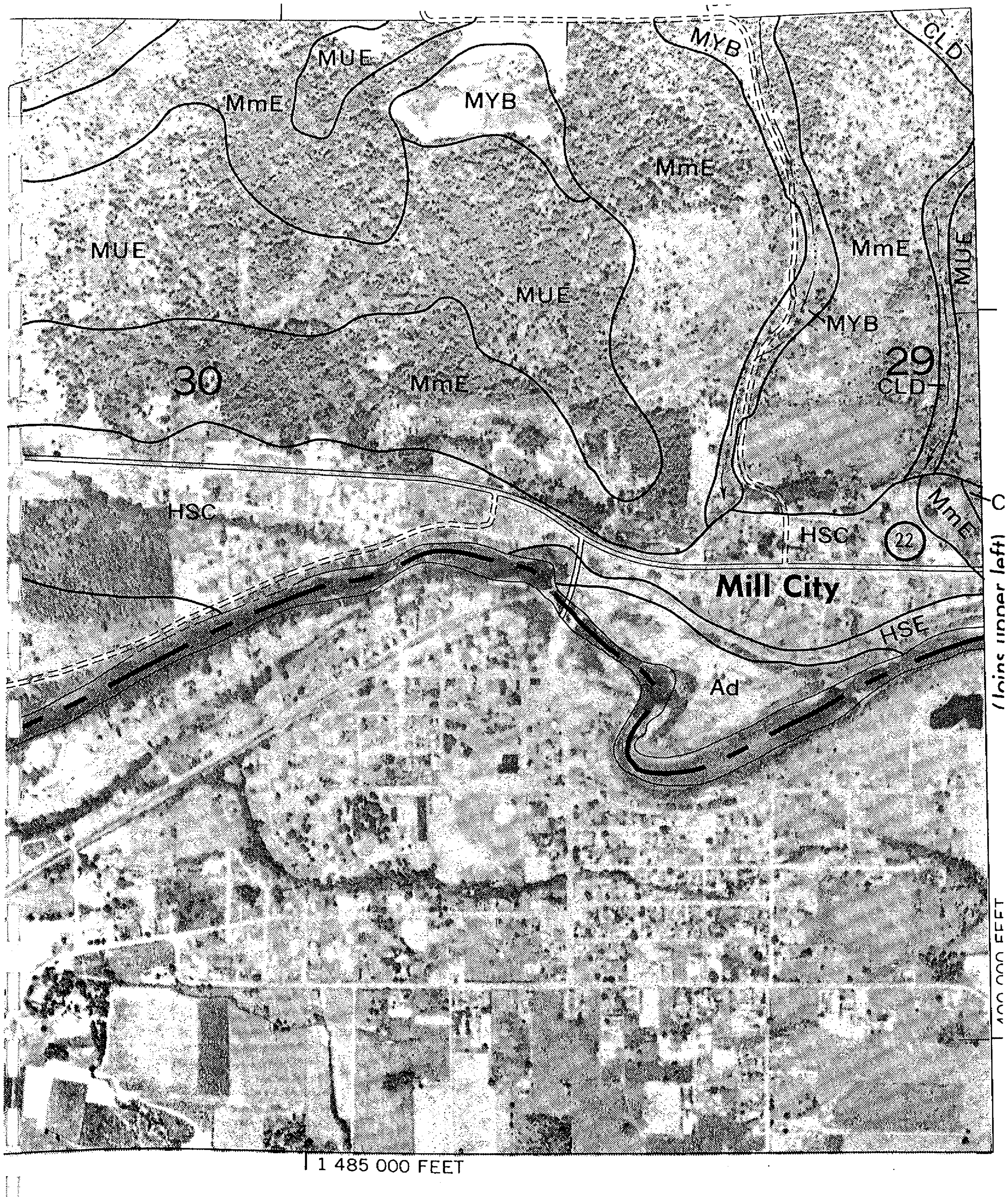
Marion and Linn County Soil Survey Information

Appendix A


MUE
MmE
MYB
MYB
CLD
MmE
MmE
MUE
MUE
MUE
MYB
29
CLD
30
MmE
HSC
C
MmE
HSC
22
Mill City
HSE
Ad
(Joins upper left)
1 485 000 FEET

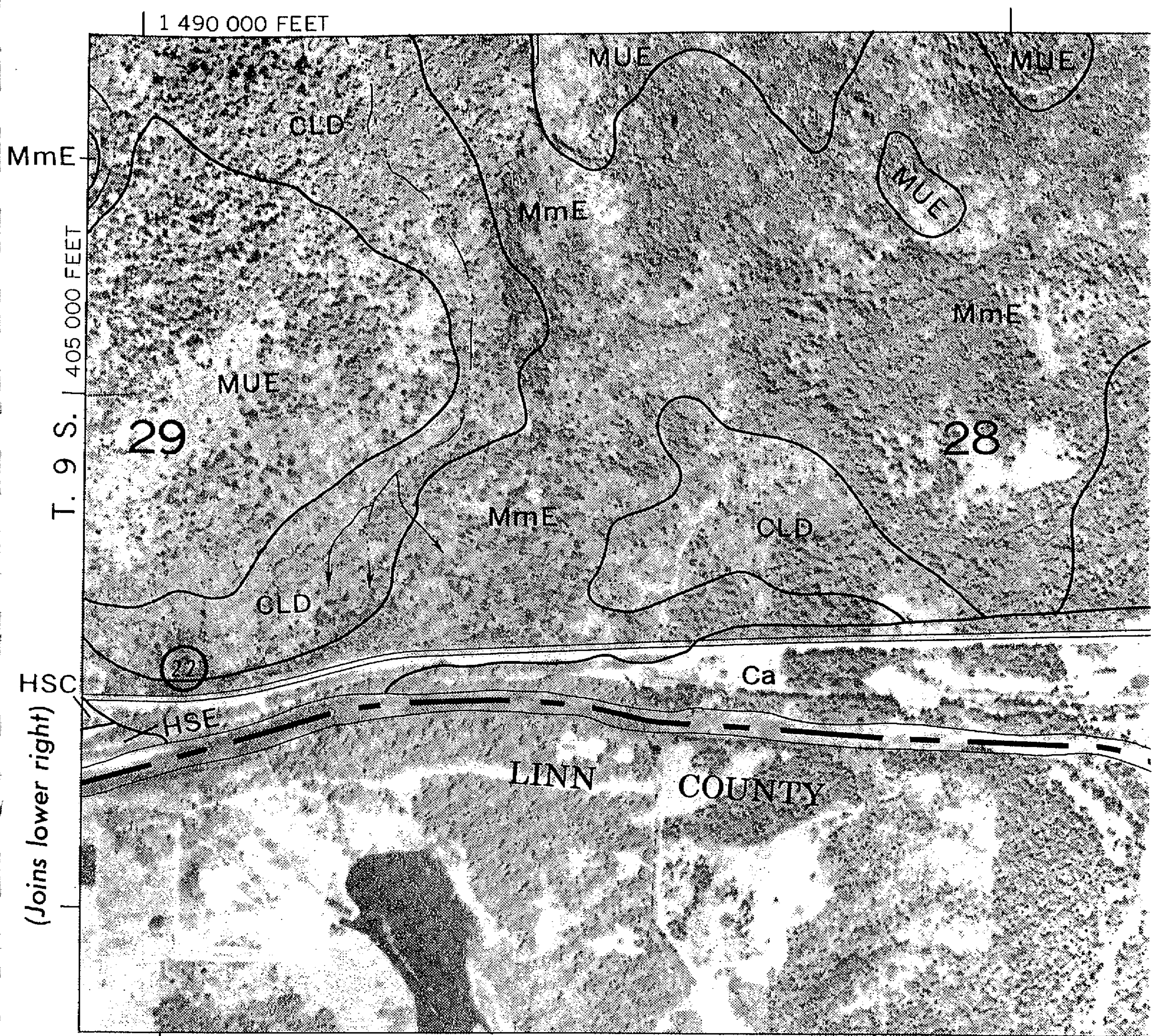

1 490 000 FEET
405 000 FEET
T. 9 S.
(Joins lower right)
MmE
MUE
CLD
MmE
MUE
MUE
MmE
MUE
29
28
MmE
CLD
CLD
22
HSC
HSE
Ca
LINN
COUNTY

TABLE 4.—*Estimated engineering*

[Alluvial land (Ad), Stony rock land (Sy), and Terrace escarpments (Te) are omitted from table because their properties are too variable for of two or more kinds of soil. The soils in such mapping units may have different properties and limitations, and for this reason it is

Soil series and map symbols	Hydrologic group	Depth to bedrock	Depth to seasonal high water table	Depth from surface	Classification		
					USDA texture	Unified	AASHO
		In.	In.	In.			
Abiqua (AbA, AbB)	C	72+	60+	0–21 21–54 54–72	Silty clay loam Silty clay Silty clay loam	ML or CL ML or CL ML or CL	A–6 A–7 A–6
Amity (Am)	C	72+	6–12	0–24 24–37 37–60	Silt loam Silty clay loam Silt loam	ML ML or CL ML or CL	A–4 A–7 A–4
Bashaw (Ba)	D	60+	0–6	0–60	Clay	CH	A–7
Camas (Ca)	A	72+	60+	0–9 9–60	Gravelly sandy loam Very gravelly sand	GM GP	A–1 A–1
Chehalem (CeC)	C	60+	6–16	0–16 16–60	Silt loam Silty clay	ML MH	A–4 A–7
Chehalis (Ch)	B	72+	60+	0–80	Silty clay loam	CL or ML	A–6
Chehulpum (Mapped only in an undifferentiated unit with Steiwer soils.)	C	10–20	(3)	0–12 12	Silt loam Hard sandstone.	ML	A–4
Clackamas (Ck)	C	60+	6–16	0–15 15–24 24–60	Gravelly loam Gravelly clay loam Very gravelly clay loam	GM GM GM	A–6 A–7 A–2
Cloquato (Cm)	B	72+	60+	0–65 65–83	Silt loam Fine sandy loam	ML SM	A–4 or A–6 A–4
Concord (Co)	D	72+	0–6	0–15 15–29 29–60	Silt loam Silty clay Silt loam	CL or ML CL or ML ML	A–4 A–7 A–4
Courtney (Cu)	D	72+	0–6	0–12 12–24 24–57	Gravelly silty clay loam Gravelly clay Very gravelly clay loam, very gravelly sand.	ML CH GC	A–4 A–7 A–1 or A–2
Cumley (CLD)	C	60+	18–48	0–9 9–60	Silty clay loam Clay, silty clay	CL or ML MH	A–6 A–7
Dayton (Da)	D	72+	0–6	0–13 13–46 46–60	Silt loam Clay Silty clay loam	ML CH ML	A–4 A–7 A–4
Hazelair (HaB, HaD, HcD2)	D	24–40	12–24	0–18 18–38 38	Silt loam, silty clay loam Clay, silty clay Fractured sandstone.	ML or CL CH	A–6 A–7
Henline (HEE, HEF, HEG)	C	20–40	(3)	0–30 30	Very stony sandy loam Fractured basalt.	GM	A–1
Holcomb (Ho)	D	72+	6–16	0–24 24–42	Silt loam, silty clay loam Clay and silty clay	ML CH	A–4 A–7
Horeb:							
(HRD)	B	60+	30–40	0–14 14–36 36–60	Loam Gravelly loam Cobbly loam	ML ML or SM ML or GM	A–4 A–4 A–4 or A–1
(HSC, HSE)	B	72+	60+	0–40 40–60	Gravelly silt loam Very gravelly sand	ML GP	A–4 A–1

See footnotes at end of table.

properties of the soils

estimating and require onsite investigation. An asterisk in the first column indicates that at least one mapping unit in this series is made up necessary to follow carefully the instructions for referring to other series that appear in the first column of this table]

Percentage passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Corrosivity for untreated steel pipe	Shrink-swell potential
No. 4 [1] (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)							
						In./hr.	In./in. of soil	pH		
100	100	95–100	80–85	35–40	11–15	0. 63–2. 0	0. 19–0. 21	5. 6–6. 0	Moderate	Moderate.
94–100	95–100	95–100	85–95	41–50	11–25	0. 20–0. 63	0. 15–0. 17	5. 1–5. 5	High	High.
100	100	95–100	80–90	35–40	11–15	0. 63–2. 0	0. 19–0. 21	5. 1–5. 5	High	Moderate.
100	100	95–100	90–95	30–40	5–10	0. 63–2. 0	0. 19–0. 21	5. 6–6. 0	High	Moderate.
100	100	95–100	95–100	41–50	11–20	0. 20–0. 63	0. 19–0. 21	6. 1–6. 5	High	Moderate.
100	100	95–100	90–95	30–40	5–10	0. 63–2. 0	0. 19–0. 21	6. 1–6. 5	High	Moderate.
100	100	95–100	85–95	70–90	40–60	<0. 06	0. 14–0. 16	5. 6–7. 3	High	High.
60–85	50–80	30–50	15–25	[2] NP	[2] NP	>20. 0	0. 07–0. 09	5. 6–6. 5	Low	Low.
40–60	40–50	20–30	0–5	[2] NP	[2] NP	>20. 0	0. 03–0. 05	5. 6–6. 5	Low	Low.
100	95–100	90–95	80–95	30–40	5–10	0. 63–2. 0	0. 19–0. 21	5. 6–6. 0	High	Moderate.
100	100	90–95	85–95	50–60	11–20	0. 06–0. 2	0. 15–0. 17	5. 6–6. 0	High	High.
100	100	95–100	85–95	35–40	11–15	0. 63–2. 0	0. 19–0. 21	6. 1–6. 6	Moderate	Moderate.
100	95–100	85–95	80–85	30–40	5–10	0. 63–2. 0	0. 19–0. 21	5. 6–6. 0	Low	Low.
75–90	70–85	60–80	40–50	35–40	11–15	0. 63–2. 0	0. 10–0. 12	5. 6–6. 0	High	Low.
60–75	60–70	45–65	40–50	41–50	11–20	0. 20–0. 63	0. 14–0. 16	5. 6–6. 0	High	Low.
15–30	10–20	5–20	5–15	41–50	11–20	0. 20–0. 63	0. 03–0. 05	5. 1–5. 5	High	Low.
100	100	95–100	80–90	34–40	5–15	0. 63–2. 0	[4] 0. 20–0. 23	5. 6–6. 5	Low	Low.
100	100	95–100	40–50	[2] NP	[2] NP	0. 63–2. 0	0. 13–0. 15	6. 1–6. 5	Low	Low.
100	100	95–100	85–95	30–40	5–10	0. 63–2. 0	0. 19–0. 21	5. 6–6. 0	High	Low.
100	100	95–100	80–90	41–50	11–20	0. 06–0. 2	0. 15–0. 17	6. 1–7. 3	High	High.
100	100	95–100	80–90	[2] NP	[2] NP	0. 20–0. 63	0. 19–0. 21	6. 1–7. 3	High	Low.
80–85	70–80	70–80	65–75	30–40	5–10	0. 20–0. 63	0. 16–0. 18	5. 1–6. 0	High	Moderate.
75–85	70–80	60–80	50–75	60–80	41–50	<0. 06	0. 10–0. 14	6. 1–6. 5	High	High.
25–60	15–50	10–50	10–35	25–40	2–10	0. 20–0. 63	0. 06–0. 12	6. 1–7. 3	High	Low.
100	90–95	85–95	70–90	35–40	11–15	0. 20–0. 63	0. 19–0. 21	5. 6–6. 5	High	Moderate.
100	100	90–95	60–90	50–60	11–25	0. 20–0. 63	0. 14–0. 16	5. 1–6. 0	High	High.
100	100	95–100	90–100	30–40	5–10	0. 20–0. 63	[4] 0. 23–0. 25	5. 6–6. 0	High	Low.
100	100	95–100	90–100	60–80	41–50	<0. 06	0. 03–0. 05	6. 1–6. 5	High	High.
100	100	95–100	90–100	25–40	2–10	0. 20–0. 63	0. 20–0. 23	6. 1–6. 5	High	Moderate.
95–100	90–95	85–95	80–90	30–40	11–20	0. 63–2. 0	[4] 0. 16–0. 18	5. 6–6. 5	High	Moderate.
95–100	85–95	75–85	70–85	60–80	40–50	0. 06–0. 2	0. 13–0. 16	6. 1–6. 5	High	High.
25–55	20–50	10–25	10–15	[2] NP	[2] NP	2. 00–6. 3	0. 05–0. 08	6. 1–6. 5	Low	Low.
100	95–100	90–95	90–95	30–40	5–10	0. 63–2. 0	0. 19–0. 21	5. 6–6. 5	High	Moderate.
100	100	95–100	95–100	60–80	41–50	<0. 06	0. 03–0. 05	6. 1–7. 3	High	High.
90–100	85–100	65–95	50–75	25–40	2–10	0. 63–2. 0	0. 16–0. 18	5. 1–5. 5	Moderate	Low.
75–85	70–80	60–75	45–60	25–40	2–10	0. 63–2. 0	0. 12–0. 14	4. 5–5. 0	Moderate	Low.
30–80	25–75	20–70	15–60	25–40	2–10	0. 63–2. 0	0. 06–0. 12	4. 5–5. 0	Moderate	Low.
75–85	70–80	65–75	50–60	25–40	5–10	0. 63–2. 0	0. 15–0. 17	5. 1–5. 5	Low	Low.
30–55	25–50	10–35	0–5	[2] NP	[2] NP	>20. 0	0. 03–0. 05	4. 5–5. 0	Low	Low.

TABLE 4.—*Estimated engineering*

Soil series and map symbols	Hydro-logic group	Depth to bed-rock	Depth to seasonal high water table	Depth from surface	Classification		
					USDA texture	Unified	AASHO
		In.	*In.*	*In.*			
Hullt (HTD, HTE, HTF, HuB, HuD).	B	40-60	(3)	0-55 55	Clay loam and silty clay loam Weathered sandstone.	CL	A-6
Jory (JoB, JoC, JoD, JoE)	C	60+	(3)	0-63	Silty clay loam, silty clay, and clay.	ML or CL	A-7
Kinney (KCD, KCF, KCG)	B	40-60	(3)	0-53 53	Cobbly loam, cobbly clay loam. Weathered agglomerate.	SM	A-5
Labish (La)	D	72+	0-16	0-60	Silty clay and clay	OH	A-7
McAlpin (MaA, MaB)	C	60+	16-30	0-14 14-65	Silty clay loam Silty clay, silty clay loam	ML or CL ML or CL	A-6 A-7
McBee (Mb)	B	72+	24-30	0-65	Silty clay loam and clay loam.	CL or ML	A-6
McCully (McB, McC, McD, McE, MID, MmE, MUE, MUF, MUG).	C	40+	(3)	0-10 10-57	Clay loam Clay	MH ML or MH	A-5 A-5
Minniece (MYB)	D	60+	0-6	0-15 15-60	Silty clay loam Clay	ML or CL MH	A-6 A-7
Nekia (NeB, NeC, NeD, NeE, NeF, NkC, NsE, NsF).	C	20-40	(3)	0-18 18-36 36	Silty clay loam, clay Clay Weathered rock.	ML or CL ML or GC	A-6 A-5
Newberg (Nu, Nw)	B	72+	60+	0-60	Fine sandy loam, sandy loam.	SM	A-4 or A-2
Salem (Sa)	B	72+	72+	0-30	Gravelly silt loam, gravelly silty clay loam.	ML, SM or GM	A-7
				30-60	Very gravelly sand	GP	A-1
Salkum (SkB, SkD, SlB)	C	72+	(3)	0-14 14-40 40-65	Silty clay loam Silty clay Silty clay loam, gravelly and cobbly clay loam.[5]	ML or CL CH ML or CL	A-6 A-7 A-6
Santiam (SnA, SnB, SnC)	C	40+	6-24	0-13 13-30 30-60	Silt loam Heavy silty clay loam Silty clay and clay	ML ML or CL CH	A-4 A-6 A-7
Semiahmoo (So)	D	72+	0-14	0-30	Muck	Pt	----------
				30-60	Peat	Pt	----------
Sifton (St)	B	72+	60+	0-24 24-60	Gravelly loam Very gravelly and cobbly sand.	SM or GM GP	A-4 A-1
Silverton (SuC, SuD)	C	20-40	(3)	0-16 16-37 37	Silt loam Silty clay loam, gravelly silty clay. Weathered basalt.	ML CL or GC	A-4 A-7
Stayton (SvB)	D	15-20	(3)	0-20 20	Silt loam Hard basalt.	ML	A-4
*Steiwer (SCE, SwB, SwD) (For Chehulpum part of SCE, see Chehulpum series.)	C	20-40	(3)	0-21 21-32 32	Silt loam Silty clay loam Hard sandstone.	ML ML or CL	A-4 A-7 or A-6

See footnotes at end of table.

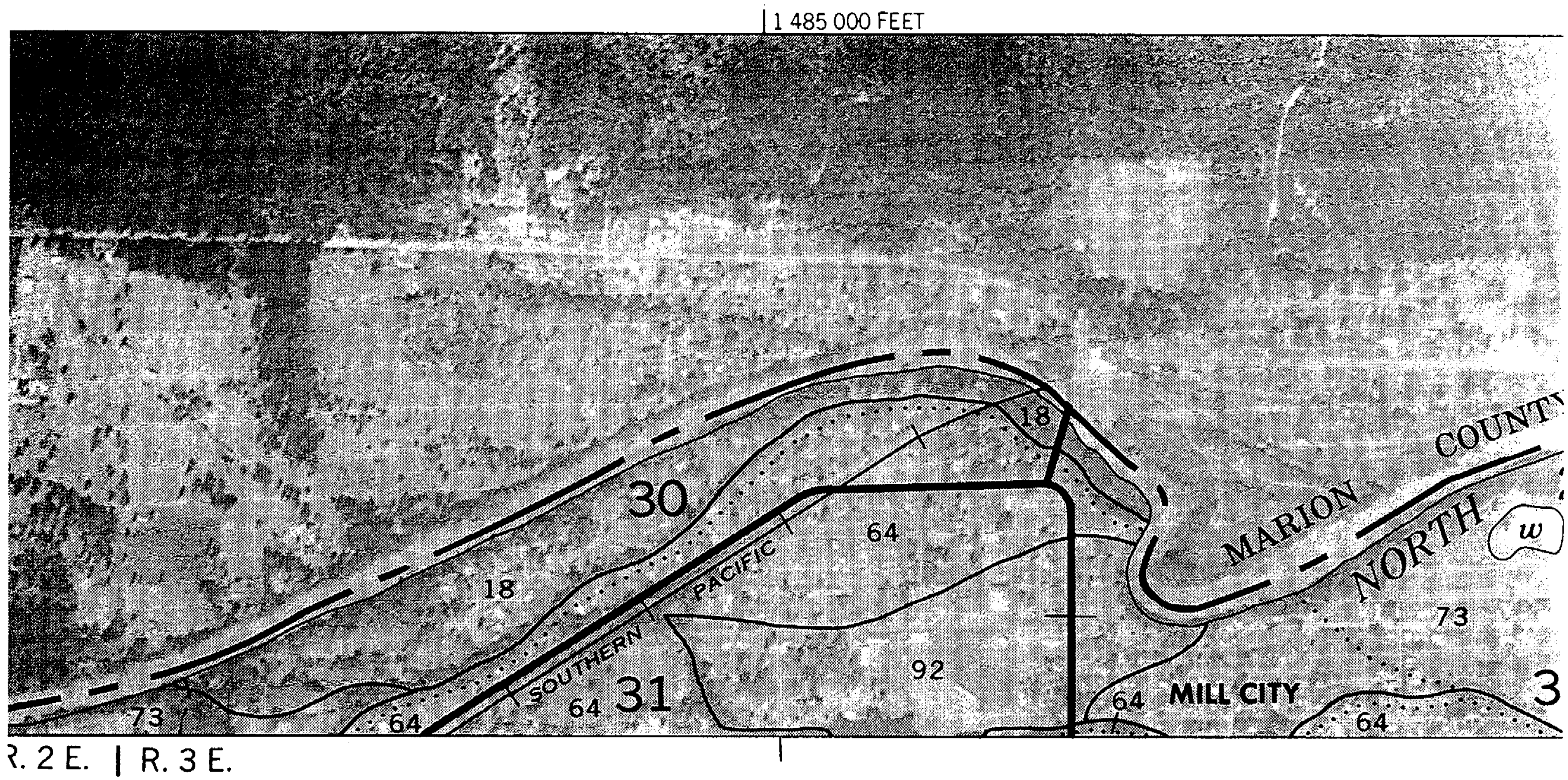
properties of the soils—Continued

Percentage passing sieve—				Liquid limit	Plasticity index	Perme-ability	Available water capacity	Reaction	Corrosivity for untreated steel pipe	Shrink-swell potential
No. 4 [1] (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)							
						In./hr.	*In./in. of soil*	*pH*		
100	85–95	75–95	65–75	30–40	11–20	0. 20–0. 63	0. 19–0. 21	4. 5–6. 0	Moderate	Moderate.
100	100	80–95	65–90	41–50	15–20	0. 20–0. 63	0. 15–0. 17	4. 5–6. 0	High	Moderate.
55–80	50–75	40–60	35–50	45–65	3–10	0. 63–2. 0	0. 13–0. 16	4. 5–5. 5	High	Low.
100	100	95–100	85–95	50–60	11–25	0. 06–0. 2	0. 20–0. 25	4. 5–7. 3	High	High.
100	100	85–95	75–90	35–40	11–15	0. 63–0. 2	0. 19–0. 21	5. 1–6. 0	High	Moderate.
100	100	95–100	90–95	41–50	11–20	0. 20–0. 63	0. 15–0. 17	5. 1–6. 0	High	High.
100	100	95–100	85–95	35–40	11–15	0. 63–0. 2	0. 19–0. 21	5. 6–6. 5	High	Moderate.
100	85–100	65–75	50–60	51–55	5–10	0. 63–0. 2	0. 17–0. 21	5. 1–5. 5	High	Low.
90–100	85–100	80–95	60–70	45–55	5–10	0. 20–0. 63	0. 14–0. 16	4. 5–5. 0	High	Moderate.
100	95–100	95–100	85–95	35–40	11–15	0. 20–0. 63	0. 19–0. 21	5. 6–6. 0	High	Moderate.
100	100	95–100	75–95	51–60	15–25	<0. 06	0. 06–0. 08	5. 6–6. 0	High	High.
100	85–100	85–95	70–80	35–40	11–15	0. 20–0. 63	0. 17–0. 21	5. 1–6. 0	High	Low.
70–100	50–100	50–90	40–75	41–45	5–10	0. 20–0. 63	0. 09–0. 16	5. 1–5. 5	High	Moderate.
100	100	60–70	30–40	[2]NP	[2]NP	2. 0–6. 3	0. 11–0. 13	5. 6–7. 3	Low	Low.
55–95	50–90	45–80	40–70	41–50	11–20	0. 63–2. 0	0. 12–0. 17	6. 1–7. 3	Moderate	Low to moderate.
20–65	15–65	5–15	0–5	[2]NP	[2]NP	>20. 0	0. 03–0. 05	6. 1–6. 5	Low	Low.
85–95	90–95	80–90	70–80	30–40	11–15	0. 20–0. 63	0. 18–0. 20	4. 5–5. 5	High	Low.
85–95	90–95	80–90	70–80	41–50	15–20	0. 20–0. 63	0. 15–0. 17	4. 5–5. 5	High	Moderate.
85–95	90–95	80–90	70–80	30–40	11–15	0. 06–0. 20	0. 15–0. 17	4. 5–5. 0	High	Low.
100	100	80–90	70–80	30–40	5–10	0. 63–2. 0	0. 19–0. 21	5. 6–6. 0	High	Low.
100	100	85–95	75–85	30–40	11–15	0. 20–0. 63	0. 17–0. 19	5. 1–6. 0	High	Moderate.
100	95–100	80–90	70–80	50–60	30–40	0. 06–0. 2	0. 14–0. 16	5. 1–5. 5	High	High.
						0. 63–2. 0	0. 20–0. 50	5. 6–6. 5	High	High shrink; low swell.
						0. 63–2. 0	0. 25–0. 50	6. 1–6. 5	High	High shrink; low swell.
65–80	60–75	50–60	35–50	[2] NP	[2] NP	2. 0–6. 3	0. 12–0. 14	6. 1–7. 3	Low	Low.
35–45	30–40	10–20	0–5	[2] NP	[2] NP	>20. 0	0. 03–0. 05	5. 6–6. 0	Low	Low.
100	100	80–90	70–80	30–40	5–10	0. 63–2. 0	0. 19–0. 21	5. 6–6. 0	Low	Low.
55–90	50–85	40–70	35–60	41–50	15–20	0. 20–0. 63	0. 13–0. 15	5. 6–6. 0	High	Moderate to high.
100	100	85–95	80–90	30–40	5–10	0. 63–2. 0	0. 18–0. 21	5. 6–6. 0	Low	Low.
100	95–100	85–95	75–85	30–40	5–10	0. 63–2. 0	0. 19–0. 21	5. 1–6. 0	High	Moderate.
100	95–100	85–95	80–90	30–45	5–15	0. 20–0. 63	0. 19–0. 21	5. 1–6. 5	High	Moderate.

TABLE 4.—*Estimated engineering*

Soil series and map symbols	Hydrologic group	Depth to bedrock	Depth to seasonal high water table	Depth from surface	Classification		
					USDA texture	Unified	AASHO
		In.	*In.*	*In.*			
Waldo (Wa)	D	60+	0–6	0–10	Silty clay loam	ML or CL	A–6
				10–60	Clay and silty clay	MH	A–7
Wapato (Wc)	D	72+	0–6	0–60	Silty clay loam	ML or CL	A–6
Whetstone (WHE, WHF, WHG)	B	20–40	(3)	0–38	Stony loam	GM	A–4 or A–2
				38	Basalt.		
Willamette (WIA, WIC)	B	72+	72+	0–24	Silt loam	ML	A–4
				24–54	Silty clay loam, silt loam	ML or CL	A–7
				54–65	Silt loam	ML or CL	A–6
Witzel (WtE)	D	12–20	(3)	0–19	Very stony silty clay loam	GC or CL	A–6 or A–2
				19	Basalt.		
Woodburn (WuA, WuC, WuD)	C	72+	30+	0–17	Silt loam	ML	A–4
				17–32	Silty clay loam	ML or CL	A–4
				32–68	Silt loam	ML or CL	A–6

[1] Includes material larger than 3 inches in diameter.
[2] NP=Nonplastic.
[3] Water table is not a restricting factor.



1 485 000 FEET
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MILL CITY
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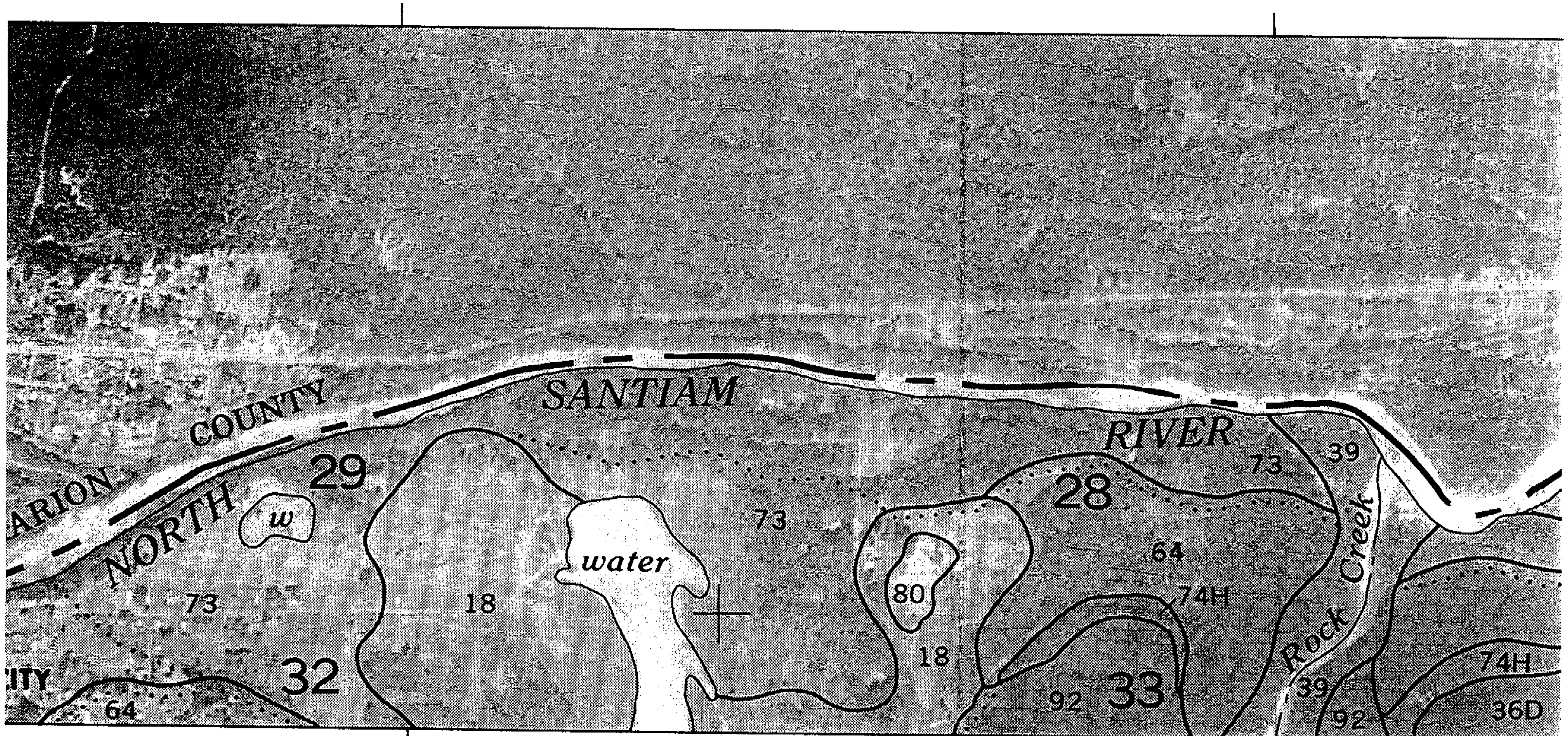
R. 2 E.
R. 3 E.

INSET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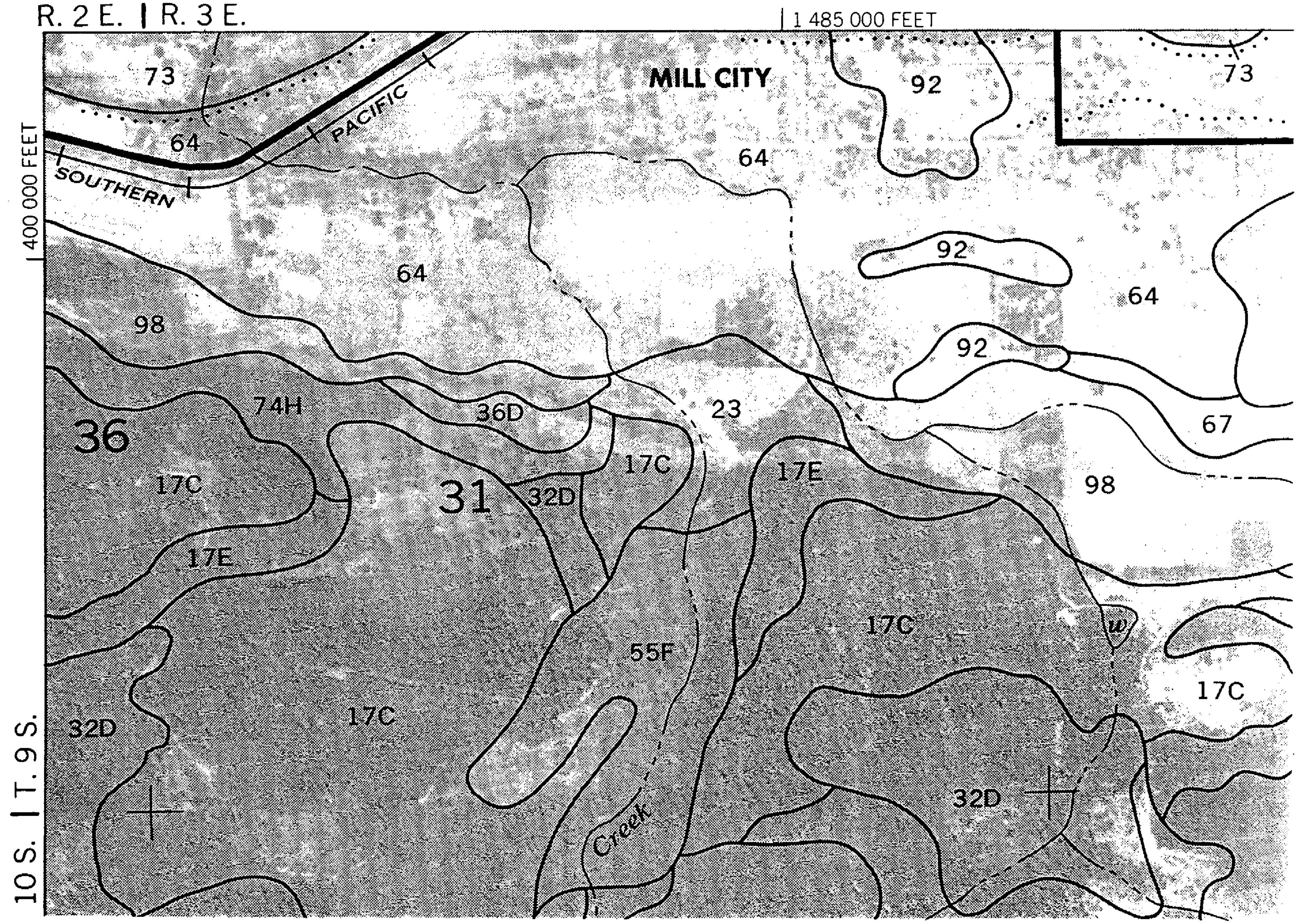

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R. 3 E.
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400 000 FEET
10 S.
T. 9 S.
MILL CITY
SOUTHERN
PACIFIC
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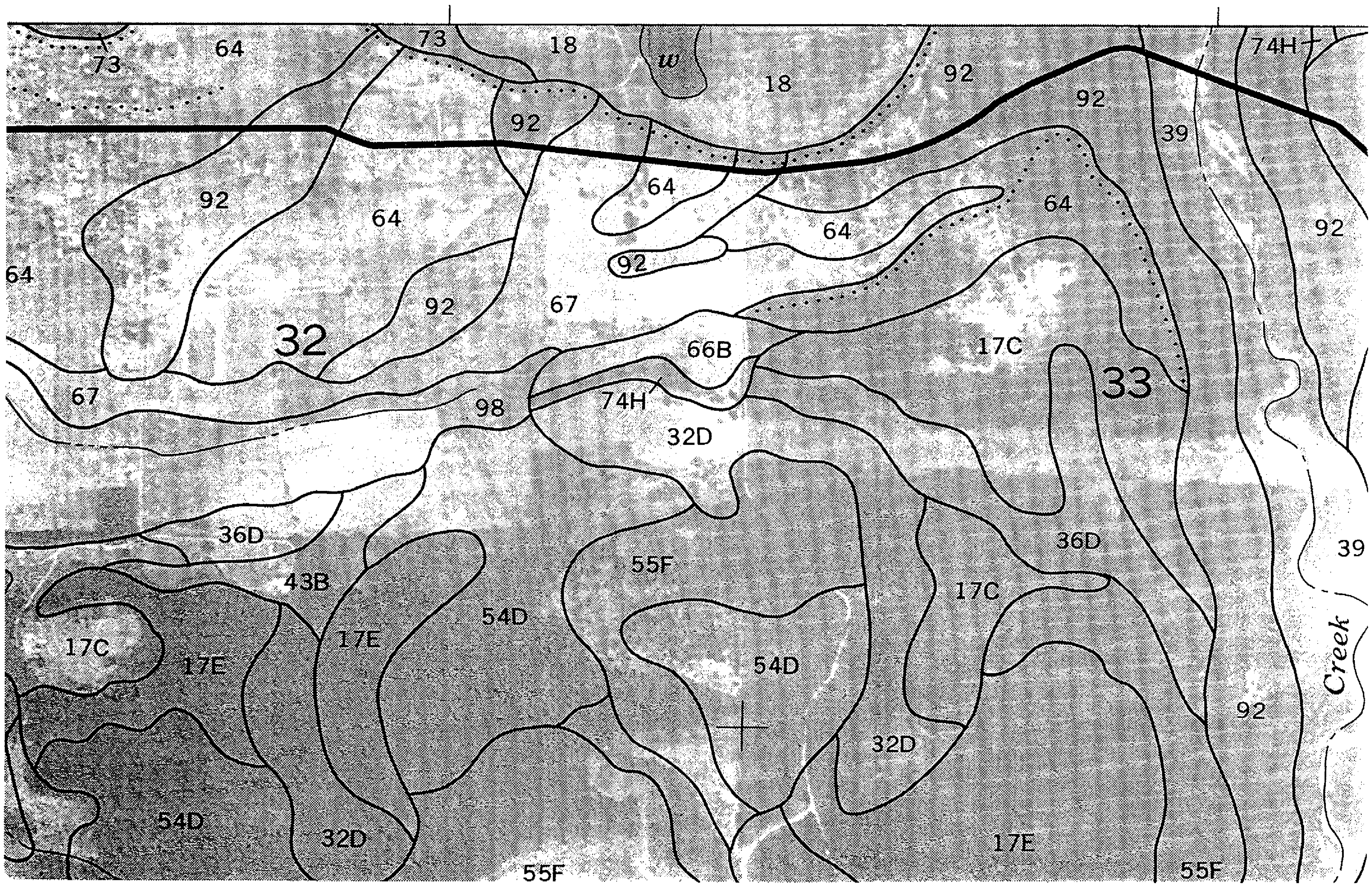
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17C
33
67
98
74H
32D
36D
36D
39
55F
43B
17C
17E
54D
17C
17E
54D
Creek
92
32D
54D
32D
17E
55F
55F

TABLE 14.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth**	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
1A, 1B----------- Abiqua	B	None--------	---	---	>6.0	---	---	>60	---	---	Moderate	Moderate.
2D--------------- Acanod	C	None--------	---	---	1.5-3.0	Perched	Nov-Mar	>60	---	---	High-----	High.
3---------------- Amity	D	None--------	---	---	0.5-1.5	Apparent	Nov-May	>60	---	---	Moderate	Moderate.
4D, 5F, 6F-------- Apt	B	None--------	---	---	>6.0	---	---	>60	---	---	High-----	High.
7---------------- Awbrig	D	Rare--------	---	---	+.5-1.0	Perched	Nov-May	>60	---	---	Moderate	Moderate.
8---------------- Bashaw	D	Frequent----	Long------	Dec-Apr	+1-0.5	Perched	Nov-May	>60	---	---	Moderate	Moderate.
9C, 9D, 9E, 9F---- Bellpine	C	None--------	---	---	>6.0	---	---	20-40	Soft	---	High-----	High.
10E-------------- Bensley	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	High-----	High.
11F*, 11G*:												
Bensley----------	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	High-----	High.
Valsetz----------	C	None--------	---	---	>6.0	---	---	20-40	Hard	Moderate	High-----	High.
12E, 13F, 13G, 14F, 14G--------- Blachly	B	None--------	---	---	>6.0	---	---	>60	---	---	High-----	High.
15D-------------- Bohannon	C	None--------	---	---	>6.0	---	---	20-40	Soft	---	High-----	High.
16B-------------- Briedwell	B	None--------	---	---	>6.0	---	---	>60	---	---	Moderate	Moderate.

See footnotes at end of table.

TABLE 14.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth**	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
17C, 17E---------- Bull Run	B	None---------	---	---	>6.0	---	---	>60	---	---	Moderate	Moderate.
18---------------- Camas	A	Occasional	Brief-----	Nov-May	>6.0	---	---	>60	---	---	Moderate	Moderate.
19---------------- Chapman	B	Rare---------	---	---	>6.0	---	---	>60	---	---	Moderate	Moderate.
20C--------------- Chehalem	C	None---------	---	---	1.5-3.0	Perched	Dec-Apr	>60	---	---	Moderate	Moderate.
21---------------- Chehalis	B	Occasional	Brief-----	Nov-Mar	>6.0	---	---	>60	---	---	Moderate	Moderate.
22C, 22E---------- Chehulpum	C	None---------	---	---	>6.0	---	---	10-20	Soft	---	Moderate	Moderate.
23---------------- Clackamas	D	None---------	---	---	0.5-1.5	Perched	Nov-May	>60	---	---	Moderate	Moderate.
24---------------- Clackamas Variant	C	None---------	---	---	2.0-3.0	Perched	Nov-May	>60	---	---	Moderate	Moderate.
25---------------- Cloquato	B	Occasional	Brief-----	Nov-Mar	>6.0	---	---	>60	---	---	Moderate	Moderate.
26---------------- Coburg	C	None---------	---	---	1.5-2.5	Apparent	Nov-May	>60	---	---	Moderate	Moderate.
27---------------- Concord	D	None---------	---	---	+.5-0.5	Apparent	Nov-May	>60	---	---	Moderate	Moderate.
28---------------- Conser	D	Rare---------	---	---	+.5-1.5	Apparent	Nov-May	>60	---	---	Moderate	Moderate.
29---------------- Courtney	D	Rare---------	---	---	+.5-1.5	Perched	Nov-May	>60	---	---	Moderate	Moderate.
30D, 30F, 30G----- Crabtree	C	None---------	---	---	2.0-3.0	Perched	Nov-Jun	>60	---	High-----	Moderate	Moderate.

See footnotes at end of table.

TABLE 14.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth**	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
31D, 31F, 31G----- Cruiser	B	None--------	---	---	>6.0	---	---	>60	---	High-----	High-----	High.
32D--------------- Cumley	C	None--------	---	---	2.0-3.0	Apparent	Nov-May	>60	---	---	Moderate	Moderate.
33---------------- Dayton	D	None--------	---	---	+.5-1.5	Perched	Nov-May	>60	---	---	Moderate	Moderate.
34C, 34E, 34F----- Dixonville	C	None--------	---	---	>6.0	---	---	20-40	Soft	---	Moderate	Low.
35C*, 35E*: Dixonville--------	C	None--------	---	---	>6.0	---	---	20-40	Soft	---	Moderate	Low.
Philomath--------	D	None--------	---	---	>6.0	---	---	12-20	Soft	---	Moderate	Moderate.
Hazelair---------	D	None--------	---	---	1.0-2.0	Perched	Dec-Apr	20-40	Soft	---	Moderate	Moderate.
36D--------------- Dupee	C	None--------	---	---	1.5-3.0	Perched	Dec-Apr	>60	---	---	High-----	High.
37D, 37F, 37G----- Flane	C	None--------	---	---	>6.0	---	---	>60	---	Moderate	High-----	High.
38F*, 38G*: Flane-------------	C	None--------	---	---	>6.0	---	---	>60	---	Moderate	High-----	High.
Moe--------------	B	None--------	---	---	>6.0	---	---	>60	---	High-----	High-----	High.
39*: Fluvents.												
Fluvaquents.												
40G*, 41G*: Harrington--------	C	None--------	---	---	>6.0	---	---	20-40	Hard	---	Moderate	Moderate.
Klickitat--------	B	None--------	---	---	>6.0	---	---	40-60	Hard	---	High-----	High.
42H*: Harrington--------	C	None--------	---	---	>6.0	---	---	20-40	Hard	---	Moderate	Moderate.
Rock outcrop.												

See footnotes at end of table.

TABLE 14.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth**	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
43B, 43D: Hazelair	D	None	---	---	1.0-2.0	Perched	Dec-Apr	20-40	Soft	---	Moderate	Moderate.
44E, 44F, 44G: Henline	C	None	---	---	>6.0	---	---	20-40	Hard	Moderate	Moderate	Moderate.
45F*, 45H*:												
Henline	C	None	---	---	>6.0	---	---	20-40	Hard	Moderate	Moderate	Moderate.
Yellowstone	D	None	---	---	>6.0	---	---	10-20	Hard	Moderate	High	High.
Rock outcrop.												
46: Holcomb	D	None	---	---	1.0-1.5	Perched	Nov-May	>60	---	---	Moderate	Moderate.
47C, 47D, 48F, 49F: Honeygrove	B	None	---	---	>6.0	---	---	>60	---	---	High	High.
50D, 50F, 50G: Hummington	C	None	---	---	>6.0	---	---	20-40	Hard	Moderate	Moderate	Moderate.
51C, 51D, 51E, 51F: Jory	B	None	---	---	>6.0	---	---	>60	---	---	High	High.
52D, 52F, 52G: Keel	C	None	---	---	>6.0	---	---	20-40	Soft	High	High	High.
53G*, 53H*:												
Kilchis	D	None	---	---	>6.0	---	---	12-20	Hard	---	High	High.
Harrington	C	None	---	---	>6.0	---	---	20-40	Hard	---	Moderate	Moderate.
54D, 55F, 55G, 56F, 56G, 57E: Kinney	B	None	---	---	>6.0	---	---	40-60	Soft	---	High	High.
58F*, 58G*, 59F*, 59G*:												
Kinney	B	None	---	---	>6.0	---	---	40-60	Soft	---	High	High.
Klickitat	B	None	---	---	>6.0	---	---	40-60	Hard	---	High	High.

See footnotes at end of table.

TABLE 14.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth**	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
60E*, 61F*, 62F*:												
Klickitat	B	None	---	---	>6.0	---	---	40-60	Hard	---	High	High.
Harrington	C	None	---	---	>6.0	---	---	20-40	Hard	---	Moderate	Moderate.
63 Malabon	C	None	---	---	>6.0	---	---	>60	---	---	Moderate	Moderate.
64 Malabon Variant	B	None	---	---	>6.0	---	---	>60	---	---	Moderate	Moderate.
65B Marcola	C	None	---	---	3.5-4.5	Apparent	Nov-May	>60	---	---	Moderate	Moderate.
66B McAlpin	C	None	---	---	2.0-3.0	Apparent	Nov-Mar	>60	---	---	Moderate	Moderate.
67 McBee	C	Occasional	Brief	Nov-May	2.0-3.0	Apparent	Nov-Apr	>60	---	---	Moderate	Moderate.
68F, 68G McDuff	C	None	---	---	>6.0	---	---	20-40	Soft	---	High	High.
69B Minniece	D	None	---	---	0-2.0	Perched	Nov-May	>60	---	---	Moderate	Moderate.
70D, 70F Moe	B	None	---	---	>6.0	---	---	>60	---	High	High	High.
71F Mulkey	C	None	---	---	>6.0	---	---	20-40	Hard	High	High	High.
72C, 72D, 72E, 72F Nekia	C	None	---	---	>6.0	---	---	20-40	Hard	---	High	High.
73 Newberg	B	Occasional	Brief	Dec-Mar	>6.0	---	---	>60	---	---	Moderate	Moderate.
74H*. Ochrepts												

See footnotes at end of table.

TABLE 14.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth**	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
75C------------- Panther	D	None---------	---	---	0-1.0	Perched	Dec-Apr	40-60	Soft	---	High------	High.
76E, 76G---------- Peavine	C	None---------	---	---	>6.0	---	---	20-40	Soft	---	High------	High.
77A------------- Pengra	C	None---------	---	---	1.5-2.5	Perched	Nov-May	>60	---	---	Moderate	Moderate.
78C, 79C, 79F----- Philomath	D	None---------	---	---	>6.0	---	---	12-20	Soft	---	Moderate	Moderate.
80*. Pits												
81D, 82F, 82G, 83F------------- Quartzville	B	None---------	---	---	>6.0	---	---	>60	---	---	Moderate	Moderate.
84E, 84G---------- Ritner	C	None---------	---	---	>6.0	---	---	20-40	Hard	---	Moderate	Moderate.
85*. Riverwash												
86G*: Rock outcrop.												
Orthents.												
87--------------- Salem	B	None---------	---	---	>6.0	---	---	>60	---	---	Moderate	Moderate.
88B, 88C---------- Salkum	B	None---------	---	---	>6.0	---	---	>60	---	---	High------	High.
89B-------------- Santiam	C	None---------	---	---	2.0-3.0	Perched	Dec-Mar	>60	---	---	Moderate	Moderate.
90B-------------- Saturn	B	Rare---------	---	---	3.5-5.0	Apparent	Dec-Mar	>60	---	---	High------	High.

See footnotes at end of table.

TABLE 14.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth**	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
91----------------- Saturn Variant	C	None--------	---	---	2.0-3.0	Perched	Nov-May	>60	---	---	Moderate	Moderate.
92----------------- Sifton Variant	A	None--------	---	---	>6.0	---	---	>60	---	---	Moderate	Moderate.
93C---------------- Silverton	C	None--------	---	---	2.5-5.0	Apparent	Nov-May	20-40	Hard	---	Moderate	Moderate.
94B---------------- Stayton	D	None--------	---	---	>6.0	---	---	12-20	Hard	---	Moderate	Moderate.
95C, 95D, 95F------ Steiwer	C	None--------	---	---	>6.0	---	---	20-40	Soft	---	Moderate	Moderate.
96E---------------- Valsetz	C	None--------	---	---	>6.0	---	---	20-40	Hard	Moderate	High-----	High.
97E*, 97H*:												
Valsetz-----------	C	None--------	---	---	>6.0	---	---	20-40	Hard	Moderate	High-----	High.
Yellowstone-------	D	None--------	---	---	>6.0	---	---	10-20	Hard	Moderate	High-----	High.
98----------------- Waldo	D	Occasional	Brief-----	Jan-Apr	0-0.5	Perched	Nov-May	>60	---	---	Moderate	Moderate.
99----------------- Wapato	D	Frequent----	Brief-----	Dec-Apr	+1-1.0	Apparent	Nov-May	>60	---	---	Moderate	Moderate.
100---------------- Whiteson	D	Frequent----	Brief to long.	Dec-Apr	0-1.0	Perched	Nov-May	>60	---	---	Moderate	Moderate.
101C, 101D, 101E, 101F-------------- Willakenzie	C	None--------	---	---	>6.0	---	---	20-40	Soft	---	High-----	High.
102---------------- Willamette	B	None--------	---	---	>6.0	---	---	>60	---	---	Moderate	Moderate.
103C--------------- Witham	D	None--------	---	---	1.5-2.5	Perched	Nov-May	>60	---	---	Moderate	Moderate.

See footnotes at end of table.

TABLE 14.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth**	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
104E, 104G-------- Witzel	D	None--------	---	---	>6.0	---	---	12-20	Hard	---	Moderate	Moderate.
105C-------------- Witzel Variant	D	None--------	---	---	>6.0	---	---	12-20	Hard	---	Moderate	Moderate.
106A, 106C-------- Woodburn	C	None--------	---	---	2.0-3.0	Perched	Dec-Apr	>60	---	---	Moderate	Moderate.
107E, 107H-------- Yellowstone	D	None--------	---	---	>6.0	---	---	10-20	Hard	Moderate	High-----	High.
108H*:												
Zango------------	D	None--------	---	---	>6.0	---	---	10-20	Hard	---	Moderate	Moderate.
Dobbins----------	C	None--------	---	---	>6.0	---	---	20-40	Hard	---	High-----	High.

* See description of the map unit for composition and behavior characteristics of the map unit.

** A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

CITY OF MILL CITY
Storm Drainage System Master Plan

Mill City Storm Drainage System Maps

Appendix B

CITY OF MILL CITY
Storm Drainage System Master Plan

Sub-Basin Summaries

Appendix C

Mill City Storm Drain Master Plan - Spring Street
1780.4060.0
August 3, 2002

BASIN CHARACTERISTICS - EXISTING CONDITIONS
Rational Method

2-yr 24 hr Rainfall 3.5 inches

SS-W1

Area	C	Description
8.3	0.55	R1
1.3	0.55	R1
2.5	0.85	ROW
12.1	0.61	Sub-Basin Total

Q= 10

Time of Concentration		'n'	Length	Slope
0.31	Sheet Flow	0.24	150	0.02

		Length	Slope	Paved?
0.14	Shallow Overland	800	0.01	n

		Length	Velocity
0.00	Length & Velocity	0	4
0.45	TOTAL (hours)		

SS-W2

Area	C	Description
5.6	0.4	R1
0.3	0.5	P
14.5	0.4	UGB-R(R1)
5.1	0.85	ROW
25.5	0.49	Sub-Basin Total

Q= 14

Time of Concentration		'n'	Length	Slope
0.52	Sheet Flow	0.24	200	0.01

		Length	Slope	Paved?
0.09	Shallow Overland	500	0.01	n

		Length	Velocity
0.04	Length & Velocity	600	4
0.65	TOTAL (hours)		

SS-W3

Area	C	Description
11.5	0.55	R1
1	0.65	R2
3.5	0.25	P
3.2	0.85	ROW
19.2	0.55	Sub-Basin Total

Q= 14

Time of Concentration		'n'	Length	Slope
0.31	Sheet Flow	0.24	150	0.02

		Length	Slope	Paved?
0.17	Shallow Overland	1000	0.01	n

		Length	Velocity
0.00	Length & Velocity	0	4
0.49	TOTAL (hours)		

SS-E1

Area	C	Description
3.8	0.55	R1
0.4	0.5	P
1.6	0.85	ROW
5.8	0.63	Sub-Basin Total

Q= 7

Time of Concentration		'n'	Length	Slope
0.23	Sheet Flow	0.24	100	0.02

		Length	Slope	Paved?
0.05	Shallow Overland	400	0.02	n

		Length	Velocity
0.00	Length & Velocity	0	4
0.28	TOTAL (hours)		

Mill City Storm Drain Master Plan - Spring Street
1780.4060.0
August 3, 2002

BASIN CHARACTERISTICS - EXISTING CONDITIONS
Rational Method

2-yr 24 hr Rainfall 3.5 inches

SS-E2

Area	C	Description
5.1	0.55	R1
0.2	0.5	P
0.8	0.85	ROW
6.1	0.59	Sub-Basin Total

Q= 6

Time of Concentration		'n'	Length	Slope
0.31	Sheet Flow	0.24	150	0.02

		Length	Slope	Paved?
0.04	Shallow Overland	500	0.04	n

		Length	Velocity
0.00	Length & Velocity	0	4

0.36	TOTAL (hours)

SS-E3

Area	C	Description
1.1	0.55	R1
5.7	0.6	R2
2.9	0.85	ROW
9.7	0.67	Sub-Basin Total

Q= 8

Time of Concentration		'n'	Length	Slope
0.42	Sheet Flow	0.24	150	0.01

		Length	Slope	Paved?
0.15	Shallow Overland	1200	0.02	n

		Length	Velocity
0.00	Length & Velocity	0	4

0.56	TOTAL (hours)

SS-E4

Area	C	Description
3.1	0.55	R2
0.5	0.5	P
0.7	0.7	CC
2.8	0.85	ROW
7.1	0.68	Sub-Basin Total

Q= 8

Time of Concentration		'n'	Length	Slope
0.21	Sheet Flow	0.15	100	0.01

		Length	Slope	Paved?
0.10	Shallow Overland	600	0.01	n

		Length	Velocity
0.00	Length & Velocity	0	4

0.31	TOTAL (hours)

SS-E5

Area	C	Description
1.8	0.6	R2
9	0.6	P(BLD)
10	0.2	P(PLAY)
2.1	0.65	CC
1.8	0.87	ROW
24.7	0.46	Sub-Basin Total

Q= 13

Time of Concentration		'n'	Length	Slope
0.52	Sheet Flow	0.24	200	0.01

		Length	Slope	Paved?
0.14	Shallow Overland	800	0.01	n

		Length	Velocity
0.00	Length & Velocity	0	6

0.66	TOTAL (hours)

Mill City Storm Drain Master Plan - Spring Street
1780.4060.0
August 3, 2002

BASIN CHARACTERISTICS - FUTURE CONDITIONS
Rational Method

2-yr 24 hr Rainfall 3.5 inches

SS-W1

Area	C	Description
8.3	0.55	R1
1.3	0.55	R1
2.5	0.9	ROW
12.1	0.62	Sub-Basin Total

Q= 11

Time of Concentration		'n'	Length	Slope
0.31	Sheet Flow	0.24	150	0.02
		Length	Slope	Paved?
0.03	Shallow Overland	200	0.01	n
		Length	Velocity	
0.05	Length & Velocity	1000	6	
0.40	TOTAL (hours)			

SS-W2

Area	C	Description
5.6	0.5	R1
0.3	0.5	P
14.5	0.5	UGB-R(R1)
5.1	0.9	ROW
25.5	0.58	Sub-Basin Total

Q= 23

Time of Concentration		'n'	Length	Slope
0.30	Sheet Flow	0.24	100	0.01
		Length	Slope	Paved?
0.03	Shallow Overland	200	0.01	n
		Length	Velocity	
0.05	Length & Velocity	1000	6	
0.38	TOTAL (hours)			

SS-W3

Area	C	Description
11.5	0.55	R1
1	0.65	R2
3.5	0.25	P
3.2	0.9	ROW
19.2	0.56	Sub-Basin Total

Q= 17

Time of Concentration		'n'	Length	Slope
0.31	Sheet Flow	0.24	150	0.02
		Length	Slope	Paved?
0.03	Shallow Overland	200	0.01	y
		Length	Velocity	
0.03	Length & Velocity	700	6	
0.37	TOTAL (hours)			

SS-E1

Area	C	Description
3.8	0.55	R1
0.4	0.5	P
1.6	0.9	ROW
5.8	0.64	Sub-Basin Total

Q= 7

Time of Concentration		'n'	Length	Slope
0.23	Sheet Flow	0.24	100	0.02
		Length	Slope	Paved?
0.02	Shallow Overland	200	0.02	y
		Length	Velocity	
0.01	Length & Velocity	200	6	
0.26	TOTAL (hours)			

Mill City Storm Drain Master Plan - Spring Street
1780.4060.0
August 3, 2002

BASIN CHARACTERISTICS - FUTURE CONDITIONS
Rational Method

2-yr 24 hr Rainfall 3.5 inches

SS-E2

Area	C	Description
5.1	0.55	R1
0.2	0.5	P
0.8	0.9	ROW
6.1	0.59	Sub-Basin Total

Q= 6

Time of Concentration				
		'n'	Length	Slope
0.31	Sheet Flow	0.24	150	0.02
		Length	Slope	Paved?
0.04	Shallow Overland	500	0.04	n
		Length	Velocity	
0.00	Length & Velocity	0	4	
0.36	TOTAL (hours)			

SS-E3

Area	C	Description
1.1	0.55	R1
5.7	0.65	R2
2.9	0.9	ROW
9.7	0.71	Sub-Basin Total

Q= 15

Time of Concentration				
		'n'	Length	Slope
0.12	Sheet Flow	0.08	100	0.01
		Length	Slope	Paved?
0.03	Shallow Overland	200	0.01	y
		Length	Velocity	
0.05	Length & Velocity	1000	6	
0.20	TOTAL (hours)			

SS-E4

Area	C	Description
3.1	0.6	R2
0.5	0.5	P
0.7	0.85	CC
2.8	0.9	ROW
7.1	0.74	Sub-Basin Total

Q= 13

Time of Concentration				
		'n'	Length	Slope
0.09	Sheet Flow	0.05	100	0.01
		Length	Slope	Paved?
0.03	Shallow Overland	200	0.01	y
		Length	Velocity	
0.02	Length & Velocity	400	6	
0.13	TOTAL (hours)			

SS-E5

Area	C	Description
1.8	0.6	R2
9	0.6	P(BLD)
10	0.35	P(PLAY)
2.1	0.8	CC
1.8	0.9	ROW
24.7	0.54	Sub-Basin Total

Q= 16

Time of Concentration				
		'n'	Length	Slope
0.52	Sheet Flow	0.24	200	0.01
		Length	Slope	Paved?
0.03	Shallow Overland	200	0.01	y
		Length	Velocity	
0.05	Length & Velocity	1000	6	
0.60	TOTAL (hours)			

Mill City Storm Drain Master Plan - Spring Street
1780.4060.0
August 3, 2002

BASIN CHARACTERISTICS - EXISTING CONDITIONS
SBUH Method

2-yr 24 hr Rainfall 3.5 inches

SS-W1

Area	C	Description
8.3	61	R1
1.3	75	R1
2.5	93	ROW
12.1	69	Sub-Basin Total

Time of Concentration

Hours	Type			
		'n'	Length	Slope
0.31	Sheet Flow	0.24	150	0.02
		Length	Slope	Paved?
0.14	Shallow Overland	800	0.01	n
		Length	Velocity	
0.00	Length & Velocity	0	4	
0.45	TOTAL (hours)			

SS-W2

Area	C	Description
5.6	67	R1
0.3	83	P
14.5	66	UGB-R(R1)
5.1	93	ROW
25.5	72	Sub-Basin Total

Hours	Type			
		'n'	Length	Slope
0.52	Sheet Flow	0.24	200	0.01
		Length	Slope	Paved?
0.09	Shallow Overland	500	0.01	n
		Length	Velocity	
0.04	Length & Velocity	600	4	
0.65	TOTAL (hours)			

SS-W3

Area	C	Description
11.5	80	R1
1	83	R2
3.5	76	P
3.2	93	ROW
19.2	82	Sub-Basin Total

Hours	Type			
		'n'	Length	Slope
0.31	Sheet Flow	0.24	150	0.02
		Length	Slope	Paved?
0.17	Shallow Overland	1000	0.01	n
		Length	Velocity	
0.00	Length & Velocity	0	4	
0.49	TOTAL (hours)			

SS-E1

Area	C	Description
3.8	68	R1
0.4	83	P
1.6	93	ROW
5.8	76	Sub-Basin Total

Hours	Type			
		'n'	Length	Slope
0.23	Sheet Flow	0.24	100	0.02
		Length	Slope	Paved?
0.05	Shallow Overland	400	0.02	n
		Length	Velocity	
0.00	Length & Velocity	0	4	
0.28	TOTAL (hours)			

Mill City Storm Drain Master Plan - Spring Street
1780.4060.0
August 3, 2002

BASIN CHARACTERISTICS - EXISTING CONDITIONS
SBUH Method

2-yr 24 hr Rainfall 3.5 inches

SS-E2

Area	C	Description
5.1	70	R1
0.2	83	P
0.8	93	ROW
6.1	73	Sub-Basin Total

Time of Concentration		'n' / Length	Length / Slope	Slope / Velocity / Paved?
0.31	Sheet Flow	0.24	150	0.02
0.04	Shallow Overland	500	0.04	n
0.00	Length & Velocity	0	4	
0.36	TOTAL (hours)			

SS-E3

Area	C	Description
1.1	75	R1
5.7	76	R2
2.9	93	ROW
9.7	81	Sub-Basin Total

Time of Concentration		'n' / Length	Length / Slope	Slope / Velocity / Paved?
0.42	Sheet Flow	0.24	150	0.01
0.15	Shallow Overland	1200	0.02	n
0.00	Length & Velocity	0	4	
0.56	TOTAL (hours)			

SS-E4

Area	C	Description
3.1	78	R2
0.5	83	P
0.7	84	CC
2.8	93	ROW
7.1	85	Sub-Basin Total

Time of Concentration		'n' / Length	Length / Slope	Slope / Velocity / Paved?
0.21	Sheet Flow	0.15	100	0.01
0.10	Shallow Overland	600	0.01	n
0.00	Length & Velocity	0	4	
0.31	TOTAL (hours)			

SS-E5

Area	C	Description
1.8	84	R2
9	86	P(BLD)
10	79	P(PLAY)
2.1	88	CC
1.8	95	ROW
24.7	84	Sub-Basin Total

Time of Concentration		'n' / Length	Length / Slope	Slope / Velocity / Paved?
0.52	Sheet Flow	0.24	200	0.01
0.14	Shallow Overland	800	0.01	n
0.00	Length & Velocity	0	6	
0.66	TOTAL (hours)			

Mill City Storm Drain Master Plan - Spring Street
1780.4060.0
August 3, 2002

BASIN CHARACTERISTICS - FUTURE CONDITIONS
SBUH Method

2-yr 24 hr Rainfall 3.5 inches

SS-W1

Area	C	Description
8.3	61	R1
1.3	75	R1
2.5	98	ROW
12.1	70	Sub-Basin Total

Time of Concentration

Hours	Component	'n' / Length	Length / Slope	Slope / Paved?
0.31	Sheet Flow ('n', Length, Slope)	0.24	150	0.02
0.03	Shallow Overland (Length, Slope, Paved?)	200	0.01	n
0.05	Length & Velocity (Length, Velocity)	1000	6	
0.40	TOTAL (hours)			

SS-W2

Area	C	Description
5.6	75	R1
0.3	83	P
14.5	75	UGB-R(R1)
5.1	98	ROW
25.5	80	Sub-Basin Total

Hours	Component	'n' / Length	Length / Slope	Slope / Paved?
0.30	Sheet Flow ('n', Length, Slope)	0.24	100	0.01
0.03	Shallow Overland (Length, Slope, Paved?)	200	0.01	n
0.05	Length & Velocity (Length, Velocity)	1000	6	
0.38	TOTAL (hours)			

SS-W3

Area	C	Description
11.5	80	R1
1	86	R2
3.5	76	P
3.2	98	ROW
19.2	83	Sub-Basin Total

Hours	Component	'n' / Length	Length / Slope	Slope / Paved?
0.31	Sheet Flow ('n', Length, Slope)	0.24	150	0.02
0.03	Shallow Overland (Length, Slope, Paved?)	200	0.01	y
0.03	Length & Velocity (Length, Velocity)	700	6	
0.37	TOTAL (hours)			

SS-E1

Area	C	Description
3.8	68	R1
0.4	83	P
1.6	98	ROW
5.8	77	Sub-Basin Total

Hours	Component	'n' / Length	Length / Slope	Slope / Paved?
0.23	Sheet Flow ('n', Length, Slope)	0.24	100	0.02
0.02	Shallow Overland (Length, Slope, Paved?)	200	0.02	y
0.01	Length & Velocity (Length, Velocity)	200	6	
0.26	TOTAL (hours)			

Mill City Storm Drain Master Plan - Spring Street
1780.4060.0
August 3, 2002

BASIN CHARACTERISTICS - FUTURE CONDITIONS
SBUH Method

2-yr 24 hr Rainfall 3.5 inches

SS-E2

Area	C	Description
5.1	72	R1
0.2	83	P
0.8	98	ROW
6.1	76	Sub-Basin Total

Time of Concentration

Time	Type	'n'	Length	Slope
0.31	Sheet Flow	0.24	150	0.02

Time	Type	Length	Slope	Paved?
0.04	Shallow Overland	500	0.04	n

Time	Type	Length	Velocity
0.00	Length & Velocity	0	4

Time	
0.36	TOTAL (hours)

SS-E3

Area	C	Description
1.1	75	R1
5.7	80	R2
2.9	98	ROW
9.7	85	Sub-Basin Total

Time	Type	'n'	Length	Slope
0.12	Sheet Flow	0.08	100	0.01

Time	Type	Length	Slope	Paved?
0.03	Shallow Overland	200	0.01	y

Time	Type	Length	Velocity
0.05	Length & Velocity	1000	6

Time	
0.20	TOTAL (hours)

SS-E4

Area	C	Description
3.1	80	R2
0.5	83	P
0.7	92	CC
2.8	98	ROW
7.1	88	Sub-Basin Total

Time	Type	'n'	Length	Slope
0.09	Sheet Flow	0.05	100	0.01

Time	Type	Length	Slope	Paved?
0.03	Shallow Overland	200	0.01	y

Time	Type	Length	Velocity
0.02	Length & Velocity	400	6

Time	
0.13	TOTAL (hours)

SS-E5

Area	C	Description
1.8	86	R2
9	86	P(BLD)
10	82	P(PLAY)
2.1	94	CC
1.8	98	ROW
24.7	86	Sub-Basin Total

Time	Type	'n'	Length	Slope
0.52	Sheet Flow	0.24	200	0.01

Time	Type	Length	Slope	Paved?
0.03	Shallow Overland	200	0.01	y

Time	Type	Length	Velocity
0.05	Length & Velocity	1000	6

Time	
0.60	TOTAL (hours)

Mill City Storm Drain Master Plan - Snake Creek Basin
JO 1780.5020.0
January 2007

BASIN CHARACTERISTICS - EXISTING CONDITIONS - RATIONAL

2-yr 24 hr Rainfall 3.5 inches

Sub-Basin SC1

Q25 (cfs): 15
Q10 (cfs): 13

Area	C	Description
9.63	0.5	R1
1.4	0.5	UGB R
7.29	0.75	ROW
3.28	0.4	Undeveloped
21.6	0.57	Sub-Basin Total

Time of Concentration

Minutes	Type			
		'n'	Length	Slope
10	Time to Curb 10 Minutes			
		Length	Slope	Paved?
8	Shallow Overland	500	0.01	n
		Length	Velocity	
16	Length & Velocity	2000	2	
34	TOTAL (minutes)			

i25 = 1.22
i10 = 1.05

Sub-Basin SC2

Q25 (cfs): 13
Q10 (cfs): 11

Area	C	Description
3.4	0.5	R1
0	0.5	UGB R
1.15	0.75	ROW
22.95	0.4	Undeveloped
27.5	0.43	Sub-Basin Total

Minutes	Type			
		'n'	Length	Slope
24	Sheet Flow	0.15	200	0.01
		Length	Slope	Paved?
15	Shallow Overland	900	0.01	n
		Length	Velocity	
2	Length & Velocity	300	2	
41	TOTAL (minutes)			

i25 = 1.08
i10 = 0.92

Sub-Basin SC3

Q25 (cfs): 10
Q10 (cfs): 8

Area	C	Description
2	0.5	R1
1.75	0.5	UGB R
0.6	0.75	ROW
24.35	0.4	Undeveloped
28.7	0.42	Sub-Basin Total

Minutes	Type			
		'n'	Length	Slope
20	Sheet Flow	0.15	200	0.015
		Length	Slope	Paved?
48	Shallow Overland	2000	0.005	n
		Length	Velocity	
0	Length & Velocity	0	4	
68	TOTAL (minutes)			

i25 = 0.79
i10 = 0.68

Sub-Basin SC4

Q25 (cfs): 11
Q10 (cfs): 9

Area	C	Description
7.02	0.5	R1
1.2	0.6	R2
0.37	0.5	UGB R
1.05	0.75	ROW
10.26	0.4	Undeveloped
19.9	0.47	Sub-Basin Total

Minutes	Type			
		'n'	Length	Slope
24	Sheet Flow	0.15	200	0.01
		Length	Slope	Paved?
13	Shallow Overland	800	0.01	n
		Length	Velocity	
1	Length & Velocity	200	2.5	
38	TOTAL (minutes)			

i25 = 1.14
i10 = 0.97

Mill City Storm Drain Master Plan - Snake Creek Basin
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BASIN CHARACTERISTICS - EXISTING CONDITIONS - RATIONAL

2-yr 24 hr Rainfall 3.5 inches

	Area	C	Description
Sub-Basin SC5	2.4	0.6	R2
	3.84	0.5	UGB R
Q25 (cfs)	7.2	0.4	EFU Fields
9	0.6	0.75	ROW
	9.36	0.4	Undeveloped
Q10 (cfs)			
8			
	23.4	0.45	Sub-Basin Total

Time of Concentration

		'n'	Length	Slope
24	Sheet Flow	0.15	200	0.01
		Length	Slope	Paved?
36	Shallow Overland	1500	0.005	n
		Length	Velocity	
0	Length & Velocity	0	4	
60	TOTAL (minutes)		i25 =	0.85
			i10 =	0.72

	Area	C	Description
Sub-Basin SC6	0.8	0.5	UGB R
	4	0.5	EFU Buildings
Q25 (cfs)	29.4	0.4	EFU Fields
10	0.5	0.75	ROW
	0.2	0.4	Undeveloped
Q10 (cfs)			
9			
	34.9	0.42	Sub-Basin Total

		'n'	Length	Slope
32	Sheet Flow	0.15	200	0.005
		Length	Slope	Paved?
60	Shallow Overland	2500	0.005	n
		Length	Velocity	
0.00	Length & Velocity	0	4	
92	TOTAL (minutes)		i25 =	0.69
			i10 =	0.6

Note: Time of Concentration Computed manually and summarized on this spreadsheet.

Mill City Storm Drain Master Plan - Snake Creek Basin
JO 1780.5020.0
January 2007

BASIN CHARACTERISTICS - DEVELOPED CONDITIONS - RATIONAL

2-yr 24 hr Rainfall 3.5 inches

Sub-Basin SC1

Q25 (cfs): 21
Q10 (cfs): 18

Area	C	Description
10.7	0.5	R1
2.8	0.5	UGB R
8.1	0.85	ROW
21.6	0.63	Sub-Basin Total

Time of Concentration

Minutes	Segment			
		'n'	Length	Slope
10	Time to Curb 10 Minutes			
		Length	Slope	Paved?
3	Shallow Overland	300	0.005	y
		Length	Velocity	
10	Length & Velocity	2300	4	
23	TOTAL (minutes)			

i25 = 1.55
i10 = 1.32

Sub-Basin SC2

Q25 (cfs): 24
Q10 (cfs): 21

Area	C	Description
11.6	0.5	R1
7.6	0.5	UGB R
2.3	0.85	ROW
6	0.85	FUTURE ROW
27.5	0.61	Sub-Basin Total

Minutes	Segment			
		'n'	Length	Slope
10	Time to Curb 10 Minutes			
		Length	Slope	Paved?
3	Shallow Overland	300	0.005	y
		Length	Velocity	
12	Length & Velocity	2000	2.8	
25	TOTAL (minutes)			

i25 = 1.47
i10 = 1.26

Sub-Basin SC3

Q25 (cfs): 23
Q10 (cfs): 20

Area	C	Description
8	0.5	R1
12.5	0.5	UGB R
1.2	0.85	ROW
7	0.85	FUTURE ROW
28.7	0.60	Sub-Basin Total

Minutes	Segment			
		'n'	Length	Slope
10	Time to Curb 10 Minutes			
		Length	Slope	Paved?
3	Shallow Overland	300	0.005	y
		Length	Velocity	
17	Length & Velocity	2600	2.5	
30	TOTAL (minutes)			

i25 = 1.32
i10 = 1.15

Sub-Basin SC4

Q25 (cfs): 23
Q10 (cfs): 20

Area	C	Description
9.7	0.5	R1
2.4	0.6	R2
2.7	0.5	UGB R
2.1	0.85	ROW
3	0.85	FUTURE ROW
19.9	0.60	Sub-Basin Total

Minutes	Segment			
		'n'	Length	Slope
10	Time to Curb 10 Minutes			
		Length	Slope	Paved?
3	Shallow Overland	300	0.005	y
		Length	Velocity	
2	Length & Velocity	700	5.8	
15	TOTAL (minutes)			

i25 = 1.95
i10 = 1.65

Mill City Storm Drain Master Plan - Snake Creek Basin
JO 1780.5020.0
January 2007

BASIN CHARACTERISTICS - DEVELOPED CONDITIONS - RATIONAL

2-yr 24 hr Rainfall 3.5 inches

Sub-Basin SC5

Q25 (cfs): 13
Q10 (cfs): 11

Area	C	Description
5	0.6	R2
8	0.5	UGB R
7.2	0.4	EFU Fields
0.6	0.85	ROW
2.6	0.85	FUTURE ROW
23.4	0.54	Sub-Basin Total

Time of Concentration

Minutes	Type	'n'	Length	Slope
28	Sheet Flow	0.15	200	0.01

Minutes	Type	Length	Slope	Paved?
10	Shallow Overland	300	0.005	n

Minutes	Type	Length	Velocity
6	Length & Velocity	1500	4

Minutes	
44	TOTAL (minutes)

i25 = 1.03
i10 = 0.88

Sub-Basin SC6

Q25 (cfs): 10
Q10 (cfs): 9

Area	C	Description
1	0.5	UGB R
4	0.5	EFU Buildings
29.4	0.4	EFU Fields
0.5	0.85	ROW
34.9	0.42	Sub-Basin Total

Minutes	Type	'n'	Length	Slope
32	Sheet Flow	0.15	200	0.005

Minutes	Type	Length	Slope	Paved?
60	Shallow Overland	2500	0.005	n

Minutes	Type	Length	Velocity
0	Length & Velocity	0	4

Minutes	
92	TOTAL (minutes)

i25 = 0.69
i10 = 0.62

Note: Time of Concentration Computed manually and summarized on this spreadsheet.

Mill City Storm Drain Master Plan - Snake Creek Basin
JO 1780.5020.0
January 2007

BASIN CHARACTERISTICS - EXISTING CONDITIONS - SBUH

2-yr 24 hr Rainfall 3.5 inches

Sub-Basin SC1

Area	CN	Description
9.63	77	R1
1.4	75	UGB R
7.29	93	ROW
3.28	69	Undeveloped
21.6	81	Sub-Basin Total

Time of Concentration

		'n'	Length	Slope
0.21	Sheet Flow	0.15	100	0.01
		Length	Slope	Paved?
0.09	Shallow Overland	500	0.01	n
		Length	Velocity	
0.28	Length & Velocity	2000	2	
0.57	TOTAL (hours)	34	TOTAL (minutes)	

Sub-Basin SC2

Area	CN	Description
3.4	78	R1
0	77	UGB R
1.15	93	ROW
22.95	69	Undeveloped
27.5	71	Sub-Basin Total

		'n'	Length	Slope
0.36	Sheet Flow	0.15	200	0.01
		Length	Slope	Paved?
0.15	Shallow Overland	900	0.01	n
		Length	Velocity	
0.04	Length & Velocity	300	2	
0.56	TOTAL (hours)	33	TOTAL (minutes)	

Sub-Basin SC3

Area	CN	Description
2	80	R1
1.75	77	UGB R
0.6	93	ROW
24.35	69	Undeveloped
28.7	71	Sub-Basin Total

		'n'	Length	Slope
0.31	Sheet Flow	0.15	200	0.015
		Length	Slope	Paved?
0.49	Shallow Overland	2000	0.005	n
		Length	Velocity	
0.00	Length & Velocity	0	4	
0.79	TOTAL (hours)	48	TOTAL (minutes)	

Sub-Basin SC4

Area	CN	Description
7.02	77	R1
1.2	80	R2
0.37	77	UGB R
1.05	93	ROW
10.26	69	Undeveloped
19.9	74	Sub-Basin Total

		'n'	Length	Slope
0.36	Sheet Flow	0.15	200	0.01
		Length	Slope	Paved?
0.14	Shallow Overland	800	0.01	n
		Length	Velocity	
0.02	Length & Velocity	200	2.5	
0.52	TOTAL (hours)	31	TOTAL (minutes)	

Mill City Storm Drain Master Plan - Snake Creek Basin
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January 2007

BASIN CHARACTERISTICS - EXISTING CONDITIONS - SBUH

2-yr 24 hr Rainfall 3.5 inches

Sub-Basin SC5

Area	CN	Description
2.4	84	R2
3.84	81	UGB R
7.2	69	EFU Fields
0.6	93	ROW
9.36	69	Undeveloped
23.4	73	Sub-Basin Total

Time of Concentration

		'n'	Length	Slope
0.36	Sheet Flow	0.15	200	0.01

		Length	Slope	Paved?
0.37	Shallow Overland	1500	0.005	n

		Length	Velocity
0.00	Length & Velocity	0	2.5

0.72	TOTAL (hours)	43	TOTAL (minutes)

Sub-Basin SC6

Area	CN	Description
0.8	81	UGB R
4	83	EFU Buildings
29.4	69	EFU Fields
0.5	93	ROW
0.2	69	Undeveloped
34.9	71	Sub-Basin Total

		'n'	Length	Slope
0.47	Sheet Flow	0.15	200	0.005

		Length	Slope	Paved?
0.61	Shallow Overland	2500	0.005	n

		Length	Velocity
0.00	Length & Velocity	0	4

1.08	TOTAL (hours)	65	TOTAL (minutes)

Mill City Storm Drain Master Plan - Snake Creek Basin
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January 2007

BASIN CHARACTERISTICS - DEVELOPED CONDITIONS - SBUH

2-yr 24 hr Rainfall 3.5 inches

Sub-Basin SC1

Area	CN	Description
10.7	77	R1
2.8	75	UGB R
8.1	95	ROW
21.6	83	Sub-Basin Total

Time of Concentration

		'n'	Length	Slope
0.21	Sheet Flow	0.15	100	0.01
		Length	Slope	Paved?
0.06	Shallow Overland	300	0.005	y
		Length	Velocity	
0.16	Length & Velocity	2300	4	
0.42	TOTAL (hours)	25	TOTAL (minutes)	

Sub-Basin SC2

Area	CN	Description
11.6	78	R1
7.6	77	UGB R
2.3	95	ROW
6	95	FUTURE ROW
27.5	83	Sub-Basin Total

		'n'	Length	Slope
0.21	Sheet Flow	0.15	100	0.01
		Length	Slope	Paved?
0.06	Shallow Overland	300	0.005	y
		Length	Velocity	
0.19	Length & Velocity	2000	2.9	
0.46	TOTAL (hours)	27	TOTAL (minutes)	

Sub-Basin SC3

Area	CN	Description
8	80	R1
12.5	77	UGB R
1.2	95	ROW
7	95	FUTURE ROW
28.7	83	Sub-Basin Total

		'n'	Length	Slope
0.21	Sheet Flow	0.15	100	0.01
		Length	Slope	Paved?
0.06	Shallow Overland	300	0.005	y
		Length	Velocity	
0.30	Length & Velocity	2600	2.4	
0.56	TOTAL (hours)	34	TOTAL (minutes)	

Sub-Basin SC4

Area	CN	Description
9.7	77	R1
2.4	80	R2
2.7	77	UGB R
2.1	95	ROW
3	95	FUTURE ROW
19.9	82	Sub-Basin Total

		'n'	Length	Slope
0.21	Sheet Flow	0.15	100	0.01
		Length	Slope	Paved?
0.06	Shallow Overland	300	0.005	y
		Length	Velocity	
0.05	Length & Velocity	700	4.3	
0.31	TOTAL (hours)	19	TOTAL (minutes)	

BASIN CHARACTERISTICS - DEVELOPED CONDITIONS - SBUH

2-yr 24 hr Rainfall 3.5 inches

Sub-Basin SC5

Area	CN	Description
5	84	R2
8	81	UGB R
7.2	69	EFU Fields
0.6	95	ROW
2.6	95	FUTURE ROW
23.4	80	Sub-Basin Total

Time of Concentration

Hours	Type			
		'n'	Length	Slope
0.36	Sheet Flow	0.15	200	0.01
		Length	Slope	Paved?
0.07	Shallow Overland	300	0.005	n
		Length	Velocity	
0.10	Length & Velocity	1500	4	
0.54	TOTAL (hours)	32	TOTAL (minutes)	

Sub-Basin SC6

Area	CN	Description
1	81	UGB R
4	83	EFU Buildings
29.4	69	EFU Fields
0.5	95	ROW
34.9	71	Sub-Basin Total

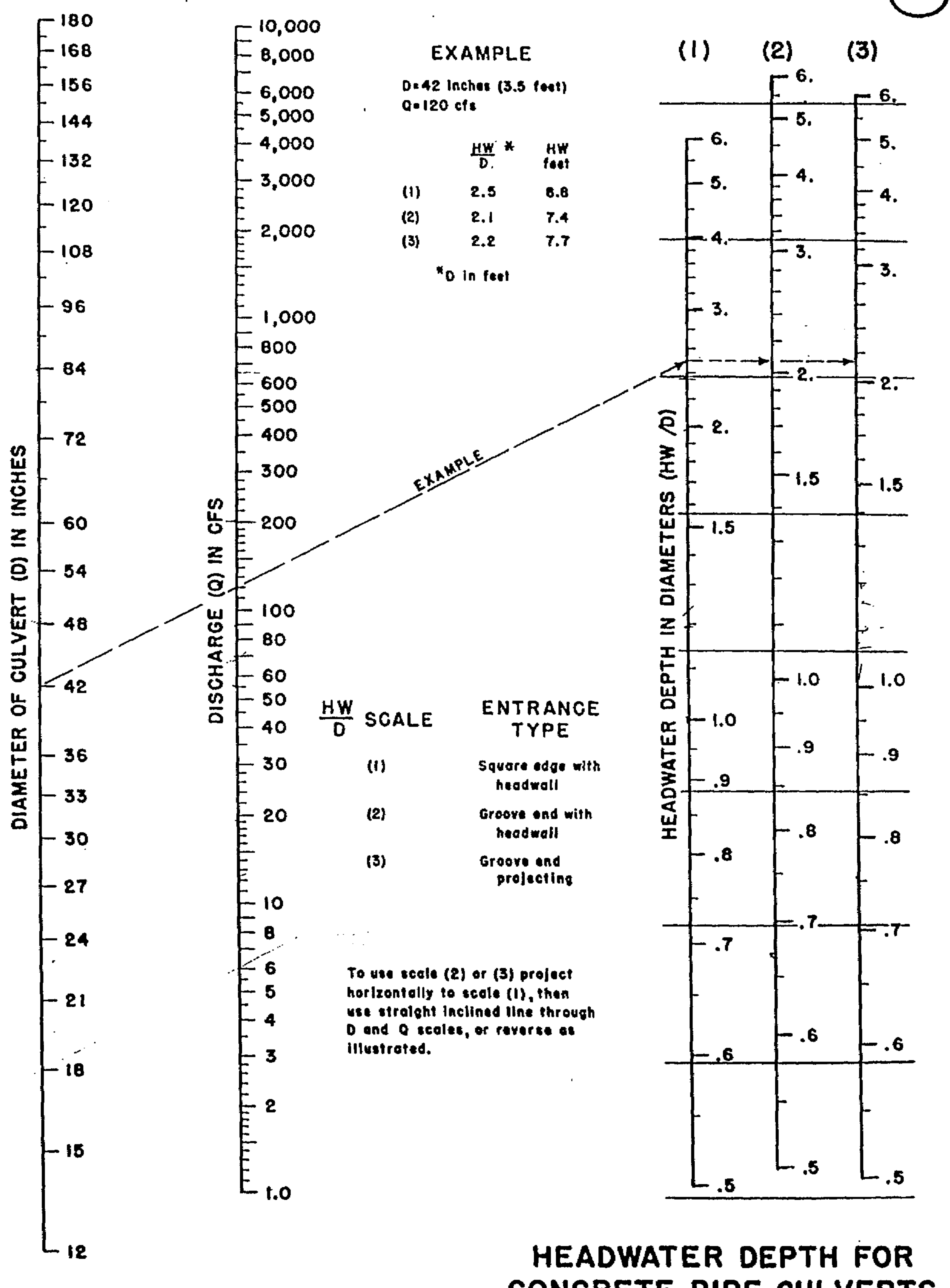
Hours	Type			
		'n'	Length	Slope
0.47	Sheet Flow	0.15	200	0.005
		Length	Slope	Paved?
0.61	Shallow Overland	2500	0.005	n
		Length	Velocity	
0.00	Length & Velocity	0	4	
1.08	TOTAL (hours)	65	TOTAL (minutes)	

CITY OF MILL CITY
Storm Drainage System Master Plan

Sample Inlet Control and Outlet Control Nomographs

Appendix D

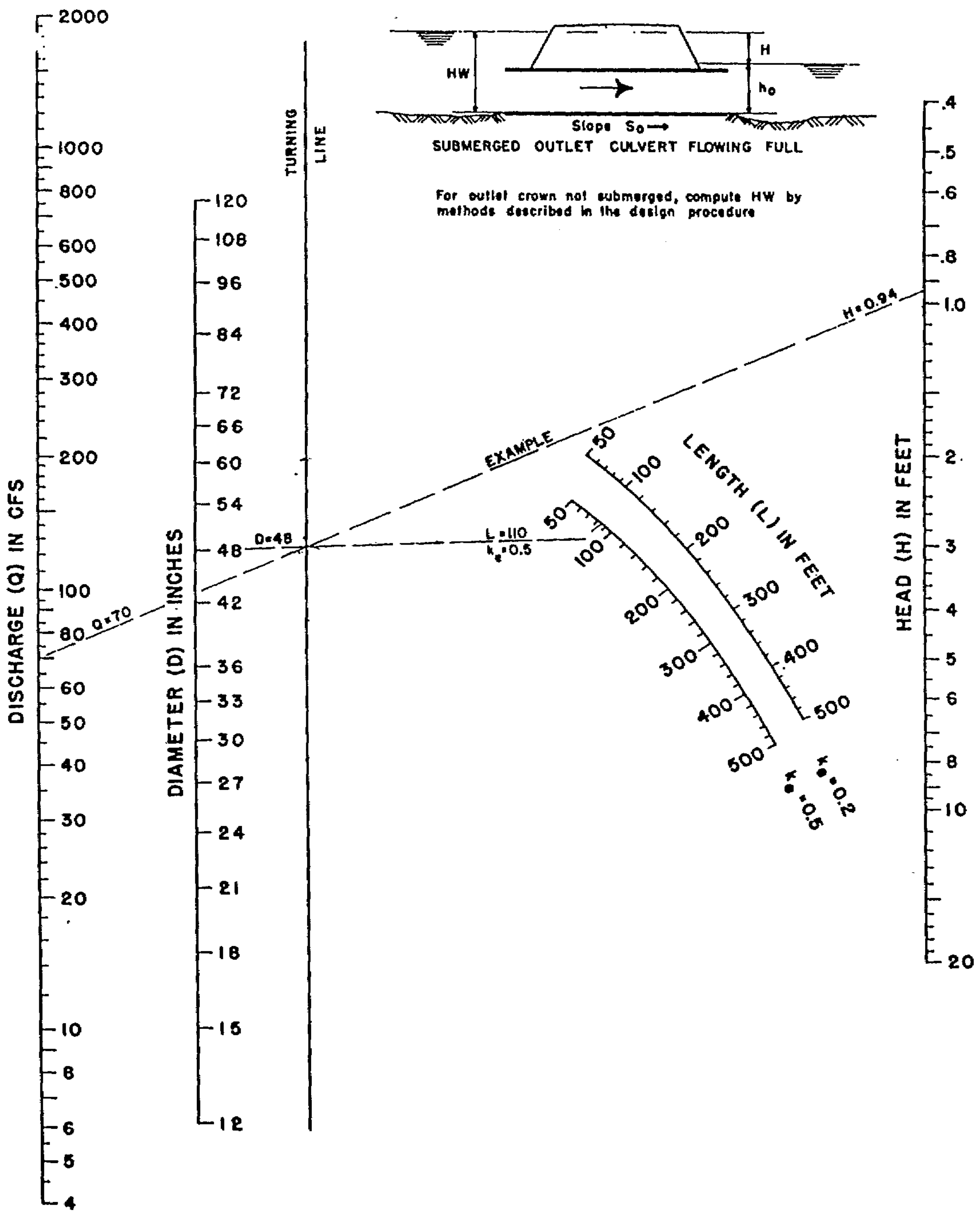
INLET CONTROL NOMOGRAPH 4.1.1



HEADWATER SCALES 2&3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963

HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL



BUREAU OF PUBLIC ROADS JAN. 1963

HEAD FOR CONCRETE PIPE CULVERTS FLOWING FULL
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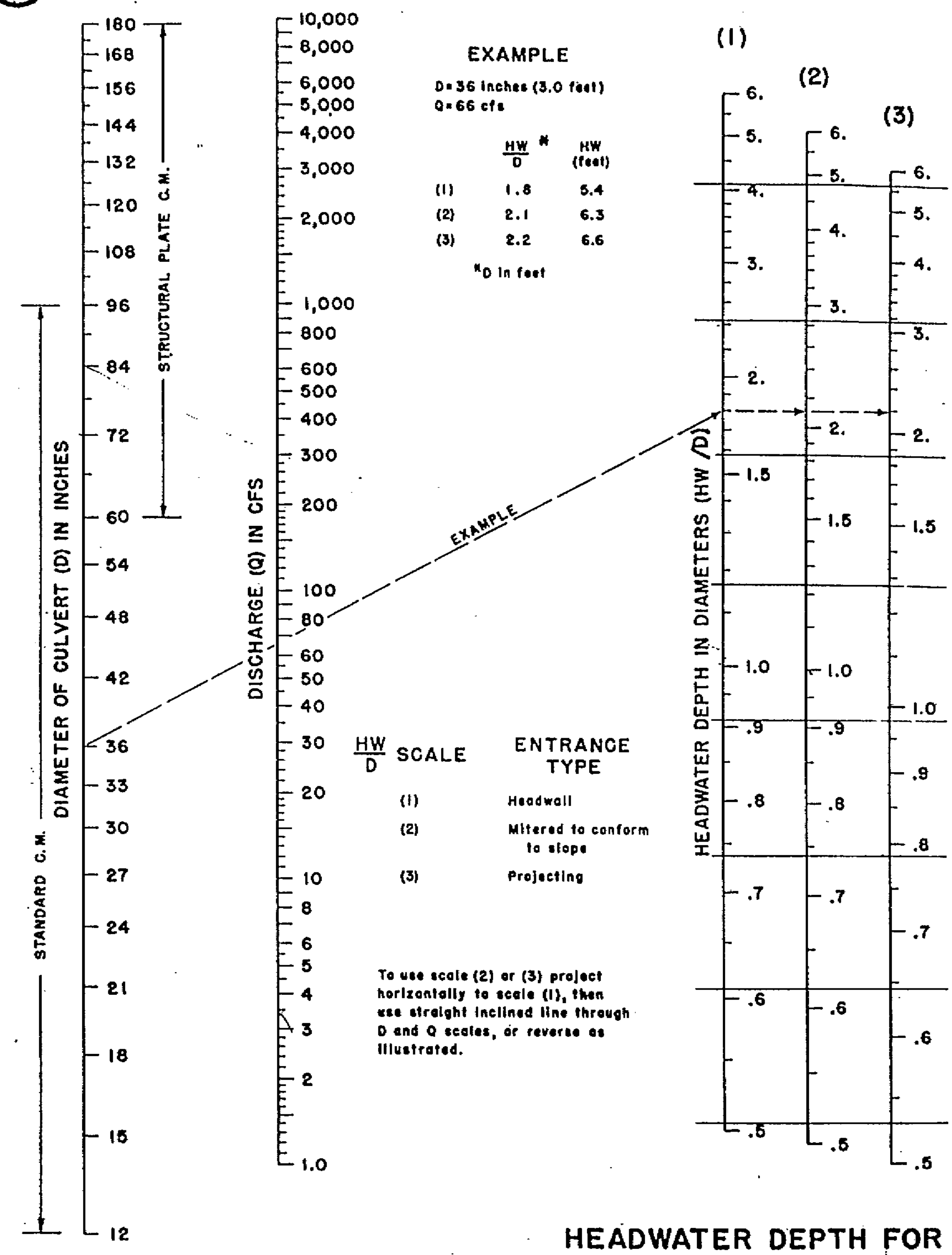
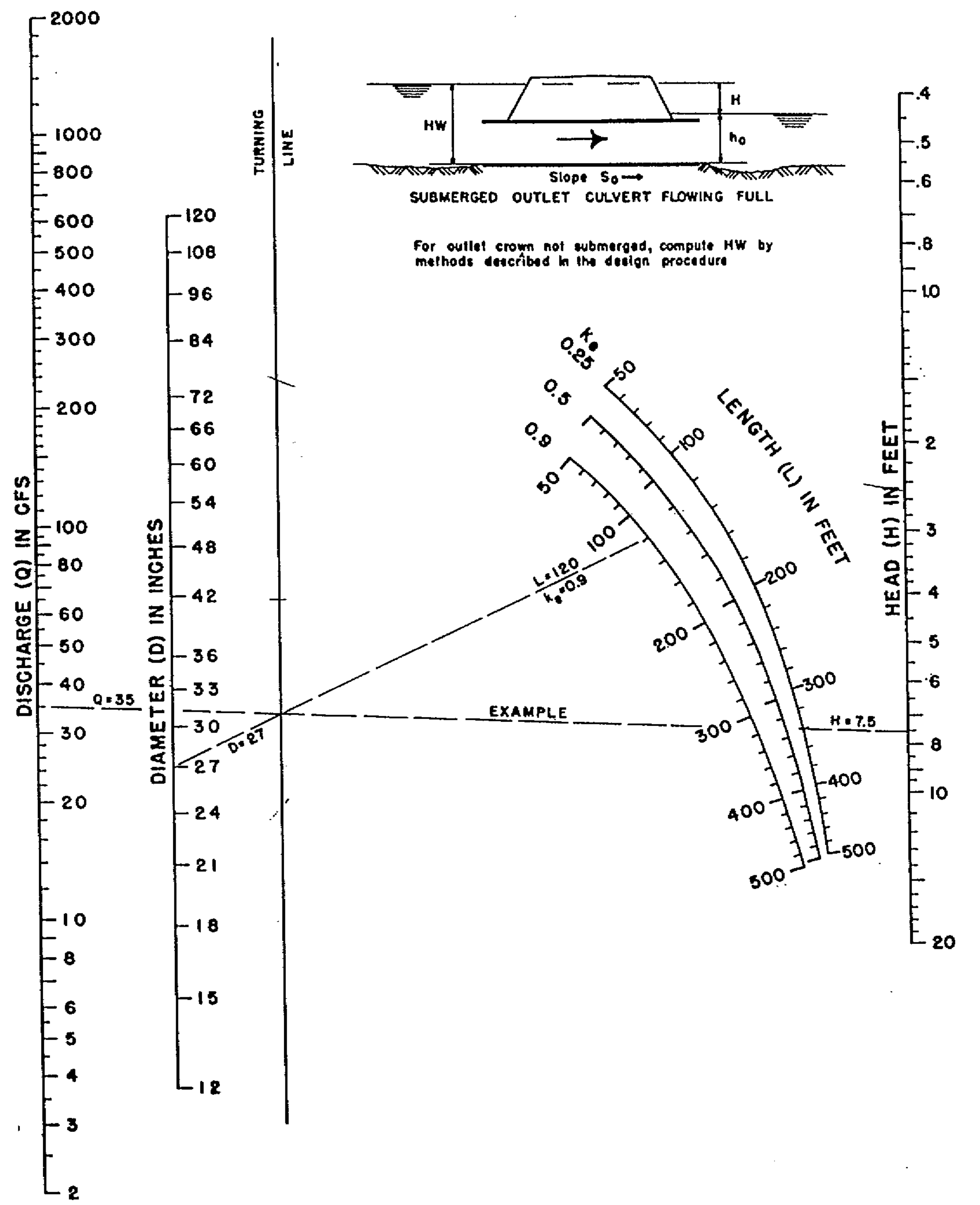
INLET CONTROL NOMOGRAPH 4.1.2



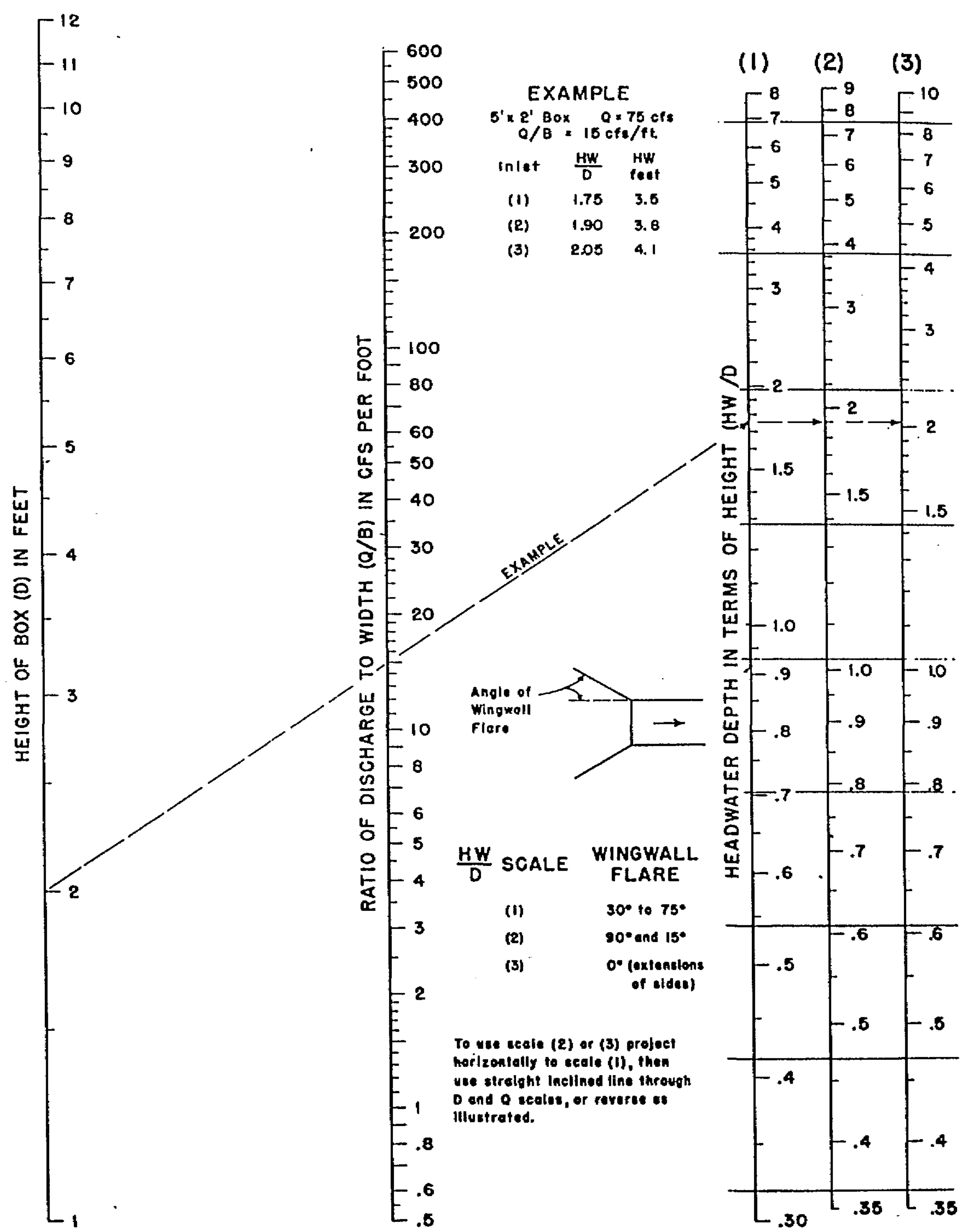
BUREAU OF PUBLIC ROADS JAN. 1963

HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL



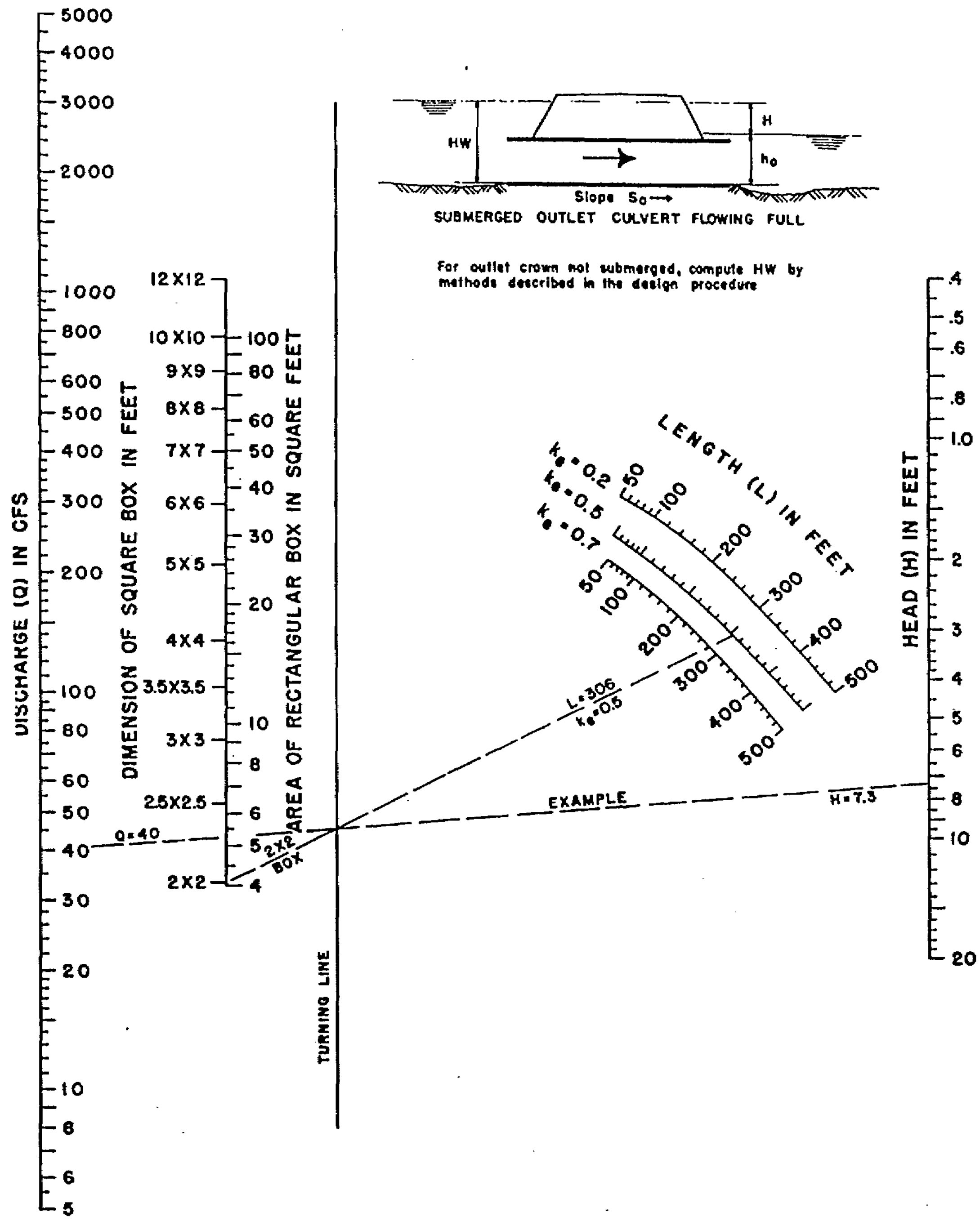
BUREAU OF PUBLIC ROADS JAN. 1963

HEAD FOR STANDARD C. M. PIPE CULVERTS FLOWING FULL $n = 0.024$



HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963



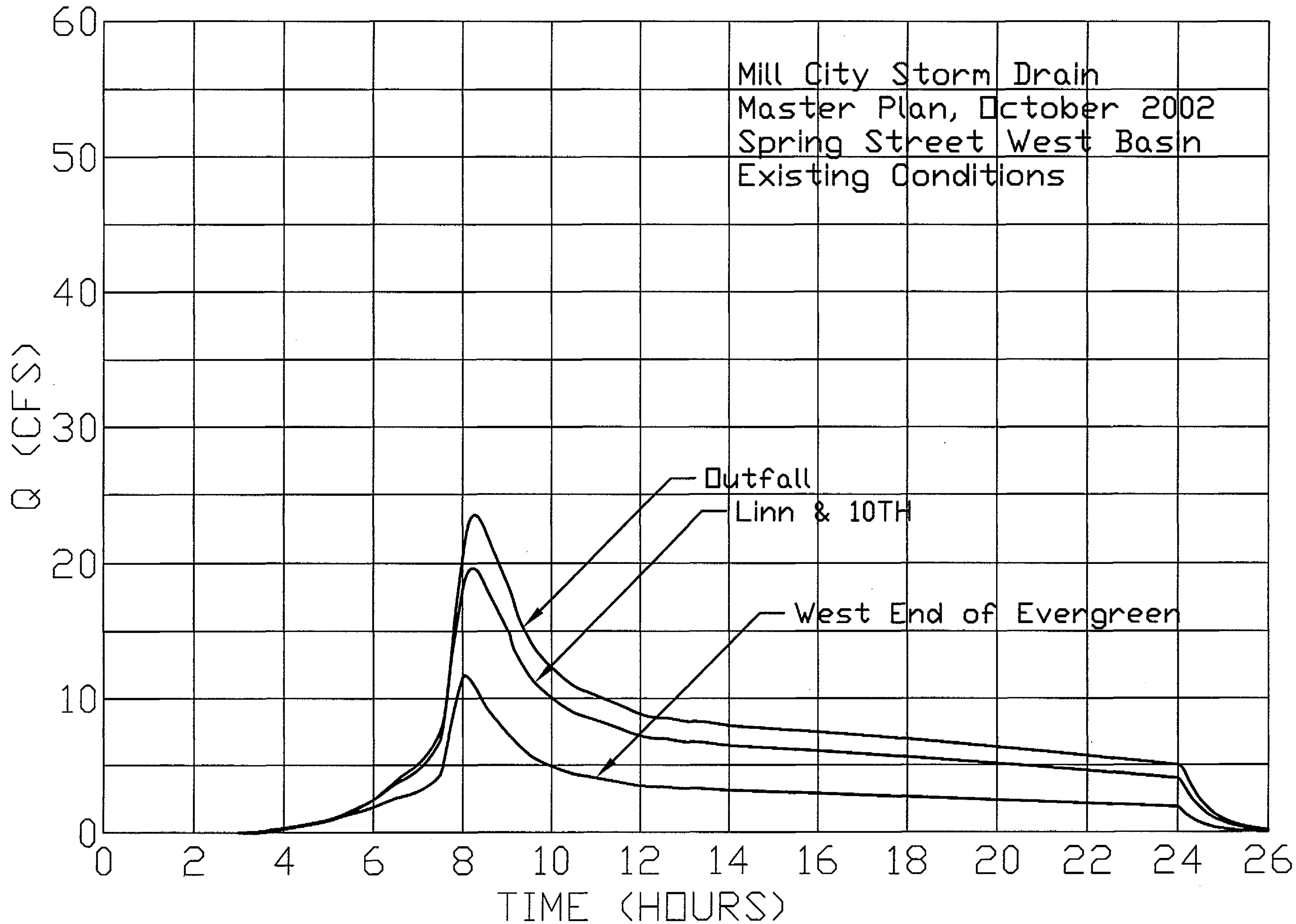
HEAD FOR
CONCRETE BOX CULVERTS
FLOWING FULL
n = 0.012

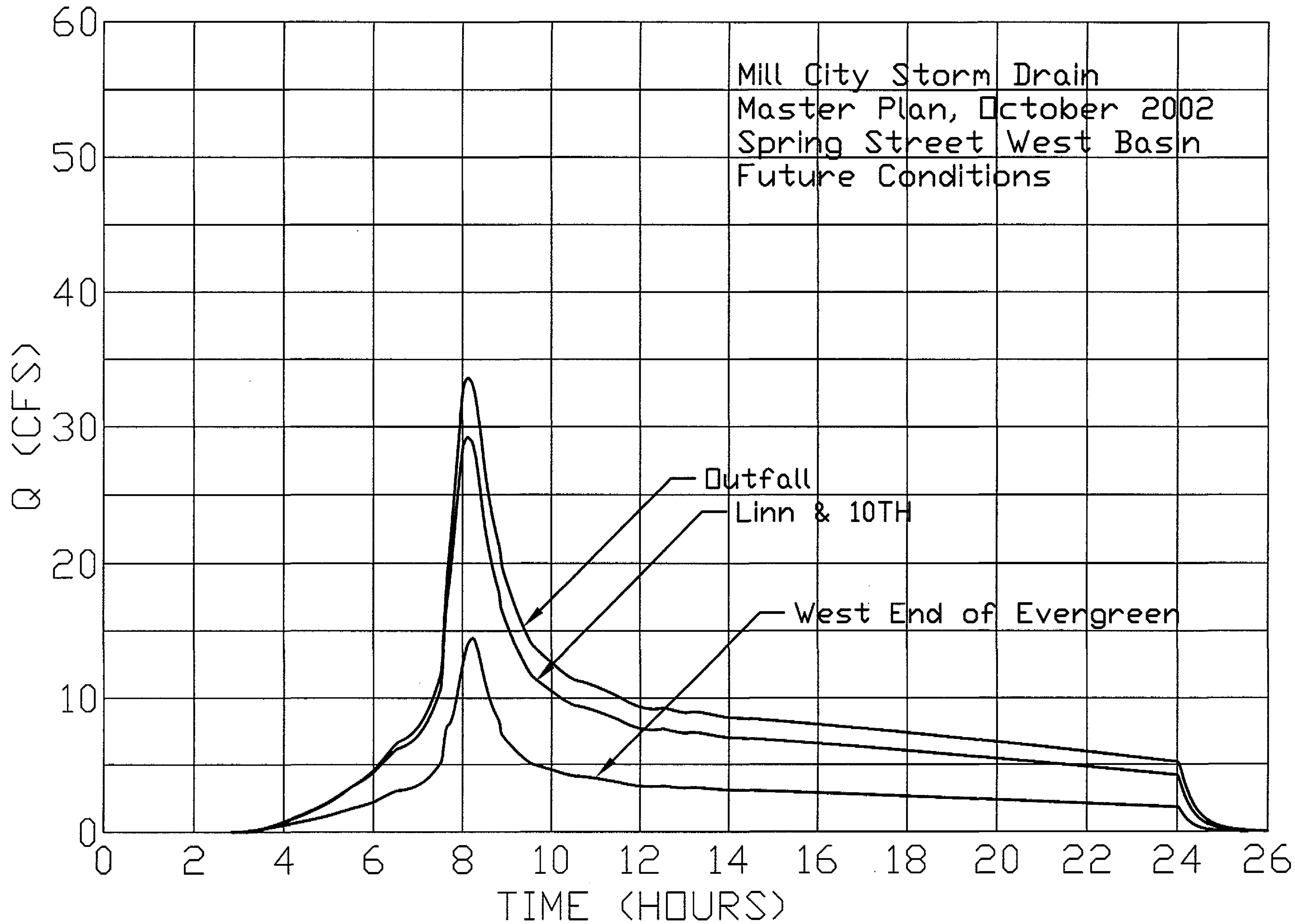
AU OF PUBLIC ROADS JAN. 1963

CITY OF MILL CITY
Storm Drainage System Master Plan

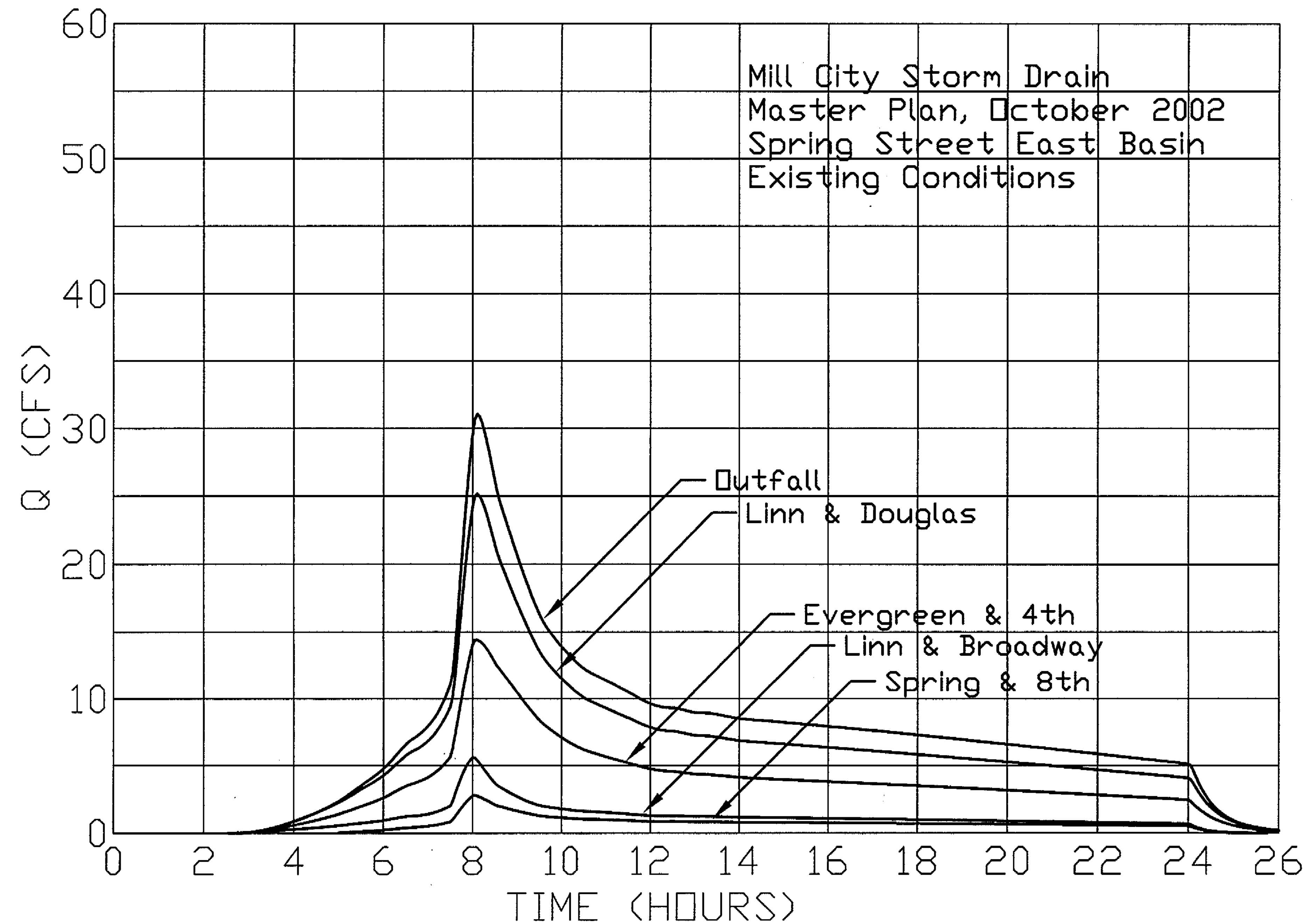
Santa Barbara Urban Hydrograph Plots

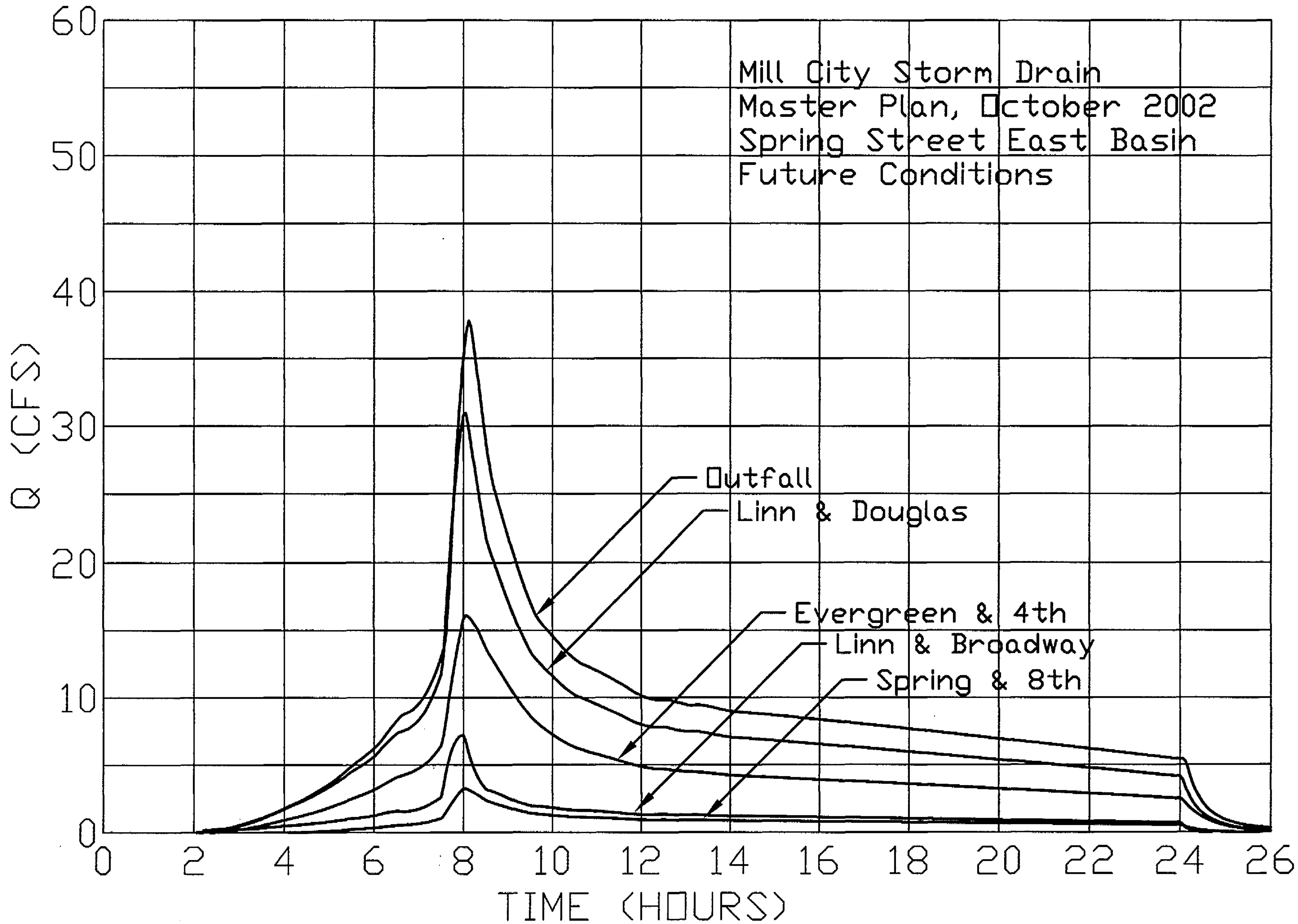
Appendix E


Mill City Storm Drain
Master Plan, October 2002
Spring Street West Basin
Existing Conditions
Outfall
Linn & 10TH
West End of Evergreen
Q (CFS)
TIME (HOURS)
0
10
20
30
40
50
60
0
2
4
6
8
10
12
14
16
18
20
22
24
26



Mill City Storm Drain
Master Plan, October 2002
Spring Street West Basin
Future Conditions
Outfall
Linn & 10TH
West End of Evergreen
Q (CFS)
0
10
20
30
40
50
60
0
2
4
6
8
10
12
14
16
18
20
22
24
26
TIME (HOURS)


Mill City Storm Drain
Master Plan, October 2002
Spring Street East Basin
Existing Conditions
Outfall
Linn & Douglas
Evergreen & 4th
Linn & Broadway
Spring & 8th
Q (CFS)
TIME (HOURS)
0
10
20
30
40
50
60
0
2
4
6
8
10
12
14
16
18
20
22
24
26



Mill City Storm Drain
Master Plan, October 2002
Spring Street East Basin
Future Conditions
Outfall
Linn & Douglas
Evergreen & 4th
Linn & Broadway
Spring & 8th
Q (CFS)
60
50
40
30
20
10
0
0
2
4
6
8
10
12
14
16
18
20
22
24
26
TIME (HOURS)

MASTER DESIGN STORM SUMMARY

Network Storm Collection: Mill City

Return Event	Total Depth in	Rainfall Type	RNF ID
10	4.5000	Synthetic Curve	TypeIA 24hr
25	5.4000	Synthetic Curve	TypeIA 24hr
50	6.0000	Synthetic Curve	TypeIA 24hr

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
1ST-MYRTLE	JCT	10	12.044		8.9000	16.45		
1ST-MYRTLE	JCT	25	16.569		8.7500	25.19		
1ST-MYRTLE	JCT	50	19.733		8.7000	31.52		
SC 1	AREA	10	4.586		8.2000	11.03		
SC 1	AREA	25	6.014		8.2000	14.91		
SC 1	AREA	50	6.991		8.2000	17.57		
SC 2	AREA	10	4.002		8.2500	8.01		
SC 2	AREA	25	5.554		8.2000	12.08		
SC 2	AREA	50	6.643		8.2000	15.00		
SC 3	AREA	10	4.177		8.4000	7.45		
SC 3	AREA	25	5.796		8.4000	11.24		
SC 3	AREA	50	6.933		8.3500	13.94		
SC 4	AREA	10	3.271		8.2000	7.19		
SC 4	AREA	25	4.456		8.2000	10.41		
SC 4	AREA	50	5.282		8.2000	12.68		

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
SC 5	AREA	10	3.697		8.3500	7.18		
SC 5	AREA	25	5.067		8.3500	10.53		
SC 5	AREA	50	6.023		8.3500	12.90		
SC 6	AREA	10	5.079		8.6500	8.05		
SC 6	AREA	25	7.048		8.6500	12.11		
SC 6	AREA	50	8.431		8.6000	15.00		
*SC OUT 1	JCT	10	4.586		8.2000	11.03		
*SC OUT 1	JCT	25	6.014		8.2000	14.91		
*SC OUT 1	JCT	50	6.991		8.2000	17.57		
*SC OUT 2	JCT	10	16.045		9.1500	19.93		
*SC OUT 2	JCT	25	22.121		8.9500	30.80		
*SC OUT 2	JCT	50	26.375		8.8500	38.71		
*SC OUT 3	JCT	10	4.177		8.4000	7.45		
*SC OUT 3	JCT	25	5.796		8.4000	11.24		
*SC OUT 3	JCT	50	6.933		8.3500	13.94		
SE 4 N	JCT	10	3.697		8.3500	7.18		
SE 4 N	JCT	25	5.067		8.3500	10.53		
SE 4 N	JCT	50	6.023		8.3500	12.90		
SE 4 S	JCT	10	5.079		8.6500	8.05		
SE 4 S	JCT	25	7.048		8.6500	12.11		
SE 4 S	JCT	50	8.431		8.6000	15.00		

MASTER DESIGN STORM SUMMARY

Network Storm Collection: Mill City

Return Event	Total Depth in	Rainfall Type	RNF ID
10	4.5000	Synthetic Curve	TypeIA 24hr
25	5.4000	Synthetic Curve	TypeIA 24hr
50	6.0000	Synthetic Curve	TypeIA 24hr

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
1ST-MYRTLE	JCT	10	4.372		8.0500	12.21		
1ST-MYRTLE	JCT	25	5.703		8.0500	16.34		
1ST-MYRTLE	JCT	50	6.612		8.0500	19.14		
HALF 2	JCT	10	4.371		8.1500	11.55		
HALF 2	JCT	25	5.703		8.1500	15.56		
HALF 2	JCT	50	6.611		8.1500	18.29		
JUNC 40	JCT	10	6.519		8.2000	16.12		
JUNC 40	JCT	25	8.462		8.2000	21.43		
JUNC 40	JCT	50	9.785		8.2000	25.03		
NODE 5	JCT	10	4.800		8.2000	11.58		
NODE 5	JCT	25	6.327		8.2000	15.78		
NODE 5	JCT	50	7.373		8.2000	18.67		
NODE 6	JCT	10	5.079		8.6500	8.05		
NODE 6	JCT	25	7.048		8.6500	12.11		
NODE 6	JCT	50	8.431		8.6000	15.00		

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
SC 1	AREA	10	4.906		8.1000	13.08		
SC 1	AREA	25	6.369		8.1000	17.38		
SC 1	AREA	50	7.365		8.1000	20.30		
SC 2	AREA	10	6.246		8.1500	16.29		
SC 2	AREA	25	8.108		8.1500	21.63		
SC 2	AREA	50	9.376		8.1000	25.25		
SC 3	AREA	10	6.519		8.2000	16.12		
SC 3	AREA	25	8.462		8.2000	21.43		
SC 3	AREA	50	9.785		8.2000	25.03		
SC 4	AREA	10	4.372		8.0500	12.21		
SC 4	AREA	25	5.703		8.0500	16.34		
SC 4	AREA	50	6.612		8.0500	19.14		
SC 5	AREA	10	4.800		8.2000	11.58		
SC 5	AREA	25	6.327		8.2000	15.78		
SC 5	AREA	50	7.373		8.2000	18.67		
SC 6	AREA	10	5.079		8.6500	8.05		
SC 6	AREA	25	7.048		8.6500	12.11		
SC 6	AREA	50	8.431		8.6000	15.00		
*SC OUT 1	JCT	10	4.906		8.1000	13.08		
*SC OUT 1	JCT	25	6.369		8.1000	17.38		
*SC OUT 1	JCT	50	7.365		8.1000	20.30		
*SC OUT 2	JCT	10	17.136		8.2000	43.44		
*SC OUT 2	JCT	25	22.273		8.1500	57.97		
*SC OUT 2	JCT	50	25.773		8.1500	67.90		
*SC OUT 5	JCT	10	4.800		8.2000	11.54		
*SC OUT 5	JCT	25	6.327		8.2000	15.75		
*SC OUT 5	JCT	50	7.373		8.2000	18.64		

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
*SC OUT 6	JCT	10	5.079		8.7000	8.01		
*SC OUT 6	JCT	25	7.048		8.6500	12.07		
*SC OUT 6	JCT	50	8.431		8.6500	14.97		

Sample (Draft) Stormwater Utility Ordinance

Appendix F

SAMPLE ONLY (DRAFT)

ORDINANCE NO. ________________

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

WHEREAS, the City Council of the City of Halsey (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 HALSEY, OREGON DOES HEREBY ORDAIN AS FOLLOWS:

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

CHAPTER_______________

STORM WATER 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 tights 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 HALSEY Municipal Code, as follows:

Chapter _____________ 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

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Mill City, OR 97360

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