City of North Plains

Stormwater Master Plan

Prepared for:

City of North Plains
31360 NW Commercial Street
North Plains, OR 97133-0537

Prepared by:

David Evans and Associates, Inc.
2828 SW Corbett Avenue
Portland, OR 97201

Rev 5.0

January 9, 2002

City of North Plains

Stormwater Master Plan

Prepared for:

City of North Plains
31360 NW Commercial Street
North Plains, OR 97133-0537

Prepared by:

David Evans and Associates, Inc.
2828 SW Corbett Avenue
Portland, OR 97201

Rev 5.0

January 9, 2002

This Stormwater Master Plan was funded, in part, by a grant from the Oregon Economic and Community Development Department
Project No. A98003

Table of Contents

SPECIAL ACKNOWLEDGEMENTS

David Evans and Associates, Inc. appreciates the assistance and support of the City of North Plains staff during preparation of this comprehensive Stormwater Master Plan.

City of North Plains Council Members

Mr. Henry Drexel	Mayor
Mr. Robert Kindel, Jr.	Council Person
Mr. Herbert L. Hirst	Council Person
Mr. David Hatcher	Council Person
Ms. Cheri Olson	Council Person
Ms. Ann Stearns	Council Person
Ms. Canda Anderson	Council Person

City of North Plains Staff

Don Otterman	City Manager
Karen-Lee Stolte	Finance Director
Blake Boyles	Public Works Director

David Evans and Associates, Inc. Project Team

Don Whitehead, P.E.	Project Manager
John Garlitz, P.E.	Professional Staff
Richard Attanasio, P.E.	Professional Staff
Garnetta Crabtree	Project Assistant

CHAPTER 1: EXECUTIVE SUMMARY

1.1 Introduction

The City of North Plains has experienced rapid growth during the past several years, and it is anticipated that this growth will continue. This Stormwater Master Plan was prepared to assist the City in planning and providing for the infrastructure and financing necessary to accommodate management of the City's stormwater systems for existing and future residents and businesses.

Standards for stormwater conveyance, detention, and water quality are established and regulated by the Clean Water Service (CWS) in a district that includes the City of North Plains. The City has adopted CWS's Design and Construction Standards as the City's standard for all stormwater facilities within the City's Urban Growth Boundary (UGB). All future storm system improvements, public and private, must comply with the CWS standards. As part of the City's Periodic Review this master plan was revised and updated in November 2001.

1.2 Study Area

The study focused on providing service to the existing UGB as it was defined in January 2000. When the original study was prepared, several growth options were under consideration by the City Council that proposed to expand the UGB beyond its current definition. When the original master plan was adopted, the City had not formally adopted or supported any of the growth options under consideration. As part of the Periodic Review process, the City's Comprehensive Plan has been modified to identify expansion areas to the North and the East of the current UGB. The expansions represent total additional areas of 84 acres and 80 acres respectively. The UGB plus the expansion areas define the Study Area for this revised Stormwater Master Plan.

Although the focus of proposed improvements is limited to the Study Area, it is important to recognize that storm sewer design and drainage analyses are also impacted by land outside of the Study Area. Both McKay Creek and the UnNamed Tributary are significant drainage ways with tributary basins and ultimate discharges outside of the UGB and City Limits. However, projections included in the study for changes in population and land use are only assumed to occur within the Study Area. No projections are made for population growth or land use changes in areas outside the Study Area.

1.3 Planning Period

A 20-year planning period was adopted when preparing projections and estimates for this report. If population and land use growth occur within the assumptions identified in this report, and the City constructs the recommended improvements to accommodate this growth, residents and businesses should experience a high level of service through the year 2021. Current CWS standards prohibit new developments from discharging runoff flows that exceed downstream capacity in the receiving stream, unless the development improves the downstream facility to eliminate the deficiency. In some instances it may be necessary to develop on-site detention facilities to insure that runoff from new development does not exceed that associated with pre-development conditions. Therefore, even if additional areas are annexed into the city's UGB or land use changes occur outside the UGB, the facilities proposed in this document will be able to accommodate the associated flows if on-site detention requirements are applied.

1.4 Population and Land Use Projections

Prior to 1980, the population of North Plains increased at a historical average rate of 3% a year. During the period from 1990 to 2000, the City experienced a growth rate of 5.2% compounded annually, growing from a population of 972 to 1,605. The City has coordinated with Washington County, Metro, and the Department of Land Conservation and Development to select a growth rate of 4.5% annually for the next 20 years.

Commercial and industrial zoned land within the UGB represent a total of 44.2 and 152.7 net acres, respectively. Of these net acreages, there are approximately 17.5 acres remaining for commercial development and 71.2 acres remaining for industrial development. The industrially zoned land east of Glencoe Road (East LID) consists of approximately 75 acres with recently constructed storm sewer improvements that were designed and built to 1996 CWS standards. The proposed expansion areas to the north and east will provide additional commercial areas of 3.0 acres and 4.8 acres respectively. The proposed expansion areas will also provide additional gross developable acreages of 12.6 acres, 20.6 acres and 11.0 acres for Institutional, Municipal Parks and Elementary School development respectively.

1.5 Existing Storm Sewer and Drainage Facilities

McKay Creek and the UnNamed Tributary to McKay Creek dominate the existing storm sewer and drainage system. Both of these streams provide significant drainage capacity, but also experience flood elevations that affect drainage, and floodplains that impact adjacent properties. The magnitude and extent of the flood plains and floodways are well established by the Federal Emergency Management Agency (FEMA) and are documented in FEMA flood plain maps and studies for the City of North Plains.

The existing storm drainage system in the City is predominantly comprised of ditches, roadside ditches, and culverts. The system consists of a collection of improvements that have been installed, or have evolved, over time to address specific problems. There have been a limited number of publicly funded projects in recent years that were designed for existing drainage facilities to accommodate flows associated with a 25-year storm event. Similarly, there are a limited number of detention or treatment facilities that have been constructed, in accordance with CWS requirements.

Recent private developments and the East Industrial LID have been designed and constructed to CWS standards. However, lacking a citywide or basin-wide Stormwater Master Plan, private development improvements are largely limited to their properties, with a minimum amount of improvement to off-site facilities. Without a Master Plan, the off-site improvements have tended to consist of ditching, and with some replacement of downstream culverts, to an extent that additional localized flooding is not exacerbated. Such improvement efforts, however, stop short of providing significant value to basin-wide drainage.

Undersized culverts and ditches create some localized flooding during heavy precipitation. This is due to the fact that many of the ditches use 12-inch diameter culverts along their entire length to convey water under driveways. A 12-inch diameter culvert is adequate for basins in the range of one or two city blocks, but inadequate to serve a larger service area or the lower reaches of a drainage basin. Additionally, most of the City's ditches are not large enough to accommodate peak flows up to and including a 25-year storm event. Maintenance of roadside ditches is problematic, and it is common for properties with drainage ditches along their road frontage to fill the ditches with yard debris and soil.

A second area of local flooding is inherent to the existing culverts and bridges in McKay Creek and the UnNamed Tributary. In particular, the UnNamed Tributary has several culverts that restrict flow and create backwater flooding. This pattern of flooding is well established and documented in the FEMA Floodplain/Floodway maps and studies. The creeks and the associated culverts fall under the jurisdiction of Washington County. As such, improvements to the stream and structures will be subject to the authority of Washington County.

Flooding in the upper reaches of the UnNamed Tributary is the result of numerous culvert and hydraulic restrictions inherent to the stream channel. Solving or significantly reducing the impact of flooding in these areas will require a comprehensive program, which addresses all hydraulic components of the stream. Improvements to the culverts located in the UnNamed Tributary of McKay Creek or to the creek's physical features that might be necessary to reduce or eliminate the impacts of flooding to adjacent properties, should only be implemented after a comprehensive hydraulic study and detailed HEC-RAS model is completed for the creek.

1.6 Proposed Improvements

The improvements proposed for the city's stormwater drainage and storm sewer system fall into two general categories:

- Those aimed at relieving specific existing problems, and
- A comprehensive citywide system to provide all properties with piped storm sewers designed and constructed to City and CWS standards.

1.6.1 Existing Storm Drainage Problems

Existing problem areas identified in this report are limited to those areas that experience frequent high water or poor drainage due to undersized or improperly constructed public improvements. In many instances these are undersized culverts or structures, or storm sewer facilities that are constructed at grades and alignments that cause surcharging during intense storm events. Improvements to public facilities to eliminate or improve drainage or reduce flooding have been identified and estimated costs provided. Priority for these improvements shall be given to projects where it is demonstrated that damage to, or the potential for damage to property and structures exists. The balance of the projects can only be completed as funds become available. The determination of which projects to undertake and the scheduling of the design and construction of the projects shall be made by the City of North Plains.

This master plan and the recommended improvements do not provide solutions to all drainage problems on private property within the Study Area. Unless poor drainage is the result of inadequate public drainage facilities, this type of improvement remains the responsibility of individual property owners.

Improvements to the culverts and other restrictions associated with the UnNamed Tributary to McKay Creek have not been identified as improvements that are recommended to be undertaken by the City of North Plains. As noted above, improvements to the conveyance of flow in the UnNamed Tributary to McKay Creek (and to McKay Creek), fall under the jurisdiction of Washington County.

1.6.2 Proposed City-wide Storm Sewer System

A proposed system of storm sewers including significant structures has been identified. The system identified in this report is conceptual and based on appropriate but limited topographic information, and hydraulic modeling. The alignments and pipe sizes identified are preliminary. Additional topographic surveying and preliminary design analysis should be completed before selecting final alignments and pipe diameters. However, the information contained, and the associated cost estimates, are sufficient to provide budget numbers necessary for planning for the financing, design and construction of the recommended improvements.

The City of North Plains city council has implemented a policy for incorporation of curbs, gutters, and storm sewers into all future street improvement projects. The improvements recommended in this Master Plan are consistent with that policy; the proposed improvements are closed pipe systems. However, the City recognizes that other types of drainage systems (such as open drainage ways or ditches) can offer water quality and aesthetic benefits that might not be realized with a closed storm system. Where appropriate and hydraulically feasible, such alternative systems will be acceptable to the City, provided the hydraulic capacity of the proposed systems is equal to the closed systems proposed herein. Final approval and acceptance of stormwater system improvement projects within the City of North Plains will be made by CWS, in accordance with CWS standards.

The priority for implementation of stormwater system improvements is dependent on:

- The nature of the development that occurs within the UGB, and
- The availability of funds necessary for the design and construction of the projects.

It is not possible, at this level of conceptual design, to predict the timing and sequence of development within the UGB necessary to mandate the sequence of implementation.

1.7 Financing

The technical concerns and issues associated with a citywide storm sewer system can be addressed relatively easily. A more difficult challenge is to obtain the financing necessary to construct the improvements in an efficient manner. It is not typical for communities to agree to commit to the public indebtedness sufficient for a massive capital improvement project to construct a citywide system of storm sewers. More than likely, the system will be constructed in smaller pieces over a long period of time, with financing obtained through a combination of Systems Development Charges (SDCs), private development, and local improvement districts.

The assessment and collection of SDCs is a complex topic that must be both fair and justified. The City has retained an independent financial consultant specializing in this subject, who will prepare a separate report after adoption of this Stormwater Master Plan.

CHAPTER 2: INTRODUCTION

2.1 Purpose

The purpose of this Stormwater Master Plan is to provide guidance for planning and implementing improvements to stormwater facilities within the City of North Plains. The Plan should be used to direct both the City and private developers as they plan for and design improved stormwater management facilities within the City's Urban Growth Boundary (UGB), and within the proposed north and east expansion areas. The objective of this Plan is to establish a long-range program that will enable the City to meet their current and future management needs, as they relate to conveyance, detention, treatment, and disposal of stormwater runoff.

The following tasks were completed and are presented as part of the study:

- A qualitative assessment, inventory and evaluation of the City's existing stormwater system has been conducted.
- Public input was solicited through a series of meetings and public hearings.
- Hydrologic and hydraulic models were applied to the study area to predict run off flows for existing and future residential, commercial, and industrial developments within the current UGB.
- System improvements were identified for locations within the existing city-owned stormwater system that have a lack of hydraulic capacity sufficient for current conditions.
- Recommended upgrades have been proposed for existing stormwater conveyance facilities to meet City and CWS standards.
- A comprehensive citywide storm sewer system was identified to meet current and future needs.
- A Capital Improvements Plan, identifying costs and priorities, was completed for the recommended improvements.

In completing the above tasks, consideration was given to the impact of potential expansions of the current UGB and to compliance with current and potential future water quality guidelines and requirements in accordance with the regulations of the Clean Water Service (CWS) and the Tualatin River Basin. However, sizing of pipes assumes development will occur only within the current UGB and the proposed north and east expansion areas. The configuration of proposed improvements should allow for service to areas outside of the UGB and Expansion Areas, however, detention for development outside of the UGB will likely be required.

2.2 Planning Scope

The study focuses on stormwater facilities and services to be provided within the City of North Plain's current UGB, as it was defined in January 2000, and the proposed north and east expansion areas. At the time of the original study preparation, several growth options were under consideration by the City Council that proposed to expand the UGB beyond its current definition. However, the City had not formally adopted or supported any of the growth options under consideration, as of November 10, 2000. The City is in the process of Periodic Review and seeks to incorporate the north and east expansion areas into the UGB. This proposed expansion would provide an additional 164 acres of gross developable land.

Location and vicinity maps for the City of North Plains are shown on Figure 2.1. The planning area, as defined by the City Limits, UGB, and the North and South Expansion Areas are shown in Figure 2.2.

Development and land use growth projections included in this study were made for areas within the City's current UGB and the north and east expansion areas. Land use and drainage basin developments will eventually occur outside of the current UGB and Expansion Areas, and may impact the streams and other stormwater and surface water facilities within the City. However, no projections for such growth and expansion beyond the UGB and Expansion Areas were made for the 20-year study period. The technical analysis conducted included consideration of all tributary lands based on their current land use definitions.

This Master Plan is not intended to resolve all storm drainage problems that exist, or may exist, within the planning area. It does not provide for storm drainage facilities that will resolve localized drainage problems on individual tax lots within the city. It does, however, provide for a basic framework of storm sewer conveyance pipes from which lateral storm sewers can be extended to serve individual lots.

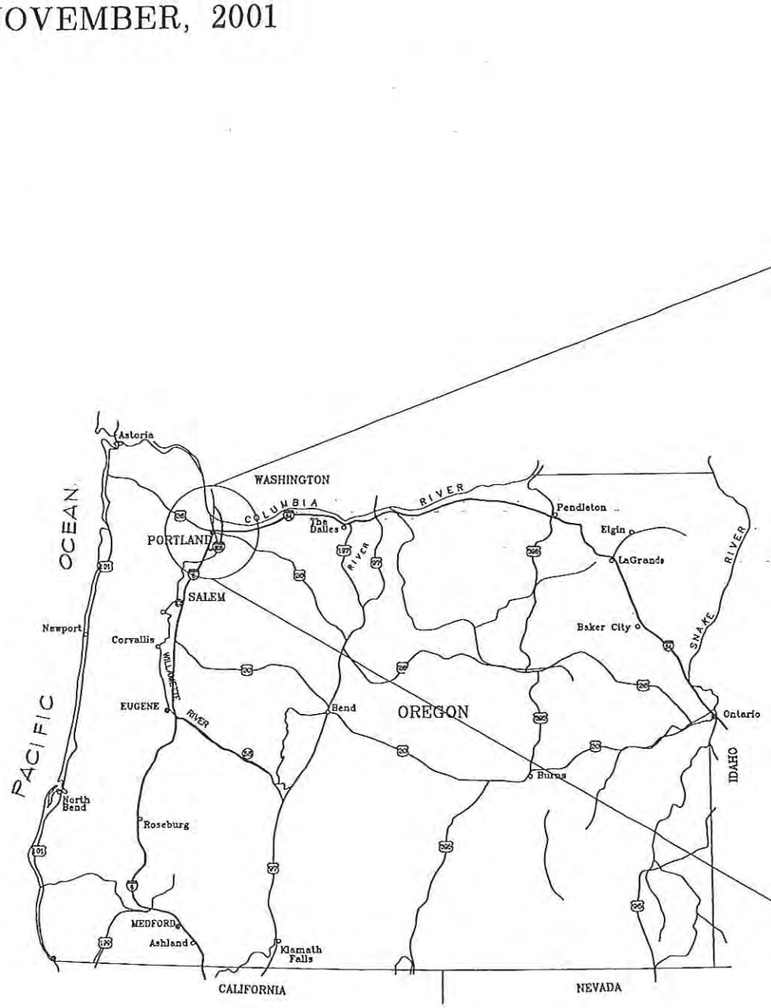
Storm drainage projects are traditionally difficult to finance. Chapter 9 of this Master Plan discusses some alternatives that are available for funding the improvements that have been recommended in this document. Unlike many other public works projects, there is very little funding assistance available through state or federal programs. In addition, local support is usually minimal unless problems are serious and obvious. Often the owners of property impacted by poor drainage represent a minority of the area's voters and landowners.

Drainage facilities do not, in most cases, have constant use. And when used, they generally operate at much less than full capacity. The capacity of the facilities, however, must be designed to provide conveyance for peak discharges that may occur infrequently (such as the 25-year rainfall event). The cost for construction of such facilities can be viewed as quite high, and it can be difficult to devise a revenue-generating plan for storm drainage projects that is viewed by the community as equitable and related directly to individuals benefits.

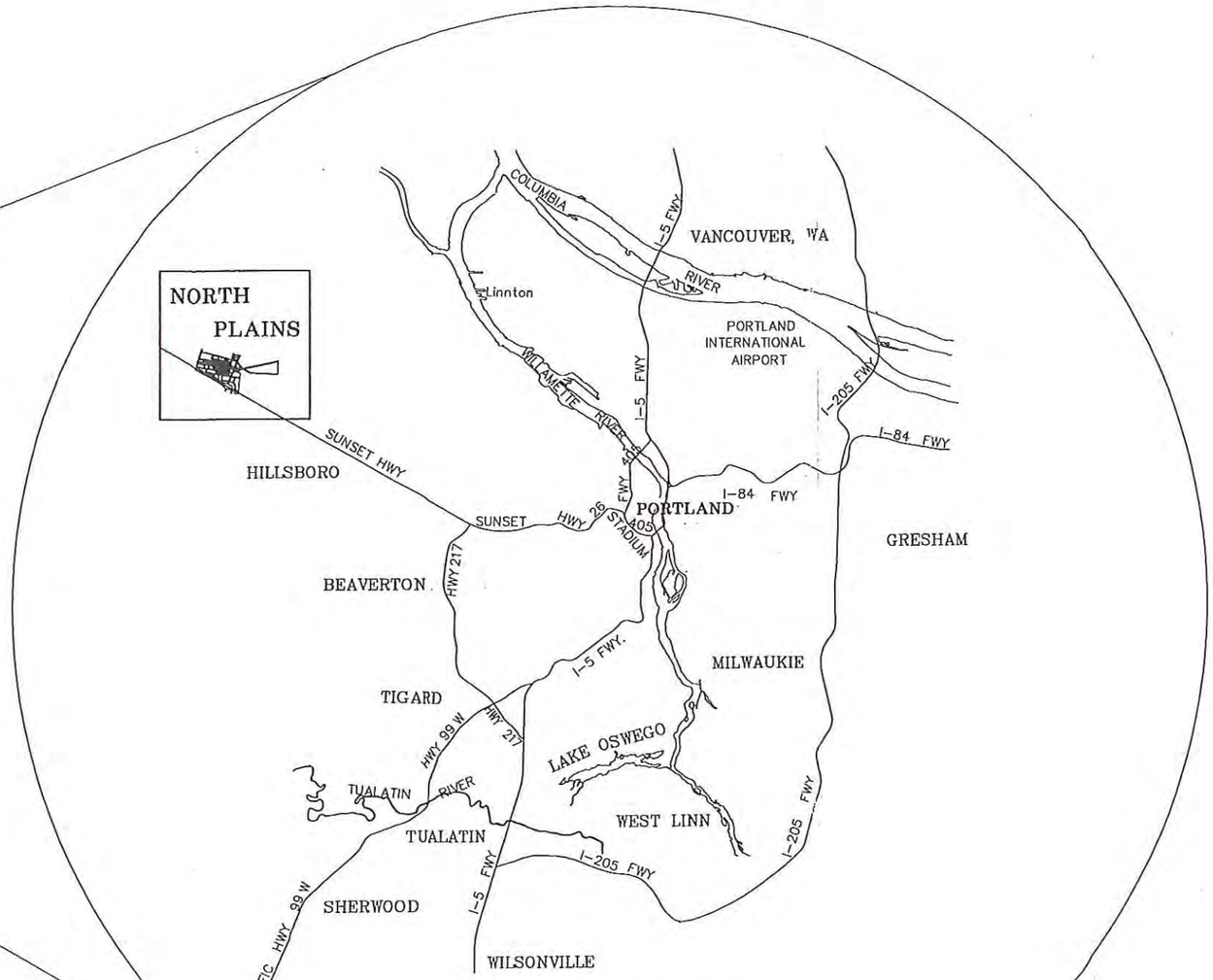
The proposed storm drainage facilities and improvements outlined in this plan reflect the City's policy that all developed urban property within the study area will eventually be served by storm sewers. Actual enforcement of this policy is not easily implemented because it is subject to the desires and needs of all affected property owners. Potential mechanisms for implementing a policy of citywide storm sewers can occur through a combination of: private development, city funded capital improvement projects, or basin specific Local Improvement Districts. A more detailed financial analysis of the proposed improvements, and alternatives for financing these improvements is to be provided in a separate document to be completed by Mr. Ray Bartlett of Financial and Economic Analysis.

City of North Plains, Oregon

STORM WATER MASTER PLAN
NOVEMBER, 2001



STATE OF OREGON
NOT TO SCALE



CITY OF NORTH PLAINS VICINITY MAP
NOT TO SCALE

FIGURE 2.1

CITY OF NORTH PLAINS
STORM WATER MASTER PLAN
LOCATION AND VICINITY MAPS

DAVID EVANS AND ASSOCIATES, INC
2828 S.W. CORBETT AVENUE
PORTLAND, OR. 97201-4830
(503) 223-6663

NO.	REVISIONS	APP'D.

SHEET OF SHEETS
SCALE: NOT TO SCALE
DESIGN: SCE
DATE: 11/12/01
DRAWN: WNH
PROJECT: NP2K0011
CHECKED: DMW
FILE NAME: Fig2-1.DWG

CITY OF NORTH PLAINS

UNNAMED TRIBUTARY TO MCKAY CREEK

PROPOSED NORTH EXPANSION AREA

URBAN GROWTH BOUNDARY
AND CITY LIMITS

EXPANSION AREA

EXPANSION AREA

MCKAY CREEK

PROPOSED EAST EXPANSION AREA

URBAN GROWTH BOUNDARY
AND CITY LIMITS

NW GORDON ROAD
NW NORTH AVE.
NW TUMERIC ST.
NW MAIN ST.
NW LENOX STREET
NW WASCOE STREET
NW HILLCREST ST.
NW 319TH AVE.
NW 309TH ST.
NW YORKSHIRE ST.
NW TUREL DR.
NW BROOKING ST.
NW SHADYBROOK RD
TIDEVIEW ESTATES
S.P. & S. RAILROAD
NW OLD WEST UNION RD
NW WEST UNION ROAD
NW COMMERCIAL STREET
NW 324TH AVE.
NW 322ND AVE.
NW 321ST AVE.
NW 318TH AVE.
NW KAYBERN ST.
NW 313TH AVE.
NW 311TH AVE.
NW 309TH ST.
NW COTTAGE ST.
NW CLAXTAR ST.
NW PACIFIC ST.
NW GLENCOE ROAD
NW 314TH AVE.
OAK HEIGHTS PARK
NW HIGHLAND COURT
NW 307TH AVE.
SUNSET HIGHWAY (OR HIGHWAY 26)

NORTH

NOT TO SCALE

LEGEND

- EXISTING CITY LIMITS AND URBAN GROWTH BOUNDARY
- PROPOSED EXPANSION AREAS

NOTE :
PLANNING AREA INCORPORATED CURRENT URBAN GROWTH BOUNDARY, CITY LIMITS AND PROPOSED EXPANSION AREA

FIGURE 2.2

CITY OF NORTH PLAINS
STORM WATER MASTER PLAN
PLANNING AREA

DAVID EVANS
AND ASSOCIATES, INC
2828 S.W. CORBETT AVENUE
PORTLAND, OR 97201-4830 (503) 223-6663

NO.	REVISIONS	APP'D.

SHEETS OF

SCALE: NOT TO SCALE
DESIGN: DAW
DATE: 11/12/01
DRAWN: WNH
PROJECT#: NPX0011
CHECKED: DAW
FILE NAME: FIG2-2.DWG

The storm drainage plan is both general and flexible in nature. The locations for and specific design details of proposed drainage facilities should be considered preliminary. Final locations and design specifics will depend upon the availability of right-of-ways or easements, the existence of other underground utilities, more detailed topographic information, and the nature of the actual development proposed for a basin. Final designs for new drainage facilities should be determined as part of detailed studies and topographic surveys conducted for specific development projects.

2.3 Authorization

The City of North Plains has experienced relatively rapid growth during the last 10 years, continued growth will impact the current drainage facilities that are already experiencing hydraulic deficiencies in some specific locations. As a first step toward addressing drainage problems in an orderly and comprehensive manner, the City of North Plains authorized David Evans and Associates, Inc, (DEA) to prepare this Stormwater Master Plan on August 3, 1998. In November 2001, DEA revised this Stormwater Master Plan to reflect to areas and specific land uses associated with the proposed north and east expansion areas of the UGB.

2.4 Organization of the Master Plan

The purpose of this Stormwater Master Plan is to provide guidance for implementing improvements to the city's stormwater facilities, which can be implemented as development and land use changes occur within the current UGB and proposed Expansion Areas. Toward those ends, the plan is organized in the following sequence:

- Presentation of the City's Drainage Basins and Their Characteristics
- Discussion of the City's Existing Stormwater Facilities
- Explanation of Land Use and Projected Population Growth
- Presentation of Analytical Methodology
- Modeling Results
- Proposed Stormwater Improvements
- Financing Options
- Stormwater Capital Improvement Plan

CHAPTER 3: DRAINAGE BASINS AND CHARACTERISTICS

3.1 Introduction

This chapter presents an overview of the regional and local basins that impact stormwater drainage within the City of North Plains. The City of North Plains is located within the McKay Creek Watershed, which is part of the Tualatin River Watershed. Most of the city drains to a sub-basin of McKay Creek referred to as the UnNamed Tributary to McKay Creek. The confluence of this tributary and McKay Creek is located on the southeast corner of the city.

3.2 Drainage Basins

3.2.1 Tualatin River Watershed

The City of North Plains is located within the Tualatin River Watershed. The Tualatin River Watershed covers an area of about 712 square miles; it is about 43 miles long and 29 miles wide. The Tualatin River is the northernmost tributary within the Willamette River Watershed, and discharges into the Willamette River at river mile 28.5 in West Linn, Oregon. Eight major tributaries flow into the Tualatin River: Wapato Creek, Scoggins Creek, Gales Creek, Dairy Creek, Rock Creek, McFee Creek, Chicken Creek, and Fanno Creek. Over 1.1 million acre-feet of water flow from the watershed into the Willamette River annually. The majority of this volume is generated during November through March. Less than 3% discharges during June through October. Hillsboro is the closest weather station to the City of North Plains with historic precipitation data, and it reports an annual average precipitation 38.01 inches (based on data collected from 1948 to 1988).

The Tualatin River Watershed has significant water quality regulations that are applied to surface water runoff in the basin. The Oregon Department of Environmental Quality (DEQ) listed the Tualatin River as water-quality limited in 1984 and 1986, due to low dissolved oxygen concentrations and excessive algae growth. In 1988, as a result of these listings, total maximum daily loads (TMDLs) were established for ammonia, nitrogen, and total phosphorus for the Tualatin River and its major tributaries. By June 1993 the ammonia-nitrogen TMDLs were met, and an extended implementation and compliance schedule had been developed and approved for the total phosphorus TMDL. A more detailed discussion related to water quality for the Tualatin River basin is presented in Section 3.5.

3.2.2 McKay Creek

McKay Creek originates about nine miles north of the City of North Plains at an approximate elevation of 1,630 feet. It meanders in a southerly route until its final discharge into Dairy Creek about five miles south of the City of North Plains at the east end of the City of Hillsboro, at an approximate elevation of 140 feet. The watershed covers about 43,520 acres, with about 26,000 acres (or 60% of the watershed) located above the City of North Plains.

CITY OF NORTH PLAINS

UNNAMED TRIBUTARY TO MCKAY CREEK

PROPOSED NORTH EXPANSION AREA

EXPANSION AREA

EXPANSION AREA

PROPOSED EAST EXPANSION AREA

MCKAY CREEK

BASIN 18
43 ACRES

BASIN 19
16 ACRES

BASIN 20
79 ACRES

BASIN 1
20 ACRES

BASIN 2
6.5 ACRES

BASIN 3
20 ACRES

BASIN 4
90 ACRES

BASIN 5
29 ACRES

BASIN 6
75 ACRES

BASIN 7
8 ACRES

BASIN 8
45 ACRES

BASIN 9
64 ACRES

BASIN 10
12 ACRES

BASIN 11
19 ACRES

BASIN 12
9 ACRES

BASIN 13
28 ACRES

BASIN 14
28 ACRES

BASIN 15
8.5 ACRES

BASIN 16
13 ACRES

BASIN 17
90 ACRES

BASIN 21
8 ACRES

BASIN EAST 1
75 ACRES

NW BERKSHIRE ST.
NW FLAREL DR.
NW BROOKING CT.
NW SPRAGUE CREEK RD.
S.P. & S. RAILROAD
NW WEST UNION ROAD
NW GORDON ROAD
NW JUNERIC
NW MAIN ST.
NW LENOX STREET
NW WASCOE STREET
NW HILLCREST ST.
NW 305TH ST.
NW COMMERCIAL STREET
NW 324TH AVE.
NW 321ST AVE.
NW 318TH AVE.
NW 313TH AVE.
NW 309TH ST.
NW LEAHY ST.
NW COTTAGE ST.
NW CLEVELAND ST.
NW PACIFIC ST.
NW CLENCO ROAD
NW HIGHLAND COURT
NW 314TH AVE.
NW DOG CREEK
SUNSET HIGHWAY
(OR HIGHWAY 26)

LEGEND

PROPOSED EXPANSION AREAS

NOTE:
BASINS 18, 19, 20, AND 21 REPRESENT FLOWS THAT ORIGINATE OUTSIDE THE CITY'S URBAN GROWTH BOUNDARY. ARROWS SHOWN INDICATE APPROXIMATE AREA WHERE BASINS DISCHARGE TO CITY SYSTEM, AND DO NOT NECESSARILY REPRESENT SPECIFIC DRAINAGE FACILITIES.

NORTH

NOT TO SCALE

FIGURE 3.1

CITY OF NORTH PLAINS
STORM WATER MASTER PLAN
CITY DRAINAGE BASINS

DAVID EVANS AND ASSOCIATES, INC
2828 S.W. CORBETT AVENUE
PORTLAND, OR. 97201-4830
(503) 223-6663

NO.	REVISIONS	APPD.

SHEET OF SHEETS

SCALE: NOT TO SCALE
DESIGN: DMW
DATE: 11/12/01
DRAWN: WNH
PROJECT: NPX00011
CHECKED: DMW
FILE NAME: FIG3-1.DWG

Several smaller creeks are tributary to McKay Creek. One of these tributaries, called the UnNamed Tributary to McKay Creek, crosses through the City of North Plains. The watershed for the UnNamed Tributary totals about 1,450 acres, which is only about 6% of the total area of the McKay Creek watershed above the City of North Plains.

Backwater from McKay Creek influences the hydraulics of the UnNamed Tributary to McKay Creek, especially in the Creek's lower reaches. This influence is discussed in more detail in Section 3.2.4.

3.2.3 City of North Plains Drainage Basins

Storm water runoff generated within the City of North Plains discharges directly to both McKay Creek and to the UnNamed Tributary to McKay Creek. About 34% of the City's area generate runoff that discharges directly into McKay Creek; the majority of that area is located east of NW Glencoe Road. The balance of the runoff from the city UGB discharges directly into the UnNamed Tributary to McKay Creek. Figure 3.1 shows a delineation of the major drainage basins within the City's UGB.

Four sub-basins of the UnNamed Tributary to McKay Creek generate stormwater runoff that must be conveyed through the City's stormwater conveyance system prior to discharge to the UnNamed Tributary. Three of these sub-basins are located north of the City (Basins 18, 19, and 20 on Figure 3.1). The basins are currently undeveloped and/or used for agricultural purposes, but future development of these lands is a possibility. For purposes of this study, these basins have been assumed to remain as they are currently developed.

3.2.4 FEMA Flood Plains

The Federal Emergency Management Agency (FEMA) conducts detailed Flood Insurance Studies (FIS) for urbanized areas throughout the United States. These studies are used to predict areas that are subject to inundation by 100-year flood events, and form the background for production of Flood Insurance Rate Maps (FIRMs), which show the areas predicted to be impacted from such events. The maps are not intended to provide detailed predictions for flooding, but do provide general predictions of areas that are likely to be impacted from floods.

The FIRM and FIS prepared for the City of North Plains (referenced as Community Number 410270 by FEMA) were originally completed in July 1980. They were revised in March 1989 with new field data that was collected for the UnNamed Tributary to McKay Creek in November 1987. Figure 3.2 shows the area that is predicted to be impacted from the 100-year flood event within the City of North Plains, according to FEMA's most recent (1989) study. The FIS modeled hydraulics for the UnNamed Tributary and McKay Creek for 10-year, 50-year, 100-year, and 500-year flood elevations. During preparation of this Stormwater Management Plan, an interpolation of the FIS data was made to also predict the 25-year flood elevations.

Field inspections conducted as part of this study indicate that a few of the culverts in the UnNamed Tributary to McKay Creek are not accurately modeled in the most recent FEMA/FIS hydraulic model of the creek. The inconsistencies between the model and the actual creek conditions, however, do not appear to significantly change the overall conclusions that can be inferred from the study results.

To assist with analysis and review of the FIRM and FIS, DEA obtained from FEMA a copy of the HEC-II model used to hydraulically model the UnNamed Tributary. The model was subsequently reviewed using HEC-RAS.

Several conclusions have been drawn from the results of the hydraulic study prepared by FEMA for the UnNamed Tributary to McKay Creek. In addition to a review of the model produced by FEMA as part of the preparation of this Master Plan, the FIS model was altered to remove all culverts located within the City limits. This additional modeling exercise, which was completed by DEA, was conducted to determine how the backwater from McKay Creek can impact the hydraulics of the UnNamed Tributary in the absence of influences from manmade creek restrictions (i.e., culverts). The conclusions drawn from the FIS review are summarized below.

- **Backwater Impacts from McKay Creek:** Backwater from McKay Creek has a significant impact on the hydraulics of the UnNamed Tributary to McKay Creek. The influence from McKay Creek's backwater extends from the confluence of the two creeks to various locations upstream, depending on the flood event studied. For the 10-year and 50-year flood events, the backwater from McKay Creek extends to the creek's crossing of Pacific Avenue. For the 100-year event, the backwater appears to extend above the crossing of Pacific Avenue. When the hydraulic model was altered to remove the culvert crossings, the backwater influence for the 25-year and 100-year events extended to the creek's crossing of 314th Street approximately 500-feet downstream from Pacific Street. Although larger culverts in the lower portions of the creek will reduce the back water some, McKay Creek remains the dominating influence.

- **Culvert Crossing at Glencoe Road:** The 60-inch culvert conveying the UnNamed Tributary beneath Glencoe Road appears to be slightly undersized for the flows at the crossing. However, the capacity of the culvert is hydraulically limited by the backwater impacts from McKay Creek. It is possible that the 60-inch culvert is adequately sized to convey the flows for the flood events used in the model if no backwater effects were present. Although the backwater impacts from McKay Creek extend upstream of the crossing, it can be seen from the water surface elevations on either side of the culvert that a slight flow restriction is also evident. When the model was run without the culvert restrictions, the water surface elevation just upstream of the crossing was lowered. This limited analysis appears to indicate that the 25-year and 100-year flood events that are predicted to overtop 314th Street could potentially be eliminated if the size of the Glencoe Road culvert were increased, even though the backwater impacts from McKay Creek will still remain. A much more detailed study of the creek's hydraulics, using updated field data, will be required before such a modification could be proposed. A downstream analysis of the creek will also be required. Such an analysis is beyond the scope of this Master Plan study.

- **Commercial Street:** Water surface elevations and topography obtained for the modeled flood events indicate that Commercial Street's pavement surface is a relative low spot along the route of the UnNamed Tributary. When the hydraulic model was run with the creek culverts removed, Commercial Street is still predicted to be overtopped during the 25-year and 100-year flood events.

- **Culvert Crossing of Railroad Embankment:** The culvert crossing beneath the railroad embankment creates a flow restriction and backwater condition that impacts the creek to City Limits (Gordon Road). It also appears that the ponding that has occurred over the years from the backwater impacts of the railroad crossing has led to an accumulation of sediment in the creek bottom. This sediment has exacerbated the flooding problems by further restricting flow through the area. It is possible that removal of sediment from the creek to redefine the natural channel and lower the creek profile might eliminate some of the backwater ponding. Such

an undertaking should not be conducted without increasing the size of the culvert crossing the railroad embankment, or the removal would be only a temporary fix. A much more detailed and comprehensive study of the creek's hydraulics, using updated field data, is required before such modifications could be proposed. A downstream analysis of the creek will also be necessary. Such an analysis is beyond the scope of this Master Plan study.

- **Gordon Road:** Gordon Road is predicted to be overtopped by all the flood events studied, even when the model was run with all the culvert restrictions removed. It is likely that making modifications to the railroad crossing and addressing channel restrictions and lowering the grade of the channel as noted above will improve the situation at Gordon Road, and thereby eliminate or reduce the frequency of the overtopping. However, a more detailed and comprehensive study of the creek's hydraulics is necessary before such a conclusion can be reached. Such an analysis is beyond the scope of this Master Plan study.

3.3 Topography and Soils

The study area has relatively moderate changes in grade with elevations varying between 210 feet at the north end of the city, to 160 feet at the southeast side of the city. Slopes vary between 0 and 7% with the greatest slopes occurring in the northeast corner of the town and along the creek corridors.

The majority of soils found in the study area are comprised of the Woodburn and Willamette associations, which are moderately well-drained and well-drained soils, respectively, that formed in old alluvium on low, broad valley terraces. The soils are silt loams with moderate to slow permeability, with better drainage occurring in soils at higher elevations within the terraces. The Woodburn series is classified by the Soil Classification system as a Type C soil. The Willamette series is a Type B soil.

Soils found along the creek and natural drainage corridors are comprised of silty clay loams of the Aloha, Amity, and Verboort series. These soils are found along the drainage corridors both within the city and in the upper watershed reaches. They are poorly drained soils that formed on stratified, fine and moderately fine textured alluvium on bottomlands. The corridor of the UnNamed Tributary to McKay Creek contains Verboort series soils, which have a Type D SCS classification. The Aloha and Amity soils are located along the natural drainages to the UnNamed Tributary, and have Type C SCS classifications.

The eastern half of the area incorporated in the city as the East Local Improvement District (LID) has soils that are classified as Dayton silt loam, which is a poorly drained silt loam. The soil is found on nearly level or concave areas, and has a Type D SCS soil classification. Figure 3.3 shows areas of differing soil types within the city limits of North Plains, and summarizes the classification, based on the SCS system. The categories and associated abbreviations are summarized in Table 3.1.

CITY OF NORTH PLAINS

UNNAMED TRIBUTARY TO MCKAY CREEK

MCKAY CREEK

NW NORTH AVE.
NW TIMERLO ST.
NW MAIN ST.
NW LENOX STREET
RIDGEVIEW ESTATES
NW 309TH ST.
NW YORKSHIRE ST.
NW TUREL DR.
NW BROOKHAVEN CT.
NW SHUTTERBROOK RD
NW RIDGEVIEW CT.
S.P. & S. RAILROAD
NW GORDON ROAD
NW WASCOE STREET
NW HILLCREST ST.
NW 319TH AVE.
NW COMMERCIAL STREET
NW WEST UNION ROAD
NW 324TH AVE.
NW 322ND AVE.
NW 318TH AVE.
NW 313TH AVE.
NW 311TH AVE.
NW 309TH ST.
NW KAYBERN ST.
NW COTTAGE ST.
NW CLAXTAR ST.
NW PACIFIC ST.
NW 314TH PL.
NW 312TH AVE.
NW GLENCOE ROAD
OAKHEAD PARK
NW HIGHLAND COURT
SUNSET HIGHWAY (OR HIGHWAY 26)

LEGEND

APPROXIMATE LOCATION OF THE 100 YEAR FLOOD PLAIN DEFINED BY THE FLOOD INSURANCE STUDY:

CITY OF NORTH PLAINS, OREGON
WASHINGTON COUNTY
FEDERAL EMERGENCY MANAGMENT AGENCY
REVISED: MARCH 16, 1989

NOTE: FLOOD BOUNDARIES SHOWN ON THIS MAP ARE APPROXIMATE AND SHOULD NOT BE USED FOR FINAL DESIGN AND LAND USE PLANNING

NORTH

NOT TO SCALE

FIGURE 3.2

CITY OF NORTH PLAINS
STORM WATER MASTER PLAN
FEMA DEFINED FLOOD PLAIN

DAVID EVANS AND ASSOCIATES, INC
2828 S.W. CORBETT AVENUE
PORTLAND, OR. 97201-4830 (503) 223-6663

REVISIONS	APP'D.

CITY OF STREETS
SCALE: NOT TO SCALE
DATE: 11/12/01
PROJECT: NPXX0011
FILE NAME: FIG3-2.DWG
DESIGN: DMW
DRAWN: WNH
CHECKED: DMW

CITY OF NORTH PLAINS

SOIL CLASSIFICATIONS TABLE

NBR	SOIL NAME	SCS SOIL TYPE
1	ALOHA SILT LOAM	C
2	AMITY SILT LOAM	C
15	DAYTON SILT LOAM	D
30	MCBEE SILT LOAM	B
42	VERBOOT SILTY CLAY LOAM	D
43	WAPATO SILTY CLAY LOAM	D
44A	WILLAMETTE SILT LOAM 0 TO 3% SLOPES	B
44B	WILLAMETTE SILT LOAM 3 TO 7% SLOPES	B
45A	WOODBURN SILT LOAM 0 TO 3% SLOPES	C
45B	WOODBURN SILT LOAM 3 TO 7% SLOPES	C

SEE TABLE 3.1 FOR A DESCRIPTION OF THESE SOIL TYPES

NORTH

NOT TO SCALE

FIGURE 3.3

CITY OF NORTH PLAINS
STORM WATER MASTER PLAN
SCS SOIL CLASSIFICATIONS

DAVID EVANS AND ASSOCIATES, INC.
2828 S.W. CORBETT AVENUE
PORTLAND, OR. 97201-4830 (503) 223-6663

REVISIONS	APP'D.

OF SHEETS
SCALE: NOT TO SCALE DESIGN: DMW
DATE: 11/12/01 DRAWN: WKH
PROJECT: NPX0011 CHECKED: DMW
FILE NAME: Fig3-3.DWG

NPX0011 sec 11/10/00 13t622 see D:\work\Fig3-3.dwg

Table 3.1

Soil Classifications in Study Area

Soil Map Symbol	Soil Name	Hydrologic Group	Drainage	Grassed Waterways
1	Aloha Silt Loam	C	Wetness, percs slowly	Wetness, percs slowly
2	Amity Silt Loam	C	Wetness	Wetness, percs slowly
15	Dayton Silt Loam	D	Wetness, percs slowly, poor outlets	Wetness, percs slowly
30	McBee Silt Loam	B	Floods, wetness	Wetness
42	Verboort Silty Clay Loam	D	Floods, wetness, percs slowly	Wetness, percs slowly
43	Wapato Silty Clay Loam	D	Wetness, floods, percs slowly	Wetness, percs slowly
44A	Willamette Silt Loam 0 to 3% slopes	B	Favorable	Favorable
44B	Willamette Silt Loam 3 to 7% slopes	B	Slope	Slope, erodes easily
45A	Woodburn Silt Loam 0 to 3% slopes	C	Wetness, percs slowly	Wetness, percs slowly
45B	Woodburn Silt Loam 3 to 7% slopes	C	Wetness, percs slowly, slope	Wetness, percs slowly

Information contained in this table is taken from the U.S. Department of Agriculture Soil Conservation Service, Soil Survey of Washington County issued July 1982.

3.4 Aquatic Habitat

The Oregon Department of Fish and Wildlife (ODFW) has conducted surveys of several creeks in the Tualatin River Watershed to identify those that are fish bearing streams. Both McKay Creek and the UnNamed Tributary to McKay Creek have been identified as fish bearing. According to the ODFW, game fish that are present in these creeks may include cutthroat trout, lamprey, steelhead trout, and coho salmon. Other aquatic species present may include the western toad, red-legged frog, painted turtle, and the western pond turtle.

The National Marine Fisheries Service (NMFS) recently issued its proposed Endangered Species Act (ESA) 4 (d) rules for the conservation of the seven threatened steelhead evolutionarily significant units (ESU) and the seven threatened salmon ESUs (Geographically this covers the bulk of SW Washington and Oregon west of the Cascades). The steelhead rules will come into effect the summer of 2000. The purpose of the ESA is to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, and to provide a program for the conservation of such endangered species and threatened species.

Within the ESA, Section 9 lays out prohibited acts in connection with endangered animals and plants. Section 9 prohibitions apply to private as well as public property, and apply regardless of whether critical habitat is involved. Section 11 outlines civil and criminal penalties for "take" actions in violation of Section 9. A "take" is defined as an act that "takes" critical habitat from an endangered or threatened animal or plant.

Section 10 provides exceptions from Section 9 whereby a "take" is authorized for those that are incidental to an otherwise lawful activity. Incidental "take" permits may be issued after the landowner develops and submits a habitat conservation plan (HCP).

Section 7 mandates that each federal agency must insure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat. This insurance is reached through consultations with FWS and NMFS as appropriate. Federal funding for roads or sewers or the requirement for a federal permit triggers the ESA, even though the project may managed locally.

3.5 Water Quality

3.5.1 Tualatin Basin Existing Total Maximum Daily Loads

The Tualatin River basin has Total Maximum Daily Loads (TMDLs) allocated for phosphorus and ammonia. In addition, temperature, bacteria, dissolved oxygen and biological communities are identified on the Department of Environmental Quality's 303(d) list as "water quality limiting" parameters that threaten beneficial uses in the watershed. Potential future TMDLs for the Tualatin Basin includes temperature and suspended solids.

3.5.2 CWS's Stormwater Management

The Clean Water Service (CWS) is a Special District charged with surface water management within a large region that includes the City of North Plains. An Inter-Governmental Agreement dated June 26, 1990, between the City and CWS defines the responsibilities each has for the storm facilities within the City limits. In accordance with the IGA, the City is responsible for a street sweeping program and an open channel maintenance program. Per Section 3 of the IGA, CWS is responsible for "installation, construction, operation, maintenance, repair, replacement; processing of permit applications; inspection of connections; billing, collection, accounting and the financing thereof, of all publicly owned storm and surface water facilities" in the City (excluding the two programs for which the City is responsible). CWS will provide review and approval of plans and specifications for all publicly owned storm and surface water system improvements that are proposed for construction within the City.

CWS's stormwater management policies are intended to reduce and minimize impacts to water quality, aquatic communities, and floodplains by requiring stormwater treatment, urban hydrology management, sensitive area protection, and vegetated corridor preservation and enhancement.

Currently, CWS requires all new development to include water quality treatment for stormwater runoff and buffers on sensitive areas. The goal of water quality treatment facilities is to remove 65-percent of phosphorus prior to discharge to receiving waters.

In December 1999 and in February 2000, CWS revised their regulations related to water quality buffers, referred to as vegetative corridors that border sensitive areas. The purpose of the buffers is to prevent or reduce adverse impacts to the water resources of the Tualatin River Basin. In combination with other state, federal, and local laws and ordinances, the requirements are intended to protect the beneficial uses of waters within the Tualatin River Basin and within the Clean Water Service district.

Under the revised regulations, the vegetated corridor shall range from 15 to 200 feet wide, measured horizontally, from the defined boundaries of the sensitive area. For perennial streams or wetlands greater than 0.5 acres, the typical vegetative corridor is 50 feet wide. If the area adjacent to the sensitive area exceeds a 25-percent slope, the vegetative corridor can be extended to up to 200 feet. The size and shape of the buffer can be adjusted through "Corridor Averaging", "Corridor Reduction", or a Type 1 or 2 Alternatives Analysis. Enhancement of the first 50 feet of the vegetative corridor to a "Good Corridor Condition", as define by CWS, is also required. Easements or separate tracts may be required for vegetative corridors.

Certain activities are permitted within vegetated corridors. These activities include:

- Roads, pedestrian paths, or bike paths crossing the vegetative corridor;
- Utility infrastructure for storm sewer, sanitary sewer, water, phone, gas, cable, etc.;
- Pedestrian or bike paths within the vegetative corridor;
- Maintenance or hazard abatement measures;
- Enhancement of the riparian corridors for water quality or quantity benefits, or for fish or wildlife habitat.

Water quality facilities may also encroach into the vegetated corridor, provided they are planted with the appropriate native vegetation. The complete and current regulations relating to water quality, water quantity, and vegetative corridors can be found in CWS's latest Design and Construction Standards.

3.5.3 CWS Water Quality Monitoring

CWS monitors the water quality for the Tualatin River Watershed. Samples are collected from McKay Creek at the following locations:

- Hornecker Road (River Mile 2)
- Glencoe Road, just north of Hillsboro (River Mile 3.9)
- Sunset Highway, just south and east of North Plains (River Mile 8)
- Northrup Road (River Mile 16)
- Pumpkin Ridge Road (River Mile 24.1)
- Wilderness Road (approximately River Mile 24)

As a rough characterization of the water quality in McKay Creek, as it flows both into and out of North Plains, the following two CWS sampling sites were selected for summary analysis:

- Northrup Road (River Mile 16), upstream of North Plains;
- Sunset Highway (River Mile 8), downstream of North Plains.

The raw sample data for these sites is contained in the appendix to this document; however, Table 3.2 presents a summary of the data based on arithmetic averages. These averages have not been adjusted to reflect sampling frequency, stream flow biasing, or seasonal variations. These averages are presented as a qualitative assessment of the effect of the urban environment on water quality. The Northrup Road site (RM16) is downstream of an upper watershed that is heavily forested with relatively steep terrain. The Sunset Highway site (RM8) is directly downstream of the City of North Plains. The watershed immediately upstream is urban and flat with residential, commercial, industrial, and agricultural land development. There are also numerous roads with culverted creek crossings upstream of the site.

Table 3.2

Water Quality Average (Unadjusted)

PARAMETER (Averages Values)	*McKay Creek at RM 16*	*McKay Creek at RM 8*	*Percent Difference RM8 to RM16*
Temperature (°C)	11.68 °C	14.00 °C	20%
Total Solids (mg/l)	76.8 mg/l	107.8 mg/l	40%
Total Dissolved Solids (mg/l)	72.8 mg/l	102.1 mg/l	40%
Total Suspended Solids (mg/l)	3.9 mg/l	5.6 mg/l	42%
Total Kjeldahl Nitrogen (mg/l)	0.202 mg/l	0.472 mg/l	134%
Total Phosphates as P (mg/l)	0.0535 mg/l	0.1521 mg/l	184%
Soluble OrthoPhosphate as P (mg/l)	0.0221 mg/l	0.0408 mg/l	85%

The data in Table 3.2 demonstrates a degradation of water quality between the upstream and downstream sampling points. The greatest effect appears to be in nutrient loading, with increases of more than 100 percent. In-stream temperatures were only increased by 20 percent, from 11.7°C to 14.0°C. The peak temperatures at the Sunset Highway site only exceeded 16.0°C during one month of the sample period. All these exceedances occurred in August of 1990 (8/01/90-18°C; 8/15/90-18°C; 8/29/90-17°C). These effects on water quality are consistent with expected impacts from an urban area.

CHAPTER 4: EXISTING STORMWATER FACILITIES

4.1 Conveyance Facilities

The properties inside of the North Plains Urban Growth Boundary (UGB) and proposed Expansion Areas, are served by a combination of roadside ditches, drainage ditches, pipes, culverts, and drain tiles. In general, the current stormwater conveyance system consists predominately of roadside ditches and driveway culverts that ultimately discharge into either McKay Creek or the UnNamed Tributary to McKay Creek. Figures 4.1a and 4.1b show the significant existing drainage facilities.

Recently constructed residential subdivisions have been developed using piped storm sewers, concrete catch basins, and manholes. Because North Plains falls under the jurisdiction of the Clean Water Service (CWS), water quality treatment and detention facilities have also been included in these recent developments, as discussed in Section 4.2 below. Some additional storm sewer improvements are scattered around the city, but most are undersized with respect to current design standards.

Industrial property at the east-end of the UGB was annexed into the city limits in 1996 (Figure 4.1b). Shortly after the annexation, the property owners formed the East Industrial Local Improvement District (East LID) to construct and pay for infrastructure improvements, including a stormwater conveyance system. As part of the storm sewer design, a hydrologic analysis of the LID properties was prepared and presented in a Preliminary Design Report titled Hydrology and Hydraulic Report, City of North Plains, East Local Improvement District Storm Sewer Design, August 20, 1997. The Preliminary Design report was reviewed and approved by CWS prior to beginning construction of the LID improvements. The report and associated analysis determined that on-site or regional detention was not necessary if the LID properties were served by a dedicated storm sewer sized to accommodate the peak hydraulic load associated with a 25-year storm event and discharging directly into McKay Creek at the West Union Road bridge. However, on-site water quality treatment facilities would be required for each site within the LID. Design of the treatment facilities would be site-specific and constructed as each site developed.

As a general pattern, properties in the northeast and east-end of the UGB and the East Expansion Area drain to McKay Creek. There are two well defined discharges: a 36-inch diameter pipe located approximately 100 feet North of the intersection of North Avenue and Glencoe Road, and a 48-inch diameter pipe located on the southeast corner of the West Union Road bridge. These two discharge points accommodate most of the recent development in these parts of the UGB. In addition to these two significant discharges, there are a number of relatively smaller pipes or swales that discharge into McKay Creek along the west bank of the creek.

Generally, properties located in the central, west and south portions of the UGB and the North Expansion Area, drain into the UnNamed Tributary, via several dispersed points of discharge. As noted previously, the drainage ways are predominantly roadside ditches and driveway culverts that follow the general topography of the city, which slopes to the South or North from a relative high point located near the intersection of 311th Street and Wascoe Avenue.

The UnNamed Tributary along the southern portion of the study area, is not deeply incised, and consequently many of the storm sewer pipes immediately adjacent to it are relatively shallow. Design and construction of future improvements to serve basins that discharge into this stream will require detailed topographic surveys to evaluate

CITY OF NORTH PLAINS

UNNAMED TRIBUTARY TO MCKAY CREEK

PROPOSED
NORTH EXPANSION AREA

NW NORTH AVE
NW YORKSHIRE
NW TUREL DRIVE
NW SHADYBROOK ROAD
BROOKWOOD CT
WATER QUALITY DETENTION AREA
NW TWEBO ST
NW LENOX ST
NW 309TH ST
NW WASCOE ST
NW GORDON ROAD
NW 309TH AVE
NW MAIN ST
NW HILLCREST ST
NW COMMERCIAL ST
NW 324TH AVE
NW 321ST AVE
NW 318TH AVE
NW KAYBERN ST
NW 313TH AVE
NW 310TH AVE
NW COTTAGE ST
NW 322ND ST
NW CLAXTAR ST
NW PACIFIC ST
NW 314TH ST
NW HIGHLAND CT
NW 307TH AVE
SUNSET HIGHWAY
WATER QUALITY DETENTION AREA

SEE FIGURE 4.1b
FOR EAST HALF OF CITY MAP

MCKAY CREEK

LEGEND – EXISTING FACILITIES

- DITCH WITH DRIVEWAY CULVERTS
- CULVERT OR PIPE
- 12" CULVERT OR PIPE DIAMETER
- MANHOLE
- OUTFALL
- WATER QUALITY OR DETENTION FACILITY
- PROPOSED EXPANSION AREAS

NORTH
NOT TO SCALE

FIGURE 4.1a

CITY OF NORTH PLAINS
STORM WATER MASTER PLAN
EXISTING STORM SEWER SYSTEM

DAVID EVANS
AND ASSOCIATES, INC
2828 S.W. CORBETT AVENUE
PORTLAND, OR. 97201-4830 (503) 223-6663

REVISIONS	APP'D.

SCALE: NOT TO SCALE
DATE: 11/12/01
PROJECT: NPX00011
FILE NAME: Fig4-1a.DWG
OF SHEETS
DESIGN: DMW
DRAWN: WNH
CHECKED: DMW

NPX00011 sae 11/10/00 13:22:10 sae D:\work\Fig4-1a.dwg

CITY OF NORTH PLAINS

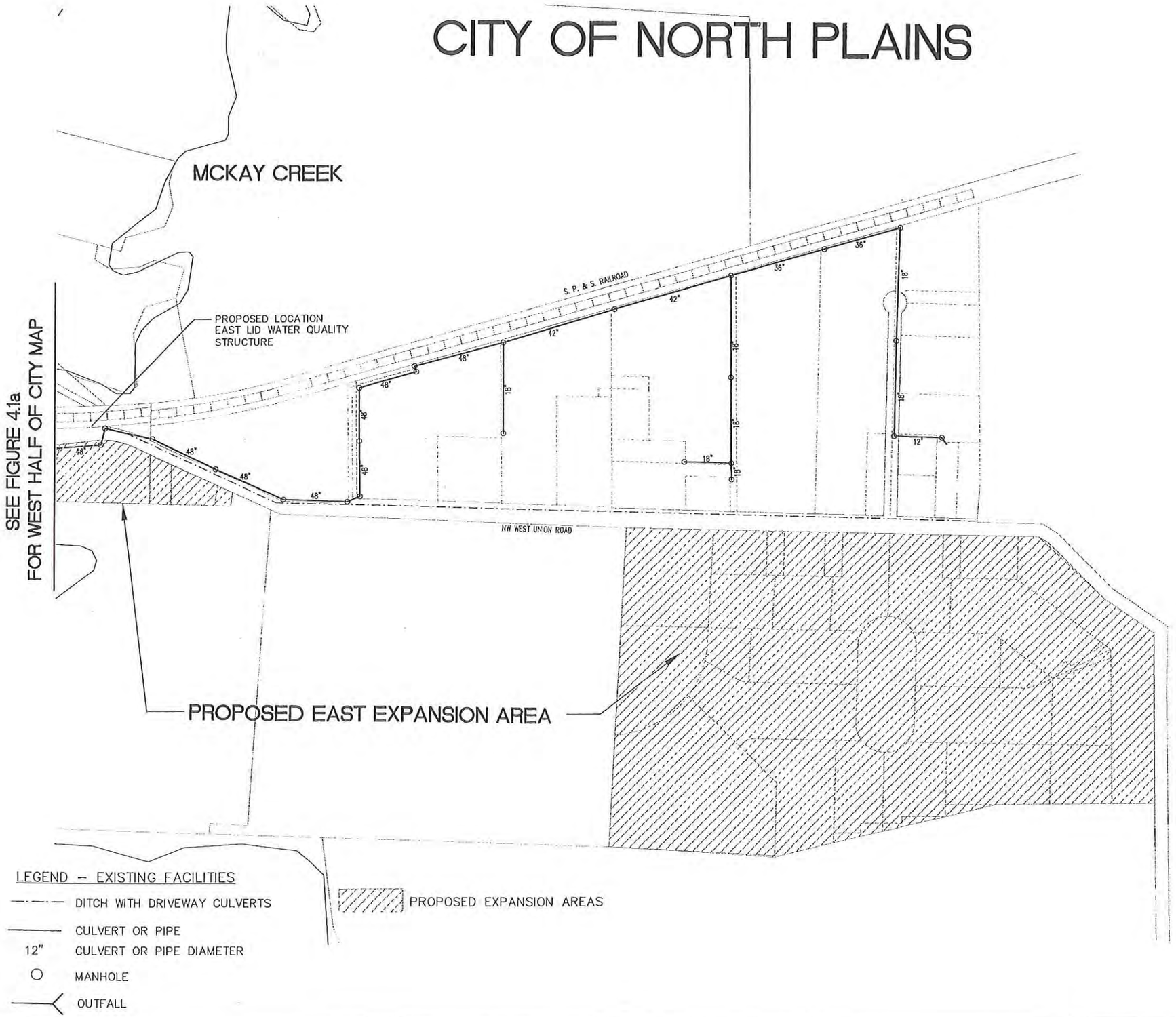


FIGURE 4.1b

CITY OF NORTH PLAINS
STORM WATER MASTER PLAN
EXISTING STORM SEWER SYSTEM

DAVID EVANS AND ASSOCIATES, INC
2828 S.W. CORBETT AVENUE
PORTLAND, OR. 97201-4830 (503) 223-6663

APP'D.	REVISIONS

SHEETS OF

SCALE: NOT TO SCALE DESIGN: DMW
DATE: 11/12/01 DRAWN: WNH
PROJECT: NPX00011 CHECKED: DMW
FILE NAME: FIG4-1b.DWG

the potential hydraulic limitations associated with the relatively flat terrain. Careful basin-wide preliminary design work and planning will help to minimize special requirements and unnecessarily high construction costs.

4.2 Stormwater Detention and Treatment Facilities

CWS regulations require detention facilities for all new development, unless an upstream and downstream analysis of the receiving system indicates there is sufficient hydraulic capacity to accommodate projected peak flows, or unless the developer elects to increase the capacity of the undersized downstream facility. This alternative is possible as long as such an increase in the conveyance structures does not increase the water surface elevation of the downstream receiving water. Detention facilities have been required for most recent developments within the North Plains UGB, the exception being the East LID, as noted in Section 4.1 above. Review and approval of the facilities falls under the jurisdiction of CWS. The locations of the existing facilities are indicated on Figure 4.1a.

After construction of the storm sewers in the East LID, the LID property owners elected to participate in a second LID effort through CWS to construct a vortex-type water quality structure to treat the combined runoff from the LID instead of providing on-site treatment facilities for each parcel. According to CWS, all of the original LID parcels agreed to participate in the cost to design and construct the water quality structure. The structure is designed to provide for a percentage of the total removal efficiency required by CWS standards. The property owners agreed to make a "fee in lieu of" payment to CWS for the remainder of the removal required, prior to discharge of the runoff water into McKay Creek. The balance of the removal efforts will be provided by CWS as part of an enhancement project to be constructed for the basin. The "in lieu of" fees to be paid by the LID participants are targeted for that future project. According to CWS, the improvement project has not yet been designed.

4.3 Identified System Deficiencies

Based on discussions with city staff, several locations have been identified where flooding is readily observed during large and/or prolonged storm events. These locations are shown on Figure 4.2 and are discussed below.

1. **West of NW Main and NW Hillcrest:** The natural drainage pattern of the City carries runoff through a demolition yard located on private property. According to city staff, stormwater is conveyed through the property via old hot water heaters laid end to end.

2. **NW 314th and NW Pacific:** A 12-inch concrete culvert crosses NW Pacific Street and conveys flow from ditches along the east side of 314th Street to the UnNamed Tributary. Based on reports from City staff that the location is subject to flooding, due to the undersized culvert.

3. **West of NW 309th and NW Hillcrest:** The City's drainage system crosses private property through an 8-inch concrete pipeline. Based on reports from City staff, the area is subject to flooding on the upstream end of the pipeline. The 8-inch pipe is too small to convey peak flows.

4. **West Ridge Residential Subdivision:** Property owners in the south part of the West Ridge Residential Subdivision (on NW Brookings Court and NW Turel Drive) have reported excessive surface water runoff from the agricultural property west of the subdivision. During heavy rainfall events, runoff from the agricultural

land reportedly bypasses the ditch inlet on the west side of 309th Street and flows down Brooking Court, at times inundating properties at the east end of the cul-de-sac.

5. **Properties South of Brookings Court:** Property owners along the south and east sides of Brooking Court have reported poor drainage of the properties, foundations, and crawl spaces. Although the Stormwater Master Plan is not intended to address drainage problems or deficiencies for specific tax lots, in this instance it appears that the cause may be due to the relatively high hydraulic grade line of the adjacent stormwater detention pond. When the pond is full, water backs up into the foundation drains and crawl spaces. Long term solutions will likely require basin-wide storm sewer improvements to the pond and downstream conveyance structures.

6. **South End of 314th Street:** A 72-inch corrugated metal pipe culvert provides passage for the UnNamed Tributary beneath NW 314th Street. This location was previously discussed in Section 3.2.3 (FEMA Flood Plain study). The FEMA study indicates that the road will be overtopped during a 10-year and greater flood events. The flooding is due to backwater impacts from McKay Creek and cannot be eliminated by increasing the size of the culvert. Raising the road surface of 314th Street at the creek crossing is a potential solution to eliminate flooding of the road.

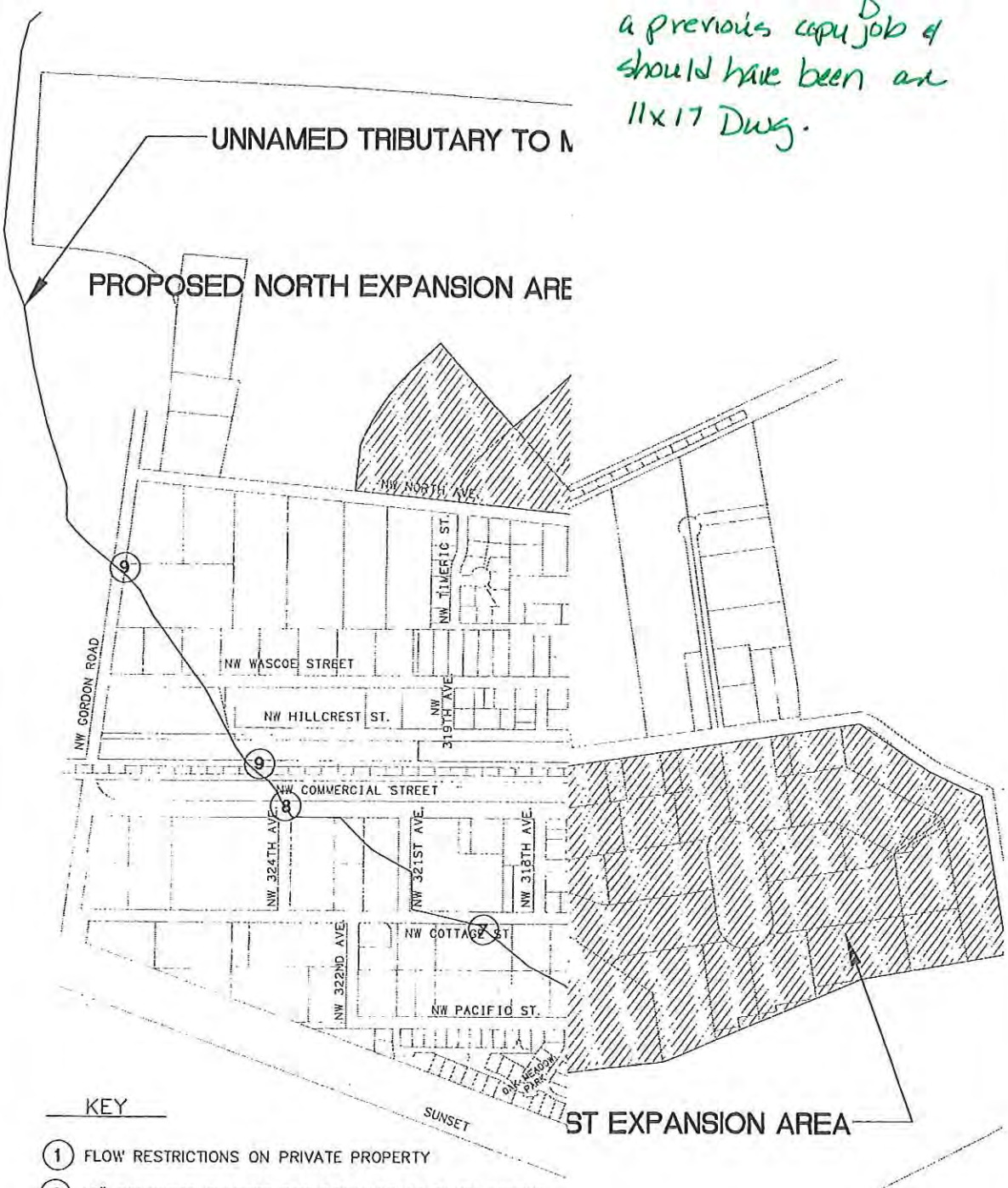
7. **Near NW Cottage and NW 318th Streets:** A 48-inch concrete culvert provides passage of the UnNamed Tributary beneath a private driveway. The culvert appears to be undersized and likely restricts flow at the crossing.

8. **NW Commercial and NW 324th Streets:** This location was previously discussed in Section 3.2.3 (FEMA Flood Plain study). The culverts crossing beneath NW Commercial Street have been replaced since the original FEMA study was conducted; the FEMA study modeled the crossing as two 48-inch culverts, but the crossing actually is two 48-inch culverts and one 42-inch culvert. The culverts are adequately sized to pass the necessary 25-year design flows, however, the top of NW Commercial Street is relatively low compared to the 25-year water surfaces.

9. **Gordon Road to the Railroad Crossing of the UnNamed Tributary:** A 60-inch culvert provides passage for the UnNamed Tributary beneath the railroad and through the railroad embankment. This location was previously discussed in Section 3.2.3 (FEMA Flood Plain study). The culvert is undersized for passage of the creek, and the backwater impacts of the flow restriction extend to and beyond the City Limits at Gordon Road. In addition, the creek's bottom between Gordon Road and the railroad appears to have filled with sediment over the years due to the excessive backwater flooding. The accumulation of sediment has raised the channel bottom reducing the channel cross section, which has further exacerbating the flooding problems.

   A detailed study of the creek and railroad crossing will be required to determine downstream impacts from increasing the size of the culvert. Alternatively, Gordon Road could be raised several feet to eliminate likely annual flooding of the road. However, raising Gordon Road would also require raising the nearby railroad crossing and grade of the railroad tracks for some distance East and West, and replacing the trestle.

This is an error from a previous copy job & should have been an 11x17 Dwg.



KEY

1. FLOW RESTRICTIONS ON PRIVATE PROPERTY
2. 12" CONCRETE CULVERT FOR DRAINAGE OF 314TH STREET
3. 8" PIPE THROUGH PRIVATE PROPERTY
4. RUNOFF FROM AGRICULTURAL LAND FLOWS OVERLAND THROU
5. POOR DRAINAGE OF PROPERTIES CAUSES FLOODING OF HOUS
6. 72" CORRUGATED METAL CULVERT FOR CREEK CROSSING OF
7. 48" CONCRETE CULVERT FOR CREEK CROSSING OF PRIVATE I
8. TWO 36" CORRUGATED METAL PIPE FOR CREEK PASSAGE IN
9. RAILROAD EMBANKMENT CREATES BACKWATER FLOODING AND

LEGEND

PROPOSED EXPANSION AREAS

NORTH

NOT TO SCALE

FIGURE 4.2

CITY OF NORTH PLAINS
STORM WATER MASTER PLAN
EXISTING DRAINAGE
PROBLEM LOCATIONS

DAVID EVANS AND ASSOCIATES, INC
2828 S.W. CORBETT AVENUE
PORTLAND, OR. 97201-4830 (503) 223-6663

					APPD.
				REVISIONS	

SCALE: NOT TO SCALE DESIGN: DWW SHEETS OF
DATE: 11/12/01 DRAWN: WNH
PROJECT: NPX00011 CHECKED: DWW
FILE NAME: FIG4-2.DWG

NPXX0011 see 11/10/00 13:25:28 see D:\work\Fig4-2.dwg

CHAPTER 5: LAND USE AND URBAN DEVELOPMENT

5.1 Projection Methodology

Although population projections do not have the direct impact on storm sewers that are noted for other infrastructure such as roads, water systems and sewer systems, growth will result in modification to the runoff characteristics of the properties in the city. Some land use changes can have significant impacts on the storm sewers and stormwater facilities. In particular, commercial and industrial properties have the potential to convert large areas of vegetated land into impervious pavement or roof top surface. In general, an increased population will require additional residential, commercial and industrial development. For this reason, population projection information is included in this document. The projections made herein are consistent with the information contained in Chapter 15.02 of the North Plains Comprehensive Plan. In preparing these projections, the City has coordinated with Washington County, Metro and the Department of Land Conservation and Development. .

The land use and population data presented in this study provides a preliminary estimate of where development is expected to occur within the North Plains study area. It serves as a basis from which to assess future needs and to plan upgrades of the stormwater system.

Prior to 1980, the population of North Plains increased at a historical average rate of 3% a year. During the period from 1990 to 2000, the City experienced a growth rate of 5.2% compounded annually, growing from a population of 972 to a population of 1,605. For the next 20 year planning horizon, the City has selected a growth rate of 4.5% a year. The City has coordinated the population projections with Washington County, Metro, and the Department of Land Conservation and Development to incorporate this projection and the underlying assumptions into the City's Comprehensive Plan.

5.2 Population

Population projections for the City through 2021 are summarized in Table 5.1. The projected growth assumes a 4.5% compound average annual rate of growth (CAARG).

Table 5.1

Actual and Projected Population Growth (1980 – 2021)

1980	*1990*	*2000*	*2010*	*2021*
715	972	1,605	2,491	4,041

5.3 Land Use

Land use within the current UGB for the City of North Plains is divided into three distinct categories: Residential, Commercial, and Industrial. The proposed north and east expansion areas include separate designations for Institutional, Public Facility and Parks and Open Space. In addition, the City of North Plains has sub-category zonings within each category, as shown in Figures 5.1a and 5.1b.

Much of the residential land within the current UGB has been developed, and the City expects that a significant portion of the remaining available residential properties will be built out within five years.. The proposed expansion areas will provide additional residential properties to accommodate anticipated growth. North Plains has adequate industrial land within the current UGB to accommodate anticipated growth. A small parcel (approximately 4 acres) is available south of Commercial Street, another approximately 75 acres east of the city (the "East LID") was annexed in 1996, about 70% of which is available for development. To accommodate growth through the year 2021, an additional 7.75 acres of commercial land will be added as part of the north and east expansion areas.

CITY OF NORTH PLAINS
STORM WATER MASTER PLAN
ZONING AND LAND USE

PROPOSED NORTH EXPANSION AREA

PROPOSED NORTH EXPANSION AREA

NORTH

NOT TO SCALE

NW NORTH AVE.

NW YORKSHIRE ST.

NW TUREL DR.

NW BROOKING CT.

NW SHADYBROOK RD

NW GORDON ROAD

NW TIMERIC ST.

NW MAIN ST.

NW LENOX STREET

RIDGEVIEW ESTATES

NW 309TH ST.

NW WASCOE STREET

NW HILLCREST ST.

NW 319TH AVE.

NW OLD WEST UNION RD

NW COMMERCIAL STREET

NW 324TH AVE.

NW 321ST AVE.

NW 318TH AVE.

NW KAYBERN ST.

NW 313TH AVE.

NW 311TH AVE.

NW 309TH ST.

NW COTTAGE ST

NW 322ND AVE

NW MAIN ST.

NW CLAXTAR ST.

NW PACIFIC ST.

NW GLENCOE ROAD

OAK MEADOW PARK

NW 314TH AVE.

NW HIGHLAND COURT

NW 307TH

SUNSET HIGHWAY (OR HIGHWAY 26)

PROPOSED EXPANSION AREAS

SEE FIGURE 5.1b FOR EAST HALF OF CITY MAP

LEGEND

EXISTING LAND USE

R 10	– SINGLE FAMILY RESIDENTIAL
R 7.5	– SINGLE FAMILY RESIDENTIAL
R 5	– SINGLE FAMILY RESIDENTIAL
R 2.5	– MULTI-FAMILY RESIDENTIAL
C 1	– GENERAL COMMERCIAL
C 2	– HIGHWAY COMMERCIAL
M 1	– LIGHT INDUSTRIAL
M 2	– GENERAL INDUSTRIAL
CS	– COMMUNITY SERVICE
HO	– HISTORIC OVERLAY DISTRICT

EXPANSION AREAS

R	– RESIDENTIAL
C	– COMMERCIAL
P	– PARKS AND OPEN SPACE
I	– INSTITUTIONAL
PF	– PUBLIC FACILITY

FIGURE 5.1a

DAVID EVANS AND ASSOCIATES, INC
2828 S.W. CORBETT AVENUE
PORTLAND, OR. 97201-4830 (503) 223-6663

REVISIONS	APPD.

SCALE: NOT TO SCALE
DATE: 11/12/01
PROJECT: NPX00011
FILE NAME: FIG5-1a.DWG
DESIGN: DMW
DRAWN: WNH
CHECKED: DMW

NPXX0011 see 11/10/00 13:43:18 see D:\work\Fig5-1a.dwg

LEGEND

EXISTING LAND USE

R 10	– SINGLE FAMILY RESIDENTIAL
R 7.5	– SINGLE FAMILY RESIDENTIAL
R 5	– SINGLE FAMILY RESIDENTIAL
R 2.5	– MULTI-FAMILY RESIDENTIAL
C 1	– GENERAL COMMERCIAL
C 2	– HIGHWAY COMMERCIAL
M 1	– LIGHT INDUSTRIAL
M 2	– GENERAL INDUSTRIAL
CS	– COMMUNITY SERVICE
HO	– HISTORIC OVERLAY DISTRICT

EXPANSION AREAS

R	– RESIDENTIAL
C	– COMMERCIAL
P	– PARKS AND OPEN SPACE
I	– INSTITUTIONAL
PF	– PUBLIC FACILITY

PROPOSED EXPANSION AREAS

NORTH

NOT TO SCALE

FIGURE 5.1b

CITY OF NORTH PLAINS
STORM WATER MASTER PLAN
ZONING AND LAND USE

DAVID EVANS
AND ASSOCIATES, INC
2828 S.W. CORBETT AVENUE
PORTLAND, OR. 97201-4830 (503) 223-6663

NO.	REVISIONS	APP'D.

SHEET OF SHEETS
SCALE: NOT TO SCALE
DESIGN: DMW
DATE: 11/12/01
DRAFT: WNH
PROJECT: NPX0011
CHECKED: DMW
FILE NAME: FIG5-1b.DWG

NPX0011 see 11/10/00 13:43:47 see D:\work\Fig5-1b.dwg

CHAPTER 6: ANALYSIS METHODOLOGY

6.1 Evaluation Methodology

6.1.1 Introduction

A Stormwater Master Plan must provide a methodology for evaluating existing and future drainage concerns. This chapter presents the criteria used for evaluating existing and proposed stormwater facility improvements.

A version of the EPA SWMM model, CAiCE Visual SWMM® (version 7.01) was used as the primary method for analyzing stormwater and surface water runoff within the North Plains Study area. SWMM is a useful tool for modeling the behavior of the storm sewer and drainage facilities including: magnitude of flows, impact of differing storm intensities, and dynamic characteristics of storm sewer collection and conveyance. In addition, specific components of the existing and proposed storm sewer system have been analyzed utilizing traditional hydrologic and hydraulic analysis to determine capacity and preliminary alignments.

Because all storm sewer systems must eventually discharge into existing drainage ways or infiltration systems, proposed improvements must be evaluated for feasibility in terms of existing topographic constraints. In an effort to incorporate a feasibility analysis into the hydrologic/hydraulic model and calculations, some field topographic surveying was completed as part of the preparation of this study. Field data collection consisted of measuring vertical elevations of key drainage structures and facilities using global positioning system (GPS) equipment. Data was collected on the days of October 12 through 22, 1999. The data collected is adequate for purposes of this master planning effort, but preliminary in nature with an accuracy and precision of +/- 0.2 feet.

This level of precision is appropriate for the tolerances of the hydraulic model used, initial feasibility analysis and preliminary cost estimates. However, it should not be used for preliminary design reports or final design preparation. Final basin or sub-basin analysis and design must be based on field topographic surveys that confirm the function and feasibility of the specific parameters of the final design.

6.1.2 Public Involvement

Public involvement is crucial to successfully planning for the development and land use changes that are expected to continue within the City of North Plains. The public involvement process encompasses many methods of incorporating the desires and visions of stakeholders of the city's stormwater management system. The stakeholders include any individual or organization that may be impacted by changes in land use and development, which might result in changes to stormwater quantity and quality. Stakeholders include citizens of North Plains or downstream communities, which may be represented by individuals, by elected representatives, or by residential or community organizations. The stakeholders also include business and business owners and employees, as well as local and regional government agencies, such as CWS and neighboring municipalities.

The stakeholders help to establish the evaluation criteria used for planning for new stormwater facilities and improvements to existing facilities. The evaluation criteria will include design standards used during technical analyses and facility design, as well as more qualitative criteria, which might include aesthetic considerations, or general policies for fish passage or aquatic habitat enhancement.

Public involvement should be encouraged on an ongoing basis, and changing public values should be incorporated into future versions of or amendments to this document. Section 6.2 describes specific measures used for generating public involvement from appropriate stakeholders in an effort to maintain consistency between the public vision for the city's stormwater management goals and the design and evaluation criteria under which stormwater systems and facilities will be constructed.

6.1.3 Design Storms

CWS prescribes a "design storm event" in terms of inches of precipitation for 2, 5, 10, 25, 50, and 100-year 24-hour storms occurring within their jurisdiction. The CWS design storms for the North Plains region are summarized in Table 6.1. The rainfall is distributed using the standard 24-hour SCS Type 1A rainfall distribution, which is a dimensionless rainfall distribution consistent with storm data recorded and published by the Weather Bureau for storms in the region west of the Cascade Mountain Range.

Analysis for this study used the 25-year storm event of 3.9 inches for the 24-hour design storm to determine peak runoff flows from various sub-basins throughout the City. CWS standards require that conveyance facilities have capacity to pass and contain flows generated from the 25-year storm event. The methodology for determining the peak flows is described in Section 6.3.

Table 6.1

24-Hour Precipitation for North Plains

Recurrence Interval (years)	*Total Precipitation Depth (inches)*
2	2.50
5	3.10
10	3.45
25	3.90
50	4.20
100	4.50

Information in this table taken from CWS's Design and Construction Standards (February 2000).

6.1.4 Conveyance Design Standards

The City of North Plains has adopted CWS's Design and Construction Standards for facilities constructed in North Plains. The design standards were updated in February 2000. In accordance with these standards, conveyance facilities are considered to be adequately sized if analyses indicate that they can pass the 25-year design storm event, and if there is no flooding of structures during the 100-year event.

Analysis for this study also considered the 100-year design storm, and the models were run using this larger storm as well. It is generally neither realistic nor economically feasible for communities to design and construct storm sewer pipes, ditches and structures to accommodate 100-year storm events. However, the 100-year storm event is significant with respect to creeks and streams (McKay Creek and the UnNamed Tributary), in that flood plains, floodways and flood insurance for the adjacent properties are determined by an event of this magnitude.

6.1.5 Stormwater Detention Design Standards

Section 3.05.3 of the CWS Design and Construction Standards requires that design engineers for new development complete a downstream capacity analysis of any facilities impacted by new development. If the design engineer is unable to document the availability of sufficient downstream capacity in conformance with CWS Standards the development will be required to either provide detention to reduce the flow from the developed area or increase the capacity of the downstream system or structure.

On-site detention facilities are not always the most cost-effective method for stormwater detention in terms of basin-wide or citywide service. In some cases, regional detention facilities can be a better option. Maintenance of numerous facilities spread throughout a city can be time consuming, expensive, and often is ignored. Appropriate placement of regional detention facilities can allow the managing agency better control over the design, construction, management, and maintenance of stormwater detention facilities.

However, implementation of regional detention is difficult, and requires a long-term commitment of financial and staff resources. There are significant difficulties inherent with regional detention. The City or agency must plan for and acquire the property necessary to accommodate a regional facility. By its definition, a regional detention facility must be located at the downstream end of a basin or citywide drainage system (at its lowest point), prior to discharging into a receiving stream, which limits the number of feasible sites. If the affected property owners are unwilling to sell their property at a fair market price, the process of acquiring and developing the site can be lengthy and contentious. In some instances the topography of the city may actually make it technically infeasible. A detailed preliminary design report should be completed on a basin-by-basin basis to determine whether regional detention is practical or possible.

Another problem related to implementation of regional detention facilities is the time line for developing and paying for the initial capital cost associated with a regional facility. It is uncommon for all of the affected areas to develop simultaneously, allowing for the pooling of financial resources. Overcoming this challenge requires that some mechanism be in place to pay for and finance the large initial "up front" costs associated with a regional facility. Without this mechanism, individual developments must pursue alternatives that address only their individual needs and capacity to finance. The net effect is a series of small, site specific detention facilities.

A third problem associated with regional detention is the impact the facilities will have on the sizing of new storm sewers necessary to convey stormwater to the site of the regional facility. Use of regional facilities will require that all undetained flow be conveyed through the basin to the regional detention facility. In extreme cases, the magnitude of the undetained flows could be as high as two or three times the flow that would otherwise be discharged from on-site detention facilities. The storm sewers and structures necessary to convey peak flows to a regional facility will be much larger and more expensive than those required under a site specific detention scenario.

One very important advantage should be noted with respect to regional detention. A regional detention facility offers a community an opportunity to provide an environmentally sound, multi-use facility. When the development timeline, topography and land acquisition make it feasible, a regional detention facility can be constructed in a manner that enhances parks and green spaces and adds to the aesthetics of a community. Proper design and construction can include additional wetlands and habitat for plants and animals in a manner that can

help offset some of the negative impacts from development of a community. Site specific detention facilities cannot provide this advantage on the same magnitude and scale as a regional facility.

6.1.6 Stormwater Treatment Standards

As mentioned in previous sections, the City of North Plains has adopted CWS's standards for stormwater management, including the requirements associated with treating stormwater runoff. These standards are based on ORS 340-041-0455. The use of regional treatment facilities provides the same advantages and limitations as regional detention facilities. While regional treatment can provide for more efficient and comprehensive treatment of stormwater runoff, they can also be difficult to site, fund, and configure.

6.2 Public Involvement

Public involvement can and should take a variety of forms. In general, any feedback or input from the stakeholders of the stormwater system is considered public comment or involvement. It is the obligation of the City to solicit involvement from the stakeholders by providing forums and facilitating educational programs. The benefit to the City from this obligation is a public that will be better informed about the necessity of planning for and providing stormwater management plans and facilities that will provide long-term service to the community.

6.2.1 Education

Limitations or problems associated with a municipality's stormwater facilities often affect only a limited number of citizens, and the problems may only be experienced a few times during the year. However, the number of people impacted and the damage caused by flooding increases rapidly when communities experience rapid growth, as is expected in North Plains. Negative impacts to water quality as a result of unplanned growth can be far reaching. It is important for the public to be made aware of the potential long-term repercussions of poor stormwater management practices.

6.2.2 Public Meetings

Public input was solicited at several meetings held during preparation of this Stormwater Master Plan. Initial efforts to incorporate the desires of the citizens were made through two 2-hour workshops with a City Council sub-committee, and subsequent public meetings held to obtain input from the community. The meetings held are summarized below. The minutes from the minutes are included in Appendix A.

- ***City Council Sub-Committee Workshop, October 8, 1999:*** This initial meeting of the Council sub-committee focused on reviewing of the existing storm sewer system inventory, discussion of existing problem areas within the UGB, a proposed storm sewer system to serve the current UGB, and proposed design and construction standards.

- ***City Council Sub-Committee Workshop, October 22, 1999:*** This second meeting of the Council sub-committee primarily focused on a review of the drainage patterns in North Plains, a review of preliminary recommended improvements, preliminary cost estimates for the improvements, financing options, and a discussion of SDCs.

- ***Public Hearing, November 1, 1999:*** A public hearing was held at the City of North Plains Community Center, as part of a City Council Meeting. A presentation of the Draft Stormwater Master Plan was provided by DEA for the Council and other attendees at the open meeting. Public input and discussion was solicited after the presentation.

- ***Public Hearing, February 9, 2000:*** A public hearing was held at the City of North Plains Community Center, as part of a Planning Commission Meeting. This meeting included discussion about the City's goal for curb and gutter street improvements and the impact of this street standard on future storm sewer improvements. Public input was solicited, but no public comment was received.

- ***Public Hearing, March 6, 2000:*** A final meeting was held in an effort to obtain final public comment on the Stormwater Master Plan prior to publication of the final document. At this meeting, DEA presented a review of changes made to the draft document. Some of these changes reflected review comments received from CWS, City Council members, and from an engineering consultant representing developers in the area. Other changes included additional narrative based on analyses and research conducted after the Draft document was prepared. The Stormwater Master Plan was adopted by the City Council at this meeting.

6.2.3 Public Comments

Written comments and feedback from the community pertaining to this Stormwater Management Plan or to other aspects of the City's stormwater facilities and their management were directed to the City of North Plains.

After the November 1, 1999 Public Hearing, the City of North Plains received review comments on the Draft Stormwater Master Plan in a letter from Alpha Engineering, dated November 15, 1999. The comments from Alpha Engineering were reviewed by DEA, and modifications to the Master Plan were made as appropriate.

6.2.4 Agency Review

In addition to review and comment solicited from the public and City Council, input and review was obtained from agency stakeholders. The following meetings and reviews were conducted as part of the preparation of this Stormwater Master Plan:

- ***CWS and ODFW, August 30, 1999:*** An initial meeting was held with members of DEA's project team and representatives from CWS and the Oregon Department of Fish and Wildlife (ODFW). The meeting was held at the office of CWS and included discussions related to CWS requirements, jurisdictional issues related to stormwater facilities in North Plains, ODFW concerns related to the study area, and schedules for review of the draft and final documents.

- ***CWS, February 7, 2000:*** A second meeting was held with members of DEA's project team and Dan Gunther of CWS. This meeting provided the opportunity to discuss review comments from CWS based on their review of the Draft Stormwater Management Plan. Following this meeting, DEA incorporated the requested modifications into the final Stormwater Master Plan document.

6.3 Hydrologic Modeling

XP-SWMM was used for the hydrologic and hydraulic modeling. The SWMM Runoff Block was used to estimate the volumes and peak flows for the city sub-basins, generated by the 25-year, 24-hour design storm (3.9-inches/24-hours).

6.3.1 Model Methodology

The SWMM model using the SCS hydrologic method, which divides the rainfall available for runoff into three components, predicted surface runoff hydrographs: initial abstraction, losses, and direct runoff. This separation is made using assumptions about the drainage areas soil type, land cover, land use, and antecedent moisture condition. The specific criteria and assumptions made for the models developed for this study are discussed below.

- ***Percent Impervious Surface.*** The city's existing land use zones were used to estimate the percent of imperious surface for each sub-basin in built-out condition. A summary of the percent impervious values used for each category is shown in the table below. In basins that included more than one type of land use zone, an estimate was made using a percentage of each zone in the basin. In addition, impervious surface values were increased in sub-basins where it was apparent that road surfaces comprised a large portion of the basin's area. The undeveloped farmland north of the city was assumed to have impervious surface areas of 2%.

Zone Classifications	*Symbol*	*Percent Impervious Assumed*
Commercial & Industrial	C1	90%
	C2	90%
	M1	90%
	M2	90%
Residential Areas	R10	40%
	R7.5	47%
	R5	55%
	R2.5	60%

- ***Pervious Area Curve Number (CN).*** The soil classification system developed by the SCS identifies four types of soils: A, B, C, and D. The soil classification and land use are used to determine a basin CN value, which is used to predict the initial abstraction and the direct runoff. These CN values are applied to the impervious surface area of each drainage basin. Impervious areas (pavements and rooftops) are given CN values of 98. The impervious area CN and the pervious area CN are used to determine an average CN for the basin, based on the basin's percent impervious area. The following CN values for the pervious areas were used in the model for the identified soil types and land uses:

Land Use	*Soil Class*	*Curve Number*
Residential, commercial, industrial land uses:	B	80
	C	86
	D	90
Undeveloped Farmland	B	78
	C	85
	D	89

- ***Time of Concentration.*** The times of concentration were estimated based on the basin size. In general, the basins were assumed to have 5, 8, and 10 minutes times of concentrations for basins less than 2, 3, and 6 acres, respectively. The large undeveloped farmland areas were assumed to have times of concentrations of 45 minutes.

- ***Initial Abstraction.*** Initial abstraction represents all the loss values in the rainfall prior to the beginning of runoff. For the models in this study, a fraction of 0.2 was assumed. This value assumes a fraction of the total potential maximum abstraction (S), which is a function of the CN.

6.3.2 Sub-basins

For modeling purposes, and to more accurately predict the directions of runoff flow, the city's major sub-basins were divided into smaller drainage areas. The use of smaller drainage areas in the model provides a better basis from which to predict sizes for conveyance facilities, and allows the model to incorporate existing conveyance facilities.

The sub-basins that were modeled are shown in Figure 6.1. The modeling parameters used to characterize each sub-basin are summarized in Table 7.1.

6.4 Hydraulic Modeling

Hydraulic analyses were conducted using SWMM's routing block, EXTRAN. This modeling tool routes the flow of runoff predicted by the Runoff Block through the prescribed stormwater network.

6.4.1 Model Methodology

Runoff in each drainage basin was routed through the storm conveyance network that, in general, followed natural drainageways. In accordance with CWS's design criteria, a minimum velocity of 3 feet-per-second (fps) is required for all pipes when flowing full. However, because the city topography allows for greater than this minimum velocity, most of the pipes were sized based on an assumption of 5 fps. Using slopes greater than the minimum required to achieve 3 fps allowed for reduced pipe sizes (and more shallow trench installations). The pipe size estimates are still conservative in nature, however, and further reductions in pipe sizes and trench installations will likely be possible during more detailed design analyses conducted for the proposed projects. A Mannings n value of 0.013 was used for all pipes in the model.

Hydraulic routing was conducted under two discharge conditions. Initially, the discharges from the pipe networks were assumed to have free fall discharge into the receiving waters (McKay Creek or the UnNamed Tributary). Under this condition, it was assumed that the creeks were not in flooded conditions, and the conveyance facilities were sized to convey the peak runoffs from the 25-year storm events.

The models were subsequently run under fixed backwater elevations at the at each outfall location. The 10-year flood elevations at each outfall were established from the FEMA FIS discussed in Section 3.2.4. The pipe sizes and slopes were adjusted, as necessary, based on the impacts from the fixed backwater elevations.

CITY OF NORTH PLAINS

UNNAMED TRIBUTARY TO MCKAY CREEK

MCKAY CREEK

MCKAY CREEK

MCKAY CREEK

EAST 1

NO SCALE

NORTH

NOT TO SCALE

LEGEND

1B 1A — BASIN BOUNDARY

SUB-BASIN BOUNDARY

MODEL NODE IDENTIFICATION

OUTFALL

FIGURE 6.1

CITY OF NORTH PLAINS
STORM WATER MASTER PLAN
STORM WATER MODEL
DRAINAGE SUB-BASINS

DAVID EVANS AND ASSOCIATES, INC.
2828 S.W. CORBETT AVENUE
PORTLAND, OR. 97201-4830 (503) 223-6663

					APPD.
					REVISIONS

SHEETS OF

SCALE: NOT TO SCALE DESIGN: WNH

DATE: 11/12/01 DRAWN: DAW

PROJECT: NPX00011 CHECKED: DAW

FILE NAME: FIG6-1.DWG

NPX00011 see 11/10/00 1351:40 see D:\work\Fig6-1.dwg

CHAPTER 7: MODELING RESULTS

7.1 Existing Conditions

The City of North Plain's existing stormwater conveyance system is comprised predominantly of shallow roadside ditches and culverts. Limited data is available to establish accurate ditch grades and shapes for a detailed analysis of the system. Because it is clear from anecdotal information that many areas of the City's conveyance system do not adequately convey runoff volumes and flows that are regularly observed in the City, it was determined that collection of data necessary to analyze the existing conditions was not warranted for this study.

The existing conditions for McKay Creek and The UnNamed Tributary to McKay Creek are based on the FEMA FIS, as described in Section 3.2.4.

7.2 Build-Out Conditions

The pipe network used for modeling the projected runoff volumes is shown in Figure 7.1. This network represents the proposed conceptual layout for the City's future stormwater system. The pipes were sized based on the results of the predicted peak runoffs from the drainage areas and the routing of these peaks through the network, based on the 25-year storm event. A summary of the pipe sizes and lengths is provided in Table 7.1.

CITY OF NORTH PLAINS

CITY OF NORTH PLAINS
STORM WATER MASTER PLAN
PROPOSED STORM SEWER IMPROVEMENTS

LEGEND

7B — MODEL NODE IDENTIFICATION

12" — PIPE SIZE – PROPOSED STORM SEWER

12" — EXISTING PIPE

OUTFALL

NO SCALE

EAST MCKAY 42"

EAST 1

DAVID EVANS AND ASSOCIATES, INC.
2828 S.W. CORBETT AVENUE
PORTLAND, OR. 97201-4830 (503) 223-6663

NO.	REVISIONS	APP'D.

SCALE: NOT TO SCALE
DESIGN: MAH
DATE: 11/12/01
DRAWN: DMW
PROJECT: NP000011
CHECKED: DMW
FILE NAME: FIG7-1.DWG
OF SHEETS

FIGURE 7.1

Table 7.1

Summary of Sub-basin Characteristics and Model Results

Basin	Drainage Zones	% Imp.	Area (ac)	PER CN	Tc (min)	Qp (cfs)	Pipe	Size (in)	Length (feet)	Qp (cfs)	Vd (fps)
1	1A	47	3.4	80	9.0	2.24	1AB	12	600	2.24	6.47
	1B	47	5.2	80	9.9	3.46	1BC	15	560	5.68	5.12
	1C	47	4.7	80	9.6	3.09	1CD	18	360	8.74	7.67
	1D	2	43.0	82	45	15.9	1DE	24	250	21.3	7.76
	1E	40	3.1	80	8.5	2.00	1EF	30	190	22.8	3.32
	1F	90	4.6	80	11	3.64	1FG	30	30	26.2	4.82
2A	2A	90	2.6	86	8.5	2.12	2AB	12	300	2.12	3.21
2B	2C	90	3.8	86	9.0	3.06	2CD	12	260	3.06	3.98
2C	2E	90	3.5	90	8.8	2.98	2CD	12	300	2.98	3.70
3	3A	90	2.5	80	7.8	1.94	3AB	12	480	1.93	7.75
	3B	90	3.2	90	7.2	2.66	3BC	12	400	4.55	5.56
	3C	90	6.5	90	8.6	5.24	3CD	18	520	9.77	6.39
	3D	90	2.1	90	7.1	1.73	3ED	12	200	1.73	5.56
	3E	90	1.5	86	7.0	1.20	3DF	21	150	12.7	5.38
4A	4A	47	4.9	80	8.1	3.26	4AB	12	200	3.26	5.56
	4B	47	3.8	80	8.8	2.38	4BD	15	280	5.61	4.45
	4C	55	1.8	82	7.3	1.27	4CD	12	440	1.27	3.75
	4D	90	3.0	80	8.2	2.40	4DE	18	360	9.27	9.91
	4E	90	3.2	90	8.2	2.61	4EF	18	280	11.9	7.94
	4F	90	2.9	90	8.2	2.36	4FG	21	280	14.2	6.82
	4G	90	3.1	90	8.2	2.53	4GH	21	84	16.7	7.19
4B	4I	90	4.8	90	9.0	3.89	4IJ	12	580	3.89	4.98
	4J	90	3.8	90	8.5	3.12	4JK	15	300	7.00	6.08
	4K	90	2.3	90	7.3	1.92	4KL	18	100	8.91	5.94
4C	4M	90	7.8	90	10.6	6.38	4MN	15	200	6.37	8.32
	4N	90	2.9	90	8.7	2.34	4NO	18	120	8.71	5.43
5	5A	90	5.8	80	9.9	4.67	5AB	12	740	4.64	6.01
	5B	90	3.7	80	8.8	2.93	5BE	18	332	7.57	9.23
	5C1	95	5.0	80	10.1	4.01					
	5C2	55	5.6	80	9.3	3.74	5CD	18	204	7.75	13.2
	5D	73	2.4	80	7.3	1.82	5DE	18	260	9.57	10.4
	5E	85	3.9	86	9.6	3.10	5EF	24	240	20.2	6.57
	5F	55	2.3	80	8.3	1.54	5FG	24	192	21.8	7.35

Table 7.1

Summary of Sub-basin Characteristics and Model Results

Basin	Drainage Zones	% Imp.	Area (ac)	Per CN	Tc (min)	Qp (cfs)	Pipe	Size (in)	Length (feet)	Qp (cfs)	Vd (fps)
6A	6A	50	2.1	86	8.5	1.52	6AC	12	350	1.51	6.18
	6B	80	2.0	80	10.7	1.53	6BC	12	250	1.53	3.51
	6C1	47.8	15.0	90	15	11.1	6C1C	18	40	11.10	10.1
	6C	60	0.9	86	5.4	0.68	6CD	21	200	14.8	9.69
	6D	47	0.8	86	5.4	0.58	6DH	21	260	15.8	8.39
	6E	47	2.6	80	8.2	1.65	6EF	12	320	1.65	4.91
	6F	50	4.5	80	8.8	3.00	6FG	15	440	4.63	6.02
	6G	50	3.3	86	8.8	2.34	6GH	18	240	6.99	8.14
	6H	50	6.0	86	9.9	4.32	6HL	24	260	26.4	9.94
	6I	55	2.4	80	8.2	1.66	6IJ	12	328	1.66	5.60
	6J	50	1.8	86	6.4	1.32	6JK	12	360	2.97	5.35
	6K	55	1.7	86	6.4	1.25	6KL	15	260	4.20	3.26
	6L	55	2.2	86	7.3	1.65	6LQ	27	260	31.7	8.80
	6M	60	1.5	80	7.3	1.06	6MN	12	240	1.06	3.59
	6N	60	1.9	80	7.3	1.34	6NO	12	328	2.39	3.54
	6O	60	2.2	83	7.3	1.62	6OP	12	360	4.00	7.85
	6P	60	2.0	86	7.3	1.52	6PQ	15	240	5.52	5.89
	6Q	60	2.9	83	8.5	2.10	6QT	30	360	39.2	7.93
	6R	90	4.2	86	9.3	3.40	6RS	12	460	3.40	4.96
	6S	90	2.5	86	8.2	2.02	6ST	15	240	5.42	4.81
	6T	90	1.8	86	6.4	1.46	6TU	30	240	45.9	9.31
	6U	90	2.6	80	8.2	2.08	6UV	30	280	47.9	9.85
	6V	60	3.8	80	8.8	2.66	6VW	36	280	50.7	7.01
	6W	60	4.7	90	8.8	3.62	6WX	36	160	54.2	7.63
6B	6AA	73	2.2	86	7.3	1.75	6AABB	12	440	1.75	3.06
	6BB	73	2.5	86	7.3	1.98	6BBDD	12	260	3.73	6.29
	6CC	55	1.9	86	7.8	1.34	6CCDD	12	280	1.34	3.83
	6DD	55	2.0	86	7.0	1.44	6DDEE	15	260	6.51	6.93
	6EE	55	3.2	90	8.8	2.43	6EEFF	18	220	8.93	5.67
	6FF	58	2.3	90	8.2	1.78	6FFGG	18	120	10.7	5.43
7	7A	60	1.4	80	8.8	0.96	7AB	12	532	0.95	8.11
	7B	60	4.1	83	9.3	2.99	7BC	12	320	3.93	5.67
	7C	60	5.7	83	9.3	4.09	7CD	18	120	8.00	6.65

Table 7.1

Summary of Sub-basin Characteristics and Model Results

Basin	Drainage Zones	% Imp.	Area (ac)	Per CN	Tc (min)	Qp (cfs)	Pipe	Size (in)	Length (feet)	Qp (cfs)	Vd (fps)
8A	8A	60	1.3	80	8.8	0.91	8AB	12	200	0.91	4.54
	8B	80	0.5	80	5.4	0.39	8BC	12	260	1.30	3.98
	8C	50	2.1	80	7.3	1.39	8CD	12	400	2.67	3.00
	8D	60	1.4	80	8.2	0.97	8DF	15	120	3.63	6.80
	8E	47	1.6	80	6.4	1.02	8EF	8	320	1.02	3.76
	8F	98	0.3	78	4.2	0.24	8FH	15	270	4.88	10.0
	8G	50	3.3	80	8.5	2.15	8GH	12	190	2.15	10.9
	8H	-	-	-	-	-	8HK	24	500	7.03	10.4
	8I	55	1.9	80	8.6	1.26	8IJ	12	320	1.26	6.21
	8J	55	2.4	80	8.2	1.61	8JK	12	320	4.75	11.1
	8K1	50	2.5	80	8.8	1.60	8KM	42	750	63.7	7.17
	8K2	60	8.4	80	9.2	5.75	-	-	-	-	-
	8K3	47	79.0	80	20	47.2	8K3K	30	360	47.2	9.56
	8L	47	3.7	80	9.0	2.33	8LM	12	450	2.32	8.69
	8M	47	6.9	80	9.9	4.39	8MO	42	170	70.2	8.75
	8N	90	1.6	80	6.4	1.29	8NO	12	670	1.28	3.42
	8O	60	7.1	80	11	4.82	8OP	42	70	76.2	9.06
9A	9A	55	1.8	90	9.0	1.78	9AB	12	220	1.37	6.84
	9B	58	3.6	82	9.0	2.51	9BE	15	380	3.88	8.75
	9C	60	4.0	83	9.6	2.84	9CE	12	460	2.83	5.39
	9D	60	1.5	86	7.0	1.10	9DE	12	220	1.10	3.75
	9E	60	3.7	86	8.8	2.72	9EF	21	260	10.5	7.37
	9F	55	5.7	85	10.1	3.33	9FG	21	260	13.8	5.00
	9G	55	3.3	83	8.8	2.28	9GL	24	444	16.1	8.37
	9H	90	2.0	83	7.3	1.65	9HJ	12	220	1.65	8.65
	9I	55	0.9	86	6.4	0.66	9IJ	12	240	0.66	4.14
	9J	55	2.4	86	7.3	1.80	9JL	15	260	4.10	10.2
	9K	55	1.9	86	8.2	1.39	9KL	15	260	1.39	7.83
	9L	55	2.1	86	7.3	1.59	9LN	27	280	23.0	5.70
	9M	55	2.9	83	8.5	2.05	9MN	12	444	2.04	7.76
	9N	55	2.9	86	8.2	2.12	9NP	30	280	27.1	7.06
	9O	55	2.6	86	8.8	1.88	9OP	12	400	1.88	6.80
	9P	55	1.3	86	7.3	0.97	9PR	30	460	29.8	5.51
	9Q	55	2.2	86	8.2	1.61	9QR	12	280	1.61	4.70
	9R	51	4.1	86	8.5	2.97	9RS	36	436	34.3	4.29
	9S	54	4.9	90	8.9	3.77	9ST	36	50	38.0	4.22

Table 7.1

Summary of Sub-basin Characteristics and Model Results

Basin	Drainage Zones	% Imp.	Area (ac)	PER CN	Tc (min)	Qp (cfs)	Pipe	Size (in)	Length (feet)	Qp (cfs)	Vd (fps)
9B	9U	50	4.1	86	9.3	2.94	9UW	12	600	2.92	4.54
	9V	60	4.3	86	8.5	3.26	9VW	12	280	3.24	3.83
	9W	50	1.8	86	7.8	1.27	9WX	18	70	7.44	5.02
10	10A	90	5.6	86	9.6	4.49	10AB	12	320	4.48	5.67
	10B	90	5.9	86	9.0	4.75	10BC	12	84	9.22	13.8
11	11A	55	1.4	80	6.4	0.97	11AB	12	260	0.97	6.89
	11B	69	2.3	83	6.9	1.70	11BC	15	320	2.67	4.16
	11C	61	3.7	83	8.8	2.64	11CD	18	480	5.29	3.84
	11D	69	2.2	80	8.5	1.63	11DE	18	180	6.91	11.7
	11E	80	3.2	80	8.2	2.46	11EF	18	320	9.37	13.7
	11F	40	4.0	80	9.3	2.41	11FG	24	260	11.8	11.8
12A	12A	90	2.9	83	8.2	2.34	12AB	12	260	2.34	10.5
	12B	90	1.2	80	6.4	0.96	12BC	12	600	3.30	9.26
	12C	40	2.2	86	6.4	1.53	12CD	15	200	4.82	4.16
12B	12E	70	1.8	80	8.2	1.32	12EF	12	352	1.31	9.67
13	13A	90	1.6	86	8.2	1.30	13AC	12	220	1.30	6.67
	13B	90	3.2	86	9.0	2.57	13BC	12	360	2.57	7.07
	13C	90	1.4	86	6.4	1.14	13CF	15	520	5.00	7.91
	13D	90	1.7	80	7.3	1.40	13DE	12	240	1.40	9.26
	13E	90	1.3	86	6.9	1.04	13EF	12	260	2.43	5.45
	13F	90	5.7	86	9.3	4.61	13FG	18	600	12.0	10.0
	13G	60	11.0	86	9.6	8.18	13GH	24	200	20.2	8.05
14A	14A	55	2.4	86	8.2	1.78	14AB	12	242	1.78	4.42
	14B	60	2.8	86	8.5	2.10	14BC	15	288	3.87	5.19
	14C	75	1.7	86	6.4	1.33	14CD	18	220	5.19	6.21
	14D	75	1.6	86	6.4	1.25	14DE	21	263	6.44	6.03
14B	14F	90	3.7	86	8.6	2.96	14FG	12	352	2.96	7.65
	14G	90	2.9	86	8.2	2.35	14GI	12	164	5.30	7.08
	14H	90	4.4	86	10.8	3.52	14HI	12	352	3.52	6.40
	14I	90	3.7	86	8.6	2.96	14IJ	18	220	11.8	6.34
16	16A	60	6.7	90	11	5.12	16AB	15	420	5.12	11.4
	16B	60	3.7	90	8.2	2.87	16BC	18	125	7.98	5.32
East 1	East 1	44.2	75	86	20	59.7	East McKay	42	1450	49.7	6.68

CHAPTER 8: PROPOSED SYSTEM IMPROVEMENTS

8.1 Introduction

This chapter summarizes improvements that are recommended for the City of North Plains stormwater management system. It should be noted that all the improvements recommended in this document are based on preliminary design information, and therefore, the level of design must be viewed as conceptual and preliminary. Each specific improvement will require a more detailed design analysis that will incorporate conditions present at each project location. Additional survey and field reconnaissance work will be required as part of all final design processes. In many instances a preliminary design report addressing a more detailed basin study and analysis may be warranted. The City of North Plains and the Unified Sewer Agency (CWS) should determine on a project by project basis the appropriate level of analysis.

8.2 The UnNamed Tributary to McKay Creek

As discussed in Section 3.2.4, the FEMA FIS conducted for the UnNamed Tributary to McKay Creek indicates some flooding of the areas adjacent to the tributary is due to undersized culverts and other channel restrictions. The culverts in this tributary are neither owned nor maintained by the City of North Plains, rather they are under the jurisdiction of Washington County.

The preliminary HEC-RAS analysis of the UnNamed Tributary, conducted as part of this Master Plan preparation, indicates that the high water and flooding of McKay Creek is the result of several factors that interact in a relatively complex manner. The backwater from McKay Creek during flood events exceeding a 10-year recurrence influences the lower portions of the UnNamed Tributary (below Pacific Avenue). Above Pacific Avenue to Gordon Road there are a number of hydraulic restrictions including: undersized culverts, poorly developed channel cross sections, and relatively flat channel grades. Although replacing specific culverts may reduce some local flooding, the interaction between all of these components is important. Replacement of a culvert in one area may transfer the flooding down stream and alter the current flood plain.

Storm system improvements, such as those proposed in this Master Plan, may be implemented only after an analysis of the impacts the improvement will have on the downstream system, including the receiving waters (the creeks). CWS may require correction to identified constrictions in the UnNamed Tributary, depending on the results of the downstream analysis.

The preliminary analysis indicates that significantly reducing flooding would require substantial channel improvements and culvert modifications along much of the UnNamed Tributary within the current UGB. As noted in Section 3.2.4, none of these improvements should be implemented without a comprehensive and detailed study of the tributary's hydraulics. Such a study will require collection of field data to update the existing FEMA hydraulic model. In addition, updated flow data should be collected for both the UnNamed Tributary and McKay Creek to reflect current flow and water surface elevations for each.

Improvements to the UnNamed Tributary must be coordinated with and authorized by Washington County, and are not the responsibility of the City of North Plains. For this reason they are not included as recommended improvement projects for the creek, nor are they included in the cost estimates for Level I or Level II improvements to the creek in Chapter 10.

8.3 Conveyance Improvements

Conveyance improvements for the City have been broken into two categories. Level I improvements include those improvements to the existing storm system that would alleviate existing problems due to existing system deficiencies. Level II improvements include those improvements that will be necessary to facilitate the development and land use utilization that are expected to occur in the City.

8.3.1 Level I Storm Sewer System Improvements

The Level I Improvements that are recommended to be implemented in the near future include the locations in the City's system that were identified as system deficiencies in Chapter 4, except those associated with modifications to the UnNamed Tributary (as discussed above, the UnNamed Tributary structures fall under the jurisdiction of Washington County). Priority for implementation of the Level I improvements should be given to locations where damage to buildings has occurred or where there is demonstrated potential for such damage to occur from flooding. Item 5 below falls under this priority. Other identified projects should be implemented based on the availability of funds, and as determined by City staff. The Level I recommended improvements are summarized below:

1. **Drainage Through Private Property (Demolition Yard):** The natural drainage pattern of the City carries stormwater from the north end of town south through private properties just west of NW Main Street. Newer residential developments north of Wasco Street have accommodated this drainage. It is reported that surface water runoff flows through the demolition yard on private property fronting NW Hillcrest and is conveyed through the site via hot water tanks laid end to end. While such a structure is unconventional for stormwater conveyance, it is even more unconventional to allow off-site stormwater runoff to enter and be conveyed through property used for demolition of automobiles, where there exists a high risk of water quality degradation.

   Recommendation: The surface runoff generated north of the subject site should be diverted away from its current route. The flows should be intercepted on Wasco Street and conveyed east toward Main Street where they can be conveyed to the UnNamed Tributary via the twin 12-inch storm pipes that are located on the east side of NW Main Street. The ditches on either side of Wasco Street should be regraded to convey the flow, which may require new driveway culverts.

2. **Culvert on East side of 314th Crossing NW Pacific:** City staff has noted that flooding occurs on the upstream side of this culvert.

   Recommendation: It is recommended that a larger culvert be installed at this crossing to convey the considerable volume of runoff that is generated north and northeast of, and that is ultimately conveyed through, the undersized culvert. The preliminary modeling efforts conducted for this study indicate that a 36-inch storm sewer will be required at this location.

3. **Drainage Through Private Property on NE Hillcrest:** Based on information provided by City staff, the natural drainage pattern of the City carries water from the north through an 8-inch pipe across private property. The 8-inch pipe does not have the capacity to accommodate the flows generated north of the crossing, which results in flooding of the area.

Recommendation: The roadside ditch that runs on the south side of Hillcrest should be regraded to divert the upland flow from entering this undersized pipe. The ditches could be regraded on the east side of the 8-inch pipe to divert the runoff toward Glencoe Road.

4. **West Ridge Residential Subdivision:** Runoff from the agricultural property west of NW 309th Street north of NW North Avenue reportedly bypasses the ditch inlets on the west side of 309th Street and flows overland through the subdivision on Brookings Court and NW Turel Drive.

   Recommendation: It is recommended that a ditch be regraded on the west side of 309th Street between NW Turell and NW North Avenue to direct runoff from the adjacent agricultural property to the existing ditch inlets. The existing ditch inlets should be lowered in conjunction with the grading to capture all the runoff from the western property.

5. **Flooded properties on South Side of Brookings Court:** The property owners located on the south side of Brookings Court have reported poor drainage of the properties, as well as flooding in their foundations and crawl spaces. The cause of the drainage problems is not entirely clear, but appears to be the result of the development's drainage system relative to the hydraulic grade line of the stormwater detention pond on adjacent property. Property owners are currently attempting to resolve the problem with the subdivision developer.

   Recommendation: It is recommended that the City conduct a review of the drainage design for the subdivision and the detention pond to confirm the cause of the flooding. A long-term solution to the problem may require basin-wide Level II Improvements.

8.3.2 Level II Storm System Improvements

The proposed Level II Improvements include the storm sewer network of pipes that were sized and located as part of the modeling processes discussed in Chapter 6. The recommended network is shown in Figure 7.1. The improvements recommended for each basin have been reviewed to determine estimated costs for design and construction. These estimates, by basin, are presented in Chapter 10.

It should be recognized that the need for many of these proposed facilities construction is dependent on projected long-term drainage requirements of the City and available funding. The need for any part of the overall system is subject to changing conditions within the city. The proposed systems should be periodically reviewed to evaluate whether conditions do or do not warrant construction, or whether basin conditions have changed enough to warrant modification to the projections. It is expected that many of these facilities may not be constructed in the foreseeable future. Some of them may not be constructed at all, depending upon conditions imposed by growth within the City's UGB and available funding.

The Level II improvements are intended to provide a citywide system of piped storm sewers from each of the current tax lots to appropriate receiving streams. The configuration of pipes, structures and associated improvements provide a logical and rational approach for serving existing properties but are preliminary and should be considered flexible in nature. Minor adjustments in alignment and configurations are likely to be made to accommodate specific topographic, utility, and easement or right-of-way constraints or limitations. Similarly, adjustments are likely to occur if actual development in the City varies from the projects made as part of this study.

It has been assumed that development of the proposed north and east expansion areas will occur in an orderly manner with construction of required storm sewer improvements paid for by private development. The construction of the associated improvements will be driven by the needs of private development. A preliminary layout has been established as part of this Stormwater Master Plan. This preliminary layout identifies the approximate configuration and pipe sizing necessary to meet the current development and design standards recommended in this report. However, subsequent basin analysis and design considerations associated with future development of these properties may identify more suitable configurations and pipe sizes. All proposed storm sewer designs for these areas should be based on detailed basin analysis and evaluated on a case by case basis.

8.4 Stormwater Detention

As noted previously in Section 6.1.5, when certain conditions are favorable, construction of regional detention facilities is preferred over construction of a series of smaller ponds and structures serving individual properties. The proposed layout of a citywide storm sewer system can facilitate inclusion of regional facilities in the vicinity of the UnNamed Tributary and McKay Creek. However, because implementation of regional detention will be dependent on cooperation and coordination with a number of private property owners, and will require significant up-front capital expenditure, the proposed configuration for a citywide storm sewer system also allows for other detention configurations.

No specific regional detention configuration is recommended by this Stormwater Master Plan. Storm water detention, if required, is prescribed by CWS regulations, but ultimately, the configuration, number, and location of any detention facilities will be dependent on the nature and timing of the development that occurs within the City, as well as any hydraulic topographic and environmental limitations that may exist.

8.5 Water Quality

CWS's preferences for water quality facilities are similar to those noted above for detention. Because the typical configurations are often similar to detention facilities, the limitations and possibilities noted are the same. Whenever conditions make it feasible, CWS and the City of North Plains will support regional or basin-wide treatment facilities. However, final location, sizing and configurations must be dependent on field topography and availability of land.

8.6 Aquatic Habitat Enhancement

8.6.1 Riparian Habitat

The State of Oregon has adopted the Oregon Plan for the protection of aquatic and riparian resources. Also, the National Marine Fisheries Service (NMFS) has listed Willamette River runs of steelhead trout and Chinook salmon as threatened and endangered. Future management of riparian areas needs to be consistent with these initiatives. NMFS has stated they will not apply "take" prohibitions to new developments governed by and conducted in accord with adequate city or county ordinances that NMFS has determined are sufficient to help conserve anadromous salmonids. To remain in harmony with these objectives, future development must include practices to protect and restore the riparian areas. These practices should include:

- Establishment and maintenance of high quality vegetative corridors bordering streams and wetlands;
- The addition of shade plants in riparian corridors;
- The provision of fish passage and riparian habitat continuity for culverts in sensitive riparian areas;
- Urban reserves or development sited in appropriate areas;
- Avoid stormwater discharge impacts to both water quality and quantity;
- Identify commitments to monitor and maintain detention basins;
- Protect historic stream meander patterns, floodplains and channel migration zones;
- Protect wetlands and the vegetation surrounding them;
- Promote landscapes that reduce need for watering, fertilizers, and pesticides;
- Prevent erosion and sediment runoff during and after construction by assuring adequate erosion prevention and sediment control for all construction projects;
- Assure water supply needs for new development can be met without adversely impacting stream flows needed for listed salmonids;
- Provides for enforcement, funding, monitoring, reporting, and implementation mechanisms to ensure development will comply with approved plans.

The practices listed above are either in the regulatory control of CWS, the State of Oregon, or the Federal government. The City of North Plains is in agreement with the introduction of these practices within the City; however, all regulatory control of these functions rests with other non-city agencies.

8.6.2 Fish Passage

The design and construction of culverts is under the jurisdiction of CWS or Washington County. For culverts with diameters of 36 inch or greater or for driveway culverts which are part of a roadside ditch system, the County is the jurisdictional agency, and their road design standards shall apply. Culverts within FEMA floodplains shall be reviewed and approved by Washington County, which is the local FEMA designated authority.

The current regulatory guidance is that all culverts shall be designed for fish passage unless otherwise approved by CWS or the County. For culverts which convey flows from or through sensitive riparian areas; a local representative of Oregon Department of Fish and Wildlife (ODFW) or other applicable state or federal agency should be contacted to determine if fish passage is required and to identify site specific design criteria.

Fish passage accommodation will also be required on any stream, regardless of size, perennial or intermittent, if fish utilizes it during a significant period of the year. Additionally, ODFW may require fish passage accommodations on any stream that has a history or the potential for fish production. Concomitantly, ODFW may require connectivity of riparian habitat in some areas. The design of culverts for both fish passage and riparian habitat connectivity should be in accordance with ODFW's design guidance.

CHAPTER 9: FINANCING ALTERNATIVES

9.1 Financing

Storm drainage projects are traditionally difficult to finance. Unlike other public works projects, there often is little funding assistance available through state or federal programs. Local support is typically also minimal unless the community has experienced some obvious and serious problems, and even then, the victims of inadequate drainage are often a minority of the area's voters and landowners.

Drainage facilities do not have continuous use, and when used they generally operate at less than full capacity. They must be sized, however, to provide protection against storm events that have a low recurrence frequency (the 25-year event) and consequently they can appear to be expensive relative to its level of use. As a result, it can be difficult to devise a revenue-generating plan for storm drainage projects that appears equitable, and that can be directly related to individual benefits. Some of the more commonly used methods of providing local drainage project financing are briefly discussed in this chapter.

9.2 Road Improvements

When projects are constructed in conjunction with State and/or County road improvement projects, the road authority generally bears the major portion of project costs. Local funds, if required, can be generated through one or more of the methods discussed in the following sections.

9.3 Improvement Districts

These projects benefit specific properties, which are can be classified has either public projects or private projects.

9.3.1 Public Projects

Public projects involve the formation of a local drainage improvement district by the City, for the purpose of a specific purpose or project. The City acts as the governing body of the district, and administers the work. The total cost of the project is apportioned among the benefited properties in the district, and levied as assessments or liens against the properties.

Local Improvement District (LID) or reimbursement districts are two common forms of improvement districts. LID's are an excellent method of developing and funding public capital improvements in a fair and equitable manner. However, consensus and support of all affected property owners is required and frequently difficult to achieve.

9.3.2 Private Projects

Private projects involve the subdivision of land for residential, commercial, or other purposes. Design and construction of the on-site drainage facilities is born by the developer, and is required to comply with the City's Stormwater Master Plan and CWS's Design and Construction Standards. The City can elect to participate in cost

sharing for some drainage facilities, if these facilities provide benefit to the general public and conform to the City's overall stormwater management plan.

9.4 General Funding

Projects funded through general funding typically are broad in scope, and serve overall municipal drainage needs. Generally, the benefits for such projects cannot be assigned solely to specific properties. To secure adequate funds for these projects, a municipal agency can borrow funds from traditional lending institutions by issuing bonds.

The bonds can be retired over a 10 to 25-year period using revenue generated from the utility improvement or from property taxes. A bond that is supported only by revenue from a utility is known as a revenue bond. A bond that is backed by property taxes is called a general obligation bond. With a revenue bond all that is pledged as security is the revenue of a utility, but with a general obligation bond, the voters of an area have, in fact, pledged their property as collateral.

General obligation bonds are relatively easy to sell, carry low interest rates, and offer some flexibility in the method of repayment. Even though property and property taxes back general obligation bonds, it is not mandatory that property taxes be used to retire the bonds. These bonds may be retired by building or connection fee revenues, as is the case with revenue bonds. Property taxes can be used when building or connection fees are not sufficient to meet current bond obligations.

The voters in a community must approve general obligation bonds. For drainage improvements, passage of a bond issue will probably require more voter education and encouragement than for some of the more direct service utilities, such as for water or sewer system improvements. The fact that some revenue for the bonds could come from future residents, through building or connection fees, could reduce the financial burden on current voters.

9.5 Systems Development Charges

Many Oregon communities collect systems development charges (SDCs) to assist with the funding of major municipal facilities. This charge is levied against new building developments, and does not typically affect existing residents of the city because existing buildings and developed lots can be exempted from the charge. The underlying theory is that new developments place an additional load on existing municipal facilities, and should therefore support the operation of these facilities.

SDCs are collected by CWS for new development within the City of North Plains, and are available to the City as a source of funding for future capital improvement projects. Specific projects must be identified by the City each year in order to be included as part of CWS's capital improvements budget. Coordination between the City and CWS is required on a yearly basis to identify the capital improvements projects proposed by the City and to get approval of the projects by CWS.

SDCs are commonly tied to the building permit fee, and are collected at the time of permit issuance. It is important to note that setting the SDC is not without limitations. If the charge is set too high, it can limit development within the community. If the charge is set too low, there will not be sufficient funds generated to support the improvements necessitated by the development(s).

By themselves, SDCs are a slow method for generating enough funds to undertake any substantial drainage improvements. In addition, there can be restrictions as the use and application of the funds. It is, therefore, prudent to look at the SDC as one of several revenue generating mechanisms for funding drainage capital improvements.

The City of North Plains has contracted with a financial analyst, who specializes in the evaluation of SDCs and funding options for public works projects. Ray Bartlett, of Financial and Economic Analysis, will be completing a study for the City after his review of this Stormwater Master Plan. A separate report will be prepared to summarize the study and financial analysis.

CHAPTER 10: STORMWATER CAPITAL IMPROVEMENTS PLAN

10.1 Introduction

This chapter provides estimated costs associated with implementation of the recommended stormwater system improvements, which were described in Chapter 8. As previously described, these improvements are recommended to accommodate projected future growth within the City of North Plains and to bring the existing stormwater system in line with current standards. In general the improvements are necessary because projections indicate that future development will generate stormwater runoff flows in excess of the hydraulic capacity of the existing facilities, and because many of the current conveyance structures and components are below acceptable standards and capacity.

The City anticipates utilizing SDCs collected by CWS from new development in anticipation of the increased impacts to the City's stormwater system. The SDCs are structured to fund improvements, as they are needed to accommodate growth. SDCs will not, however, provide sufficient funding necessary to construct all of the proposed improvements. Other financing mechanisms, as described in Chapter 9, will be necessary.

The following sections outline the recommended improvements to the system, summarize the priority for the recommended improvements, and present the associated cost estimates for the proposed projects.

10.2 Cost Estimate Scope

This study is based on a 20-year planning period, during which time it has been assumed that all land within the current UGB will be fully developed, and that the population projections identified in Chapter 5 will be fully realized. The storm system improvements identified in this report range from those that represent immediate needs to those that will only be necessary to accommodate projected growth and land use changes within the City.

10.3 Basis for Construction Cost Estimates

All costs presented herein are based on current construction practices and recent general bid pricing for similar work. The costs are presented in 2000 year dollars, but because construction and associated costs tend to escalate over time, they should be adjusted to account for inflation. The recommended method is to utilize the construction cost index prepared by Engineer News Record (ENR Index), which compiles data from 20 major U.S. cities into an index. This index is adjusted and published weekly.

The ENR index for this plan was selected to be 6198, as published in Engineering News Record in April 2000. Budget level estimates presented in this document should be adjusted for future projects by calculating the ratio of the ENR Index at the time of construction to 6198, and multiplying this ratio by the estimated project cost shown in this report. Although the ENR Index is not an absolute measure of trends in any particular area, it is widely recognized as a viable method for estimating the escalation of construction costs over time.

Costs for the construction of detention and treatment facilities do not easily fall within the framework of historical construction cost trends, because each tends to be site-specific. Where data for a specific size and configuration in available and appropriate, it was used to calculate a reasonable budget level estimate. As part of the revisions to

accommodate the proposed north and east expansion areas, the original cost estimates were updated to reflect the November 2001 ENR index of 6410.

In this report, costs have been grouped to represent total construction costs on a "per-foot complete" basis for the construction of pipelines. Included in these costs are pipe materials, excavation, pavement repair (where applicable), and other miscellaneous costs. Because these specific components are not broken out separately, the per-foot unit cost may seem higher than is seen in typical bid tabulations.

The process of estimating construction costs for this study resembles that of a "budget cost estimate", with the important difference being that some preliminary layout of the recommended system has been committed to paper. Because of the preliminary nature of the recommended projects, the accuracy of estimates included herein is believed to be on the order of plus or minus 15% of actual costs.

10.3.1 Soft Costs

For each construction project that is undertaken, certain "soft" costs will be necessary, which must be accounted for in the overall budget estimate. Experience with similar project estimates completed at this preliminary level of planning indicate that "soft" costs can be estimated with reasonable accuracy based on a percentage of the estimated construction costs. Soft costs included in the estimates include Engineering and Construction Management, Contingencies, and Legal and Administration costs. These costs are described below:

- ***Engineering and Construction Management:*** In addition to the preliminary design analysis, topographic surveying and engineering final design costs that are standard for these projects, competent construction services are critical to maintaining project control and keeping project construction costs to a minimum. This is particularly true for large public works projects where the selection of a construction contractor is based on the lowest responsible bid. Poor construction management and inspection can result in project overruns and poor construction. In extreme cases, public agencies have been left with incomplete or improperly constructed facilities without adequate records and legal recourse to correct the problems. Engineering and construction management are critical costs which must be anticipated and included when budgeting for all capital improvements projects.

The costs associated with engineering services include the following:

- Preliminary Engineering Studies and Pre-design Reports
- Geotechnical Investigations
- Design and Construction Surveys
- Design Documents (Plans, Specifications and Contract Documents)
- Construction Inspection
- Preparation of Record Drawings
- Operation and Maintenance Manuals
- Construction Management

- ***Contingencies:*** Contingencies must be provided at all levels of the project. At the planning or conceptual level, allowances must be made to accommodate the wide range of engineering and construction alternatives, which may be considered and necessary to solve a problem. At this level a construction contingency of 15 to 25% is not uncommon. As a project moves through preliminary design, final design and bidding, the project begins to gain more focus with progressively fewer variables, construction contingency amounts can be reduced accordingly. However, even a project with excellent planning, design and bidding will have unforeseen problems arise during the time of construction and some contingency must be included in the project construction financing. Construction contingencies after bid opening should typically be in the range of 5 to 10% depending on the complexity and size of the project.

- ***Legal and Administrative, Land and Right-of-Way Acquisition:*** All projects will include legal and administrative costs. These can come in the form of contract administration, contract review, grant administration, land or right-of-way acquisition, bond sales, property assessments and claims resolution. Projects which are funded through grants or bond sales, or those which require a significant amount of right-of-way acquisition will have correspondingly high legal and administrative costs.

10.3.2 Soft Cost Estimate

The factors we have included in our estimates of soft costs are summarized in Table 10.1. A total professional services and contingencies "soft cost" factor of 40% is applied to each of the project construction cost estimates made for this study.

Table 10.1

Estimated Construction Soft Costs

Description	*Estimated Percentage of Construction Cost*
Engineering Services:	15%
Construction Contingency:	15%
Legal and Administrative Costs:	5%
Land, Right-of-Way and Easement Acquisition:	5%
Total Percentage:	**40%**

10.4 Level I Storm Sewer System Improvements

The Level I Stormwater System Improvements are items that address deficiencies which meet one or more of the following concerns:

- Represent immediate problems that threaten public safety or private dwellings or businesses.
- Impact many properties.
- Require basin wide improvements to correct.
- Involve public facilities that are typically on a large scale.

Most of these are areas subject to high water where increasing significant culverts or drainage structures downstream will reduce or eliminate the problem.

It is not the intent of this report or any of the recommended improvements to eliminate all drainage problems throughout the study area for all storm and flood events. Identifying and correcting all occurrences of ponding and all driveway culverts that have become blocked or covered would be unnecessarily cumbersome. In most cases these are matters that are primarily the responsibility of the private property owner, or can be corrected through an aggressive annual maintenance program.

It is also important to note that the recommended improvements will not eliminate or lower the flood elevations in McKay Creek or the UnNamed Tributary. The flood water elevations are the result of an interaction of several hydraulic components in these streams. In many cases the high water levels are the result of downstream restrictions and/or tributary creeks outside of the study area.

However, none of the items identified in the Level I category of improvements address hydraulic restrictions in the UnNamed Tributary. They are included in this report but as noted in Section 8.2 must be addressed with caution and in a comprehensive basin wide manner to insure that increasing the hydraulic capacity of these deficiencies does not create additional flood plain area and flooding downstream. The flood elevations and storage patterns are well established inside the study area and altering these will help some property owners but may have negative impacts on others. For this reason, modifications to existing culverts and drainage structures in either McKay Creek or the UnNamed Tributary require a detailed analysis of the Flood Plain and Floodway including, at a minimum, hydraulic modeling using the HEC-RAS (HEC-II) computer model. In many instances this will also require requesting and modifying the FEMA defined Floodplain and Floodway Maps. This process can be lengthy and expensive particularly if the modifications are significant.

Table 10.2

Level I Storm Sewer System Improvements

Item No.	*Description*	*Cost Estimate*
1	Regrade ditch on Wasco Street to Main Street to divert stormwater from private property containing the demolition yard.	$209,302
2.	Install 36-inch storm sewer crossing Pacific Street on 314th Street to UnNamed Tributary.	$152,338
3.	Regrade ditches on the east side of NE Hillcrest towards Glencoe Road.	$ 15,513
4.	Regrade ditch and reset inlets, as needed, along 309th Street west of the West Ridge Residential Subdivision.	$ 21,718
5.	Conduct engineering study of hydraulics and design and construction modifications of the stormwater detention facility south of the properties on Brookings Court.	$190,293
	Total	**$589,164**

10.5 Level II Storm Sewer System Improvements

The Level II Storm Sewer System Improvements consist of a proposed system of storm sewers to serve the Study Area (UGB). The proposed layout is conceptual and is intended to provide a network of storm sewers to serve all areas of the Study Area in an efficient and economical manner. The proposed improvements and approximate pipe sizes are shown on Figure 7.1. Quantity takeoffs for the proposed alignments were completed and are summarized basin by basin in Table 10.3

TABLE 10.3

Level II Storm Sewer Improvements

Item	Description	Total Estimated Cost
BASIN 1 STORM SEWER IMPROVEMENTS		
1	Mobilization and Bonding	$15,500.00
2	Storm Sewer Mainline	$183,668.00
3	Manholes and Catchbasins	$36,144.00
4	Storm Water Detention and Treatment Facilities	$67,200.00
5	Miscellaneous Improvements	$10,100.00
	Subtotal	*$312,612.00*
	Total Soft Costs and Contingencies @40%	*$125,044.80*
	TOTAL BASIN 1 IMPROVEMENTS	$437,656.80
BASIN 2 STORM SEWER IMPROVEMENTS		
1	Mobilization and Bonding	$8,500.00
2	Storm Sewer Mainline	$58,520.00
3	Manholes and Catchbasins	$17,040.00
4	Storm Water Detention and Treatment Facilities	$67,200.00
5	Miscellaneous Improvements	$10,100.00
	Subtotal	*$161,360.00*
	Total Soft Costs and Contingencies @40%	*$64,544.00*
	TOTAL BASIN 2 IMPROVEMENTS	$225,904.00
BASIN 3 STORM SEWER IMPROVEMENTS		
1	Mobilization and Bonding	$14,500
2	Storm Sewer Mainline	$133,238.00
3	Manholes and Catchbasins	$20,064.00
4	Storm Water Detention and Treatment Facilities	$67,200.00
5	Miscellaneous Improvements	$3,850.00
	Subtotal	*$238,852.00*
	Total Soft Costs and Contingencies @40%	*$95,540.80*
	TOTAL BASIN 3 IMPROVEMENTS	$334,392.80
BASIN 4 STORM SEWER IMPROVEMENTS		
1	Mobilization and Bonding	$30,000.00
2	Storm Sewer Mainline	$168,276.00
3	Manholes and Catchbasins	$63,192.00
4	Storm Water Detention and Treatment Facilities	$67,200.00
5	Miscellaneous Improvements	$7,600.00
	Subtotal	*$336,268.00*
	Total Soft Costs and Contingencies @40%	*$134,507.20*
	TOTAL BASIN 4 IMPROVEMENTS	$470,775.20

TABLE 10.3

Level II Storm Sewer Improvements

Item	Description	Total Estimated Cost
BASIN 5 STORM SEWER IMPROVEMENTS		
1	Mobilization and Bonding	$17,000.00
2	Storm Sewer Mainline	$212,524.00
3	Manholes and Catchbasins	$53,208.00
4	Storm Water Detention and Treatment Facilities	$67,200.00
5	Miscellaneous Improvements	$8,850.00
	Subtotal	*$358,782.00*
	Total Soft Costs and Contingencies @40%	*$143,512.80*
	TOTAL BASIN 5 IMPROVEMENTS	$502,294.80
BASIN 6 STORM SEWER IMPROVEMENTS		
1	Mobilization and Bonding	$64,000
2	Storm Sewer Mainline	$769,424.00
3	Manholes and Catchbasins	$177,600.00
4	Storm Water Detention and Treatment Facilities	$67,200.00
5	Miscellaneous Improvements	$21,350.00
	Subtotal	*$1,099,574.00*
	Total Soft Costs and Contingencies @40%	*$439,829.60*
	TOTAL BASIN 6 IMPROVEMENTS	$1,539,403.60
BASIN 7 STORM SEWER IMPROVEMENTS		
1	Mobilization and Bonding	$8,000.00
2	Storm Sewer Mainline	$71,256.00
3	Manholes and Catchbasins	$20,064.00
4	Storm Water Detention and Treatment Facilities	$67,200.00
5	Miscellaneous Improvements	$5,100.00
	Subtotal	*$171,620.00*
	Total Soft Costs and Contingencies @40%	*$68,648.00*
	TOTAL BASIN 7 IMPROVEMENTS	$240,268.00
BASIN 8 STORM SEWER IMPROVEMENTS		
1	Mobilization and Bonding	$45,000.00
2	Storm Sewer Mainline	$501,000.00
3	Manholes and Catchbasins	$115,416.00
4	Storm Water Detention and Treatment Facilities	$67,200.00
5	Miscellaneous Improvements	$5,100.00
	Subtotal	*$733,716.00*
	Total Soft Costs and Contingencies @40%	*$293,486.40*
	TOTAL BASIN 8 IMPROVEMENTS	$1,027,202.40

TABLE 10.3

Level II Storm Sewer Improvements

Item	Description	Total Estimated Cost
BASIN 9 STORM SEWER IMPROVEMENTS		
1	Mobilization and Bonding	$44,000
2	Storm Sewer Mainline	$650,072.00
3	Manholes and Catchbasins	$140,496.00
4	Storm Water Detention and Treatment Facilities	$67,200.00
5	Miscellaneous Improvements	$10,100.00
	Subtotal	*$911,868.00*
	Total Soft Costs and Contingencies @40%	*$364,747.20*
	TOTAL BASIN 9 IMPROVEMENTS	$1,276,615.20
BASIN 10 STORM SEWER IMPROVEMENTS		
1	Mobilization and Bonding	$7,500.00
2	Storm Sewer Mainline	$30,032.00
3	Manholes and Catchbasins	$15,048.00
4	Storm Water Detention and Treatment Facilities	$67,200.00
5	Miscellaneous Improvements	$3,850.00
	Subtotal	*$123,630.00*
	Total Soft Costs and Contingencies @40%	*$49,452.00*
	TOTAL BASIN 10 IMPROVEMENTS	$173,082.00
BASIN 11 STORM SEWER IMPROVEMENTS		
1	Mobilization and Bonding	$16,000.00
2	Storm Sewer Mainline	$170,670.00
3	Manholes and Catchbasins	$42,168.00
4	Storm Water Detention and Treatment Facilities	$67,200.00
5	Miscellaneous Improvements	$3,850.00
	Subtotal	*$299,888.00*
	Total Soft Costs and Contingencies @40%	*$119,955.20*
	TOTAL BASIN 11 IMPROVEMENTS	$419,843.20
BASIN 12 STORM SEWER IMPROVEMENTS		
1	Mobilization and Bonding	$9,000
2	Storm Sewer Mainline	$97,736.00
3	Manholes and Catchbasins	$23,064.00
4	Storm Water Detention and Treatment Facilities	$67,200.00
5	Miscellaneous Improvements	$3,850.00
	Subtotal	*$200,850.00*
	Total Soft Costs and Contingencies @40%	*$80,340.00*
	TOTAL BASIN 12 IMPROVEMENTS	$281,190.00

TABLE 10.3

Level II Storm Sewer Improvements

Item	Description	Total Estimated Cost
BASIN 13 STORM SEWER IMPROVEMENTS		
1	Mobilization and Bonding	$18,000.00
2	Storm Sewer Mainline	$202,400.00
3	Manholes and Catchbasins	$55,224.00
4	Storm Water Detention and Treatment Facilities	$67,200.00
5	Miscellaneous Improvements	$10,100.00
	Subtotal	*$352,924.00*
	Total Soft Costs and Contingencies @40%	*$141,169.60*
	TOTAL BASIN 13 IMPROVEMENTS	$494,093.60
BASIN 14 STORM SEWER IMPROVEMENTS		
1	Mobilization and Bonding	$16,000.00
2	Storm Sewer Mainline	$177,863.00
3	Manholes and Catchbasins	$62,256.00
4	Storm Water Detention and Treatment Facilities	$67,200.00
5	Miscellaneous Improvements	$7,600.00
	Subtotal	*$330,919.00*
	Total Soft Costs and Contingencies @40%	*$132,367.60*
	TOTAL BASIN 14 IMPROVEMENTS	$463,286.60
BASIN 16 STORM SEWER IMPROVEMENTS		
1	Mobilization and Bonding	$6,500.00
2	Storm Sewer Mainline	$45,836.00
3	Manholes and Catchbasins	$15,048.00
4	Storm Water Detention and Treatment Facilities	$67,200.00
5	Miscellaneous Improvements	$5,100.00
	Subtotal	*$139,684.00*
	Total Soft Costs and Contingencies @40%	*$55,873.60*
	TOTAL BASIN 16 IMPROVEMENTS	$195,557.60
TOTAL CAPITAL IMPROVEMENT PROGRAM		**$8,081,565.80**
BASIN EAST 1 STORM SEWER IMPROVEMENTS		
1	Mobilization and Bonding	$25,000.00
2	Storm Sewer Mainline	$210,250.00
3	Manholes and Catchbasins	$10,000.00
4	Storm Water Detention and Treatment Facilities	$0.00
5	Miscellaneous Improvements	$0.00
	Subtotal	*$245,250.00*
	Total Soft Costs and Contingencies @40%	*$98,100.00*
	TOTAL BASIN EAST 1 IMPROVEMENTS	$343,350.00

(1) Project soft costs include: Engineering, Legal and Administration, Land Easement and R.O.W.

(2) Project Contingency includes a 15% construction cost contingency.

Appendix A

Water Quality Raw Data

USA Water Quality Data
McKay Creek
30-Aug-99

		Parameter Number:	3	5	10	61	65	76	95	340	403	410	500	515	530	535	610	615	620	625	630	665
			DEPTH	TIME		FLOW-INT	GAUGE_HT	TURBIDITY	COND-LAB	T-COD	PH-LAB	T-ALK-CACO3	TS	TDS	TSS	TVSS		NO2-N	NO3-N	TKN	NO2NO3-N	T-PO4-P
SAMPLE	SDATE	TYPE	PROJ	FEET	24-HR	DEG C	CFS	FEET	NTU	UMHO	MG/L	PH	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L
McKay Creek - Sunset Hwy																						
8902030	06/13/89	GRIT	AG01	2.5	10.2												0.06			0.46	0.34	0.1
8902177	06/27/89	GRIT	AG01	2	10.1												0.1			0.29	0.29	0.11
8902197	07/11/89	GRIT	AG01	2.5	10.05												0.08			0.27	0.304	0.056
8902372	07/25/89	GRIT	AG01	1.7	10.12												0.088			0.32	0.2	0.072
8902561	08/08/89	GRIT	AG01	1.2	10.09												0.08			0.37	0.24	0.091
8902806	08/22/89	GRIT	AG01	2.1	10												0.04			0.38	0.2	0.13
8903160	09/06/89	GRIT	AG01	2.25	9.58	15											0.044			0.32	0.166	0.09
8903369	09/19/89	GRIT	AG01	2	9.3												0.036			1.35	0.006	0.85 Q
8903506	10/03/89	GRIT	AG01	2.75	10.11	15											0.074			0.71	0.041	0.155
8903913	10/17/89	GRIT	AG01	2.75	9.41	11											0.027			0.3	0.055	0.08
8904207	10/31/89	GRIT	AG01	3.06	10.18	9											0.044			0.48	0.297	0.06
9001744	05/23/90	GRIT	AG01	2.9	10.32	13				78		7.6		84	80	4	0.033			0.37	0.348	0.06
9001870	06/06/90	GRIT	AG01	3	10.08	14				67		7.5		74	67.3	6.7	0.051			0.39	0.503	0.062
9002102	06/20/90	GRIT	AG01	2.5	9.55	16				74		7.5		108	99.1	8.92	0.055			0.25	0.366	0.09
9002341	07/11/90	GRIT	AG01	2.1	8.59					90		7.4		100	93.2	6.8	0.067			0.26	0.339	0.08
9002657	07/18/90	GRIT	AG01	2.2	9.41	16				109		7.7		100	96	4.04	0.079			0.5	0.351	0.138
9002813	08/01/90	GRIT	AG01	1.9	10.13	18				124		7.5		124	118	5.76	0.073			0.45	0.554	0.104
9003135	08/15/90	GRIT	AG01	1.8	10.23	18				180		7.3		166	153	12.7	0.025			1.1	0.01 Q	0.552 Q
9003491	08/29/90	GRIT	AG01	2.2	9.23	17				108		7.5		92	87.9	4.12	0.182			0.72	0.142	0.114
9003764	09/12/90	GRIT	AG01	2	10.16	16				113		7.6		116	114	1.76	0.1				0.142	
9004083	09/26/90	GRIT	AG01	1.8	10.21	15				123		7.3		116	110	5.84	0.087			0.41	0.136	0.11
9004392	10/10/90	GRIT	AG01	3	10.01	9				96		7.5		94	90	4.16	0.036			0.34	0.11	0.128
9004706	10/24/90	GRIT	AG01	2.2	10.31	8				89		7.4		120	117	2.52	0.049			0.34	1.34	0.114
McKay Creek - Northrup Road																						
9103860	07/11/91	GRIT	AG01							68	4	7.3		84	83	0.6	0.045	0.002 E	0.349 E	0.28	0.351	0.05
9103861	07/25/91	GRIT	AG01	1.1	7.5	15				72		7.5		66	66	0.48	0.038	0.005 E	0.025 E	0.37	0.33	0.013
9104072	08/08/91	GRIT	AG01		9.31	16	5.18	1.94		76	2	7.5		64	63	0.74	0.052	0.001 L	0.209 E	0.1	0.21	0.02
9104499	08/22/91	GRIT	AG01	1.8	10.02	16				167	16.4	7.9		170	166	4.4	0.046	0.004	0.25	0.57	0.254	0.2
9104935	09/05/91	GRIT	AG01		9.15		4.35	1.89		79	1 L	7.4		80	76	3.64	0.027	0.039	0.22	0.15	0.259	0.027
9105286	09/19/91	GRIT	AG01		9.46	14	3.52	1.83		83		7.6		72	69	2.94	0.02 E	0.005	0.204		0.209	0.061
9105703	10/03/91	GRIT	AG01		10.02	10	3.52	1.83		82		7.4		82	65	16.7	0.015	0.004	0.198	0.2	0.202	0.157
9106298	10/17/91	GRIT	AG01		8.36	8	3.39	1.82		86		7.6		106	103	2.96	0.024	0.004	0.149		0.153	0.155
9106569	10/31/91	GRIT	AG01		10.07	4	4.51	1.9		79		7.3		80	78	1.74	0.029	0.002 L	0.259 E		0.261	0.068
9202119	04/14/92	GRIT	AG01		10.09	10	21.1	2.38	2.8	54	5 L	7.2		54	52	2	1.2	0.017 L			0.25 L	0.705	0.033
9204690	07/28/92	GRIT	FD01		10.55	16	2.11 E	1.72 E	1.6	82	7.8	7.4		66	64	1.8		0.025 E			0.25 L	0.146	0.058
9301825	05/04/93	GRIT	AG01		9.29	8	76.6	3.09	3.1	41	5 L	7.2	14	56	53	3.2		0.012 L	0.005 L	1.02	0.122 E	1.02	0.029
9301918	05/18/93	GRIT	AG01		8.03	12.5	27.1	2.49	3.2	45	6.1 E	7.2	18.5	60	56	3.8		0.029	0.01 L	0.757 E	0.1 L	0.767	0.02 L
9302239	06/01/93	GRIT	AG01		8.01	11.5	76.6	3.09	5.6	38	14	7.1	17.6	64	56	8.2		0.013 E	0.01 L	0.797 E	0.202	0.807	0.035
9302630	06/15/93	GRIT	AG01		9.13	12.5	21.6	2.39	5.5	49	7.2 E	7.4	20.8	76	52	23.6		0.012 L	0.01 L	0.636 E	0.227	0.646	0.049
9303014	06/29/93	GRIT	AG01		9.05	11	12.2	2.18	2.1	52	5 L	7.4	25.1	66	64	1.6		0.012 L	0.01 L	0.436 E	0.11 E	0.446	0.028
9303378	07/13/93	GRIT	AG01		9.25	11.5	7.6	2.04	2.3	61	5 L	7.6	29.4	60	58	1.8		0.01 L	0.01 L	0.319 E	0.166	0.329	0.024
9303758	07/27/93	GRIT	AG01		10.18	13.5	6.6	2	2.4	68	11	7.6	31	72	70	2		0.02 L	0.01 L	0.274 E	0.214	0.284	0.029
9304070	08/10/93	GRIT	AG01		8.4	13.5	5.6	1.96	3	71	6.7 E	7.5	32.4	68	66	2		0.018 E	0.01 L	0.212 E	0.156 E	0.222	0.058
9304455	08/24/93	GRIT	AG01		9.03	12	5.3	1.95	2.8	75	5.2 E	7.5	35.4	76	74	2.4		0.01 L	0.01 L	0.097 E	0.117 E	0.107	0.03
9304861	09/07/93	GRIT	AG01		7.1	14	4.3	1.9	2.8	81	7 E	7.5	36.7	66	64	1.6		0.02 L	0.01 L	0.223 E	0.119 E	0.233	0.038
9305261	09/21/93	GRIT	AG01		7.25	8	4.1	1.89	2.4	79	5 L	7.5	38.7	82	80	2		0.02 L	0.01 L	0.136 E	0.151	0.146	0.033
9305638	10/05/93	GRIT	AG01		7.37	11	2.8	1.82	2.7	86	5.7 E	7.7	39.1	84	82	2.4		0.02 L	0.01 L	0.14 E	0.271	0.15	0.045
9306014	10/19/93	GRIT	AG01		7.4	9	4.7	1.92	2.5	82	5 L	7.6	36.6	90	88	2		0.02 L	0.01 L	0.18 E	0.118 E	0.19	0.025

USA Water Quality Data
McKay Creek
30-Aug-99

			Parameter Number:	671	900	916	927	929	937	940	1002	1007	1012	1022	1027	1034	1037	1042	1045	1051	1055	1059	1062
				S-OPO4-P	HRD-CACO3	T-CA	T-MG	T-NA	T-K	CHLORIDE	T-AS	T-BA	T-BE	T-B	T-CD	T-CR	T-CO	T-CU	T-FE	T-PB	T-MN	T-TL	T-MO
SAMPLE	SDATE	TYPE	PROJ	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
McKay Creek - Sunset Hwy																							
8902030	06/13/89	GRIT	AG01	0.015																			
8902177	06/27/89	GRIT	AG01	0.023																			
8902197	07/11/89	GRIT	AG01	0.018																			
8902372	07/25/89	GRIT	AG01	0.031																			
8902561	08/08/89	GRIT	AG01	0.029																			
8902806	08/22/89	GRIT	AG01	0.022																			
8903160	09/06/89	GRIT	AG01	0.024																			
8903369	09/19/89	GRIT	AG01	0.26																			
8903506	10/03/89	GRIT	AG01	0.052																			
8903913	10/17/89	GRIT	AG01	0.024																			
8904207	10/31/89	GRIT	AG01	0.025																			
9001744	05/23/90	GRIT	AG01	0.011																			
9001870	06/06/90	GRIT	AG01	0.012																			
9002102	06/20/90	GRIT	AG01	0.015																			
9002341	07/11/90	GRIT	AG01	0.023																			
9002657	07/18/90	GRIT	AG01	0.036																			
9002813	08/01/90	GRIT	AG01	0.018																			
9003135	08/15/90	GRIT	AG01	0.13																			
9003491	08/29/90	GRIT	AG01	0.059																			
9003764	09/12/90	GRIT	AG01	0.038																			
9004083	09/26/90	GRIT	AG01	0.038																			
9004392	10/10/90	GRIT	AG01	0.023																			
9004706	10/24/90	GRIT	AG01	0.013																			
McKay Creek - Northrup Road																							
9103860	07/11/91	GRIT	AG01	0.02						2.05													
9103861	07/25/91	GRIT	AG01	0.027		5.144		4.471	1.039	2.15		21.01	0.025 U		0.38 E	1.58 E	0.1 U	1.62	304.9	1.5 U		5.68 E	
9104072	08/08/91	GRIT	AG01	0.02						2.12													
9104499	08/22/91	GRIT	AG01	0.099		14.86	5.77	7.79	1.84	6	4.41	30.08	0.02 U		1.1 E	1.69 E	0.56 E	3.9	1394	1.5 U		1 U	
9104935	09/05/91	GRIT	AG01	0.034						3.1													
9105286	09/19/91	GRIT	AG01	0.031		6.942	2.609	4.921	1.456	3.5	0.2541 Q	22.09	0.02 U		0.18 U	0.5 E	0.1 U	0.69 E	2.59	1.5 U		1 U	
9105703	10/03/91	GRIT	AG01	0.018						1.8													
9106298	10/17/91	GRIT	AG01	0.022		6.159	2.812	4.46	1.295	2.03	1.897	21.4	0.02 U		0.18 U	3.86	0.3 E	3.19	320.8	1.5 U		1 U	
9106569	10/31/91	GRIT	AG01	0.011						2.35													
9202119	04/14/92	GRIT	AG01	0.015 L						2.13													
9204690	07/28/92	GRIT	FD01	0.024 E						2.15													
9301825	05/04/93	GRIT	AG01	0.01 L	11.3	2.64	1.14	2.66	0.594 E	2.2	3.44 U	12.2	0.04 E	6.55	0.4 U	3.08 E	0.36 U	4.3	399	3.48 U	10.5	2.89 U	0.6 U
9301918	05/18/93	GRIT	AG01	0.016 E						1.97													
9302239	06/01/93	GRIT	AG01	0.018 E	12.2	2.86	1.24	2.5	0.465 E	2.38	3.44 U	14.2	0.01 U	2.91	1.18 E	10.2	0.68 E	4.38	106	3.48 U	32.5	2.89 U	0.6 U
9302630	06/15/93	GRIT	AG01	0.014 E						1.86													
9303014	06/29/93	GRIT	AG01	0.01 L						1.96													
9303378	07/13/93	GRIT	AG01	0.016 E	14.6	3.51	1.41	2.7	0.09 U	1.88	3.43 U	12	0.01 U	4.6 E	0.4 U	4.8	0.36 U	16	323	3.47 U	13.9	2.89 U	0.7 E
9303758	07/27/93	GRIT	AG01	0.014 E						2.04													
9304070	08/10/93	GRIT	AG01	0.018 E	21.7	4.98	2.26	4.1	0.959	1.8	3.44 U	20	0.01 U	14.5	0.4 U	4.74 E	0.38 E	3.4	495	3.48 U	25.8	2.89 U	0.6 U
9304455	08/24/93	GRIT	AG01	0.019 E						2.1													
9304861	09/07/93	GRIT	AG01	0.022 E	23.1	5.26	2.43	3.98	1.28	1.77	3.12 U	20.8	0.04 U	13.1	0.38 U	2.34 E	0.38 U	3.6 E	451	1.8 U	28.8	3.14	0.38 U
9305261	09/21/93	GRIT	AG01	0.016 E						2.11													
9305638	10/05/93	GRIT	AG01	0.024 E	26.1	5.85	2.78	4.18	1.54	2.27	3.12 U	22.8	0.08 E	12.4	0.38 U	1.5 E	0.38 U	2.36 E	503	3.74 E	33.8	3.14 U	
9306014	10/19/93	GRIT	AG01	0.013 E						2.26													0.38 U

USA Water Quality Data
McKay Creek
30-Aug-99

			Parameter Number:	1067	1077	1087	1092	1097	1105	1147	31613	31639	31648
				T-NI	T-AG	T-V	T-ZN	T-SB	T-AL	T-SE	F-COL-AGAR	ENTEROCOCCI	E-COLI.-MF
SAMPLE	SDATE	TYPE	PROJ	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	/100ML	/100ML	/100ML
McKay Creek - Sunset Hwy													
8902030	06/13/89	GRIT	AG01										
8902177	06/27/89	GRIT	AG01										
8902197	07/11/89	GRIT	AG01										
8902372	07/25/89	GRIT	AG01										
8902561	08/08/89	GRIT	AG01										
8902806	08/22/89	GRIT	AG01										
8903160	09/06/89	GRIT	AG01										
8903369	09/19/89	GRIT	AG01										
8903506	10/03/89	GRIT	AG01										
8903913	10/17/89	GRIT	AG01										
8904207	10/31/89	GRIT	AG01										
9001744	05/23/90	GRIT	AG01										
9001870	06/06/90	GRIT	AG01										
9002102	06/20/90	GRIT	AG01										
9002341	07/11/90	GRIT	AG01										
9002657	07/18/90	GRIT	AG01										
9002813	08/01/90	GRIT	AG01										
9003135	08/15/90	GRIT	AG01										
9003491	08/29/90	GRIT	AG01										
9003764	09/12/90	GRIT	AG01										
9004083	09/26/90	GRIT	AG01										
9004392	10/10/90	GRIT	AG01										
9004706	10/24/90	GRIT	AG01										
McKay Creek - Northrup Road													
9103860	07/11/91	GRIT	AG01										
9103861	07/25/91	GRIT	AG01	7.58	0.4 U	3.08	24.02	0.7 U	162.9	3.22 E			
9104072	08/08/91	GRIT	AG01										
9104499	08/22/91	GRIT	AG01	3.29	0.4 U	5.39	4.98	7 U	227.4	1 U			
9104935	09/05/91	GRIT	AG01										
9105286	09/19/91	GRIT	AG01	2.86	0.4 U	0.64 E	2.19	0.7 U	0.1 U	1 U			
9105703	10/03/91	GRIT	AG01										
9106298	10/17/91	GRIT	AG01	2.04 E	0.4 U	2.34	2.48	0.7 U	40.26	1 U			
9106569	10/31/91	GRIT	AG01										
9202119	04/14/92	GRIT	AG01										
9204690	07/28/92	GRIT	FD01										
9301825	05/04/93	GRIT	AG01	1.52 E	0.6 U	1.5 E	8.98	2.36 U	225	3.7 U	40 E	4 L	12 E
9301918	05/18/93	GRIT	AG01								40	80	16 E
9302239	06/01/93	GRIT	AG01	15.3	0.6 U	0.4 U	15.3	2.36 U	358	3.7 U	83	300 G	52
9302630	06/15/93	GRIT	AG01								34 E	24 E	36 E
9303014	06/29/93	GRIT	AG01								40 E	97	24 E
9303378	07/13/93	GRIT	AG01	11 E	0.6 U	1.65 E	6.62	2.36 U	101	5.04 E	80	44	52
9303758	07/27/93	GRIT	AG01								99	52	100
9304070	08/10/93	GRIT	AG01	2.96 E	0.6 U	2.71 E	13.9	2.36 U	184	3.7 U	300 G	160	300 G
9304455	08/24/93	GRIT	AG01								170 E	290	220 E
9304861	09/07/93	GRIT	AG01	1 U	0.65 U	2.78 E	6.05	2.95 U	124	2.76 U	160	290	110 E
9305261	09/21/93	GRIT	AG01								80 E	420	88 E
9305638	10/05/93	GRIT	AG01	1.04 U	0.65 U	2.98 E	7.76	2.95 U	139	2.76 U	220	1200 G	150
9306014	10/19/93	GRIT	AG01								52 E	680	52 E

USA Water Quality Data
Remark & Parameter Codes

Remark Codes

USA	EPA	Description	Explanation
E	J	ESTIMATE	ESTIMATED VALUE
G	L	GREATER THAN	ACTUAL VALUE IS KNOWN TO BE GREATER THAN VALUE GIVEN
L	K	LESS THAN	ACTUAL VALUE IS KNOWN TO BE LESS THAN VALUE GIVEN
Q		QUESTIONABLE	QUESTIONABLE VALUE, POOR QUALITY CONTROL
U	U	NOT DETECTED	INDICATES MATERIAL WAS ANALYZED FOR BUT NOT DETECTED
X		ABNORMAL	ABNORMAL VALUE - RESULT VERIFIED.

Parameter

Code	Analysis	Title	Units
3	VERT-DEPTH	SAMPLE LOCATION - VERTICAL DEPTH	FEET
5	TIME	TIME	24-HR
10	TEMP-C	TEMPERATURE- DEGREES CENTIGRADE	DEG
61	FLOW-INT	FLOW-INSTANTANEOUS	CFS
65	GAUGE_HEIGHT	GAUGE HEIGHT	FEET
76	TURBIDITY	TURBIDITY	NTU
95	COND-LAB	CONDUCTIVITY IN LAB	UMHO
340	T-COD	TOTAL CHEMICAL O2 DEMAND	MG/L
403	PH-LAB	PH-GRAB IN LABORATORY	PH
410	T-ALK-CACO3	TOTAL ALKALINITY CACO3	MG/L
500	TS	TOTAL SOLIDS	MG/L
515	TDS	TOTAL DISSOLVED SOLIDS	MG/L
530	TSS	TOTAL SUSPENDED SOLIDS	MG/L
530	TVSS	TOTAL VOLATILE SUSPENDED SOLIDS	MG/L
610	NH3-N	AMMONIA NITROGEN	MG/L
615	NO2-N	NITRITE NITROGEN	MG/L
620	NO3-N	NITRATE NITROGEN	MG/L
625	TKN	TOTAL KJELDAHL NITROGEN	MG/L
630	NO2NO3-N	NITRITE/NITRATE NITROGEN	MG/L
665	T-PO4-P	TOTAL PHOSPHATE AS PHOSPHORUS	MG/L
671	S-OPO4-P	SOLUBLE ORTHO-PHOSPHATE	MG/L
900	HRD-CACO3	HARDNESS AS CALCUIM CARBONATE	MG/L
916	T-CA	TOTAL CALCIUM	MG/L
927	T-MG	TOTAL MAGNESIUM	MG/L
929	T-NA	TOTAL SODIUM	MG/L
937	T-K	TOTAL POTASSIUM	MG/L
940	CHLORIDE	CHLORIDE	MG/L
1002	T-AS	TOTAL ARSENIC	UG/L
1007	T-BA	TOTAL BARIUM	UG/L
1012	T-BE	TOTAL BERYLLIUM	UG/L
1022	T-B	TOTAL BORON	UG/L
1027	T-CD	TOTAL CADMIUM	UG/L
1034	T-CR	TOTAL CHROMIUM	UG/L
1037	T-CO	TOTAL COBALT	UG/L
1042	T-CU	TOTAL COPPER	UG/L
1045	T-FE	TOTAL IRON	UG/L
1051	T-PB	TOTAL LEAD	UG/L
1055	T-MN	TOTAL MANGANESE	UG/L
1059	T-TL	TOTAL THALLIUM	UG/L
1062	T-MO	TOTAL MOLYBDENUM	UG/L
1067	T-NI	TOTAL NICKEL	UG/L
1077	T-AG	TOTAL SILVER	UG/L
1087	T-V	TOTAL VANADIUM	UG/L
1092	T-ZN	TOTAL ZINC	UG/L
1097	T-SB	TOTAL ANTIMONY	UG/L
1105	T-AL	TOTAL ALUMINUM	UG/L
1147	T-SE	TOTAL SELENIUM	UG/L
31613	F-COL-AGAR	FECAL COLIFORM AGAR	/100ML
31639	ENTEROCOCCI	ENTEROCOCCI BACTERIA	/100ML
31648	E COLI. MF	E. COLIFORM AGAR	/100ML

Appendix B

Public Hearing and Council Subcommittee Minutes

RECEIVED
MAR 13 2000

CITY of NORTH PLAINS
CITY COUNCIL MEETING ACTION AGENDA
March 6, 2000 - 7:00 PM
LOCATION: JESSIE MAYS COMMUNITY HALL
30975 NW HILLCREST STREET

1. CALL TO ORDER. *7:03 PM*
2. FLAG SALUTE.
3. ROLL CALL. *H. Drexel, H. Hirst, R. Kindel, A. Stearns, C. Olson, C. Anderson present. D. Hatcher excused.*

4. APPEARANCE OF INTERESTED CITIZENS. *(This additional time is provided by the Council for questions or statements by persons in the audience on ANY item of city business, except those items which appear on this agenda or refer to zone changes or land use requests. Comments may be limited at the Mayor's discretion.)*

Chief McKenzie introduced Officer Thurber & Cadet Officer Otterman to the council.

5. PUBLIC HEARING - ORDINANCE NO. 270. *D. Otterman explained items 5.A, B, C, D will all have public hearings that can be done under one hearing.*

Mayor Drexel opened the public hearing at 7:09 pm.

A. CONDUCT HEARING ON THE STORM WATER MASTER PLAN AND IT'S CODIFICATION INTO THE COMPREHENSIVE PLAN. *D. Whitehead, of David Evans & Associates, went over final points of the plan & answered questions of the council. Mayor Drexel asked for public testimony. There was none.*

B. CONDUCT HEARING ON THE STORM WATER MASTER PLAN AND IT'S CODIFICATION INTO THE COMPREHENSIVE PLAN. *D. Ganer, of Ganer & Associates, came forward to answer questions of the council. Mayor Drexel asked for public testimony. There was none.*

C. CONDUCT HEARING ON CODIFICATION OF THE WATER MASTER PLAN INTO THE COMPREHENSIVE PLAN. *Mayor Drexel asked for public testimony. There was none.*

D. CONDUCT HEARING ON CODIFICATION OF THE COMPREHENSIVE PLAN AND IT'S MODIFICATION FOR GRAMMAR AND SPELLING CORRECTIONS AND CLARIFICATION OF IT'S WORDING. *Mayor Drexel asked for public testimony. There was none.*

Mayor Drexel closed the public hearing at 7:39 pm.

E. ORDINANCE NO. 270 AN ORDINANCE ADOPTING A CODIFIED COMPREHENSIVE PLAN OF THE CITY OF NORTH PLAINS CHAPTER 15.00 ENTITLED "NORTH PLAINS COMPREHENSIVE PLAN" AND AMENDING THE CITY OF NORTH PLAINS COMPREHENSIVE PLAN TO INCLUDE VARIOUS MASTER PLANNING DOCUMENTS. *First reading by title only.*

MSA/H. Hirst/A. Stearns to read Ordinance No. 270 by title only for first reading. Motion carried unanimously.

Mayor Drexel read Ordinance No. 270 by title only for first reading.

6. PUBLIC HEARING - ORDINANCE NO. 271.

A. ORD. NO. 269 AN ORDINANCE ADOPTING A CODIFIED CITY OF NORTH PLAINS CHAPTER 16.00 ENTITLED "NORTH PLAINS ZONING AND DEVELOPMENT ORDINANCE". *First reading by title only.*

Mayor Drexel opened the public hearing at 7:40 pm.

Mayor Drexel asked if there was any public testimony from the audience. There was none.

Mayor Drexel closed the public hearing at 7:42 pm.

7. ORDINANCE NO. 272 - IMPOUNDMENT OF VEHICLES.

A. ORD. NO. 272 AN ORDINANCE OF THE CITY COUNCIL OF THE CITY OF NORTH PLAINS AMENDING MUNICIPAL CODE SECTION 5.20.430 IMPOUNDMENT OF VEHICLES. *Second Reading and Adopt.*

MSA/H. Hirst/C. Anderson to read Ordinance No. 272 by title only for second reading. Motion carried unanimously.

Mayor Drexel read Ordinance No. 272 by title only for second reading.

CITY OF NORTH PLAINS
CITY COUNCIL MEETING
MARCH 6, 2000

1. CALL TO ORDER. Mayor Drexel called the meeting to order at 7:03 p.m.

2. FLAG SALUTE. The flag salute followed.

3. ROLL CALL. H. Drexel, R. Kindel, H. Hirst, A. Stearns, C. Olson, C. Anderson present. D. Hatcher excused.

STAFF: D. Otterman - City Manager, D. Owens - City Recorder, G. McKenzie - Chief of Police, T. Thurber - Patrol Officer, D. (David) Otterman - Cadet Officer.

VISITORS: I. Rollins, D. Ganer, M. Cropp, M. Reh.

4. APPEARANCE OF INTERESTED CITIZENS. Chief G. McKenzie presented new police officer Tim Thurber, and cadet officer David Otterman. He introduced them to the council and described in brief his (Chief McKenzie's) goal for the department, ie: building up the police reserves and cadet programs.

R. Kindel asked OfficerThurber how much experience he has in law enforcement. Officer Thurber said he has eleven years total, an Associate Degree in Criminal Justice, an Advanced Police Certificate, and seven years in the military, his experience is fairly broad based.

C. Anderson asked how the city will be covered. Chief McKenzie said starting Friday Officer Thurber will begin the graveyard shift, and will be working the same hours as Officer Olson.

The council welcomed the new officers and thanked them for coming tonight.

5. PUBLIC HEARING - ORDINANCE NO. 270. D. Otterman explained for this next agenda item four of the items (5A, B, C, D) will have public hearings tonight and may be done under one public hearing.

Mayor Drexel opened the public hearing at 7:09 pm.

D. Otterman stated he would like the council to go through each public hearing agenda item, review, discuss, and take public testimony.

C. CONDUCT HEARING ON CODIFICATION OF THE WATER MASTER PLAN INTO THE COMPREHENSIVE PLAN. D. Otterman stated a public hearing had already been held on the Water Master Plan, and tonight the public hearing is on the codification of this plan into the Comprehensive Plan.

Mayor Drexel asked if there were any questions from the councilors. There were none. He asked if there was any public testimony from the audience. There was none.

D. CONDUCT HEARING ON CODIFICATION OF THE COMPREHENSIVE PLAN AND IT'S MODIFICATION FOR GRAMMAR AND SPELLING CORRECTIONS AND CLARIFICATION OF IT'S WORDING. D. Otterman stated this public hearing item is for modifications, corrections, and clarifications done by the Planning Commission which in no way changes policy. This will enable the comprehensive plan to come together in an effective and efficient manner for any further amendments.

Mayor Drexel asked if there were any questions from the councilors. There were none. He asked if there was any public testimony from the audience. There was none.

Mayor Drexel closed the public hearing at 7:39 p.m.

E. ORDINANCE NO. 270 AN ORDINANCE ADOPTING A CODIFIED COMPREHENSIVE PLAN OF THE CITY OF NORTH PLAINS CHAPTER 15.00 ENTITLED "NORTH PLAINS COMPREHENSIVE PLAN" AND AMENDING THE CITY OF NORTH PLAINS COMPREHENSIVE PLAN TO INCLUDE VARIOUS MASTER PLANNING DOCUMENTS. First reading by title only.

MSA/H. Hirst/A. Stearns to read Ordinance No. 270 by title only for first reading. Motion carried unanimously.

Mayor Drexel read Ordinance No. 270 by title only for first reading.

6. PUBLIC HEARING - ORDINANCE NO. 271

A. ORDINANCE NO. 271 AN ORDINANCE ADOPTING A CODIFIED CITY OF NORTH PLAINS CHAPTER 16.00 ENTITLED "NORTH PLAINS ZONING AND DEVELOPMENT ORDINANCE". First reading by title only.

Mayor Drexel opened the public hearing at 7:40 p.m.

Mayor Drexel asked if there was any public testimony from the audience. There was none.

Mayor Drexel closed the public hearing at 7:42 p.m.

Development). It will be put into a format necessary for approval of by the department. The Planning Commission will also be discussing various density issues.

H. Hirst commented regarding the problem he has with the density issue is that DLCD does not hold other cities to the same density standard that they are wanting to impose on North Plains.

D. Otterman informed the council he is attending a meeting on March 7, 2000, at Washington County with C. Cameron, Chief Administrative Officer of Washington County, B. Curtis, Washington County Planner, J. Rosenberger, department head of LUT (Land Use & Transportation), and one additional person from the County Commissioner's office. This meeting is to discuss the letter sent to the city by B. Curtis, and hopefully come to an agreement on cooperation between North Plains and Washington County.

D. Otterman stated he had sent a letter to T. Brian, Chairman of Washington County Board of Commissioners, on March 3rd stating the City Councilors would still like to have a meeting with the County Commissioners.

Mayor Drexel commented he had discussions with J. Rosenberger at the Transportation Coordinating Committee meeting. J. Rosenberger noted issues regarding North Plains to look into, such as use of TIF (Traffic Impact Fee) funds on Gordon Road.

9. ADJOURNMENT. Mayor Drexel adjourned the meeting at 7:58 p.m. The next regularly scheduled meeting will be Monday, March 20, 2000, at 7:00 p.m. at the Jessie Mays Community Hall.

Debbie Owens
City Recorder
Recording and Transcribing

Public Hearing
3/6/00
7:00p

DAVID EVANS AND ASSOCIATES, INC.

2828 SW Corbett Avenue
Portland, Oregon 97201
Tel: 503.223.6663
Fax: 503.223.2701

MEMORANDUM

TO: City Council

FIRM: City of North Plains

FROM: Don Whitehead, P.E. – City Engineer

DATE: March 6, 2000 DMW

SUBJECT: STORM WATER MASTER PLAN

PROJ. #: NPXX0011

COPIES:

Recommended Modifications to Draft Storm Water Master Plan

1. ***General Edits:*** Spelling, typographic errors, formatting, and graphics edits to figures
2. ***Back Check and Revisions to Existing Facilities:*** Confirm size and location, Figure 4.1
3. ***Back Check and Revisions to Hydrology and Hydraulic Model:*** Minor changes and fine tuning to the basins, pipe configuration and sizes, backwater impacts from UnNamed Tributary.
4. ***Back Check and Revisions to Cost Estimates:*** Reflect final sizing and changes due to changes in pipe sizing, minor configuration changes and backwater impacts from UnNamed Tributary.
5. ***Additional Narrative to Address USA Standard:*** Since the first of the year USA has adopted new design standards.
6. ***Additional Narrative to Address Current Endangered Species Act (ESA):*** The ESA will likely impact all potentially fish bearing streams. Impact is not clear at this time but water quality and temperature requirements will likely impact future development and public storm water improvements.
7. ***Review Comments from Unified Sewerage Agency:***
8. ***Additional Narrative on UnNamed Tributary and Current Hydraulic Restrictions:*** Description of current restrictions, options for improvement, cost estimates.
9. ***Executive Summary Update:*** The Executive Summary has been updated to reflect the changes made to the document.

Response to Public Input:

See attached Memo dated January 3, 2000 – Planning Commision

See attached Memo dated March 6, 2000 – November 15, 1999 letter from Alpha Engineering

DAVID EVANS AND ASSOCIATES, INC.

2828 SW Corbett Avenue
Portland, Oregon 97201
Tel: 503.223.6663
Fax: 503.223.2701

MEMORANDUM

TO: City Council

FIRM: City of North Plains

FROM: Don Whitehead, P.E. - City Engineer DMW

DATE: March 6, 2000

SUBJECT: STORM WATER MASTER PLAN - QUESTION SUBMISSION

PROJ. #: NPXX0011

COPIES:

On November 15, 1999 a letter of comment for the Draft Storm Water Master Plan was submitted to the City of North Plains by Alpha Engineering. In the following paragraphs we will provide response to their questions as they were presented. Our response will address the issues raised in the order that they were presented and reference specific pages and paragraphs.

Page 1, Paragraphs 1 and 2

As a point of clarification the Unified Sewerage Agency (USA) does not require detention for all new development. The actual requirement establishes several criteria that must be met by new development with respect to storm water runoff. USA does require that new development demonstrate that additional storm water runoff from the improvements will not exceed the hydraulic capacity of down stream facilities for a maximum of 0.25 miles. If this requirement cannot be met and the new development produces additional runoff that exceeds 5 percent of the existing flows in the receiving stream, on-site detention must be provided, or the development must improve the down stream facilities in a manner that removes the hydraulic restriction. The only recent instance where on-site detention was not required or the on-site detention option was not selected, was the construction of storm sewer improvements for the East LID that discharged directly into McKay Creek.

It is possible that future development(s) immediately adjacent to McKay Creek will be able to demonstrate that undetained discharge into McKay Creek is acceptable. However, this must be demonstrated on a project by project basis with final determination by USA and should not become a policy of the City of North Plains. Other portions of the current UGB will likely continue to require some form of detention or down stream improvements.

We will clarify the perception that the draft report indicates that future growth outside of the UGB, will not affect conveyance systems inside the current UGB. The correct statement is that existing and recommended storm sewer improvements within the current UGB cannot and should not be oversized to accommodate projected future development outside of the current UGB.

Page 1, Paragraph 3

Regional detention facilities are preferable from the standpoint that they usually are more efficient to operate and maintain. However, as the draft report indicates, the logistics of implementing a regional detention or treatment facility are very difficult since it usually requires a financial commitment of many property owners simultaneously. The actual siting of a regional facility is dependent on a number of factors including not limited to: the geographic location with respect to projected development, topography, existing wetlands, and the willingness of the affected property owners to sell the property at a reasonable price.

Future public or private improvements will need to demonstrate the feasibility of a regional facility. It is possible that constructing a facility upstream from the current UGB may provide this regional detention by reducing current peak flows and recovering downstream capacity. However, this would need to be proposed with detailed hydraulic and hydrologic analysis to allow for review by the City of North Plains and the Unified Sewerage Agency. This should be viewed as just one of many potential options for regional detention. We cannot agree with a request that the Storm Water Master Plan identify this as a preferred alternative or provide hydraulic analysis as to its feasibility.

Page 2, Paragraph 1

A detailed analysis of the UnNamed Tributary is complicated in that it requires a detailed computer hydraulic model to account for all of the culvert crossings, flood plain concerns and backwater affects from McKay Creek. The cost of preparing such a model is substantial. This effort was offered at the time that the Storm Water Master Plan was proposed to the City. Because the flood plain had previously been established and modeled in preparation of the 1989 FEMA Flood Insurance Study, it was decided to remove the HEC-II analysis from the scope of the Storm Water Master Plan.

We are concerned that review comments and suggestions have focused on specific hydraulic elements of the UnNamed Tributary (culvert crossings under Gordon Road and the railroad tracks). Such an approach is inadequate in that replacing one culvert rarely resolves the hydraulic bottleneck completely, and frequently creates a new problem down stream. To address this concern we contacted the National Flood Insurance Program in Fairfax Virginia and obtained a copy of the technical backup data and HEC-II computer model that was used to hydraulically model the UnNamed Tributary in preparation of the "UnNamed Tributary for McKay Creek (Washington County, Oregon, Community Number 410270).

Some of the hydraulic elements of the Creek have been modified since the model was originally prepared. However, most of the culverts sizes, invert elevations and creek bottom elevations were confirmed during our field investigation and GPS topographic survey work. Upon receipt of the HEC-II model we converted the files for use in the current HEC-RAS hydraulic model then ran a simulation to identify or verify specific problem areas. It should be noted that this effort was not a detailed HEC-II analysis of the UnNamed Tributary.

Some additional information and insights were obtained from the model replication and will be incorporated into the narrative of the final report along with refined improvement definitions and associated cost estimates. In addition to verifying the results of the floodplain map, DEA ran an additional simulation that included removing all of the existing culverts and bridges in the creek. The purpose of this effort was to identify if any of the hydraulic elements other than the culvert sizes are causing the local flooding. The results of this effort indicated that backwater from McKay Creek, and the elevation, shape and width of the channel are also significant influences producing local flooding. Increasing the size or adding additional culverts in the vicinity of the railroad crossing and Gordon Road will not eliminate flooding upstream from the railroad and Gordon Road. The elevation of the channel bottom and the width of the channel also strongly influence the water level and must be lowered and increased respectively.

The review of the model did allow us to clarify some of the specific areas of concern, and help to identify the extent of the problems. Final design of recommended improvements will require a more detailed analysis and sizing of proposed improvements in a comprehensive manner. We recommend that future public and private improvement projects utilize the HEC-II model for analysis and support for final design recommendations.

Page 2, Paragraph 2

The issue of utilizing storm sewers and catch basins for future storm sewer improvements is consistent with the direction provided by the Planning Commission and City Council prior to beginning the Storm Water Master Plan. Since receiving the Novermber 15, 1999 letter from Alpha Engineering DEA has met with the Planning Commission on two separate occasions to discuss this design standard. It is our understanding that the Planning Commission desires to continue to require that future street improvements include piped storm sewers, curbs and catch basins.

Page 2, Paragraph 3 – Additional Review Comment No. 1

Additional narrative discussion has been added to the Storm Water Master plan to discuss the potential that Endangered Species Act requirements will be added to McKay Creek and the UnNamed Tributary. This issue is very recent and the regulatory agencies have not completely resolved the impact that it will have on streams of this size and in this location. It would be premature to recommend a firm policy be included as part of this Storm Water Master Plan.

Page 2, Paragraph 3 – Additional Review Comment No. 2

As part of our final field inventory back check DEA will verify the correct pipe size.

Page 2, Paragraph 3 – Additional Review Comment No. 3

This error has been corrected.

Page 2, Paragraph 3 – Additional Review Comment No. 4

We do not see the need to delete this reference.

Page 2, Paragraph 3 – Additional Review Comment No. 5

As noted previously, the existing culverts in the UnNamed Tributary have been analyzed using the original HEC-II model from the FEMA study. Additional narrative has been added to the Storm Water Master Plan.

Most of the existing roadside drainage ditches serving much of the town are undersized (predominantly ditches and 12-inch driveway culverts), and do not meet current USA design standards. Although a detailed hydraulic analysis could be completed, it would require a lot of additional topographic survey and associated cost to the City. Such an effort would be of significant benefit and cost savings to future developments that are required to complete downstream analysis of existing ditches. However, we do not believe that the detailed analysis to identify the specific magnitude of the hydraulic restrictions will significantly benefit the City if the recommended standard is to replace the ditches with piped storm sewers.

Page 2, Paragraph 3 – Additional Review Comment No. 6

The final Storm Water Master Plan will include additional narrative recommending regional treatment facilities whenever feasible and acceptable to USA. There appear to be several opportunities for this along McKay Creek and the UnNamed Tributary. However, developing and constructing regional treatment facilities has the same inherent problems as regional detention facilities. Due to geographic and topographic constraints, there are a finite number of locations where these could be constructed. The property owners of these sites must be willing to sell at a reasonable price, and the participating properties (developers) must be willing to combine their efforts in a timely manner.

Page 2, Paragraph 3 – Additional Review Comment No. 7

This error will be corrected in the final master plan.

Page 2, Paragraph 3 – Additional Review Comment No. 8

Additional editing and clarification will be provided in the report narrative and the associated figures in the final master plan.

We hope that this information is helpful and are available to discuss this further at your convenience.

NPXX0011 100

DAVID EVANS AND ASSOCIATES, INC.

MEMORANDUM

TO: Planning Commision

FIRM: City of North Plains

FROM: Don Whitehead, P.E. - City Engineer DMW

DATE: January 3, 2000

SUBJECT: STORM WATER MASTER PLAN - QUESTION SUBMISSION

PROJ. #: NPXX0011

COPIES:

We appreciate the opportunity to provide clarification to the questions raised by Commissioner Fernane regarding the City Street Standards. In the following paragraphs we will attempt to respond to the questions as they were presented the December 15, 1999 memorandum. As noted in our earlier memorandum, the selection of a street standard dictates the type of storm water conveyance that can be applied throughout the City.

ROADS W/DITCHES & CURB AND GUTTER

Most other Cities of similar size and circumstance have adopted curb, sidewalk and storm sewers as standard for new development. Although the City has the option of requiring these standards of all properties, typically the adopted standard applies only to *new* development or redevelopment within the City.

The two circumstances that must be addressed when applying this standard:

a. *Existing Urban Development and Redevelopment*

It is very uncommon for a community to rebuild existing neighborhoods to a curb, sidewalk and storm sewer standard through a large Citywide or basin wide (bond funded) capital improvement project. Usually, the standard is adopted by the City then applied only to new development. Curb, gutter, sidewalk and storm sewers are required of all new developments, and redeveloped parcels or subdivisions. Because it is often unfeasible and uneconomical to design and construct these improvements on a "piece meal" lot by lot basis, a pro-rated "fee in lieu" is often assessed by the City for small developments or minor partitions. When the fund is sufficient, a local improvement district is formed to construct the improved street and storm sewer.

b. *New Development*

New developments of a larger scale, particularly residential subdivisions, are typically required to construct to the adopted standard. Most City's of a size comparable to North Plains have adopted a standard using curbs, gutters, sidewalks and piped storm sewers. If this is an adopted standard and is applied to all developments without exception, there is generally little disagreement. New development is also responsible to insure that it does not exceed the hydraulic capacity of down stream facilities. To meet this requirement additional "off-site" improvements or on-site detention facilities are frequently required.

Unless the City adopts and applies this standard to all properties in one large capital improvement project, there will initially be different standards of improvement within the City. However, overtime the adopted standard will begin to predominate.

Walkways via bike paths using pavement markings are discouraged by most jurisdictions including the Oregon Department of Transportation because they do not provide as strong of a physical and visual barrier as curbs and

sidewalks. A second reason that this approach is viewed with disfavor is that it represents an on-going maintenance cost to keep the markings cleaned and clearly painted.

DESIGN STANDARDS

The reference to Iron Ridge was specifically focusing on the detention/water quality pond configuration. The facility approved by the Unified Sewerage Agency and constructed at Iron Ridge utilizes retaining walls and a cyclone fence. This configuration allows a development to meet the volume requirements for detention/water quality, and minimizes the amount of land removed from the developable parcel. In the past USA has allowed this configuration but many Planning Commissions and Design Review Boards have expressed a strong preference for ponds that have a more natural appearance including berms and specific landscaping requirements. The City can require aesthetic features of new development beyond the minimum technical requirements of USA.

SUMMARY OBSERVATIONS

Streets without curbs, sidewalks and piped storm sewers currently predominate in North Plains and this does provide a more "rural" character and appearance. However, the existing system was not developed in a coordinated manner and does not meet current standards for either water quality or hydraulic capacity.

Water Quality

Because North Plains is part of the Tualatin River drainage basin, it falls under the jurisdiction of the Unified Sewerage Agency (USA). USA has specific guidelines with respect to water quality that must be met and the City does not have the option of non-compliance. So far these are being applied to and required of *new or re-development* only.

Hydraulic Capacity

USA also has established hydraulic requirements for new development. These requirements are intended to providing "reasonable" protection for properties. The current requirement is that all storm water conveyance facilities be sized to accommodate a 25-year storm (a probability of occurring once every 25 years). Again this is applied to all *new* private and public development or improvements. The USA standards for hydraulic capacity are similar to many other jurisdictions.

Inadequate hydraulic capacity is a problem throughout the City but especially severe in the lower portions of the drainage basins. This is particularly acute in neighborhoods adjacent to the Unnamed Tributary. While it would be possible to accomplish this using larger ditches and driveway culverts, the size of appropriate driveway culverts in the blocks adjacent to the Unnamed Tributary would be in the range of 3 to 5 feet in diameter. To accommodate a culvert of this size would require a ditch a minimum of 4 to 6 feet deep and 17 to 25 feet wide. The impact on adjacent properties and the associated safety hazards are major reasons why most communities that reach the size of North Plains adopt a piped storm sewer standard.

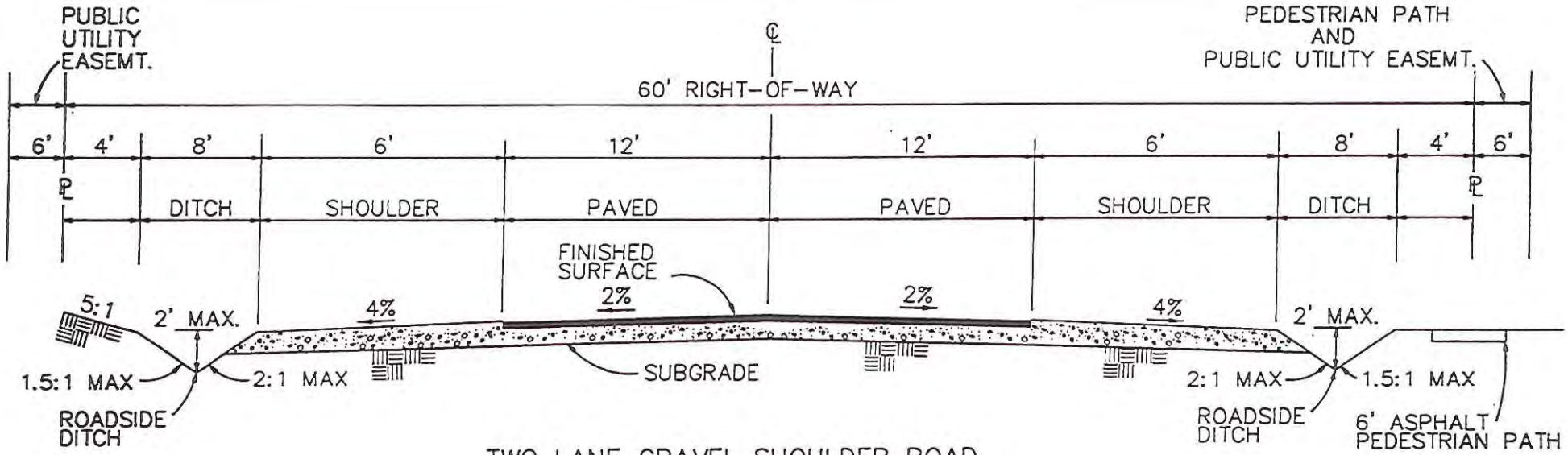
RELATED QUESTION

The most immediate concern if the City were to ignore the conditions listed in the document is the issue of non-compliance with respect to USA's standards that would likely cause a political and legal reaction.

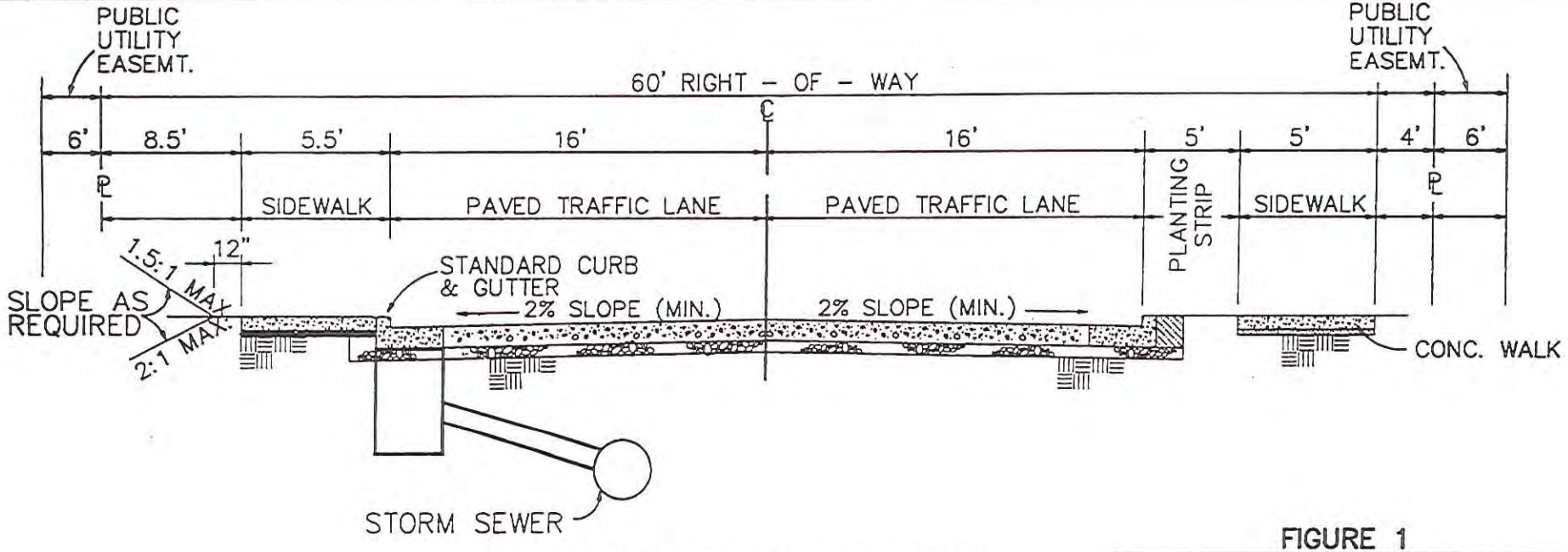
A second possible outcome is that any future development will likely be targeted by downstream property owners as the cause of any drainage concerns. Even if this is not true, the City is put in the position of defending itself against potential legal claims and frequently ends up paying to defend itself and/or for the construction of improvements without the assistance of the private development.

Without an adopted standard and specific deficiencies identified, the City cannot collect Systems Development Charges (SDC's) from new development. New public improvements must be built to current USA standards including upsizing deficient facilities. New publicly funded street improvements, similar to the 309th and Claxter Street project that was built last summer, would not have the benefit of SDC's to off-set the costs. In this sense a policy of ignoring conditions means that the City is unable to require new development to pay its share of increased capacity. The result is the City is placed in a reactionary position and accepts full financial responsibility for infrastructure improvements.

We hope that this information is helpful and are available to discuss this further at your convenience.



TWO LANE GRAVEL SHOULDER ROAD



TWO LANE ROAD-CURB AND GUTTER

FIGURE 1

TYPICAL RESIDENTIAL STREET SECTION - 60 FOOT RIGHT-OF-WAY

Review Comments
City of North Plains
Storm Water Master Plan
Dan Gunther, Unified Sewerage Agency
7-Feb-00

1. Section 4.2 and Figure 4.2 Describe more clearly the areas to be corrected. Describe the problem better. What is capacity of culverts e.g. of 84" with flow over road of 1-inch. Would that be acceptable in 25 year event?
2. Is flooding of dwellings during a 25 year event the main thing that that governs the priority of proposed projects? If so say so, if not, say what criteria do govern the decisions. If it comes down to political decisions do not try to direct the decisions but do point out alternatives. The report should be a lighting rod for stakeholder comments and decisions to be made.
3. DEA should list it to the reader, in the Executive Summary, the priorities for making the system adequate or list the decisions that should be made to set priorities.
4. Drainage system is mostly "open" will ESA allow it to be "closed" by improvements to the system? If not what is the cost of "fish friendly" construction?
5. With Master Plan are SDC fees assessable on new development? Sec 1.7 says yes. When will the report be prepared?
6. Section 1.5: Would solutions to flooding at certain culverts include buying out property owners in low areas? If so state this as an alternative, if not possible state why.
7. Describe prioritization of projects, or method of setting priority.
8. Section 2.2 says its difficult to finance drainage projects. The reader may know that. What is DEA proposing that will help? They are the consultant. ?
9. Section 3.2 seems dated. No discussion of ESA or new limits on temp, bacteria, etc. Section 3.5.1 covers it a little.
10. Update Section 3.5.2 re buffer widths.
11. Section 4.1 mid page: Be more clear on who is participating in vortex WQ facility. Paragraph 5 should point to a map for the locations discussed
12. Figure 4.1a creek channel should be shown on map.
13. Section 4.2 number the deficiencies. Get the order the same as map 1 through 8.
14. Section 6.1: Describe problems associated with development of a regional detention facility. Can the report do more to flesh out the concept and possibilities for stakeholders to discuss?
15. Section 8.1: Number the items rather than use bullets. Describe the improvement proposed more clearly.
16. Section 8.2: This section states that USA prefers regional facilities. That is not exactly true. The Agency seeks to use them if it is possible, and there are advantages with respect to maintenance and multipurpose aspects but it has not worked out most of the time to be possible to implement and there are not many regional facilities.
17. Section 8.3: This section needs more development to discuss ESA and the effect it will have on this Master Plan. Would a regional facility cause unacceptable increase in stream temperature? Has this been considered?

ALPHA ENGINEERING, INC.

November 15, 1999

City of North Plains
31360 NW Commercial Street
North Plains, OR 97133-0537

RE: Draft Storm Water Master Plan

Job No. 211-010

Gentlemen:

The following comments are offered as a review of the Draft Storm Water Master Plan, prepared by David Evans and Associates, dated November 1, 1999. The Storm Water Master Plan is clear that it only evaluates the system within the existing UGB. It does suggest policies, however, that would affect the potential future growth areas outside the UGB. At numerous points through the report, it is inferred that storm water detention is required by USA. Such a statement can be found on Page 12 of the report. In reality detention is not required by USA unless there is a downstream capacity issue and that capacity issue cannot be corrected. The correct statement as to the policies of USA is found on Page 17 of the report. This is mentioned because a statement within the report suggests that any future growth outside the UGB will not affect the conveyance systems within the UGB, since they will be "required to provide detention". That is not the policy of USA.

A case in point is the Neighbor City Study and Planning Commission supported potential development to the east and northeast. These areas do not drain to any of the existing storm drainage systems of the City, but will drain directly to McKay Creek. It is our belief that no detention should be considered for any drainage area tributary to McKay Creek. There are no known deficiencies of storm drainage capacity within the existing drainage course.

Along the lines of detention, it is referred in the report that regional detention is preferred. If detention is required, we would agree that basin-wide/regional facilities are preferable for maintenance and effectiveness. The report suggests on Paragraph 8.2, Page 27, that the regional detention system be at the confluence of the tributary with McKay Creek. We offer an alternative that a regional detention facility would be more effective at the upper reaches of the unnamed tributary of McKay Creek. A good location of that would be at or above Gordon Road, or just immediately upstream of the railroad crossing. Regional detention at this location would provide for mitigation of effects of future growth outside the UGB and more importantly, address deficiencies and a lack of capacity within and along the unnamed tributary as it flows through the existing UGB.

Plaza West · Suite 230 · 9600 SW Oak · Portland, Oregon 97223
Office 503-452-8003 · Fax 503-452-8043

One of the major concerns with the report is the lack of adequate analysis of the capacity and deficiencies within the unnamed tributary of McKay Creek. Few of the deficiencies of the culvert crossings, or even the tributary of McKay Creek itself are identified. Of note, is that there is no mention of the capacity of the culvert under the railroad. It is deficient in capacity. Of notice is the flood plain increases upstream of the railroad, and in fact there is frequent flooding of Gordon Road. Neither the capacity of that rail crossing or the capacity of the Gordon Road culvert crossings are mentioned in this report. The lack of adequate analysis of this tributary really does not provide for adequate evaluation of this major conveyance system of the City of North Plains.

A third major consideration that is affected by the adoption of a master plan for storm water systems, is the effect it would have on the improvement standards of existing streets and future streets within the City. It is suggested in the report that the conveyance system within the existing streets is to be "modern". What is being referred to is an underground pipe system of conveyance from the lots to the street and in the street to the unnamed tributary of McKay Creek and McKay Creek. With such a "modern" system, curb and gutter will be required, along with catch basin systems. This is only mentioned because there is a direct correlation between the storm drainage system conveyance and street standards. As such, they should be reviewed by the Planning Commission to assure that the street standards that would result from the storm water conveyance system be what the City envisions.

The following are additional areas of corrections or review comments:

1. On page 9, the statement is made that McKay Creek and the unnamed tributary of McKay Creek are "fish bearing". From evidence presented by consultants during the Planning Commission consideration of the Neighbor City Study, there may be a need to further examine the degree or nature of the aquatic species within both the tributary and McKay Creek.
2. There appears to be a discrepancy between Figure 4.2 versus 4-1A. On one of the exhibits at the tributary of McKay Creek and 314th, a 72-inch culvert is suggested, and on the other an 84-inch culvert is suggested.
3. On page 15, the top paragraph has text referring to water consumption. This paragraph appears to be inappropriate for this Storm Water Master Plan.
4. In paragraph 2 (below table 5.3) on page 15, the last sentence of that paragraph refers to density and projected populations within the future potential expansion areas of the City. Given the Planning Commission status of review of those specific numbers that sentence should be deleted.

DAVID EVANS AND ASSOCIATES, INC.

2828 SW Corbett Avenue
Portland, Oregon 97201
Tel: 503.223.6663
Fax: 503.223.2701

MEMORANDUM

TO: City Council – Subcommittee

FIRM: City of North Plains

FROM: Don Whitehead, P.E. – City Engineer

DATE: October 22, 1999

SUBJECT: STORM WATER MASTER PLAN

PROJ. #: NPXX0011

COPIES:

Focus of Meeting:

Review Drainage Patterns in North Plains

Review Recommended Improvements

Review Preliminary Cost Estimates

Review Financing Options

Discussion of Systems Development Charges (SDC's)

Major Drainage Facilities:

McKay Creek

UnNamed Tributary

East LID Storm Sewer

Downtown Core Area – Historic Drainage Channels to UnNamed Tributary

Recommended Improvements: *To address specific problem areas*

- **NW Commercial and NW 324th**: Three concrete culverts provide passage of the Unnamed Tributary just downstream from two 36-inch corrugated metal pipe culverts, that provide passage of the creek beneath a road on private property adjacent to the railroad.
- **Near NW Cottage and NW 318th**: A 48-inch concrete culvert providing passage of the Unnamed Tributary beneath a private driveway must be increased in capacity. An additional culvert should be added.
- **West of NW Main and NW Hillcrest**: The City's drainage system crosses private property, which contains a demolition yard. According to City staff, storm water is conveyed through the property via old hot water heaters laid end to end. A dedicated storm sewer pipe should be constructed using proper materials and design standards. A storm sewer easement should negotiated with the property owner and filed with the County Surveyor.
- **West of NW 309th and NW Hillcrest**: The City's drainage system crosses private property through an 8-inch concrete pipeline that appears to be undersized.

- NW 314th and NW Pacific: A 12-inch concrete culvert crossing NW Pacific Street restricts flow traveling towards the Unnamed Tributary along the ditches on the east side of 314th Street.

- South end of 314th Street: An 84-inch corrugated metal pipe culvert provides passage for the Unnamed Tributary beneath NW 3145th Street. The culvert appears to be undersized for the crossing.

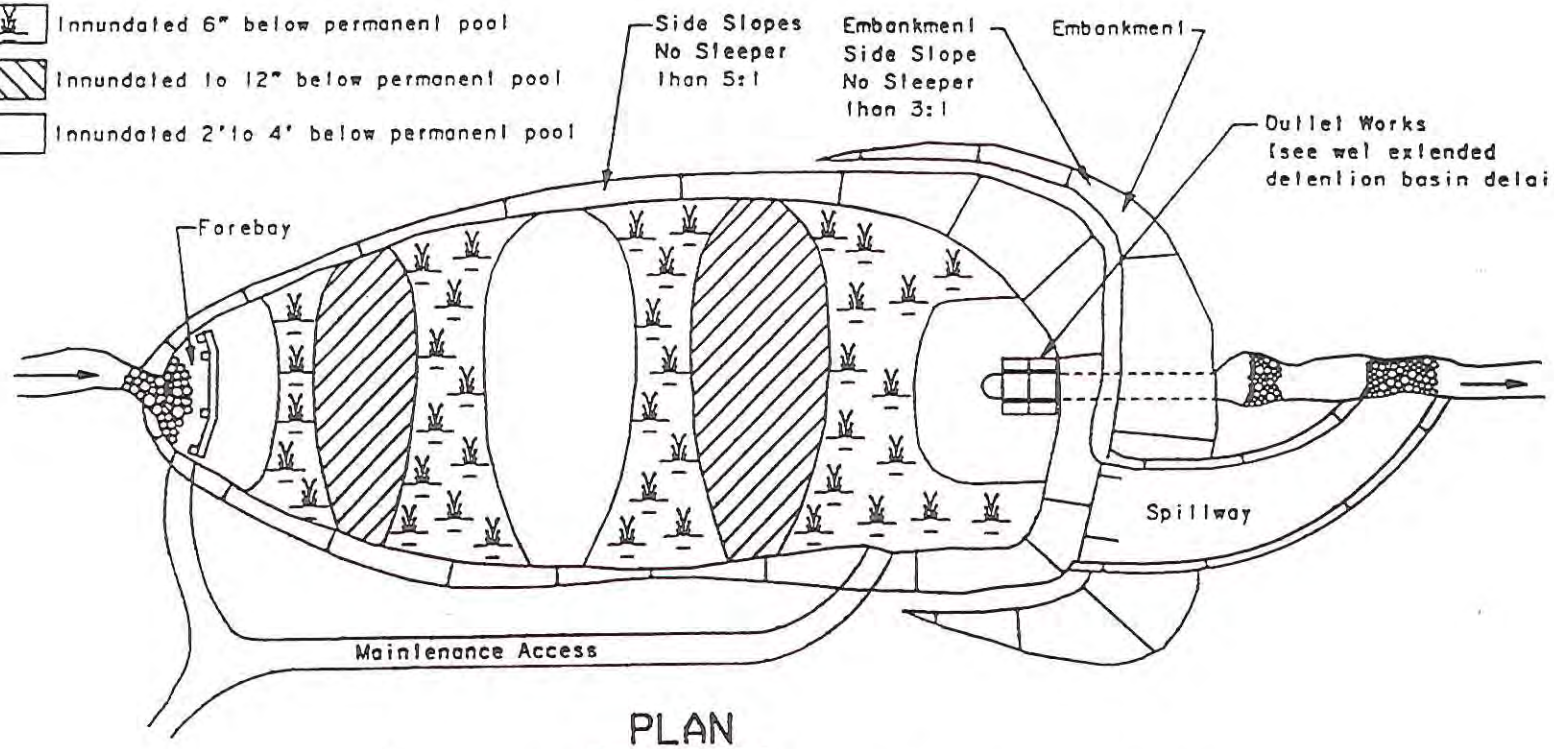
WETLAND POND

DRAWING NO. 140-CH3

unified sewerage agency

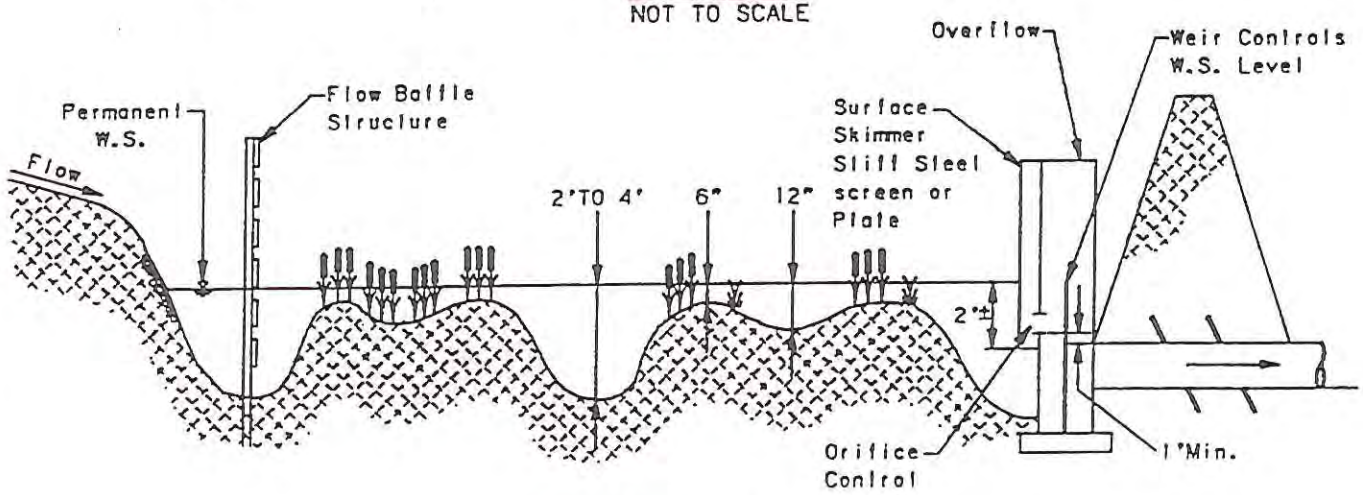
DEPTH VARIATION LEGEND

- Innundated 6" below permanent pool
- Innundated to 12" below permanent pool
- Innundated 2'to 4' below permanent pool



PLAN

NOT TO SCALE



PROFILE

NOT TO SCALE