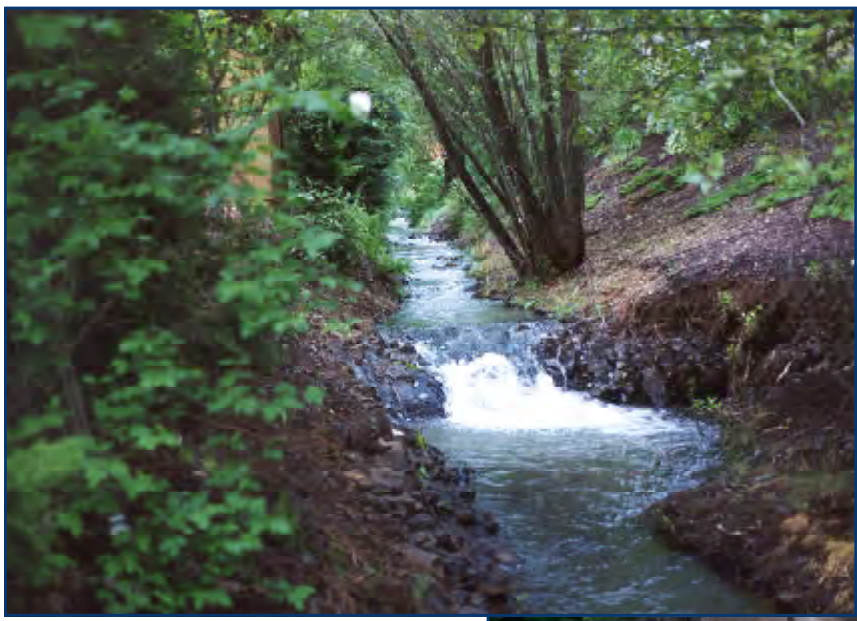
City of Salem, Oregon

Stormwater Master Plan

September 2000



MONTGOMERY WATSON

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Section 1
Introduction

Traditionally, stormwater master plans (drainage plans) have focused on the technical issues of moving a community's stormwater through the community and to the receiving stream as efficiently as possible. Increasingly stormwater program managers are now being asked to provide multi-disciplined and multi-use solutions to a community's broader concerns about water quality and healthy urban watersheds. This is now true of Salem. Consequently the overall goal of the City of Salem's Stormwater Master Plan is a stormwater management program that cost effectively balances reductions in flood damages with improvements in stream water quality, reflecting the community's financial resources to support such a broadened program.

This section introduces the City of Salem Stormwater Master Plan (this document), and its two technical supplements, the Drainage System Improvement Plan and the Stormwater Management Program Plan. It describes the purpose and goals, the planning area, the planning approach, public participation, reports produced, and the contents of this report.

PURPOSE AND GOALS

The City of Salem Stormwater Master Plan addresses issues of stormwater quantity (i.e., conveyance and flood damage reduction) and stormwater quality in a manner that is compatible with the City's National Pollutant Discharge Elimination System (NPDES) Municipal Stormwater Permit. During the study, the Endangered Species Act (ESA) relative to anadromous fish became a factor for many Pacific Northwest jurisdictions including the City of Salem. However, there has been no final Federal rule-making as of the date of preparation of this plan. The Master Plan therefore initiates the process for examining stream enhancement and fish restoration, with the expectation that amendments will follow as the ESA rules are promulgated. The Master Plan also provides the foundation for preserving and improving the water quality of Salem's urban streams, consistent with the goals of the Federal Clean Water Act Act and the anticipated implementation of Total Maximum Daily Loads (TMDL's) for the Willamette River.

One major goal of the Master Plan project was to develop a Drainage System Improvement Plan (DSIP) for the storm drains, culverts, open channels, streams, detention storage, and conjunctive use (with detention, parks, etc.) water quality facilities. The DSIP is the detailed plan which lists the recommended construction projects identified through computer modeling of the existing and future drainage systems.

The second major goal was to develop a Stormwater Management Program Plan (SMPP) consisting of the following:

- The institutional aspects of stormwater management
- Listing and description of the new information needed for a successful comprehensive program
- Description of the financial concepts for implementing the program

- Evaluation of the current operations and maintenance level of service and recommendation of an adequate level of service
- Recommendation of changes from the City's existing stormwater program direction through the preparation of an "Existing Direction Report"
- Assistance to the City in establishing a public involvement program specifically for the project and for the stormwater management program in general
- Development of solutions to various stormwater problems, and in doing so, responding to six issue papers prepared by the City/consultant project team and the Stormwater Advisory Committee (SWAC)
- Finally, every effort has been made to reflect a balance between the need to safely and cost effectively move stormwater with the environmental and aesthetic needs and values associated with one of Salem's unique community amenities – its urban stream system.

PLANNING AREA

The planning area included all of the land and water within the Salem city limits and urban growth boundary, except for the Willamette River (Figure 1-1). The hydrologic-hydraulic analysis considered all of the lands within each of the watersheds affecting Salem except for the Willamette River itself and the main channels of the Mill Creek system (Mill Creek, Shelton Ditch, Mill Race). The main channels of the Mill Creek system were not evaluated by this study because previous studies of the Mill Creek basin have shown that little flood damage reduction benefit can be achieved through conveyance improvements within the City of Salem; a regional solution is needed. The U.S. Army Corps of Engineers (COE) is currently studying potential regional solutions for flooding in the Mill Creek basin. It is anticipated that the COE study (scheduled to be completed in mid-2001) will identify several major flood mitigation projects for future implementation, possibly including one or more major detention projects within the Mill Creek watershed upstream from Salem. Areas of downstream flooding, such as in Keizer, were also considered by evaluating potential detention projects within Salem that would reduce such downstream area flooding. The hydrologic-hydraulic analysis also considered the flows projected to be contributed by areas outside, yet upstream, of the study area (particularly in West, South, and Southeast Salem).

PLANNING APPROACH

Conclusions, institutional recommendations and a policy plan were developed jointly by the consultant and City staff, working with SWAC. Six issue papers considered: (1) quantity, (2) quality, (3) policies, standards and procedures, (4) operations and maintenance, (5) public involvement/education and environmental protection, and (6) financing. For the Drainage System Improvement Plan, the hydrologic-hydraulic model, XP SWMM, was used to evaluate the following:

- Existing land use and stormwater facilities (the results were compared with known flooding problem areas to provide a reality check on the basic model)

- Build out land use conditions and existing stormwater facilities (to determine future problem areas)
- Build out conditions with selected regional detention facilities and conveyance facilities adequate to transport the new flows as affected by detention (improvement project development)

"Conjunctive Water Quality Potential" was an evaluation criteria for screening detention opportunity sites. Incorporation of water quality facilities, where appropriate, into detention projects as well as other water quality enhancements will be completed as opportunities and financing are available during the Master Plan's implementation.

PUBLIC PARTICIPATION IN THE PLANNING PROCESS

Public participation in this planning process involved the SWAC development of issue papers, a number of initial meetings with neighborhood and watershed groups, two series of watershed workshops, a survey of stakeholders, dissemination of a watershed oriented questionnaire (Perceptionnaire) throughout the community, and SWAC review prior to presenting the plan to the Water/Wastewater Task Force, Planning Commission and City Council.

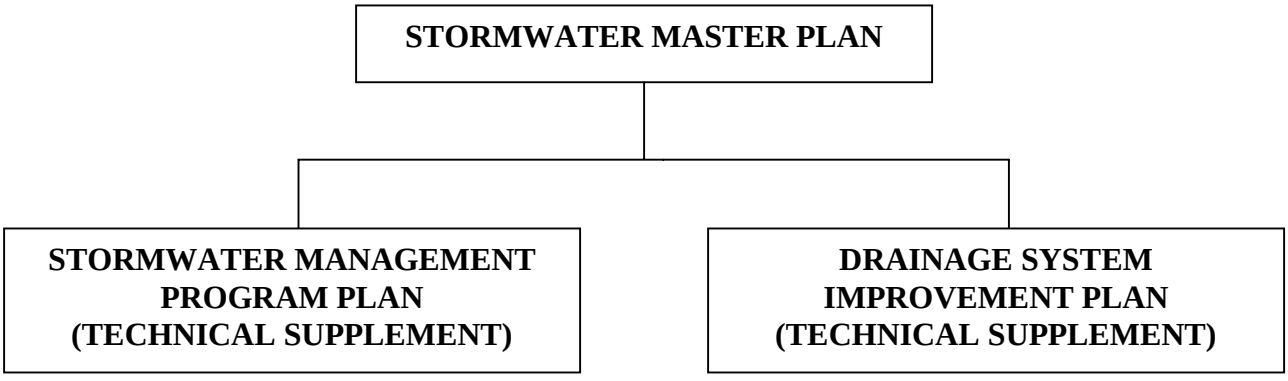
REPORTS

The reports produced by this planning effort include the following:

- Stormwater Master Plan (this summary document)
- Drainage System Improvement Plan Technical Supplement (development of drainage system improvements)
- Stormwater Management Program Plan Technical Supplement (management program development)

As portrayed by Figure 1-2, the Drainage System Improvement Plan Technical Supplement and its companion Stormwater Management Program Plan Technical Supplement serve as reference documents to this overall Stormwater Master Plan. The Master Plan itself will be adopted by the City's Planning Commission and City Council as a detailed plan and supporting document to the City's Comprehensive Plan.

Figure 1-2
Components of Salem's Stormwater Master Plan



CONTENTS OF THIS REPORT

This report consists of six sections. Section 1 introduces the report. Section 2 summarizes the study area characteristics. Section 3 describes the development of the Stormwater Management Program Plan and highlights the role of public involvement in the process. Section 4 presents the recommended policies of the Stormwater Management Program Plan. Section 5 describes the development of the Drainage System Improvement Plan. Section 6 presents the recommended Drainage System Improvement Plan.

Section 2
Study Area Characteristics

This section presents summaries of existing stormwater facilities, stormwater-related history, development and land use, and related planning. The section also defines each study area drainage basin and provides a brief introduction to the unique properties of each basin.

For information on NPDES Stormwater Permit requirements, vegetation, wetlands, water quality, and fish and wildlife, please see Section 2 of the Stormwater Management Program Plan Technical Supplement. For information on flooding history, existing problem areas, soils, and hydrology, please see Section 2 of the Drainage System Improvement Plan Technical Supplement.

STORMWATER FACILITIES

The City of Salem provides stormwater drainage service to approximately 126,600 people within the current Salem City limits (1999). The City's overall service area encompasses 150,000 to 160,000 people within the greater Salem Metropolitan area, as represented by the City's urban growth boundary (UGB). The City's existing drainage system currently encompasses an area of approximately 40 square miles. The stormwater collection system is separate from the sanitary sewer system, and consists of the following (as of 1997):

- 456 miles of storm drains (“closed system”)
- 54.4 miles of drainage and roadside ditches (“open system”)
- 9,442 catch basins
- 27.6 miles of stream within the City limits (“open system”)
- 50 bridges longer than 20 feet
- 128 stream crossings of less than 20 feet
- 2,100 grates/trash racks

HISTORY

The City of Salem stormwater-related history is summarized as follows:

- 1881 - Salem's first sewer carrying both sanitary waste and stormwater was constructed
- 1881 to1927 - continued construction of sanitary-stormwater sewers
- 1964 - the most significant and extensive Pacific Northwest flood event in recorded history, caused by warm rain on top of snow and frozen ground
- 1968 - Salem's first comprehensive Storm Drainage Study
- 1987 - adoption and repeal of a Stormwater Utility and user charge

- 1991 to1992 - City Council approves funding the stormwater system through the Sewer Utility Fund
- 1992 - initiation of a 20-year plan, including provisions to update master plans for all three utility infrastructure systems (water, wastewater, and stormwater)
- 1992 - Salem experienced an approximately 10-year runoff event which resulted in localized flooding
- 1996 - Salem, through staff and a team of various consultants, initiated the Stormwater Master Plan
- 1996 - the Willamette Valley and areas throughout the Pacific Northwest experienced flooding similar to the 1964 event
- 1996 - the City of Salem City Council appointed the Stormwater Advisory Committee (SWAC)
- 2000 - completion of the Stormwater Master Plan

DEVELOPMENT AND LAND USE

Salem's development and land use is similar to that of other cities in the Willamette basin. Much of the industrial land is in the older portions of the City, and is generally in the lower reaches of the numerous streams that pass through the City. Most of the new development is occurring in the upper reaches of the watersheds, and this pattern will continue as the City expands into the undeveloped portions of the urban growth boundary. Development has resulted in an increase in surface water runoff, further complicating downstream flooding problems. Several areas, particularly within the Battle Creek, West Bank, Glenn Gibson, and Little Pudding basin, are presently undergoing rapid development. This will cause a further increase in the amount of impervious area and will (in the absence of effective stormwater detention facilities) result in even higher flow volumes and flood peaks.

Figure 2-1 shows the projected land use conditions for the study area. This information was compiled from zoning maps from the City of Salem, Marion County, and Polk County. There are over twenty zoning categories represented within the Salem urban growth boundary. These have been simplified to the following categories: Single Family Residential, Medium-Density Residential, High-Density Residential, Commercial, Industrial, Public (parks, schools, cemeteries, etc.), Residential Agricultural, and Exclusive Farm Use.

RELATED PLANNING

Salem is developing, or has recently completed, a number of plans that affect the land and water systems within its boundaries. The most significant of the recent and current planning efforts that are related to stormwater management are as follows:

- Water Master Plan (1994)
- Wastewater Master Plan (1996)

- City of Salem Part 2 NPDES Municipal Stormwater Permit Application (1996)
- Transportation System Plan (1998)
- Utilities Cost of Service Analysis (COSA)
- Pringle Creek Watershed Council Recommendations
- Salem-Keizer Region Local Wetland Inventory, Marion and Polk Counties, Oregon (1999)
- Comprehensive Park System Master Plan (1999)

BASIN / WATERSHED DESCRIPTIONS

Figure 2-2 shows the study area basins. The following descriptions highlight the unique characteristics of each basin. Information for these descriptions was taken from basin reports prepared by City staff, maps, and field observations.

Battle Creek Basin

- Battle Creek basin drains 10.0 square miles. Approximately one third of the basin is within the UGB. Battle Creek flows southeast out of the Salem UGB near Interstate 5, and eventually feeds into Mill Creek near the City of Turner. The basin terrain is generally steep.
- Battle Creek is a complex system with numerous tributaries within and upstream of the UGB, including Battle Creek itself, Jory Creek, Powell Creek, Waln Creek, Scotch Creek, and Cinnamon Creek.
- Land use in the Battle Creek basin is typical for the developing basins of Salem. The lower reaches are more highly developed, and the upper portions of the basin within the UGB are developing rapidly. The areas outside the UGB contain mostly agricultural and forested areas in addition to rural residences.
- Several potential regional detention facilities were identified and evaluated in the Battle Creek basin.
- Stormwater from the Battle Creek basin (and all of the other basins in the study area) eventually drains to the Willamette River, which has been placed on the Oregon Department of Environment Quality (DEQ) 303(d) list of water quality limited waterbodies. The Willamette River is listed for bacteria, temperature, toxics, and biological deformities found in squawfish.
- Portions of Battle, Waln, Jory and Powell Creeks were identified as "fish bearing" by the Oregon Department of Fish and Wildlife's (ODFW) report entitled "City of Salem Fish Distribution (1995)".

Croisan Creek Basin

- Croisan Creek basin encompasses 4.9 square miles of southwest Salem, approximately half of which are within the UGB. The basin is narrow with steeply-sloped sides. The drainage system is primarily open, with Croisan Creek as the dominant drainage feature.
- Croisan Creek originates outside the UGB near Skyline Road and flows north through Salem, across South River Road, and into the East Willamette Slough.
- Three potential regional detention sites were identified and evaluated.
- Land use in the lower portions of the basin is primarily residential. The upper reaches within the UGB are currently rural. Outside the UGB, land use is primarily agricultural.
- Historically, Croisan Creek has been habitat for cutthroat trout and the stream was identified as "fish bearing" by the ODFW.

East Bank Basin

- The East Bank basin consists of 2.0 square miles entirely within the UGB that drain directly to the Willamette River. The basin is urban and flat, with land use including residential, commercial and industrial areas.
- The drainage system in the East Bank basin is closed. For this reason, no potential regional detention facilities were identified.

Glenn Gibson Basin

- The Glenn Gibson basin drains 10.4 square miles of West Salem, approximately half of which are within the UGB. The basin terrain is steep, particularly in the upper reaches, with flatter slopes near the basin outlet. Over twenty small tributaries exist in the basin. The two main drainage channels are Glenn Creek and Gibson Creek, both of which are identified as "fish bearing" by the ODFW. The Glenn Gibson basin is experiencing rapid growth in the upper-western reaches inside the UGB. Some development is also occurring outside the UGB in Polk County.
- Glenn Creek originates outside the UGB, on the west fringe of Best Road north of Dahlia Way, and flows east through agricultural areas and residential developments. It eventually flows into the West Willamette Slough. Two potential regional detention facilities were identified and evaluated along Glenn Creek.
- Gibson Creek is a tributary of Glenn Creek. It originates outside the UGB near Eagle Crest Road, and flows east through primarily agricultural and rural residential areas to a confluence with Glenn Creek near Wallace Road. Several potential regional detention sites were identified and evaluated along Gibson Creek. Most of these sites are outside of the UGB.

Little Pudding Basin

- The Little Pudding basin is a long, narrow basin, 9.1 square miles in area, that drains much of east Salem. Stormwater from the Little Pudding basin flows into the Little Pudding River, and eventually reaches the Willamette River near Canby (via the Pudding River). The basin slope is flat.
- There are no major creeks in this basin. The drainage system consists of both open and closed conduits.
- Land use in the basin ranges from rural and agricultural in the outlying areas to residential and commercial closer to the center of Salem.
- High groundwater levels and saturated soils are a common complaint in the Little Pudding basin during the winter months.
- The Pudding River, which receives stormwater from the Little Pudding basin, is listed on the DEQ 303(d) list for bacteria, temperature, and toxics.

Lower Claggett Creek Basin

- The Lower Claggett Creek basin is a small area (1.5 square miles) in North Salem near the City of Keizer. It is mildly sloped with one primary drainage path, Labish Ditch, which drains to Claggett Creek downstream of Keizer. The basin is currently zoned for industrial, commercial, public, and residential agricultural uses.
- This area is currently being studied as part of the Blossom Drive Street improvement/urban renewal project now in predesign. The Lower Claggett Creek basin presents very few development opportunities that cannot be handled with a detailed analysis of the particular site, if needed. Therefore, the basin was not modeled for this plan.

Mill Creek Basin

- As shown in Figure 2-3, the Mill Creek basin is approximately 110 square miles in area and originates in the foothills of the Cascades northeast of Stayton. Land use within the basin upstream of Salem is primarily agricultural. However, the basin receives stormwater flows from the cities of Stayton, Aumsville, Sublimity, Turner, and Salem (including the Battle Creek basin), with Salem essentially serving as the funnel outlet for the basin's entire stomwater discharge to the Willamette River. Aumsville also seasonally discharges treated wastewater into the Mill Creek system.
- This study focused on the portion of the Mill Creek basin within the Salem UGB. This portion of the basin is 8.0 square miles in area and contains lands zoned for agricultural, residential, commercial, and industrial uses. It also contains an extensive land area owned by the State of Oregon Department of Corrections, some of which is being considered for sale and development into more intensive land uses.

- Growth within the Mill Creek basin is occurring rapidly, particularly in the towns of Stayton, Aumsville, Sublimity, and Turner. Under current standards and practices, this will impact downstream water quality and quantity. Within the City of Salem, a few large parcels of vacant land exist and are targeted for development.
- Flows through the Mill Creek basin are incredibly complex. There are several upstream diversions for irrigation and industry, a diversion to Shelton Ditch, and overland overflows during large flood events into East and Middle Pringle Creeks, Turner Road, and into the River Bend/Walling gravel pits (southeast of the I-5 / Highway 22 interchange).
- Mill Creek is a tributary of the Willamette River. Shelton Ditch flows into Pringle Creek just upstream of its confluence with the Willamette.
- Mill Creek provides habitat for anadromous fish including fall chinook, steelhead, and cutthroat trout. Drainage improvements for the Mill Creek basin will be need to be compatible with efforts to protect native fish runs**.** Both Mill Creek and Shelton Ditch have been identified as "fish bearing" by the ODFW. Mill Creek has also been identified as “essential salmon habitat” by the ODFW and Oregon Division of State Lands (DSL).
- Mill Creek is listed on the DEQ 303(d) list for bacteria.
- The Mill Creek/Shelton Ditch drainage system is also the subject of a Corps of Engineers Section 205 (Flood Control Act of 1948 as amended) Flood Damage Reduction Study that is scheduled to be completed by mid-2001. It is anticipated that several major flood mitigation projects will be identified for future implementation, possibly including one or more major detention projects within the Mill Creek watershed upstream from Salem.

Pettijohn Laurel Basin

- The Pettijohn Laurel basin is 2.6 square miles in area, located in southwest Salem. Less than half of the basin is within the UGB. It is moderately sloped with two primary drainage paths (Pettijohn Creek and Laurel Creek) which drain to the Willamette Slough. Land use in the basin is primarily residential agricultural. The Pettijohn Laurel basin presents very few development opportunities that cannot be handled with a detailed analysis of the particular site, if needed. Therefore, the basin was not modeled for this plan.
- The lower reaches of Pettijohn Creek and Laurel Creek have been identified as "fish bearing" by the ODFW.

Pringle Creek Basin

- The Pringle Creek basin includes 13.3 square miles almost all of which are within the UGB. The Pringle Creek system is very complex. There are three forks of Pringle Creek: the East Fork, the West Fork, and the Middle Fork. There are also several tributaries including Clark Creek, Mill Creek (which overflows during flood conditions to East and Middle Pringle Creeks) and Shelton Ditch (upstream of Pringle Creek’s confluence with

the Willamette). In addition, there is a diversion from the West Fork to the Middle Fork near Madrona Avenue SE. Pringle Creek drains to the Willamette River. The basin terrain is moderate in slope.

- Pringle Creek basin contains a variety of land uses ranging from the central business district to single family residential and agriculture. Most of the basin is developed. However, the southern portion of the basin contains currently undeveloped areas which are zoned for industrial, commercial, and residential uses.
- There are two existing regional detention facilities in the Pringle Creek basin. Both of these are on Clark Creek. Several other regional detention opportunities were identified and evaluated as part of this study.
- Pringle Creek is listed on the DEQ 303(d) list for bacteria, temperature, and toxics. Clark Creek, a tributary of Pringle Creek, is also on the 303(d) list for bacteria.
- East, Middle and West Pringle Creeks and Clark Creek have been identified as "fish bearing" by the ODFW. The lower portion of Pringle Creek itself has also been identified as “essential salmon habitat” by the ODFW and the DSL.

Upper Claggett Creek Basin

- The Upper Claggett Creek basin drains 7.4 square miles, all of which are within the UGB. The Upper Claggett basin drains into Claggett Creek which flows through the City of Keizer and is a tributary of the Willamette River. The basin slope is very flat.
- The Upper Claggett Creek basin is highly developed, with land use including single and multi-family residential, industrial, commercial, rural and agricultural areas.
- Two existing city-owned regional detention facilities are located in the basin: the 37th Place NE facility and the Eastgate Soccer Field. In addition, several other potential detention facilities were identified and evaluated.

West Bank Basin

- The West Bank basin consists of those areas in West Salem that drain directly to the Willamette River. The basin area is 2.3 square miles and is almost entirely within the UGB. The terrain has two distinct regions: high rolling hills that are developing rapidly, and a large flat area (near Edgewater Street) that is highly developed. The hills are zoned primarily single family residential. The flat area contains industrial, commercial, multi-family and single family residential zones.
- The West Bank basin includes three primary drainage paths that were evaluated by this study. One of these is primarily an open system, the other two are a mixture of open and closed systems.
- One potential regional detention facility was identified and evaluated for the West Bank basin.

Willamette Slough Basin

- The Willamette Slough basin is 4.8 square miles in area and consists mostly of low elevation areas along the Willamette River. This basin is flat and almost entirely within the Willamette River 100-year floodplain. Land use within the Willamette Slough basin is primarily for parks, recreation, and agriculture, with some residential areas at higher elevations. The Willamette Slough basin presents very few development opportunities that cannot be handled with a detailed analysis of the particular site, if needed. Therefore, the basin was not modeled for this plan.

Section 3
Public Involvement and Development of the Stormwater Management Program Plan

The primary vehicle for providing public input into development of the Stormwater Master Plan and its two accompanying technical supplements was the City of Salem Stormwater Advisory Committee (SWAC). Described in this section are the SWAC's purpose and membership, values and guiding principles, and the issue papers agreed upon during development of recommended policies.

PURPOSE AND MEMBERSHIP

The Salem City Council appointed the 15-member Stormwater Advisory Committee in 1996 to provide advice to staff concerning the preparation of the master/management plans for stormwater. The committee was composed of community leaders representing neighborhood associations, regulatory agencies, watershed councils and business interests.

VALUES AND GUIDING PRINCIPLES

The City's staff-consultant-SWAC master planning team recognized the need to undertake a multi-disciplined and multi-use solutions approach to Salem's stormwater management program, and sought to establish some basic stormwater-related values and guiding principles during the planning process. The planning team also believed the City's Stormwater Master Plan must reflect a community-supported balance between controlling water quantity and improving water quality, consistent with the City's financial resources and Federal/State regulatory requirements. These values and principles have helped formulate a general "vision" for Salem's stormwater management program and urban stream environment, and have served as the foundation for developing various policy recommendations. Those policies, in turn, are the foundation for similar recommendations related to developing standards and procedures for implementing a proactive, visionary, comprehensive long-term stormwater management program for Salem's future. With this as a basis, the SWAC adopted the following values on November 21, 1996:

- Properly manage the City's stormwater infrastructure system so as to minimize flooding damages and protect life and property
- Implement prudent long-range capital, operation/maintenance, programmatic, and financial planning to meet the community's existing and long-range needs for cost effective stormwater management
- Continue to be proactive stewards of Salem's urban watersheds as natural amenities in an urban environment

- Sustain or enhance Salem's urban streams as naturally occurring watercourses
- Preserve or enhance Salem's urban stream riparian corridors to produce and maintain native plant and animal life forms
- Implement efforts to improve water quality in, and the beneficial uses of, Salem's urban streams
- Apply a balanced perspective between water quantity and quality issues
- Highest priority should be given to the safety and security of persons and property potentially affected by watershed stream flow
- Promote public awareness and education on stormwater management and urban watershed issues
- Disseminate stormwater management information in a timely and accurate manner.
- City staff should provide prompt and effective customer service in the area of stormwater management
- Properly manage the City's stormwater program so as to meet at least the minimum Federal and State regulatory requirements

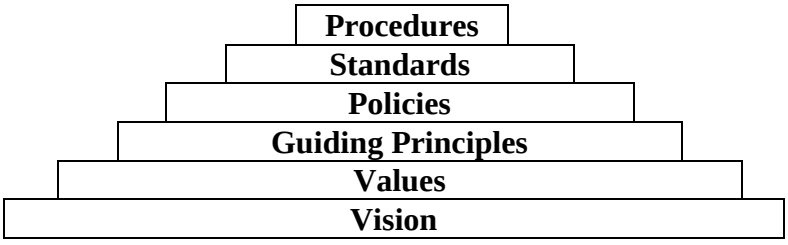
Stormwater issues should be represented to the public in a professional manner. City staff and the SWAC developed a set of guiding principles to be used by the staff, consultants, SWAC, and the City's Water/Wastewater Task Force. The consensus-based value statements presented above and guiding principles presented below were used to test planning assumptions, choose viable options, select the preferred alternatives, and make associated recommendations concerning foundational policies and implementing standards and procedures. Those guiding principles were adopted on October 17, 1996, and are presented below:

- Continue sound environmental stewardship
- Continue as proactive stewards of the stormwater management infrastructure and Salem's urban stream environment
- Anchor stormwater planning and management in sound principles of environmental science, economics, engineering, and public works management
- Provide a long-term vision for system improvements and expansion, and ongoing operation and maintenance consistent with land-use plans
- Identify cost-effective solutions for:
  - Protecting the safety and security of persons and property affected by stormwater flows, and minimizing the impacts of flooding
  - Maintaining and improving the water quality in, and the beneficial uses of, Salem's urban streams
  - Providing stormwater management services to City customers (residents, businesses, and industry)

- Provide a feasible implementation strategy for timely construction of improvements and the satisfactory operation and maintenance of the entire stormwater system
- Provide for cost-effective compliance with existing and anticipated regulatory requirements
- Provide a sound planning base for properly operating, maintaining, and financing the City's stormwater management program to meet the desired level of service identified and supported by the greater Salem community

A principle can be defined as "a comprehensive and fundamental law, doctrine, or assumption," and as such, the above principles establish the foundation upon which Salem's Stormwater Master Plan is built. Policies build on those foundational principles, and fit the definition of "definite courses or methods of action selected from among alternatives and in light of given conditions to guide and determine present and future decisions." Standards provide the next layer of building blocks; are defined as "something set up and established by authority as a rule for the measure of quantity, weight, extent, value, or quality"; and serve as the minimum benchmarks for the stormwater infrastructure's planning, design, construction, operation, maintenance, and financing. A procedure can be defined as "a particular way of accomplishing something or of acting," and should be thought of as the "how to's" of meeting the adopted standards, and fulfilling the established policies and principles for a successful stormwater management program. As portrayed by Figure 3-1 below, these definitions and associated hierarchy of terms (one building upon another) served as the basis for considering foundational stormwater management functions, evaluating Salem's current management programs, and developing conclusions and recommendations tailored to meet the needs of Salem.

Figure 3-1. Stormwater Master Plan Building Blocks



ISSUE PAPERS

A major goal of the Stormwater Management Program Plan (SMPP) development was to provide for the following:

- Institutional aspects of stormwater management
- Listing and description of the new information needed for a comprehensive program
- Description of the financial concepts for implementing the program

- Evaluation of the current operations and maintenance level of service and recommendation of an adequate level of service
- Recommendation of changes in the City's existing stormwater program direction through the preparation of an "Existing Direction Report"
- Assistance to the City in establishing a public involvement program for the project
- Development of solutions to various stormwater problems, and in doing so, respond to six issue papers prepared by the Stormwater Advisory Committee (SWAC)
- Reflect a balance between the need to safely and cost effectively move stormwater with the environmental and aesthetic needs and values associated with one of Salem's unique community amenities – its urban stream system.

The development of the basic conclusions and institutional recommendations was a joint effort by the consultant and City staff working with SWAC to develop a policy plan through six issue papers as follows:

- No. 1 - Quantity (flood reduction)
- No. 2 - Quality
- No. 3 - Policies, Standards, and Procedures
- No. 4 - Operations and Maintenance
- No. 5 - Public Involvement/Education and Environmental Protection
- No. 6 - Financing

The Issue Papers are presented in Appendix B of the Stormwater Management Program Plan Technical Supplement.

Section 4
Stormwater Management Program Plan

This section presents the policies for a Salem stormwater management program. The policies are consistent with and complement the recommendations of the Salem Stormwater Advisory Committee (SWAC) contained in Appendix B of the Stormwater Management Program Plan (SMPP) Technical Supplement, the Existing Direction Report (Appendix A of the SMPP Technical Supplement), and the City's National Pollutant Discharge Elimination System (NPDES) Municipal Stormwater Permit. In some cases the SWAC recommendations provide more detail and shall be considered as supplemental guidance indicating the intent of specific policies.

SUMMARY OF THE ISSUES

This summary follows the SWAC Issue Paper format involving six types of issues:

- No. 1 - Stormwater Quantity
- No. 2 - Stormwater Quality
- No. 3 - Stormwater Policies, Standards, and Procedures
- No. 4 - Stormwater Operations and Maintenance
- No. 5 - Stormwater Public Involvement/Education and Environmental Protection
- No. 6 - Stormwater Financing

Stormwater Quantity

The policies concerning stormwater quantity management include drainage system improvement projects, detention storage, floodplain management, and streams/ponds/wetlands storage.

Implementing regional detention storage is a critical element of the stormwater management program. A number of sites were found where detention storage is possible [refer to Section 6 of this report for the Recommended Drainage System Improvement Plan (DSIP) projects], but such sites were not so abundant that they can be allowed to be lost by default or inaction. Some of the sites found were ideal for in-stream storage, while others were found to be best suited for off-stream storage.

In-stream detention (brief/temporary) storage can be benign in its impact on fish passage and habitat, in contrast to water quality facilities that require permanent ponding and consequently need special attention to fish passage during design. Many sites offer opportunities for in-stream detention (i.e., rare and brief/temporary ponding during major flood events only), stream-riparian restoration within the site, and off-stream wetlands for habitat and water quality functions.

Where off-stream detention is feasible it can be designed to provide a wide array of benefits including water quality wetlands, wetland habitat, stream and riparian habitat improvements, and passive recreation. Off-stream detention storage is most appropriate when the site involves wide,

alluvial plains and it is desired to permanently pond water for water quality or habitat purposes in addition to the brief/temporary detention storage.

In watersheds where regional detention can be implemented, an in-lieu-of detention charge could be a component of the Systems Development Charge (SDC). Conversely, a credit could be given for on-site detention when regional detention is unavailable. Therefore the determination of which watersheds have significant regional storage opportunities must occur early in the implementation process to define where on-site detention is still required and where SDC's can be based partially on an in-lieu-of charge.

Although a number of regional detention opportunity sites were found, others will emerge during the implementation process. The City should encourage maintenance, development review, and field personnel to continue to look for regional detention opportunity sites that can be investigated for feasibility and, if feasible, added to the DSIP project list. Monitoring the performance of the detention storage facilities that are constructed is very important and may lead to resizing or reconfiguring the hydraulic control structures.

Restoring anadromous fish runs is a high priority for the Pacific Northwest, and Salem is fortunate to have a number of streams that currently and/or historically have provided habitat for such fish. Urbanization causes downstream flood hydrographs to have higher flood peaks and results in greater flood damage to property, but higher flood peaks also affect fish habitat. The impacts include higher than natural rates of channel erosion/scouring and riparian damage. Both development policies and attenuation (detention) facilities can mitigate such impacts. Restoration and improvement can also reverse the urban impacts on high potential streams.

Anadromous fish habitat is also affected by water quality degraded by urbanization, particularly related to erosion-sedimentation and temperature increases due to the removal of shading. For these reasons, a stormwater management plan that addresses quantity, quality, and fish habitat involves a number of interlocking policies and projects.

Stormwater Quality

As previously discussed, urbanization increases peak flood flows. It also affects water quality by accelerating mass erosion, surface erosion of exposed surfaces, channel erosion, and the wash-off of urban particulate from various urban surfaces. Such erosion causes downstream sedimentation and water quality problems related to high levels of suspended solids. The higher flows associated with urbanization erode stream banks and channels, reducing both stream and riparian habitat values. Just as the quantity problems associated with urbanization can be mitigated, the water quality problems can be mitigated through development policies and public/private facilities. The facilities can include both regional and on-site facilities such as ponds, marshes, filters, separators and detention storage that reduce the high velocities associated with the higher flood flows. Stream bank stabilization projects involving bioengineering can reduce channel/bank erosion, provide riparian habitat and reduce unacceptably high water temperatures.

This study did not include an exhaustive inventory of all potential sites where regional water quality facilities could be constructed. It did, however, include the evaluation of conjunctive use

of the recommended detention sites for regional water quality pond-wetland purposes, and development policies/programs for water quality enhancement.

The water quality improvement aspect of an urban stormwater management program is closely related to fishery enhancement and restoration. While most of the relationships are positive, some can be negative. Stream and bank improvement projects can improve (reduce) stream temperatures through shading by riparian vegetation. Such projects can include improvements to stream alignment, fish passage, in-stream cover, and spawning areas. On the other hand, water quality ponds and wetlands can have a negative effect on fish passage if they are improperly sited or designed. Unlike in-stream detention projects, in-stream water quality ponds or wetlands usually include permanent/long-term ponding. The standpipes or other hydraulic controls used to maintain a minimum water level in these water quality ponds/wetlands can present barriers to fish passage. Fish passage can be provided (and would be required for an in-stream water quality pond/wetland), but at small facilities it is usually very costly. Consequently, in narrow ravines where in-stream detention facilities are feasible it is usually best to provide conjunctive use water quality ponds and marshes upstream or off-stream. Stream/riparian improvements can, however, be included with in-stream detention.

The primary legal mandate for the water quality portion of this plan is the City's National Pollutant Discharge Elimination System (NPDES) Municipal Stormwater Permit issued by the Oregon Department of Environmental Quality (DEQ). These policies reflect the requirements of the NPDES permit. The effects of the recent and future fish species listing under the Endangered Species Act (ESA) and DEQ's Total Maximum Daily Loads (TMDL's) program for the Willamette River, are not well understood at this point, and the adopted plan may require updating as their implications become more clear. This can be accomplished through the recommended stream/fish studies and Policy 7 recommendations.

Policies, Standards, and Procedures

The institutional aspect (policies, standards, and procedures) is one of the three primary legs of a comprehensive stormwater management program. The other two legs include quantity/quality facilities and public support/financing. Salem's program has had a relatively low public profile in the past, except for brief periods in the 1980s involving financing. Consequently a number of necessary elements, such as grading and erosion control have not been emphasized. On the other hand, Salem has some notable regional detention facilities such as at Eastgate and Gilmore Fields, and has had strong operations leadership during the last four or five years particularly related to computerized maintenance management systems.

A more visible stormwater management program will encourage accountability, which is always a challenge in stormwater management. This is due to the infrequent nature of major storm-flood events that stress the stormwater system, as compared to drinking water and wastewater systems that may show their deficiencies daily. It is understandable that drainage system improvement projects and maintenance activities would be directed at day-to-day problems as compared to problems that may only be noticed every 10 to 20 years. When flooding problems do occur, though, millions and even hundreds of millions of dollars can be lost in a very short time.

Land use and development controls are very important elements in this category. Of particular importance are stream, pond, and wetland setback buffers for water quality and fish habitat purposes. Erosion and sediment control are also important. Floodplain protection to minimize flood damages is important and can be strengthened in Salem, particularly regarding flows and floodplains that are in historical flood problem areas or projected for build-out conditions.

Another important consideration is to have the stormwater management program coordinated with jurisdictions that either affect, or are affected by, land and water within the Salem urban growth boundary. Such jurisdictions include local governments such as Keizer, Polk County, Marion County, and federal and state regulatory agencies such as the Oregon Department of Environmental Quality (DEQ), the Oregon Division of State Lands (DSL), Oregon Department of Fish and Wildlife (ODFW), the U.S. Army Corps of Engineers (Corps or COE), and the National Marine Fisheries Service (NMFS).

One of the most important elements of a stormwater management program is enforcement of local, state, and federal regulations affecting water quality and flooding. It is also important to consider all aspects of the program during the review of proposed public and private development projects. The availability of information such as soil classifications/erosion-risk and guidance documents is also of key importance, particularly for water quality and fish improvements because these are relatively new areas for development projects.

Operations and Maintenance

The operations and maintenance work performed as part of this study has been presented in SWAC Issue Paper No. 4, and was completed through a cooperative effort of the consultant, City project manager, and Public Works Operations Services Division personnel. City staff agree that operation and maintenance service levels for stormwater are not adequate to address all of the desired programs. Moreover, the definition of an "adequate" level of service is somewhat subjective and community specific. For water and wastewater systems, most of the problems that exist are typically detected as soon as they occur because the systems are continually utilized close to, or at, their capacity levels. Stormwater problems, however, may go undetected for decades because of the infrequency of high-volume storm and peak flood events. To complicate matters the same type of stormwater problem may create severe flood damage at one location, but simply result in culvert flooding at another.

Regardless of how the existing service level compares with an "adequate" or "standard" level of service, it is clear through the joint consultant-staff evaluation that serious inadequacies exist. Unless such inadequacies are addressed, Salem residents are subject to an ever-increasing risk of flood damage. The primary needs are for trained personnel and funding for projects.

One of the most significant maintenance problems is inadequate access to portions of the stormwater system: primarily open channels, streams, and culverts on private property. The result is poor to nonexistent maintenance of private facilities, including hundreds of on-site detention facilities. The current inventory of stormwater facilities needs to be expanded to include all open channels, streams, waterways, and other water-related resources such as wetlands.

As the provisions of the NPDES stormwater permit and DSIP are implemented, an increase in the maintenance requirements should be anticipated because of more publicly owned detention and water quality facilities. In addition, the City may become increasingly responsible for a number of riparian areas and/or reconstructed waterways. All of these are more maintenance intensive than urban storm drains and culverts. Water quality facilities are designed to remove sediments and other constituents from the water column, and these in turn must be removed from the deposition area. In some urban areas, such as Seattle, such sediments from some industrial/commercial locations have been found to require hazardous materials disposal methods. Although it is unlikely that Salem is approaching that point, the materials removed from water quality facilities will need to be periodically monitored to determine their quality and the required method of disposal.

As Salem expands into the urban growth area, the Public Works Operations Services Division will find its resources spread even thinner. There may be opportunities to pay nearby residents at remote locations for maintenance support involving basic tasks such as periodic observation and rudimentary trash rack or inlet grate cleaning.

Public Involvement / Education and Environmental Protection

Salem currently has a public education program that has primarily addressed water quality and watershed issues with good success during the last three years. To address all of the types of issues that are included in this program plan, the public involvement and education effort needs to be expanded. Such expansion is particularly needed to ensure that the program adequately covers water quantity and flood management issues.

One of the key areas of expansion involves the development of issue-specific public education activities and materials. Policy No. 9.1 later in this section lists eight guidance documents that are needed for the stormwater program. Each of these documents will include the preparation of an executive summary for the highly interested members of the public. A handout brochure will also be prepared for each of the guidance documents for citizens who are interested in the topic, but with not as much interest as those expected to read the executive summaries.

Urban stormwater management covers a wide range of current issues in the Pacific Northwest. The downside of this is that solving the problems is complex and requires participation from many fields of expertise and strong public support. The upside is that if the various interests concerned with urban stormwater can be motivated and brought together to support programs and projects, much can be accomplished. To do this, both educational materials and graphic presentations that coalesce public support and help build a constituency for the program are needed. Urban stormwater management involves all of the surfaces within an urban area, plus all the water features including wetlands, ponds, streams, and ditches. Obviously this affects fish and wildlife habitat and every property owner, so strong public interest is the result. Because of this, a stormwater program can be the catalyst for a proactive, cost efficient environmental program in addition to dealing with flood management and water quality.

Financing

In-depth background information regarding financing is provided in the SMPP Technical Supplement (Section 5 and Appendix B). In brief, Salem has in recent years depended on wastewater charges to fund the stormwater program. An attempt was made in the 1980s to establish a separate stormwater charge but this was unsuccessful. The current method of charging residents for stormwater service is inequitable in some cases and has resulted in a stormwater program that is significantly less than what is needed. With the current emergence of stormwater quality and fish issues, in addition to extensive flooding issues, the need for adequate financing of the stormwater program is even more apparent than it was in the 1980s.

RECOMMENDED POLICIES

The recommended policies are presented in 12 categories as follows:

1. Drainage System Improvements
2. Streams, Ditches, and Pipes
3. Detention Program
4. Flood Damage Reduction
5. Water Quality Facilities
6. Source Controls
7. Programs and Procedures
8. Operations and Maintenance
9. Implementation Guidance
10. Public Participation
11. Financing
12. City of Keizer and Marion County Coordination in Specific Areas of Concern
13. Early Action

The imperative form “shall” is used in the recommended policies because the Salem Planning Commission and City Council will eventually adopt them, or revised versions, as City policies. The thirteen primary policies present the essence of the proposed action for each of the categories, and a number of more specific clarifying statements expand on each category. The recommended policies are consistent with the SWAC recommendations (Appendix B-1 of the SMPP Technical Supplement).

1. Capital Improvements

The Drainage System Improvement Plan (DSIP) adopted as part of this plan (refer to Section 6) shall be implemented, commensurate with funding levels, on a priority basis so as to protect life and property, minimize flood damages, and reflect a balanced perspective between water quantity and quality issues.

1.1 The DSIP projects, presented in Section 6 of this report and developed in the DSIP Technical Supplement, and including those that may be added over time, will be implemented on a priority basis in accordance with the following categories:

- Early/critical action (1 - 5 years)
- High priority (5 - 10 years)
- Medium priority (10 - 20 years)
- Long-term (20 years plus)

1.2 The primary prioritization criterion for quantity projects should be flood reduction benefits with a high benefit-to-cost ratio. Other criteria will include conjunctive or multiple use potential, low regulatory complexity, environmental benefits, and public support.

1.3 The Stormwater Management Program Plan includes the following early action steps:

- Assign the recommended DSIP projects to time horizons and schedule expenditures
- Begin implementing the early/critical action DSIP projects, including the early phases of the regional detention projects such as land acquisition and permitting
- Add projects that are determined to be feasible from Policies 2.1 and 5.2 and City-staff/citizen recommendations
- Continue the public involvement program regarding specific project sites, particularly those for regional detention
- Determine if any of the regional detention projects cannot be implemented
- In watersheds where proposed regional detention cannot be implemented, either increase the size of the downstream conveyance projects or continue reliance with on-site detention facilities
- Implement a flow monitoring program to refine the hydrologic-hydraulic model and aid in the design of specific major DSIP projects (refer to Section 6 for the recommended flow monitoring program)

2. Streams, Ditches, and Pipes

The City shall construct, operate, and maintain a stormwater conveyance system consisting of streams, ditches, and pipes, commensurate with funding levels, that:

- **Protects the safety and security of persons and property affected by stormwater flows**
- **Maintains and improves the water quality in and the beneficial uses of Salem's urban streams**
- **Provides professional management for all stormwater services to City customers**

2.1 Some of the streams, open channels, and ditches within Salem will be converted and/or restored to provide stream and riparian area habitat. Restoration projects will be added to the DSIP project list and will reflect the recommendations of the "Stream, Riparian, Open Channel and Aquatic Resources Inventory" listed under Policy 9.1. As stream projects are completed the hydraulic model should be updated to reflect changed channel characteristics.

2.2 The City will provide open channel, stream, pond, and wetlands setback buffers along each side of the waterbody, with the width of the buffer based on the results of the stream study/inventory (Policy 9.1). The setbacks, improvements, and study/inventory should consider current and historical fish use, potential for fish use with restoration, current and projected flood mitigation needs, conjunctive use potential, cost, the value and priority of restoration, LCDC Goal 5 natural resource policies and priorities, the City's NPDES Municipal Stormwater Permit, ESA compliance priorities, TMDL compliance requirements, and acquisition costs (if any).

3. Detention Program

The Public Works Department shall establish a stormwater regional detention program consisting of both in-stream and off-stream detention facilities where technically, environmentally and financially feasible and practical.

3.1 The Public Works Department will continue to evaluate detention opportunities within the urban growth boundary, and consider sites in upstream areas that may affect Salem, and in downstream areas that may be affected by runoff from Salem.

3.2 High priority will be placed on designing the regional detention projects to include as many conjunctive uses as possible. Each site will be reviewed specifically for opportunities to provide the following benefits:

- Parks
- Passive recreation such as wildlife observation
- Water quality improvement areas such as ponds or wetlands

- Fish habitat for passage, cover, rearing, and spawning
- Wetland, riparian, and upland habitat

3.3 The regional detention design process/criteria should include the following:

- Size the maximum storage capacity (i.e., highest flood-stage water level) for the 100-year recurrence interval in accordance with the criteria set forth by the Drainage System Improvement Plan.
- Locate the overflow at the water surface elevation associated with the runoff from that storm
- Optimize the downstream reduction in flows as much as possible in the 10- to 100-year range, considering recorded and projected flood damages
- Focus the reduction analysis on the reach immediately above and below the detention facility and at the nearest downstream critical flooding reach
- Allow optimized resizing of the hydraulic controls during predesign if storage at the site is limited and downstream flow reduction is more critical at the lower recurrence intervals
- Design to take maximum advantage of the potential available storage at the site including the storage that can be realized through berming and excavation
- Ensure that the 100-year flow can be passed through or over the fill area safely
- Refine the hydrologic-hydraulic model to reflect any rainfall and flow monitoring data for the watershed

3.4 On-site detention requirements will be eliminated for watersheds where the Public Works Director determines that regional detention is the preferred stormwater management alternative and can indeed be implemented. In such cases, an in-lieu-of detention fee should be incorporated into the methodology for a stormwater systems development charge. A similar approach should be taken for any drainage catchment area where the Public Works Director determines that neither on-site nor regional detention is appropriate.

3.5 For watersheds where the Public Works Director determines that regional detention is not feasible for significantly reducing flood peaks, on-site detention will continue to be required. In those cases, a credit system for on-site detention should be incorporated into the methodology for a stormwater systems development charge.

3.6 If a specific regional detention project cannot be implemented within 48 months after adoption of this plan, the Public Works Director will evaluate whether detention is feasible at that site and reevaluate the need to resize the downstream conveyance projects if it is not.

3.7 The Public Works Department will implement regional detention in the following manner:

- Complete predesign hydrology and hydraulics to determine the actual storage available and downstream benefits, including flow monitoring to refine the hydrologic-hydraulic model as necessary (refer to Section 6, "Monitoring Program")
- Initiate permit inquiries and applications, preferably for entire watersheds
- Conduct neighborhood and watershed meetings to discuss the project(s)
- Initiate the land acquisition process to address both flooding/access easements and fee title purchases
- Complete project design and construction

3.8 In those watersheds where the use of existing on-site detention facilities can be terminated, City staff will determine those that warrant conversion to on-site water quality facilities, consistent with Policies 5.2 and 5.3.

4. Flood Damage Reduction

Flood Insurance Rate Maps (FIRMs) as adopted and updated by FEMA, supplemented by any additional "best available information", shall be adhered to for any new development or redevelopment within Salem's Urban Growth Boundary.

4.1 City staff will review the City's current FEMA maps for consistency with existing conditions and the results of the Drainage System Improvement Plan, prioritize the updating needs, and request FEMA to develop updated maps for those high priority streams.

4.2 Salem's land development and zoning requirements, in addition to protecting the FEMA defined floodway (including a zero vertical rise), should protect the 100-year floodplain within the urban growth boundary, and the areas known to have flooded in the February, 1996 flood. That protection should consider future development within the urban growth boundary, stream buffers/setbacks (Policies 2.2 and 7.4), and the potential applicability of establishing specific "areas of flood concern."

4.3 As the various regional detention projects are implemented, revision of the floodplain protection maps and FEMA FIRM maps will be considered, since detention should result in a reduction in floodplain size.

5. Water Quality Facilities

Commensurate with funding levels, the City shall develop and implement a surface water quality facility program reflecting the requirements associated with the NPDES Municipal Stormwater Permit, the Endangered Species Act, DEQ's TMDL Program, and the water quality needs of the community's urban streams.

5.1 During the predesign of a regional detention facility, the potential for water quality conjunctive use at the site will be evaluated.

5.2 The Public Works Department will undertake a comprehensive inventory of potential sites for public regional water quality facilities, including ponds, wetlands, and vegetated swales. This inventory will examine the existing on-site detention facilities which are not functioning adequately or which are not needed due to regional detention that is planned. Such existing investments may provide good opportunities for water quality retrofitting in some watersheds. The arrangements for ownership and maintenance must be resolved before the facility is retrofitted.

5.3 City staff will evaluate and prioritize those urban watersheds in which water quality facilities (either regional or on-site) are required. For those high priority watersheds not served by regional facilities, on-site water quality facilities should be required for all new public and private development projects that are identified through an early action priority (Policy 13).

5.4 The Public Works Department will prepare a guidebook for water quality facilities and best management practices (Policy 9.1). It will include information for predesign planning and design of containment facilities for new industrial/commercial developments that will trap runoff containing hazardous materials. Such a guidebook will provide guidance for private developments and public facility projects, and will address design flows and facility ownership and maintenance responsibilities.

6. Source Controls

The Community Development and Public Works Departments shall develop, as an early action priority, an erosion prevention and sediment control, vegetation removal, and local grading ordinance/program.

6.1 Erosion prevention and sediment control, vegetation clearing and management, and local grading ordinances/programs, including discharge controls and enforcement provisions, are early action priorities for the City of Salem. The ordinances and programs will be integrated into the City's land use and development processes. Performance based limits on vegetation clearing will be addressed in a stand-alone ordinance, and in the erosion prevention and sediment control and grading programs. The erosion prevention and sediment control and grading programs will be performance based; and reflect the varying complexities associated with size and type of development/redevelopment, site soils and slopes, hydrologic position within the watershed, potentially affected streams and their beneficial uses, and other site specific conditions.

6.2 The City will prepare a guidebook concerning erosion prevention and sediment control (Policy 9.1).

6.3 A number of NPDES Municipal Stormwater Permit requirements are included by reference in these plan-policies. They include:

- Improve operations and maintenance levels of service, access to waterways and stormwater facilities, and assure that the private stormwater facilities and programs will perform as intended

- Add landscape requirements for new public and private development projects that provide water quality improvement, including stream, wetland, and pond setback buffers
- Continue and expand the public education program which now includes alternative gardening, school presentations, and storm drain stenciling
- Develop a City stormwater grant program to provide system users with financial incentives for doing more than the basic requirements
- Encourage the watershed council work, using the Pringle Creek Watershed Council as an example, but adjusting goals and scope as appropriate
- Accelerate and formalize the illicit discharge and illegal dumping programs which will involve system-wide monitoring, tracking illicit discharges to the source and enforcement against violators
- Continue the spill prevention and response program
- Expand and formalize the industrial stormwater discharge program

7. Programs and Procedures

The City shall implement the various programs and procedures necessary for the proper management of the stormwater program so as to meet at least the minimum Federal and State regulatory requirements, reflecting a balance between water quantity and quality issues.

7.1 City practices, procedures, and projects will be reviewed specifically to identify water quality improvement and flood peak reduction opportunities. Examples of the types of things to review include the following:

- All land use, site development, and growth management requirements
- Storage and disposal methods involving materials and waste
- Operations and maintenance practices
- Construction practices and requirements for public and private projects
- Enforcement consistency and success

7.2 The Public Works Director will evaluate the existing stormwater management organizational structure, and reorganize it as necessary so that it is consistent with City's other utility units, and has the type of visibility, accountability, and funding needed for success. Specific stormwater program goals should be established annually that reflect the SMPP, the DSIP, SWAC policies, the NPDES Municipal Stormwater Permit, ESA implementation requirements, TMDL compliance requirements, the Existing Direction Report recommendations, and the various current stormwater issues that will emerge each year. Some of the primary functions of the stormwater organization should include the following:

- Provide financial analysis of priority needs for rate setting and budgeting purposes
- Provide the engineering hydrologic-hydraulic modeling needed to implement this plan
- Equip project managers to lead the engineering design of the recommended DSIP projects
- Ensure that adequate operations and maintenance service levels are provided
- Manage all stormwater related programs
- Initiate and complete the various technical guidance documents (Policy 9.1)
- Provide engineering and environmental liaison and information to the public education program, the watershed councils, and the community at large

7.3 The Public Works Director should have the authority to approve, if technically feasible, non-traditional stormwater approaches such as infiltration for water quantity/quality purposes.

7.4 Stream buffers/setbacks for water quality protection and flood mitigation are needed for the streams and waterways within Salem. Setback buffers along each side of the streams within the Salem Urban Growth Boundary should be established, with the specific setback for each stream reach being established as part of the stream inventory (Policy 9.1).

7.5 Land use and development requirements will be reviewed for stormwater quality improvement and flood peak reduction opportunities. Necessary Salem Revised Code (SRC) revisions will be recommended as an early action priority to address the following purposes:

- Review parking minimums and maximums for commercial development to reduce the total impervious area involved in developments, or allow for pervious area offsets by infiltration/detention strategies.
- Construction of vegetated swales instead of gutters for selected street or land development projects, with early projects serving as prototype examples.
- Extension of the existing excavation and fill provisions in City ordinances to apply to all private property developments covering more than one acre.
- Review landscaping standards for commercial and industrial developments to include at least 15 percent of the site as pervious area.
- Improvement in the review and comment processes involving the City, Marion County, Keizer, Polk County, the Corps of Engineers, DSL, DEQ, NMFS, ODFW, and other regulatory agencies, with formal agreements regarding coordinated reviews of projects.
- Strengthening of the enforcement of all stormwater requirements pertaining to public and private project development.

7.6 An LCDC Goal 5 natural resource planning study will contribute to the implementation of the Stormwater Management Program Plan and such a study will be initiated as an early action priority.

7.7 A volunteer citizen stream watch program should be created that includes the following:

- Annual training sessions for volunteers
- Management of stream monitoring and cleanup activities designated by the City
- Coordination with the watershed councils and other special interest groups
- Utilization of formalized procedures and checklists

7.8 The Public Works Department will review the City's NPDES Municipal Stormwater Permit monitoring program and revise it, with DEQ concurrence, to monitor selected sources of stormwater pollutants. Such revisions will include identifying and implementing specific pilot programs/projects and control strategies related to implementation of the ESA and TMDL compliance strategies.

7.9 A Stormwater Master Plan management review will be completed every three years. Necessary amendments to the Master Plan will be implemented yearly.

7.10 The City's stormwater data base (Geographic Information System and Hansen Information Management System) will be updated annually to reflect completion of DSIP projects, new facilities added to the system, and refinement of data for the existing system (especially the open channel system).

8. Operations and Maintenance

As a steward of the stormwater management infrastructure and Salem's urban stream environment, the City shall sustain an adequate level of system operation and maintenance so as to provide cost effective stormwater management service to City customers.

8.1 The basic operations and maintenance study performed as part of the stormwater management planning process will be expanded, primarily to develop Salem-specific performance standards for various maintenance activities. Such standards are critical for budgeting and resolving concerns about the level of service, and to determine the "Salem standard" for operations and maintenance activities.

8.2 Operations and maintenance service levels are currently inadequately funded, and the funding of adequate service levels is a high priority component of the stormwater management program. The current level is approximately half the adequate level. This does not include the water quality and detention facilities or the expansion of the conveyance system included in the Drainage System Improvement Plan. The operation and maintenance service levels funded for the stormwater system will be increased to an adequate level as a critical need priority. The ultimate goal is to achieve the "Salem standard" for all operations and maintenance activities within ten years.

8.3 The Public Works Operations Services Division will inventory and rank stormwater problem areas that are related to inadequate access for operation and maintenance, particularly

involving problems on private property, followed by a prioritized program of access acquisition and remedial maintenance.

8.4 A private stormwater detention and water quality facility maintenance program will be established involving City inspection, public information regarding owner operation and maintenance responsibilities, compliance assurance procedures to encourage owners of the system to perform maintenance, followed, if necessary, by City or contractor maintenance and billing for the service to the owner.

8.5 The Public Works Operations Services Division should prepare for increased levels of cleaning and materials disposal as detention and water quality projects are implemented. Periodic sampling of materials and innovative disposal/recycling methods will be needed.

8.6 A citizen-volunteer maintenance program, perhaps as part of an Adopt-A-Stream program, should be evaluated for implementation involving training for facility observation/reporting and basic cleaning by nearby residents. The most likely facility cleaning involved would be trash racks at small culverts, inlet grates, and possibly some small ditches or stream corridors. If such a program is implemented, a checklist and protocol will be prepared and provided by the City.

8.7 The City and the Marion County East Salem Service District (ESSD) should establish agreements regarding uniform operations and maintenance activities with the City's urban growth boundary.

8.8 A public communication program will be implemented for City field personnel. They are frequently involved with the public, and the relationships between service levels and flooding problems do not appear to be well understood in the community. This program will include:

- Educational presentations at schools
- Volunteer training and use (see Policy 10.4)
- Periodic tours of problem areas for interested citizens and public officials
- Informational materials such as videos and handout materials

8.9 An early priority will be to develop maintenance management procedures that respond to current NPDES Municipal Stormwater Permit conditions, regulatory constraints, sensitive areas, and the types of future management actions likely to be needed; including those needed for regional and on-site detention and water quality facilities (ponds, wetlands, and vegetated swales), streams, channels, and setbacks.

8.10 Commensurate with funding, the Public Works Department will implement a monitoring program for streamflow and detention/water quality facilities.

8.11 Operation and maintenance procedures will be prepared for all regional detention facilities.

9. Implementation Guidance

A number of guidelines, maps, and documents shall be prepared, commensurate with funding levels, identifying stream and riparian areas, erosion-sedimentation potential, water quality facilities and Best Management Practices (BMPs), pollution sources, soil/geotechnical characteristics, and infiltration potential/criteria.

9.1 The following guidelines, maps, and documents will be prepared for Salem area use according to the "critical," "high," or "medium" priority assigned:

- Stream, Riparian, Open Channel, and Aquatic Resources Inventory and Evaluation that evaluates the existing streams and waterways within the Salem urban growth area, determines improvement needs, considers flood mitigation potential, establishes setback requirements, and rates improvement potential (critical priority)
- Erosion prevention and Sediment Control Guidebook (critical priority)
- Stream and Riparian Enhancement Guidelines (high priority)
- Inventory and Evaluation of Potential Water Quality Facility Sites (high priority)
- Erosion and Sedimentation Risk Maps that address surface, mass, and channel erosion (medium priority)
- Best Management Practices and Facilities for Non-point Source Control Guidebook which includes planning and design guidance for improvement practices, water quality facilities, and hazardous materials containment site design concepts (medium priority)
- Potential Pollutant Sources Map and Characterization Report (medium priority)
- Soil-Geological Infiltration Potential Maps and Characterization Report for quality and quantity purposes (medium priority)

9.2 The City's Public Works Design Standards and Construction Specifications will be reviewed and revised to reflect the hydrologic-hydraulic modeling used for the Drainage System Improvement Plan, including the various design storms for the respective components of the stormwater infrastructure system. That review will include potential revisions to reflect current "state-of-the-art" practices in the stormwater management industry.

9.3 The hydrologic-hydraulic model should be refined as additional rainfall and flow monitoring data and subsequent storm incident experiences are collected. The model should also be updated as DSIP projects are implemented and new facilities are brought on-line.

10. Public Participation

The public involvement and education program shall be expanded, commensurate with funding levels, to include flood management/mitigation in addition to water quality, stream and riparian habitat restoration, the NPDES Municipal Stormwater Permit, LCDC Goal 5

natural resources implementation, the Endangered Species Act implementation, Total Maximum Daily Load (TMDL) compliance activities, and specific watershed health issues.

10.1 The public involvement and education program should include the four elements of water quality, stream and riparian habitat restoration, urban watersheds, and flood management/mitigation. The primary elements of such a program include special volunteer projects, public presentations including a speaker's bureau, and brochures/videos.

10.2 The expanded program should include the production or purchase of various brochures and/or videos including the following:

- Erosion prevention and sediment control (one for general use and one for engineers-developers-contractors)
- Water quality facilities and best management practices (general use and engineers-developers-contractors)
- Stream and riparian restoration, including fish issues and the Endangered Species Act
- Wetlands for both habitat and water quality management
- Stormwater system maintenance
- Chemical use (fertilizers and pesticides)

10.3 Commensurate with funding and community commitment, the Salem area watershed councils should be sustained and expanded to cover all of the streams/watersheds within the Salem urban growth boundary. Such councils should involve both City (predominantly) and County members (for the watersheds that affect both areas).

10.4 A citizen assistance program, including volunteer training and internship, should be established to achieve the following:

- Perform basic, low-risk activities related to maintenance
- Monitoring of water quality, streamflow, flood stage, and stream/riparian/ wetland habitat
- Observation and reporting of activities possibly requiring enforcement of City requirements
- Public presentations

10.5 The City should continue to support the Adopt-A-Stream program for urban stormwater management and related issues, including the following:

- Salem area streams and watersheds
- Fish restoration and the Endangered Species Act
- Wetlands for water quality improvement and habitat

- Urban stormwater problems and solutions
- Erosion prevention and sediment control

11. Financing

The City shall implement a feasible financing strategy for the timely construction of improvements and satisfactory management of the entire stormwater management program, including adequate operations and maintenance of the stormwater infrastructure system.

11.1 The City shall review the feasibility of a separate stormwater charge that recovers the cost from users in proportion to the demands/impacts of various user classes. That charge should have both a water quantity and water quality component, and reflect the major land use classifications of system users.

11.2 As discussed in Policy 8.2, the stormwater system operations and maintenance activities will be funded at an adequate level of service as soon as financially feasible, estimated at approximately twice the current level, and eventually at the Salem standard.

11.3 As provided for in Oregon law, a stormwater System Development Charge (SDC) will be considered as an early action priority that includes both improvement and reimbursement portions of the facilities involved. Reimbursement will only be applicable if there is "excess" capacity in the existing storm drainage system. The City will develop an SDC methodology, taking into consideration the basis of facility replacement costs, "in lieu of" detention fees, and credits for on-site detention and/or water quality facilities.

11.4 The charges and SDCs should be reviewed and revised every two years.

11.5 A Perpetual Life ("pay-as-you-go") capital replacement program will be implemented and eventually be fully funded for stormwater facilities. This may require a "ramping up" of Perpetual Life expenditures over time as existing water/sewer revenue bonds are retired.

12. City of Keizer and Marion County Coordination in Specific Areas of Concern

Salem's policy is to work with the City of Keizer and Marion County to establish an inter-jurisdictional work group, composed of representatives from their respective public works departments and supplemented as needed by additional staff, to identify and address issues of mutual concern within the Claggett Creek, Labish Ditch and Little Pudding River watersheds.

13. Early Action

The early action phase of the stormwater management program shall include the following high-priority actions, commensurate with funding levels, and depending on the regulatory requirements of the NPDES Municipal Stormwater Permit, ESA, and TMDL programs:

Within One Year

13.1 Develop erosion prevention and sediment control, vegetation control and management, and local grading ordinances/programs and associated handbooks

13.2 Continue to implement the NPDES Municipal Stormwater Permit requirements (on-going and in accordance with the NPDES Permit schedule)

13.3 Fund a review of City practices, procedures, and projects to determine water quality improvement and flood peak reduction opportunities

13.4 During the first year, complete the Stream, Riparian, Open Channel, and Aquatic Resources Inventory and Evaluation (Policy 9.1). During the second year, establish appropriate setback buffers on each side of Salem waterways, drainageways, and streams.

13.5 Review land use and development requirements (Policy 7.5)

13.6 Initiate an LCDC Goal 5 natural resources study that will result in Comprehensive Plan recommendations

13.7 Expand the public involvement and education program, particularly involving flood management, watershed councils, citizen assistance, teacher training, and posters

13.8 Complete a financing study that addresses separate stormwater charges and SDCs

13.9 Develop updated operations and maintenance procedures to address new types of projects and regulatory conditions

13.10 Determine which watersheds have the potential for flood peak reduction through regional detention facilities and elimination of the on-site detention requirement for the purpose of acquiring rights or ownership of regional detention sites

13.11 Evaluate the existing stormwater management organizational structure, and reorganize it as necessary so that it is consistent with the City's other utility structures and has adequate staff and resources to implement this program

13.12 Implement a flow monitoring program to aid in the design of major DSIP projects, and refine the hydrologic-hydraulic model on an on-going basis to reflect that data

13.13 Implement early/critical action projects in the DSIP

13.14 Implement any necessary amendments to the Stormwater Master Plan

Within Two Years

13.15 Evaluate and prioritize those urban watersheds in which water quality facilities are required. For those watersheds in which on-site facilities will be required, identify the affected land uses and minimum development sizes subject to those requirements.

13.16 Revise the City code provisions to protect the 100-year floodplain within the urban growth boundary and areas known to have flooded during the February 1996 flood event (Policy 4.2)

13.17 Perform a comprehensive inventory of potential sites for public regional water quality facilities within those specified high priority watersheds

13.18 Within those specified high priority watersheds, revise the City Code (SRC) to require on-site water quality facilities for new developments meeting certain specified threshold criteria

13.19 Increase, if financially feasible, the level of funding for operations and maintenance to approximately twice its current level

13.20 Establish an enforceable private stormwater system maintenance program

13.21 Complete the Policy 9.1 "critical" priority guidelines, maps, and documents

13.22 Implement early/critical action projects in the DSIP

13.23 Implement any necessary amendments to the Stormwater Master Plan

13.24 Recommend appropriate City Code revisions to land use and development requirements for stormwater quality improvement and flood peak reduction (Policy 7.5)

Within Three Years

13.25 Implement early/critical action projects in the DSIP

13.26 Add stream/habitat improvement projects to the DSIP

13.27 Implement any necessary amendments to the Stormwater Master Plan

13.28 Successfully negotiate renewal of the City's NPDES Municipal Stormwater Permit with DEQ, reflecting the Stormwater Master Plan (and its technical supplements), the NPDES Phase II Program, the Endangered Species Act, and the TMDL Program

13.29 Conduct a management review of the Stormwater Master Plan and its implementation

Within Four Years

12.30 Implement early/critical action projects in the DSIP

13.31 Determine which recommended regional detention projects can be implemented, and increase the sizing for downstream conveyance facilities below the recommended regional detention projects which are determined to not be feasible

13.32 Implement any necessary amendments to the Stormwater Master Plan

Section 5
Development of the Drainage System Improvement Plan

One major goal of the Master Plan project was to develop a Drainage System Improvement Plan (DSIP) for the storm drains, culverts, open channels, streams, detention storage, and conjunctive use (with detention) water quality facilities. The DSIP includes a comprehensive list of recommended drainage system improvements and is a product of the policies developed in the Stormwater Management Program Plan (SMPP), the results of hydrologic-hydraulic modeling, and City staff experiences and records based on past flood events.

This plan reflects not only prevailing staff and community experiences and the hydraulic modeling results, but endeavors to coordinate projects with other concurrent City programs (Urban Service Areas – USA's, street projects, other master plan projects – water, wastewater and parks) and opportunities for multiple benefits/conjunctive uses.

EVALUATION APPROACH

The evaluation approach consisted of the following steps:

- Public and Stormwater Advisory Committee (SWAC) meetings to determine the community's desired policies for stormwater quantity management, water quality, stream corridor enhancement, and funding (refer to Sections 3 and 4 for development of the SMPP and recommended policies)
- Identification of existing problem areas using City/County staff experiences and files, citizen input and field observation (refer to the DSIP Technical Supplement, Section 2 for "Existing Problem Areas")
- Development of an XP-SWMM hydrologic/hydraulic model for each basin
- Identification of future problem areas using XP-SWMM model results (refer to Section 4 of the DSIP Technical Supplement)
- Development of potential regional detention facility screening criteria and review of criteria by the SWAC
- Identification and screening of potential regional detention facilities
- Development of the recommended alternative for each basin
- Estimating the cost of the recommended plan
- Establishing project implementation priorities
- Coordination of projects and priorities among City departments for implementation and funding
- Balance stormwater quantity management projects with water quality and stream enhancement projects

PUBLIC INVOLVEMENT

Public involvement, most notably input from the Stormwater Advisory Committee (SWAC), was an important part of improvement project development. The committee was composed of community leaders representing neighborhood associations, regulatory agencies, watershed councils and business interests. The SWAC discussed topics including stormwater quantity and quality; policies, standards, and procedures; operations and maintenance; public involvement and environmental protection; and financing. The SWAC gave feedback on the values of the community regarding preferred stormwater management alternatives. For more discussion of the role of the SWAC, refer to Section 3.

MODEL SELECTION AND DESCRIPTION

Levels of detail in stormwater computer models range from planning-level models which calculate runoff hydrographs and route flows, to more sophisticated design, operational, and water quality models which evaluate complex hydraulic structures, flood elevations, and water quality parameters. The more complex models require calibration and verification data (rainfall, runoff, streamflow, and water quality) and detailed system information including overflow elevations, stream cross-sections, as-built information for hydraulic structures, base flow measurements, and outfall conditions (river stage or tidal elevation).

As is typical for a master plan, the project consultant team and City staff determined a planning-level model was appropriate. A significant amount of additional data collection would be required to construct the more complex operational-level model. Specifically, all channels and culverts should be surveyed, and flow and rainfall gages installed on major tributaries. Future model enhancements are anticipated as data becomes available, and the software used is capable of including operational and water quality analyses. Refinement of the newly developed XP-SWMM model is also anticipated to facilitate individual project design, and to extend the model into smaller catchments served by existing relatively small storm drainage systems.

XP-SWMM (XP-Software) was chosen as the model to use for this study because it was the most appropriate and cost effective means to analyze current conditions and future needs. The following factors were considered:

- Watershed characteristics
- Availability of required data
- Cost of and time for setting up and running
- Potential model enhancement to incorporate complex hydraulics
- Potential model enhancement for flood level evaluation
- Potential model enhancement to simulate water quality
- Potential for the City to use as an ongoing planning, design, and operational tool

MODEL DEVELOPMENT

For a detailed description of model parameters and assumptions, refer to Section 3 of the DSIP Technical Supplement. The steps below summarize the model development process:

- Review of basin reports (developed by City staff) and background information
- Collection and review of existing inventory information and field review to characterize the stormwater facilities needed for the XP-SWMM modeling
- Delineation and hydrologic characterization of basins, sub-basins, and catchment areas
- Development of a conveyance schematic for each basin to represent the drainage system
- Review of catchments and schematic by City staff to verify that the model accurately represents the existing drainage system
- Incorporation of City comments and development of model input files to characterize the existing stormwater collection system
- Field verification of model results for existing conditions using maintenance records and City staff reviews
- Evaluation of full build-out hydrologic parameters and incorporation into model
- Addition of screened potential detention sites to model

Storm Type and Volume of Rainfall

Total 24-hour rainfall volumes for each of the storm recurrence intervals (2-, 5-, 10-, 25-, 50-, and 100-year) in the Salem area were determined from isopluvial maps obtained from the National Oceanographic and Atmospheric Administration (NOAA). The 24-hour storm volumes for each of these events are shown in Table 5-1, and served as sizing criteria for the analyses of the respective drainage system components (pipes, open channels, regional detention facilities, and FEMA streams).

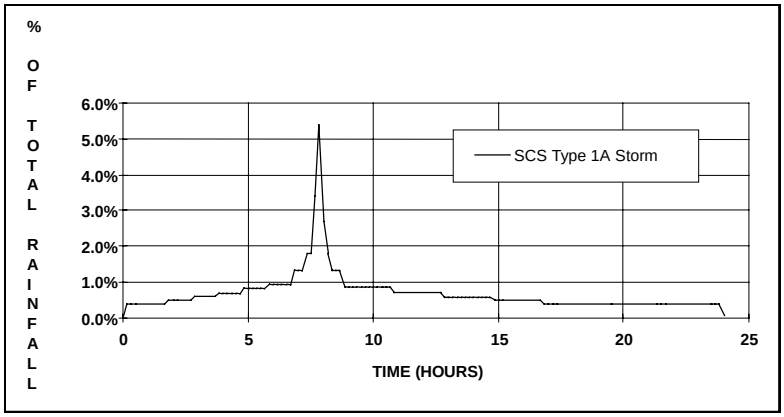
The isopluvial maps depict the volume of rainfall over a 24-hour period. How the volume is distributed over the 24-hour period is provided in the form of a rainfall distribution curve (hyetograph), which is a volume versus time graph of the storm. The shape of the hyetograph is very important in that it shows at what hour the peak(s) occur, as well as the peak intensities for the storm event. The shape of the hyetograph will influence the flow patterns of the rainfall after it hits the ground.

The Soil Conservation Service or SCS (now known as the Natural Resources Conservation Service or NRCS) has developed 24-hour hyetographs with shapes that are typical for various geographic locations within the United States. The SCS Type 1A curve used in this study was developed for western Oregon and Washington and northwestern California (Figure 5-1). This figure portrays the anticipated distribution of rainfall over the 24-hour period for the Table 5-1 storms, with the area under the distribution curve totaling 100 percent of the storm volume.

Table 5-1
Recurrent 24-Hour Storm Volumes

Recurrence Interval (years)	Depth (inches)
2	2.7
5	3.2
10	3.5
25	4.0
50	4.4
100	4.7

Figure 5-1
SCS Type 1A Rainfall Hyetograph



The SCS Type 1A hyetograph has a distribution with a single peak that occurs at the eighth hour of the 24-hour storm duration. This is more conservative (i.e., it generates higher peak flows) than storms that might have a less intense peak, or multiple peaks during the 24 hours. While this is an idealized distribution of a storm, it is a widely accepted storm event for use in the sizing of conveyance facilities. It also provides a standard for maintaining consistency during planning and design

Mill Creek System Modeling

The main channels of the Mill Creek system (Mill Creek, Shelton Ditch, and Mill Race) were not evaluated by this study because previous studies of the Mill Creek basin have shown that little flood damage reduction benefit can be achieved though conveyance improvements within the City of Salem; a regional solution is needed. The U.S. Army Corps of Engineers (COE) is currently studying potential regional solutions for flood reduction in the Mill Creek basin. It is anticipated that the COE study (scheduled to be completed in mid-2001) will identify several

major flood mitigation projects for future implementation, possibly including one or more major detention projects within the Mill Creek watershed upstream from Salem.

For this study, the Mill Creek basin model was limited to the drainage systems within Salem's UGB and tributary to Mill Creek or Shelton Ditch. Because the main channels of the Mill Creek system were not modeled, peak flow values from recent work by the COE were used to evaluate areas affected by overflows from Mill Creek and Shelton Ditch. Peak flows from the COE were also used to evaluate the portion of Pringle Creek downstream of Shelton Ditch. These values are summarized in Table 5-2 below. As more information becomes available from the COE 205 study, the Mill Creek and Pringle Creek models and DSIP projects should be updated to reflect the recommendations of the study.

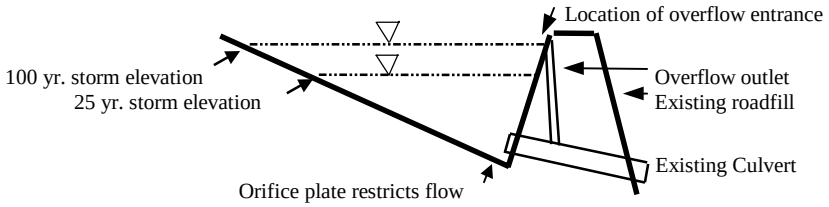
Table 5-2
Peak Flow Values for Mill Creek and Pringle Creek Systems

Location	Peak Flow Values (cfs)		
	10-year	25-year	100-year
Peak flow along Turner Rd. and Mission St. (100-year event only)	-	-	300
Peak flow in East Pringle downstream of Turner Rd. (100-year event only)	-	-	990
Peak flow in Middle Pringle downstream of Turner Rd. (100-year event only)	-	-	400
Peak flow in Pringle Creek downstream of confluence with Shelton Ditch	5600	-	8550

IDENTIFICATION OF DETENTION OPPORTUNITIES

One of the primary goals of this study was to evaluate the opportunities for regional detention to manage stormwater quantity and quality and also protect stream habitat. Implementing regional detention storage has been identified by the Stormwater Management Program Plan as "a critical element of the stormwater management program." A detention facility is an open space depression/basin with an outlet designed to detain storm runoff during infrequent flood events. Detention facilities can be located alongside the waterway or conveyance system (off-stream) or within the waterway or conveyance system (in-stream). Off-stream facilities are usually more costly to construct and operate, but are often more acceptable to regulatory agencies because of fish passage and wetlands/riparian issues. With sufficient capacity, the water detained in the basin is released slowly over a period of minutes to hours, reducing the downstream peak flow. An overflow outlet provides a safety measure in the event of blockage of the outlet and for extreme storm events. One to two feet of freeboard is typically provided between the 100-year storm elevation and the top of the facility berm. Figure 5-2 shows a typical in-stream detention facility located behind an existing roadfill.

Figure 5-2
Schematic profile of an in-stream detention facility located in a depression above an existing roadfill.



Potential detention storage sites were initially identified using topographic maps and site visits. Each site was screened using the "Potential Detention Opportunity Site Evaluation Criteria" worksheets, located in Appendix C of the DSIP Technical Supplement. These worksheets rate the sites according to variables such as the size of the drainage area served, regulatory issues, and other urban suitability criteria. They provided direction to the modeling process by identifying the sites with the greatest potential, as well as those with fatal flaws (e.g., adverse environmental impacts or site too small for the watershed served). Once the sites were screened and rated, the most promising sites in each basin were incorporated into the model to analyze their hydraulic benefits (refer to "Development of the Recommended Plan" later in this section).

FACILITY SIZING CRITERIA

Table 5-3 summarizes the sizing criteria for DSIP development established as part of the Stormwater Management Program Plan. These criteria were developed by the consultant team and City staff. They were used to size the drainage system improvements, using the design storm volumes summarized in Table 5-1. The design storm recurrence interval represents the "size" of storm that the specific facility type must be sized to pass.

Table 5-3
Facility Sizing Criteria

Facility Type	Design Storm Recurrence Interval (years)
Open system in FEMA floodplain	100
All other open systems	25
Closed system	10
Regional detention facilities	100

ALTERNATIVES CONSIDERED

For each basin, two alternatives were considered:

- Optimum detention: This option incorporated the best regional detention facilities with conveyance improvements as required. This was the preferred alternative based on the recommendations of the Stormwater Management Program Plan.

- Conveyance improvements only: This alternative was selected when no regional detention facilities were identified and selected (e.g., East Bank basin).

The following section describes the application of these alternatives within the study basins to develop recommended system improvements.

DEVELOPMENT OF THE RECOMMENDED PLAN

The detention opportunity site screening worksheets identified a number of potential sites. The recommended plan was developed by first evaluating and selecting the optimum combination of regional detention facilities for each basin and then sizing conveyance improvements based on the resulting flows. City staff reviewed the recommended improvement projects and provided input based on their experiences and records.

Evaluation and Selection of Detention Facilities

For basins where detention opportunities were identified, the following steps were used to evaluate and select the detention facilities to be included in the recommended alternative:

- The highest-rated potential detention facilities were incorporated into the XP-SWMM future land use model (refer to Section 3 of the DSIP Technical Supplement).
- Facilities were evaluated for peak flow reduction immediately downstream. Those with significant reductions (greater than 10%) were selected for further analysis.
- Further model analysis developed the optimum combination of facilities by examining the incremental benefits of potential facilities for reducing the peak flow at a critical downstream location.
- The results of the evaluation were reviewed with City staff and a list of recommended facilities was finalized.

Identification of Conveyance Improvements

Conveyance improvements for each basin were identified for future land use conditions, including any selected detention facilities, using the XP-SWMM model. Conveyance improvements were sized to transport the peak flow for the applicable design storm (refer to Table 5-3).

City Staff Review and Additions

Once a draft improvement project list was assembled, City staff reviewed the list and made additions, corrections, and comments. This input was valuable because it provided a real-world check on the recommended projects and helped to define the scope of the recommendations based on actual field conditions.

ESTIMATING COSTS

Unit costs were developed for project components such as pipes, culverts, bridges, detention facilities, easements, outlet structures, etc. These values were reviewed by City staff and modified to represent recent project experience. Appendix C of the DSIP Technical Supplement contains a summary of the unit costs used for this study. The improvement project costs were estimated by applying the unit costs to the quantities specified in the recommended plan project list. Allowances of 15% for permitting, acquisition, preliminary and final design, 6% for administration and 9% for construction management were added to the project total.

As is typical for a master planning effort, the uncertainties involved in estimating project costs are high due to the lack of detailed site-specific information on subsurface soils, groundwater, buried utilities, final design criteria, permitting difficulty (waterway, wetlands, Endangered Species Act, etc.) and land acquisition or easement costs. This information will be developed during the predesign and design phases of each project. To account for these uncertainties, a 40% contingency was added to project costs.

The DSIP project development process did not recommend drainage improvements for relatively small pipes and ditches which were beyond the scope of the modeling effort. An allowance of 5% was added to the project total for small conveyance improvements. In addition, an allowance of 2% was added to the project total for implementation of water quality facilities, and 3% was budgeted for stream restoration/habitat improvement. These allowances will be updated once project lists are developed (Refer to "Early Action" items in the SMPP: Section 4, Policy 13).

DRAINAGE SYSTEM IMPROVEMENT PRIORITIES

Policy 1 of SMPP (refer to Section 4) recommends that the DSIP quantity projects be divided into the categories of "Early action" (1 to 5 years), "High priority" (5 to 10 years), "Medium priority" (10 to 20 years), and "Long term" (20 years plus) using the following criteria:

- High flood reduction benefit-to cost ratio
- Conjunctive or multiple use potential, particularly as a balance between moving water and enhancing stream water quality and habitat/aesthetics
- Low regulatory complexity
- Environmental benefits
- Public support

Numeric benefit-to-cost ratios were not developed in this study because the site-specific flood reduction cost benefits are difficult to quantify at this master-planning level. However, to make a qualitative benefit-to-cost assessment, the project priorities should reflect the following:

- Timeline: existing or future problem area

- Flood damage risk: high, medium, or low (including a qualitative assessment of potential downstream effects)
- Relative cost: high, medium, or low
- Opportunities to preserve or enhance stream water quality and habitat value
- "Avoidance" opportunities (e.g., coordinating drainage improvements with scheduled street projects or park improvements)

Existing problems with high risk and low relative cost are considered to have the highest benefit-to-cost ratio, whereas future problems with low risk and high relative cost are considered to have the lowest benefit-to-cost ratio.

This Drainage System Improvement Plan represents a major investment by the City to efficiently manage stormwater quantity and quality and protect and enhance the urban environment. To implement the plan, the City must ensure that adequate funding is available when needed. In addition, the implications and requirements of several regulatory programs (Stormwater NPDES, ESA, TMDL's, and the COE Section 205 Study) will produce a considerable amount of additional information and direction within the next three years that will have a significant influence on DSIP project priorities.

The Stormwater Management Program Plan identified several "Early Action Items" (refer to Section 4, Policy 13) which the City believes must be carried forward with early implementation. In addition, several of the DSIP projects meet the "highest benefit-to-cost ratio" criteria outlined above and warrant "early action" priority.

The remaining DSIP projects will be appropriately prioritized once the stormwater funding picture becomes clearer and the requirements of the associated regulatory programs are known. Prioritization will take place through the City's annual Capital Improvement Program (CIP).

PERCENTAGE FOR GROWTH

One major question typically raised during any utility master planning process is one of how many or what percentage of the identified system improvements are needed to address existing problems, and how many are needed to accommodate future growth. Oregon law for System Development Charges allows for improvement fees to recover costs "*…of projected capital improvements needed to increase the capacity of the systems to which the fee is related*." For planned facilities that are needed entirely to serve projected development, the total cost of the improvements may be included in the improvement fee (e.g., extension of an existing storm drain into a currently undeveloped catchment area). However, for system improvements that will serve both new and existing customers, the costs must be allocated equitably between existing users and future development.

Since the designs and therefore costs of most stormwater system improvements are generally flow dependent, efforts were initially made during the master planning process to apportion DSIP project costs on a flow basis; either as a direct flow proportion (e.g., existing flow/future flow), or flow proportion relative to the capacity of the existing drainage system component in question.

However, practical application of these methods by the consultant-City staff team found that neither produced consistently reliable or equitable results and that more in-depth analysis was required. Therefore, it was decided to defer this decision and include the project-by-project analyses as part of the proposed stormwater system development charge methodology study that is recommended as an early action priority.

Section 6
Drainage System Improvement Plan

This section describes the projects included in the recommended Drainage System Improvement Plan (DSIP), future model development and data collection, and the addition of water quality facilities to the DSIP. Every effort has been made during the development of this recommended plan to reflect a balance between the need to safely and cost effectively move stormwater, with the environmental and aesthetic needs and values of Salem's urban streams. The implications of the Endangered Species Act listings and the water quality status of several Salem streams will undoubtedly influence project prioritization and specific project designs during the Master Plan implementation.

The Mill Creek/Shelton Ditch drainage system is also the subject of a Corps of Engineers Section 205 (Flood Control Act of 1948 as amended) Flood Damage Reduction Study that is scheduled to be completed by mid-2001. It is anticipated that several major flood mitigation projects will be identified for future implementation, possibly including one or more major detention projects within the Mill Creek watershed upstream from Salem. The improvement projects recommended by this Master Plan for the Mill Creek basin are for those tributary drainage systems within Salem's UGB. It is envisioned that these priorities and this Master Plan will be reviewed and updated to reflect the recommendations of the 205 Study.

FUTURE MODEL ENHANCEMENT

A planning-level XP-SWMM model for each basin provided the appropriate level of detail for master plan development consistent with the level of data available for the City's stormwater system. However, verification and design of the individual improvement projects will require development of more detailed models [an "Early Action Item" in the Stormwater Management Program Plan (SMPP), refer to Section 4, Policy 1.3] particularly for those basins with very gradual slopes where backwater effects are more important. Once these models are developed and mathematically calibrated and verified, they can be utilized to refine the operation of hydraulic structures, define surcharge levels for culverts and manholes, and perform a floodplain analysis. The recommended steps for future model development are:

- Collect system inventory data as described in the following section, "System Inventory"
- Collect rainfall and runoff data as described in the "Monitoring Program" section that follows
- Develop Extran models (the module of XP-SWMM that models backwater effects and complex hydraulic structures) for each basin in Salem. Basins such as Claggett Creek, Little Pudding, Mill Creek, and Pringle Creek with gradual slopes, a history of flood damages, and high benefit-to-cost projects which require verification should be upgraded first.

Further model enhancements to include water quality parameters should also be considered. Water quality models can aid in the evaluation of management practice alternatives to meet state and federal regulatory requirements [e.g., Endangered Species Act (ESA), National Pollutant

Discharge Elimination System (NPDES) Stormwater Permit, Total Maximum Daily Loads (TMDL's), etc.].

SYSTEM INVENTORY

The system inventory should systematically gather the additional information required to construct the Extran model:

- Channels: cross-sections should be surveyed every 500 feet or at changes of grade, roughness, or section. For a floodplain analysis, it will be necessary to extend cross sections to include areas outside the channel section which may be inundated during floods. During the course of the survey, photographs and descriptions of stream condition and vegetation should be gathered and estimates of roughness factors should be made.
- Culvert data: culvert information should include shape, invert elevations, size, top of embankment, material, and condition
- Hydraulic structure data: verify data for orifice diameters and configurations, overflow elevations, weir lengths, gate openings and dimensions, and basin stage/volume curves
- Closed system: closed system TV reports should be reviewed to estimate roughness factors for pipes and determine their structural condition

The data collected including the schematics and basins delineated for this study, should be integrated into Salem's Geographical Information System (GIS). This will centralize the data, streamline future modeling efforts, and facilitate periodic GIS updates.

MONITORING PROGRAM

Calibration and verification data is vital to development of an accurate and comprehensive model. Calibration is typically performed using three to six observed storm events; verification usually requires one to three additional events (Water Environment Federation, *Design and Construction of Urban Stormwater Management Systems*, 1992). The data that must be monitored includes:

- Rainfall hyetographs
- Conveyance flow hydrographs
- Outfall stage (e.g., Willamette River stage during the storm)

In addition, water quality data from existing NPDES Permit sampling sites should be gathered to aid in future development of a water quality model.

To gather this data, two to three rain gages should be installed in each basin, depending on basin size. Flow monitoring stations should also be located on each major basin tributary, and detention facilities should be monitored for inflow, stage and discharge. Section 5 of the DSIP Technical Supplement identifies the recommended locations of monitoring stations, including a description of each location. These sites have been selected not only for the purpose of hydraulic model calibration and verification, but also to serve the dual function of flood warning as part of

the City's Flood Hazard Mitigation Plan. It is estimated that the recommended system inventory work, model enhancements, and associated monitoring program will cost approximately $3 million.

WATER QUALITY FACILITIES

Urbanization degrades water quality by accelerating mass erosion, surface erosion, channel erosion, and wash-off of urban particulates from various urban surfaces. Water quality projects such as wetlands, regional detention facilities, streambank stabilization and bioengineering projects are tools that can be used to mitigate the effects of urbanization by reducing velocities or channel/bank erosion, removing pollutants, and reducing unacceptably high water temperatures.

The Stormwater Management Program Plan recommends a set of policies to implement a surface water quality facility program reflecting the requirements associated with the NPDES Municipal Stormwater Permit, the Endangered Species Act, the Total Maximum Daily Load program, and the ecological needs of the community's urban streams (refer to Section 4, Policies 5 and 12). These policies will be used to develop an inventory of potential regional water quality sites and a list of basins that will require either regional or on-site water quality facilities (an "Early Action Item" in the SMPP). These facilities will be funded on a prioritized basis as part of the City's annual rate funded "Pay As You Go" funding program. An allowance of 2%, or approximately $4 million, has been allocated for implementation of regional water quality facilities.

It must be emphasized that the implications and requirements of the Stormwater NPDES, ESA, and TMDL programs are still unfolding, and will not likely be fully known until the Willamette River TMDL is established (currently projected for 2003). The appropriate water quality facilities and their locations are currently unknown. Therefore, the allowance cited above should be considered a placeholder for future drainage system improvement needs.

STREAM RESTORATION / HABITAT IMPROVEMENT

The Stormwater Management Program Plan has adopted policies to complete a Stream, Riparian, Open Channel, and Aquatic Resources Inventory and Evaluation (refer to Section 4, Policy 12). This, coupled with probable ESA compliance activities, will likely lead to additional stream/habitat improvement projects added to the DSIP project list. Completion of the resources inventory and addition of stream/habitat projects to the DSIP list is an "Early Action Item" in the SMPP. In addition, some of the open channel conveyance improvements for stormwater quantity will include bioengineering and habitat improvements to address community, water quality, and ESA requirements. An allowance of 3%, or approximately $6.1 million, has been allocated for stream/habitat improvement projects. These facilities will be funded on a prioritized basis as part of the City's annual rate funded "Pay As You Go" funding program.

REGIONAL DETENTION FACILITIES

The recommended regional detention facilities are listed in Tables 6-1 to 6-9 and shown in Figures 6-1 to 6-9. Although a number of potential regional detention opportunity sites were found, such sites were not so abundant that they can be allowed to be lost by default or inaction.

Therefore, the development of regional detention has been identified as an "Early Action Item" in the SMPP (refer to Section 4, Policies 1.3 and 3.1-3.8). Numerous sites were investigated during this study. It is anticipated that others will emerge during the implementation process. The City should encourage maintenance, development review, and field personnel to continue to look for regional detention opportunity sites to be evaluated and, if feasible, added to the DSIP project list. Additional regional detention and/or water quality facility opportunities may arise as the City's Parks Master Plan is implemented. Monitoring the performance of the constructed detention storage sites is very important and may lead to the resizing or reconfiguring of the hydraulic control structures (see "Monitoring Program" above).

RECOMMENDED CONVEYANCE FACILITIES

The recommended conveyance facilities are listed in Tables 6-1 to 6-9 and project locations are shown in Figures 6-1 to 6-9. These facilities include pipes, culverts, and channel capacity improvements (including a budget for anticipated associated bioengineering, stream bank stabilization, and small conveyance improvement costs). It is conceivable that some open channel conveyance improvements cannot be implemented to achieve projected full-flow carrying capacity needs due to physical or regulatory constraints. Each will have to be evaluated on a case-by-case basis in close coordination with the various regulatory agencies. If implemented, the channel capacity improvement projects will require careful planning and mitigation to protect fish and wildlife habitat.

The recommended improvement projects that involve open channels and streams may have up to three distinct components: "Channelization", "Bioengineering/Habitat", and "Special Stream Habitat." These project components are identified in the basin-specific DSIP project lists located in Appendix C of the Drainage System Improvement Plan Technical Supplement. Brief definitions are presented below:

"**Channelization"** refers to capacity-increasing and erosion-preventing types of projects in waterways and ditches. It generally involves widening of channels by sloping the banks back away from the waterway to create a more stable, less steep slope; and removing obstructions such as accumulations of trash and debris, non-native brush, diseased or unstable trees, old concrete walls or riprap which impede the free flow of water. While channelization is generally done in combination with bioengineering or stream habitat work, it can also be done as a stand-alone project.

"Bioengineering/Habitat" refers to restoration efforts primarily aimed at stabilizing waterway banks through the use of mostly natural materials such as ground covers, burlap or coconut fiber blankets, closely planted / densely rooted trees, or low-growing hardy native species; placement of tree trunks, larger rocks, or small constructed flow-diverting structures at critical erosion-prone locations; velocity dissipaters or meanders in the waterway bed.

"Special Stream Habitat" refers to more extensive waterway restoration efforts where attempts are made to restore or enhance both the stream channel and the riparian zones along the waterway, including both in-stream restoration of waterway channels (spawning gravels, riffles,

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Table 6-1
Battle Creek Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
BCB1		Battle Creek from Commercial St. to I-5	Channelization/ Bioengineering/ Habitat	$ 605,319		FEMA stream LWI implications
BCB2		Battle Creek east from Battle Creek Golf Course to Commercial St.	Channelization/ Bioengineering/ Habitat; Remove/upsize small culverts on Battle, Scotch, and Powell Creeks	$ 2,176,850		FEMA stream
BCB3		Battle Creek crossing Fairway Ave.	Bridge	$ 297,500	Yes	FEMA stream, G.O. Bond F Bridge Project (2000-01)
BCB4		Battle Creek from Sunnyside Rd. to Battle Creek Golf Course	Channelization/ Bioengineering/ Habitat; Place berm along Sunnyside to prevent over-topping of road near Pawnee Circle	$ 1,431,060		FEMA stream
BCB5		Cinnamon Creek from Rees Hill Rd. to confluence w/ Battle Creek	Channelization/ Bioengineering/ Habitat; Replace undersized culvert	$ 484,755		Proposed neighborhood park upstream
BCB6		Powell Creek from Meriweather Ct. to 220 ft east of Doral Dr.	Replace undersized culvert; Channelization/ Bioengineering/ Habitat; Bridge	$ 600,236		FEMA stream, LWI implications
BCB7		Powell Creek from Sunnyside Rd. to 13th Ave.	Bridge; Channelization/ Bioengineering/ Habitat; Add parallel culvert	$ 973,828		FEMA stream, LWI implications
BCB8		Powell Creek crossing Elkins Way	Replace undersized culvert	$ 12,325		
BCB9		Scotch Creek crossing of Rees Hill Rd.	Channelization/ Bioengineering/ Habitat	$ 424,320		
BCB10		Scotch Creek crossing Sunnyside Rd.	Replace undersized culvert	$ 51,340		
BCB11		Waln Creek from Madras St. to Battle Creek	Channelization/ Bioengineering, Replace 2 small culverts	$ 1,161,100		FEMA stream
BCB12		Waln Creek crossing Madras St.	Bridge	$ 297,500		FEMA stream
BCB13		Waln Creek from Wiltsey Rd. to Madras St.	Bridge; Channelization/ Bioengineering/ Habitat	$ 808,010		FEMA stream
BCB14		Waln Creek from Woodside Dr. to Wiltsey Rd.	Channelization/ Bioengineering/ Habitat	$ 994,500		Partial USA project
BCB15		Drainage system crossing Fabry, tributary to Waln Creek	Replace undersized culvert	$ 14,790		Partial USA project
BCB16		Waln Creek from Shannon to Woodside Dr.	Channelization/ Bioengineering/ Habitat	$ 1,306,110		
BCB17		Waln Creek crossing Fabry Rd.	Bridge	$ 297,500		
BCB18		Waln Creek between 7th Ave. and Sunnyside Rd.	Channelization/ Bioengineering/ Habitat	$ 191,250		
BCB19		Waln Creek crossing pedestrian path north of Springwood Ave.	Replace undersized culvert	$ 51,680		
BCB20		Intersection of Holder Lane and Lone Oak Rd.	Replace undersized culvert; Channelization/ Bioengineering/ Habitat	$ 296,276		
BCB21		Jory Creek at Liberty Rd.	Detention Facility: Jory Creek at Liberty	$ 993,650	Yes	Proposed community park NE

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Table 6-1
Battle Creek Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
BCB22		Battle Creek at Liberty/Bates Road	Detention Facility: Liberty/Bates	**$ 1,575,900**	Yes	
			Subtotal	**$ 15,045,799**	**-**	
			Small conveyance improvement allowance	**$ 752,290**	-	This allowance is 5% of the subtotal.
			Total ($)	**$ 15,798,089**		

1. INCLUDES ALLOWANCES FOR PERMITTING, ACQUISITION, PREDESIGN, AND FINAL DESIGN (15%), ADMINISTRATION (6%), CONSTRUCTION MANAGEMENT (9%) AND CONTINGENCY (40%).

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Table 6-2
Croisan Creek Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
CCB1		Croisan Creek railroad crossing, 2600 block South River Road.	Bore/Jack 3 new culverts under railroad; Remove weir near railroad	$ 1,467,440		FEMA stream, remove weir as "early action"
CCB2		Croisan Creek at 2611 South River Rd.	Replace culvert w/ Bridge	$ 297,500		FEMA stream
CCB3		2600 Block South River Rd.	Replace undersized pipe	$ 45,356	Yes	Street CIP G.O. Bond F (2000-01)
CCB4		Croisan Creek at 2900 Block South River Rd.	Replace Culvert w/ Bridge	$ 297,500		FEMA stream
CCB5		Golf Course Rd. at South River Rd.	Replace undersized pipe and ditch system	$ 127,687	Yes	Partial Street CIP G.O. Bond (2000-01)
CCB6		Croisan Creek between Croisan Creek Rd. and Golf Course Rd.	Channelization/ Bioengineering/ Habitat	$ 648,635		FEMA stream
CCB7		Croisan Creek Rd. at South River Rd.	Replace undersized culvert	$ 30,689	Yes	Street CIP G.O. Bond F (2000-01)
CCB8		Croisan Creek Rd. at South River Rd.	Replace undersized box culvert	$ 297,500		FEMA Stream, Street CIP (2004-05)
CCB9		Croisan Creek, South of River Rd. West of Croisan Creek Rd.	Remove weir	$ 85,000		FEMA Stream , water rights considerations
CCB10		Croisan Creek at 3281 Croisan Creek Rd.	Bridge	$ 467,500		FEMA Stream, Street CIP (2004-05)
CCB11		Croisan Creek, Spring St. to Madrona Ave.	Channelization/ Bioengineering/ Habitat	$ 1,148,316		FEMA Stream, Street CIP (2004-05)
CCB12		Croisan Creek at Roberta Ave. South	Bridge	$ 297,500		FEMA Stream
CCB13		Croisan Creek at 4451 Croisan Creek Road to Spring St.	Channelization/ Bioengineering/ Habitat	$ 1,726,775		FEMA Stream, LWI implications
CCB14		Croisan Creek at Kuebler Rd.	Kuebler Rd. Detention Facility	$ 1,360,000	Yes	FEMA Stream, regional detention facility, proposed neighborhood park south
CCB15		Croisan Creek at Ballyntine Rd. S.	Install additional culvert	$ 49,470		Currently Marion County
			Subtotal	$ 8,346,868	-	
			Small conveyance improvement allowance	$ 417,343	-	This allowance is 5% of the subtotal.
			Total ($)	**$ 8,764,212**		

1. INCLUDES ALLOWANCES FOR PERMITTING, ACQUISITION, PREDESIGN, AND FINAL DESIGN (15%), ADMINISTRATION (6%), CONSTRUCTION MANAGEMENT (9%) AND CONTINGENCY (40%).

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Table 6-3
East Bank Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
EBB1		Columbia Ave between Front St and Liberty St	Replace undersized pipe	$ 182,410		Sinkhole observed
EBB2		Hickory St between the Willamette River and 4th St	Replace undersized pipe	$ 259,318		
EBB3		Parallel to Riviera Dr between the Willamette River and Maple Ave	Replace undersized pipe	$ 718,395	Yes	Bad pipe. Street CIP G.O. Bond F (2000-01)
EBB4		Liberty St. between Riviera Dr and Tryon Ave	Replace undersized pipe	$ 253,351		
EBB5		Intersection of Hickory St and Commerical St to intersection of Johnson St and Church St	Replace undersized pipe	$ 464,831	Yes	Street CIP G.O. Bond F (2000-01), Sinkhole near railroad.
EBB6		On Locust St and Maple St between Johnson and Laurel St	Replace undersized pipe	$ 200,779		Cracked pipes
EBB7		Norway St between Commercial St and Fairgrounds Rd	Replace undersized pipe	$ 780,147	Yes	Sinkhole reported. On-going maintenance problems, bad pipe.
EBB8		Fairgrounds Rd between Winter St and Capital St	Replace undersized pipe	$ 303,739		
EBB9		From Fairgrounds Rd and Norway St to Baker St, along Baker to Market St and east to 16th St	Replace undersized pipe	$ 1,143,395		Flooded basements reported. Cracked pipe, heavy roots.
EBB10		Hickory St between the Willamette River and Commercial St	Replace undersized pipe	$ 202,300		
EBB11		On Salem Pkwy between Commercial and Broadway	Replace undersized pipe	$ 349,690		
EBB12		Donna St between Highland Av and Fairgrounds Rd	Replace undersized pipe	$ 251,923		Rocks in pipe
EBB13		Sunnyview Ave between Warner St and 16th St	Replace undersized pipe	$ 77,155		Bad joints, cracked pipe
EBB14		Stark St between Willamette Dr and North River Rd.	Replace undersized pipe	$ 338,360		Heavy roots, cracked pipe
EBB15		Stark St crossing River Rd and Broadway	Replace undersized pipe	$ 95,795		
EBB16		Gaines St between the Willamette River and Front St	Replace undersized pipe	$ 32,292		
EBB17		From Front St and Gaines east to 15th and Nebraska	Replace undersized pipe	$ 1,768,969		
			Subtotal	$ 7,422,846	-	
			Small conveyance improvement allowance	$ 371,142	-	This allowance is 5% of the subtotal.
			Total ($)	**$ 7,793,988**		

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Table 6-3
East Bank Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments

1. INCLUDES ALLOWANCES FOR PERMITTING, ACQUISITION, PREDESIGN, AND FINAL DESIGN (15%), ADMINISTRATION (6%), CONSTRUCTION MANAGEMENT (9%) AND CONTINGENCY (40%).

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Table 6-4
Glenn Gibson Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
GGB1		Wallace Road north of Rogers Lane	Replace undersized pipe	$ 287,145		New ODOT system, monitor performance
GGB2		Rogers Lane	Replace undersized pipe; Replace undersized flow-equalizing culvert	$ 378,701		Currently being designed. Bad pipe, properties flooded.
GGB3		Gibson Creek at Doaks Ferry Rd.	Bridge	$ 297,500		FEMA stream
GGB4		Gibson Creek at Brush College Rd.	Bridge; Replace undersized culverts	$ 359,346	Yes	FEMA stream. Brush College street CIP G.O. Bond F (2001)
GGB5		Drainage system from Wintergreen and Brush College to Gibson Creek	Replace undersized pipe	$ 211,990	Yes	Brush College street CIP G.O. Bond F (2001)
GGB6		Drainage system along Wilark Dr.	Replace undersized culvert	$ 261,188		West Salem USA?
GGB7		Culvert across Doaks Ferry Road north of Brush College Rd.	Replace undersized culvert	$ 20,953		West Salem USA?
GGB8		Culvert across Orchard Heights, east of Grice Hill Rd. Draining to Gibson Creek.	Replace undersized culvert	$ 71,859		
GGB9		Glenn Creek crossing of Harritt Dr. 200 ft west of Wallace Rd.	Bridge	$ 297,500		FEMA stream
GGB10		Culvert crossing Harritt Dr.	Replace undersized culvert	$ 47,090		Partnership with private development
GGB11		Culvert across Linwood St.	Replace undersized culvert	$ 52,207		LWI implications
GGB12		Glenn Creek crossing of Orchard Heights Rd..	Bridge; Channelization/ Bioengineering/ Habitat	$ 629,000		FEMA stream
GGB13		Glenn Creek upstream of Orchard Heights Rd.	Channelization/ Bioengineering/ Habitat	$ 739,245		FEMA stream, LWI implications
GGB14		Pipe along Glenn Creek road east of Windemere Dr.	Replace undersized pipe	$ 57,086		
GGB15		Glenn Creek crossing of Glenn Creek Rd.	Bridge	$ 297,500		FEMA stream
GGB16		System draining to Glenn Creek from the intersection of Ptarmigan and Doaks	Replace undersized pipe	$ 128,920		West Salem USA?
GGB17		Culvert under Doaks Ferry Rd. 600 ft east of Mogul St.	Replace undersized culvert	$ 40,664		Overtopped in 1996
GGB18		Hidden Valley Detention Facility: Glen Creek just upstream of Glen Eden Ct	Add detention facility	$ 3,825,850	Yes	FEMA stream, outside UGB in Polk County
GGB19		Gladow Pond: Gibson Creek upstream of Orchard Hts. Rd.	Add detention facility at Gladow Pond, or at pond approx. 1000 ft downstream	$ 1,013,200		Outside UGB in Polk County
GGB20		Orchard Heights Park	Add detention facility	$ 1,079,500		FEMA stream
GGB21		Grice Hill Road crossing-South	Add detention facility	$ 986,850	Yes	
GGB22		Grice Hill Road crossing-North	Add detention facility	$ 1,473,900	Yes	

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Table 6-4
Glenn Gibson Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
GGB23		Holiday Tree Farm Pond	Add detention facility	$ 724,200		Outside UGB in Polk County
			Subtotal	**$ 13,281,393**	**-**	
			Small conveyance improvement allowance	**$ 664,070**	-	This allowance is 5% of the subtotal.
			Total ($)	**$ 13,945,462**		

1. INCLUDES ALLOWANCES FOR PERMITTING, ACQUISITION, PREDESIGN, AND FINAL DESIGN (15%), ADMINISTRATION (6%), CONSTRUCTION MANAGEMENT (9%) AND CONTINGENCY (40%).

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Table 6-5
Little Pudding Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
LPB1		Lake Labish Rd NE, North of Hazel Green Rd.	Replace undersized culvert; Channelization/ Bioengineering/ Habitat	$ 951,745		Currently Marion County, LWI implications
LPB2		Crossing Hazel Green Rd. NE	Bridge	$ 467,500		LWI implications
LPB3		Crossing Manning Dr.NE and Kale Rd. NE	Bridges	$ 595,000		
LPB4		Between Kale Rd. NE and Hazel Green Rd. NE	Replace undersized culvert; Channelization/ Bioengineering/ Habitat	$ 1,292,000		Proposed large urban park. LWI implications
LPB5		South of Settlers Dr. NE, Flintlock to Siesta	Replace undersized pipe	$ 718,403		
LPB6		Crossings of Hayesville, Jan Ree and Rebecca NE	Replace undersized culverts	$ 238,493		
LPB7		South of Hayesville Dr. NE	Replace undersized culvert	$ 447,083	Yes	Proposed neighborhood park. Localized flooding.
LPB8		Along Cordon Rd. NE, south of Hayesville Dr.	Replace undersized pipe	$ 299,982		
LPB9		Along Cordon Rd. NE, between Hayesville Rd. and Silverton Rd.	Replace undersized culvert; Channelization/ Bioengineering/ Habitat	$ 2,937,408		Proposed neighborhood park, LWI implications
LPB10		Herrin Rd. NE, west of Cordon Rd.	Replace undersized pipe	$ 284,665		
LPB11		Cordon Rd. NE, south of Silverton Rd.	Bridge	$ 1,020,000		
LPB12		From Indiana/Muncie to Mooreland/Mendocino NE	Replace undersized culvert; Channelization/ Bioengineering/ Habitat	$ 1,074,825		
LPB13		Oak Park Dr./ Cordon Rd.	Channelization/ Bioengineering/ Habitat	$ 1,114,520		1996 flooding
LPB14		Carolina NE south, east of San Diego	Channelization/ Bioengineering/ Habitat; Bridge	$ 912,764		
LPB15		Culverts at Sunnyview/Brown, 47th Ave/Cedro Loop	Replace undersized culverts	$ 251,498		
LPB16		East side of Salem Academy	Replace undersized culvert	$ 69,700		Possibly remove culvert?
LPB17		Center St. at Citation NE	Replace undersized culvert	$ 193,630		
LPB18		Culverts at Hudson NE, Eldin NE, State St., , Channel improvements East of Evelyn, north of Hudson	Replace undersized culvert; Channelization/ Bioengineering/ Habitat	$ 481,491		
LPB19		East of Elma, Macleay to Durbin and along Durbin SE to Beck	Replace undersized pipe	$ 534,650		
LPB20		Carolina NE at Cordon Rd.	Replace undersized culvert; Channelization/ Bioengineering/ Habitat	$ 673,540		LWI implications
LPB21		Swegle west of Royalty Dr. and west end of Future Dr. NE	Replace undersized culverts	$ 120,598		Swegle street CIP G.O. Bond F (2000-01)

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Table 6-5
Little Pudding Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
LPB22		Regal Dr NE, Camelot Dr NE, Kingdom Way NE, Squire Ct. NE	Replace undersized pipe	$ 1,077,018		
LPB23		South of Auburn Rd. and Cordon Rd. to Cordon Rd. north of Center St.	Replace undersized culvert; Replace undersized pipe; Channelization/ Bioengineering/ Habitat	$ 893,172		Proposed large urban park upstream, LWI implications
LPB24		From 46th and Mahrt to East of Clearwater and Avens	Replace undersized culvert; Replace undersized pipe	$ 788,197		
LPB25		Cordon Rd at Powderhorn and north of Arrowood Ct. SE	Replace undersized culvert; Channelization/ Bioengineering/ Habitat	$ 512,074		
LPB26		Wagon SE to Pennsylvania at Cordon Rd.	Replace undersized culvert; Channelization/ Bioengineering/ Habitat	$ 644,385		Localized flooding, LWI implications
LPB27		West of Seattle Slew Dr SE and across Clydesdale Dr SE	Replace undersized culvert; Channelization/ Bioengineering/ Habitat	$ 307,972		LWI implications
LPB28		Highway 22, west of Kuebler/Cordon	Replace undersized culvert	$ 387,974		ODOT, LWI implications
LPB29		Crossing Arabian Ave SE and the East end of Red Cherry Ct. SE	Replace undersized pipe	$ 201,144		
LPB30		West end of Red Cherry, Black Cherry Ct.	Replace undersized pipe	$ 121,669		
LPB31		Highway 22 and Campbell St. SE	Replace undersized culvert	$ 379,304	Yes	ODOT, LWI implications. Localized flooding.
LPB32		Across Kuebler/Cordon at HWY 22 and at the SW corner of HWY 22 and Kuebler/Cordon	Replace undersized culvert; Channelization/ Bioengineering/ Habitat	$ 424,618		Corrections Farm Redevelopment
LPB33		Buckhorn/Burntwood and 49th Ave. /Burntwood	Replace undersized pipe	$ 503,719		Localized flooding
LPB34		Shenandoah Dr. SE, 49th/Adobe, 48th Ct. SE	Replace undersized culvert; Replace undersized pipe	$ 894,387		Localized flooding
LPB35		Rickey to Macleay SE, Pennsylvania Ave SE, 46th to 47th Ave SE	Replace undersized pipe	$ 913,980		
LPB36		Cordon at Caplinger Rd. SE	Bridge	$ 467,500		LWI implications, downstream flooding
LPB37		East of Macleay Rd. between Cordon and Caplinger	Channelization/ Bioengineering/ Habitat	$ 1,088,553		LWI implications
LPB38		Macleay Rd. SE	Bridge	$ 297,500		LWI implications
LPB39		Macleay and Cordon Rd.	Channelization/ Bioengineering/ Habitat	$ 324,615		LWI implications
LPB40		Cordon at Macleay	Replace undersized culvert	$ 75,990		LWI implications
LPB41		Cordon Rd. at Gaffin and south of Gaffin	Replace undersized culvert; Channelization/ Bioengineering/ Habitat	$ 772,225		Correction Farm Redevelopment
LPB42		South of Highway 22 and east of Cordon Rd.	Channelization/ Bioengineering/ Habitat	$ 1,390,643		Corrections Farm Redevelopment, proposed large urban park

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Table 6-5
Little Pudding Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
LPB43		Near Arabian Ave. and crossing Macleay Rd. west of 49th	Replace undersized culverts	**$ 810,815**		Proposed neighborhood park
LPB44		Indiana Ave NE, west of 49th, Glendale Ave NE, Oak Park Dr NE, and Greenbrook Dr. NE	Bridges	**$ 1,190,000**		
			Subtotal	**$ 29,146,945**	**-**	
			Small conveyance improvement allowance	**$ 1,457,347**	-	This allowance is 5% of the subtotal.
			Total ($)	**$ 30,604,293**		

1. INCLUDES ALLOWANCES FOR PERMITTING, ACQUISITION, PREDESIGN, AND FINAL DESIGN (15%), ADMINISTRATION (6%), CONSTRUCTION MANAGEMENT (9%) AND CONTINGENCY (40%).

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Table 6-6
Mill Creek Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
MCB1		Turner Rd. north of I-5	Channelization/ Replace undersized culverts	$ 2,751,630		Impacted by Mill Creek overflows
MCB2		Turner Rd. South of Mission St.	Channelization/ Replace undersized culverts	$ 2,111,352		Turner Rd. CIP (2004-05). Impacted by Mill Creek overflows. Possibly divert high flows back to Mill Creek or Shelton Ditch.
MCB3		Mission St. SE from Airport to 20th St.	Replace undersized culverts	$ 2,738,513		ODOT coordination. Possibly divert high flows to Shelton Ditch.
MCB4		Along Airport Rd. and Ryan Dr. from Mission St. to Shelton Ditch	Replace undersized culverts	$ 731,029	Yes	Airport Rd. CIP G.O. Bond F (2000-01). May need to further upsize if Turner Rd. flows are diverted.
MCB5		NE quadrant of I-5/Highway 22 interchange	Channelization/ Replace undersized culverts	$ 266,512		ODOT
MCB6		Along Lancaster St. SE from Glenwood Dr. to Munkers St.	Replace undersized pipe; Replace undersized culverts	$ 520,109		
MCB7		East of I-5, south of Santiam Hwy	Replace undersized culvert	$ 110,908		ODOT
MCB8		Along Lancaster St SE from State St. to Mahrt St.	Replace undersized culvert	$ 201,672		
MCB9		East of I-5 near Bayonne Ct. SE	Replace undersized pipe	$ 223,633		
MCB10		Along Hawthorne Ave. near State St.	Replace undersized culvert	$ 336,663		
MCB11		Along Hawthorne Ave. NE south of Monroe Ave.	Channelization/ Bioengineering	$ 158,125		ODOT
MCB12		Along Monroe Ave. from Illinois Ave. NE to Hawthorne Ave. NE	Replace undersized culvert	$ 287,517		Coordinate with new OSP Ballfield.
MCB13		Between 25th St. NE and Blacksmith Dr.	Replace undersized pipe	$ 482,878		OSP/State Hospital responsibility
MCB14		Near 24th St. NE from Walker to Breyman	Replace undersized pipe	$ 701,749	Yes	Localized flooding/ flooded basements
MCB15		Near 23rd St. NE between State St. and Breyman	Replace undersized pipe	$ 389,246		Flooded basements
MCB16		West of 14th St. north from Lee St. to Shelton Ditch	Replace undersized pipe	$ 171,687		Railroad permit?
MCB17		Across Mission St. near 13th St.	Replace undersized pipe	$ 41,412		
MCB18		East of Liberty St. between Trade St. and Ferry St. and along Ferry St. to High St.	Replace undersized pipe	$ 153,668		
MCB19		Along Cottage St. from Ferry St. to Court St. and along Court St. east to Winter St.	Replace undersized pipe	$ 321,995	Yes	State and Court St. CIPs G.O. Bond F (2000-01)
MCB20		Along State St. from Cottage St. to Capitol St.	Replace undersized pipe	$ 304,145	Yes	State St. CIP G.O. Bond F (2000-01)
MCB21		Along 15th St. from Court St. to Chemeketa St.	Replace undersized pipe	$ 120,714		Northern Downtown Urban Renewal Improvements (2000-04). Rocks, roots,

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Table 6-6
Mill Creek Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
MCB22		Along Church St. from Union St. north to Mill Creek	Replace undersized pipe	$ 274,337		
MCB23		Summer St. from Marion St. north to Mill Ck, Union St. and 12th St. north to Mill Ck	Replace undersized pipe	$ 474,442		Restricted line, alignment break
MCB24		Along D St. NE from 12th St. to Mill Ck and along Winter St. from Market St. to D St.	Replace undersized pipe	$ 1,191,336		Cracked pipe. Norther Downtown Urban Renewal Improvements (2000-04)
MCB25		From the intersection of 12th St. and Nebraska St. to Stewart St. and	Replace undersized pipe	$ 439,169		Flooded basement reports
MCB26		West along B St. from 19th St. to Stewart St. and Lamberson St.	Replace undersized pipe	$ 576,330		
MCB27		Along B St. from 19th St. to Thompson St.	Replace undersized pipe	$ 459,547		
MCB28		From 23rd and B St. to B St. and Thompson St.	Replace undersized pipe	$ 369,999		1/4 full of water
MCB29		From 24th St. and Greenway Dr. to B St. and Thompson St.	Replace undersized pipe	$ 479,382	Yes	Center St. CIP G.O. Bond F (2000-01)
MCB30		Crossings of Deer Park and Aumsville Hwy	Replace undersized pipe; Replace undersized culvert	$ 173,466		
MCB31		Along Mill St. near 12th St.	Replace undersized pipe	$ 102,867		Coordinate with Mission Mill
MCB32		From Stand Ave. and Mill St. to Trade St. and 17 St.	Replace undersized pipe	$ 224,828	Yes	17th St. CIP G.O. Bond F (2000-01)
MCB33		Along Trade St. from 17th St. to Richmond Ave.	Replace undersized pipe	$ 598,259		
MCB34		Along Mill St. from 17th St. to 21st St.	Replace undersized pipe	$ 398,524	Yes	17th St. CIP G.O. Bond F (2000-01)
MCB35		Crossing Turner Rd. south of Gath Rd. SE	Replace undersized pipe	$ 16,354		
MCB36		Along Hawthorne north of Ryan Dr.	Replace undersized pipe	$ 103,150		
MCB37		Along 15th St. from Hines St. to Oak St.	Replace undersized pipe	$ 441,304		
MCB38		Crossing Kuebler east of Turner Rd.	Replace undersized culvert	$ 297,500		Downstream from Corrections Farm Redevelopment
MCB39		Crossing Kuebler south of Aumsville Hwy	Replace undersized culvert	$ 241,598		Downstream from Corrections Farm Redevelopment
			Subtotal	$ 19,987,552	-	
			Small conveyance improvement allowance	$ 999,378	-	This allowance is 5% of the subtotal.
			Total ($)	**$ 20,986,930**		

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Table 6-6
Mill Creek Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments

1. INCLUDES ALLOWANCES FOR PERMITTING, ACQUISITION, PREDESIGN, AND FINAL DESIGN (15%), ADMINISTRATION (6%), CONSTRUCTION MANAGEMENT (9%) AND CONTINGENCY (40%).

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Stormwater Master Plan

Table 6-7
Pringle Creek Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
PCB1		Clark Creek from Lefelle to Howard	Add Additonal Pipe/Culvert	$ 785,400		
PCB2		Piped system along Oxford St.	Replace Undersized Pipe	$ 735,148		
PCB3		Clark Creek crossing Rural Ave. SE	Replace Undersized Culvert	$ 163,115		
PCB4		Clark Creek North of McGilchrist	Channelization/ Bioengineering/ Habitat	$ 49,725		
PCB5		Clark Creek at Fairview, 12th St and Bluff Rd	Replace Undersized Culverts	$ 399,500		
PCB6		Clark Creek between Winter St and Summer St; Summer St.	Replace Undersized Culvert; Channelization/ Bioengineering/ Habitat	$ 210,171		
PCB7		Clark Creek at Ratcliff Dr	Bridge	$ 297,500		
PCB8		Clark Creek upstream of Ratcliff Dr and at intersections with Ratcliff Dr and Salem Hts Ave South	Replace Undersized Culverts; Channelization/ Bioengineering/ Habitat	$ 455,175		
PCB9		Clark Creek upstream of Commercial near Hillview; Triangle Dr SE	Replace Undersized Pipe/Culvert	$ 233,767		
PCB10		Clark Creek from Ewald to Halifax	Channelization/ Bioengineering/ Habitat	$ 467,500		LWI implications
PCB11		Drainage system to Clark Creek upstream of Ewald Ave	Replace Undersized Pipe	$ 150,280		
PCB12		Clark Creek from Ewald Ave to Vine St.	Replace Undersized Pipe/Culvert; Channelization/ Bioengineering/ Habitat	$ 300,475		
PCB13		Clark Creek at Browning Ave	Replace Undersized Pipe/Culvert	$ 42,670		
PCB14		East Fork Pringle Creek from Pringle Creek to McGilchrist	Channelization/ Bioengineering/ Habitat	$ 1,776,840		FEMA stream
PCB16		East Pringle crossing 16th St.	Bridge	$ 297,500		FEMA stream
PCB17		East Pringle crossing McGilchrist; 22nd Ave SE	Bridges	$ 595,000		FEMA stream, street CIP (2004-05), LWI implications
PCB18		East Pringle from McGilchrist to 25th	Channelization/ Bioengineering/ Habitat	$ 3,096,210		FEMA stream
PCB19		East Pringle at Madrona	Bridge	$ 467,500		FEMA stream, street CIP (2004-05)
PCB20		East Pringle from Airway Dr to Madrona	Channelization/ Bioengineering/ Habitat	$ 2,983,500		FEMA stream, street CIP (2004-05)
PCB21		Culvert across Airway Drive Draining Airport; near Airway Drive	Replace Undersized Culvert	$ 160,990		
PCB22		East Fork Airway Dr to I-5	Channelization/ Bioengineering/ Habitat	$ 2,850,900		FEMA stream, LWI implications

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Table 6-7
Pringle Creek Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
PCB23		East Fork: Culvert Under I-5; Middle Fork near I-5	Channelization/ Bioengineering/ Habitat; New box culvert/ bridge	$ 626,025		FEMA stream
PCB24		East/Middle Fork upstream I-5 to Kuebler	Channelization/ Bioengineering/ Habitat	$ 1,657,500		
PCB25		East/Middle Fork at Treistad and Kuebler	Channelization/ Bioengineering/ Habitat; Bridge; Add Culvert	$ 457,079	Yes	LWI implications, street CIP G.O. Bond F (2000-01)
PCB26		East Middle Fork upstream of Kuebler	Channelization/ Bioengineering/ Habitat	$ 1,633,700		LWI implications, partial USA project
PCB27		Middle Fork along SPRR from Pringle Creek to Boise Cascade	Channelization/ Stream Bank Stabilizaton; Bridge	$ 1,044,701		FEMA stream
PCB28		Middle Fork crossing Madrona	Bridge	$ 467,500		FEMA stream
PCB29		Middle Fork from Madrona to Ewald; from Fairview Ind Dr to SPRR	Channelization/ Bioengineering/ Habitat	$ 1,371,900		FEMA stream
PCB30		Culvert across Marietta	Replace Undersized Culvert	$ 44,693		
PCB31		Middle Fork upstream of 27th crossing Reed Ln	Replace Undersized Culvert	$ 170,136		
PCB32		Middle Fork at Battle Creek Rd and Reed Ln.	Replace Undersized Culvert	$ 108,460		Partial USA project
PCB33		Culvert across Baxter Rd SE	Replace Undersized Culvert	$ 48,450		
PCB34		Pringle Creek from Commercial to High St	Channelization/ Bioengineering/ Special Stream Habitat	$ 1,144,168		FEMA stream: COE study, LWI implications
PCB35		Pringle Creek at Liberty St	Bridge	$ 8,500,000		FEMA stream: COE study, LWI implications. Street CIP (2004-05)
PCB36		Pringle Creek at Church St	Bridge	$ 3,400,000		FEMA stream: COE study, LWI implications
PCB37		Pringle Creek at Winter St	Bridge	$ 2,550,000		FEMA stream
PCB38		Pringle Creek at Mission St	Bridge	$ 2,550,000		FEMA stream
PCB39		Pringle Creek at Cross St	Bridge	$ 2,550,000		FEMA stream
PCB40		Pringle Creek at 13th St	Bridge	$ 2,550,000		FEMA stream
PCB41		West Pringle Creek from Oxford to McGilchrist	Channelization/ Bioengineering/ Habitat; Bridge	$ 1,961,851		FEMA stream
PCB42		West Pringle Creek at McGilchrist	Bridge	$ 850,000	Yes	FEMA stream, railroad permit, street CIP (2004-05)
PCB43		Drainage system on Pringle Rd near Vista	Replace Undersized Pipe	$ 194,489		
PCB44		Drainage system crossing Commerical near Browning	Replace Undersized Culvert	$ 214,209		

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Table 6-7
Pringle Creek Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
PCB45		West Pringle Creek at Commercial near Welcome Way SE	Replace Undersized Culvert	$ 176,205		
PCB46		Drainage system upstream of Idylwood as well as Sunnyside Rd	Replace Undersized Pipe	$ 123,114		LWI implications
PCB47		Drainage system upstream of Marietta Way and Coloma Dr	Replace Undersized Pipe	$ 384,200		
PCB48		West Pringle Creek at Woodmansee Park	Channelization/ Bioengineering/ Habitat	$ 722,500		
PCB49		West Pringle, Culvert across Jones Rd., upstream of Woodmansee Park	Bridge	$ 297,500		
PCB50		West Pringle Creek from Jones Rd to Bristol Dr and at Firdell and Lone Oak	Replace Undersized Culvert; Channelization/ Bioengineering/ Habitat	$ 418,319		
PCB51		West Pringle from Gardner Rd to Jones Rd SE	Channelization/ Bioengineering/ Habitat	$ 119,000		
PCB52		Closed system along Lone Oak and Gardner	Replace Undersized Pipe	$ 203,363		
PCB53		Closed system near Kuebler and Liberty	Replace Undersized Pipe	$ 361,420		
PCB54		West Pringle Creek near Skyline and Liberty	Channelization/ Bioengineering/ Habitat	$ 507,238		Proposed Canney Park improvements
PCB55		Pipe/Ditch system along Skyline downstream of Kuebler	Replace Undersized Pipe	$ 480,675		Street CIP G.O. Bond F (2000-01)
PCB56		Clark Creek Park at Ratcliff Dr.	Detention Facility, Clark Creek	$ 412,250	Yes	Upgrade existing facility
PCB57		Leslie Middle School, East Pringle Rd.	Detention Facility, West Pringle	$ 1,458,600	Yes	LWI implications, proposed Leslie School Park
PCB58		Webb Lake , 25th and McGilchrist	Detention Facility, East Pringle	$ 2,210,000	Yes	LWI implications
			Subtotal	$ 58,488,109	-	
			Small conveyance improvement allowance	$ 2,924,405	-	This allowance is 5% of the subtotal.
			Total ($)	$ 61,412,514		

1. INCLUDES ALLOWANCES FOR PERMITTING, ACQUISITION, PREDESIGN, AND FINAL DESIGN (15%), ADMINISTRATION (6%), CONSTRUCTION MANAGEMENT (9%) AND CONTINGENCY (40%).

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Stormwater Master Plan

Table 6-8
Upper Claggett Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
CLB1		Hyacinth St. near Salem Industrial Dr.	Replace undersized pipe	$ 978,393		
CLB2		Claxter Rd. to Hyacinth St.	Replace undersized pipe	$ 589,560		LWI implications
CLB3		Claggett Creek at Burlington Northern Railroad	Remove culvert. Restore open channel.	$ 487,900		FEMA stream, railroad permits
CLB4		Claggett Creek at SPRR	Add parallel culvert. Requires boring	$ 303,620		FEMA stream, railroad permits
CLB5		Claggett Creek along Claggett Gravel Pit	Channelization/ Bioengineering/ Special Stream Habitat	$ 1,905,360	Yes	FEMA stream, LWI implications, Northgate Urban Renewal proposed park
CLB6		Claggett Creek at Portland Rd. NE	Bridge	$ 467,500		FEMA stream, Portland Rd. street improvement (2001-02)
CLB7		Claggett Creek at Deerhaven	Bridge	$ 297,500		FEMA stream, proposed neighborhood park
CLB8		Claggett Creek near I-5 and Hyacinth	Channelization/ Bioengineering/ Habitat	$ 274,482		FEMA stream
CLB9		Claggett Creek crossing Hyacinth near I-5	Bridge	$ 297,500	Yes	FEMA stream, Hyacinth St. CIP G.O. Bond F (2000-01)
CLB10		Claggett Creek crossing I-5	Replace undersized culvert	$ 739,160		FEMA stream, ODOT
CLB11		Claggett Creek upstream of I-5 to NE Fisher Rd.	Channelization/ Bioengineering/ Habitat, Replace undersized culvert	$ 526,065		
CLB12		Crossing Cooley Rd. NE	Replace undersized culvert	$ 97,665		
CLB13		Along Lancaster from Cooley to Stortz	Channelization/ Bioengineering/ Habitat	$ 768,825		Proposed neighborhood park
CLB14		Along Lancaster from Devonshire Ct. to Wolverine	Replace undersized pipe	$ 272,629		
CLB15		Along Lancaster from Stortz to Devonshire	Replace undersized pipe	$ 513,307		
CLB16		Along Fisher Rd. from Ward Dr. NE to Covington	Replace undersized pipe	$ 73,551		
CLB17		From crossing of Fisher Rd. northeast along Lancaster to Hayesville	Replace undersized pipe/culvert	$ 1,341,232		Proposed neighborhood park
CLB18		39th Ave NE Ward Dr. to Ivy Way	Replace undersized pipe	$ 283,475		
CLB19		East from Fisher Rd. to Lancaster	Channelization/ Bioengineering/ Habitat	$ 393,975		
CLB20		Crossing of Lancaster Dr., south of Ibex St. NE	Replace undersized culvert	$ 299,073		
CLB21		Along Ibex St. NE and Ward Dr. from Lancaster to 45th Ave. NE	Channelization/ Bioengineering/ Habitat	$ 624,143		
CLB22		Along 42nd Ave. NE from Ward Dr. to Jade St.	Replace undersized pipe	$ 311,823		

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Table 6-8
Upper Claggett Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
CLB23		Crossings of 45th Ave. NE and Harlan	Replace undersized culverts	$ 140,590		
CLB24		Crossings of Satter Dr. and Selby Ct. NE	Replace undersized culverts	$ 171,530		
CLB25		Crossings of Sesame St. and 47th Ave. NE	Replace undersized culvert	$ 324,020		
CLB26		East of Brown Rd. NE from Idaho Ave. to Glendale Ave.	Channelization/ Bioengineering/ Habitat	$ 638,860		
CLB27		Culvert crossing Surfwood Dr. NE	Replace undersized culvert	$ 58,752		
CLB28		Shellyanne Way south to Roselawn Dr.	Replace undersized pipe	$ 414,460		
CLB29		From Lancaster and Stortz southeast to Tierra Dr.	Replace undersized culverts	$ 509,363		
CLB30		Along Phipps Ln. NE south from Carolina Ave NE to Phipps Circle	Replace undersized culvert/ pipe	$ 810,475		
CLB31		Crossings of Scotsman Ln. and Sunnyview Rd.	Replace undersized culverts	$ 188,224		LWI implications, possibly re-route as open channel into McKey Park
CLB32		Along Lancaster Dr. south from Market St to D St. NE	Replace undersized pipe	$ 931,450	Yes	Market St. CIP G.O. Bond F (2000-01)
CLB33		Along Hawthorne from North of Felina Court to 32nd and Rockingham	Channelization/ Bioengineering/ Habitat, Replace undersized culvert	$ 784,635	Yes	ODOT coordination, Hawthorne CIP G.O. Bond F (2000-01)
CLB34		South from Wooddale Ave NE to Silverton Rd. near Hawthorne NE	Replace undersized culvert/pipe	$ 1,540,115		LWI implications
CLB35		Along Silverton Rd. near Beacon St. NE	Replace undersized pipe	$ 25,415	Yes	Partially ODOT, Silverton Rd. CIP G.O. Bond F (2000-01)
CLB36		Drainage system east of Hawthorne from Devonshire Ave. to Beverly Ave. NE	Replace undersized pipe	$ 679,626		
CLB37		Along Hawthorne from Monarch Dr. to Sunnyview Rd.NE	Replace undersized pipe	$ 782,425		ODOT coordination
CLB38		Sunnyview Rd. from Hawthorne Ave. to Fisher Rd. NE	Replace undersized pipe	$ 125,715		
CLB39		Northeast of Hawthorne Ave. and Rawlins NE	Replace undersized pipe/culvert	$ 8,670		ODOT coordination
CLB40		Near Market St. and Hawthorne Ave. NE	Replace undersized pipe	$ 96,135		
CLB41		From Hummingbird St. and Portland Rd. south to Silverton Rd. near Abrams Ave.	Replace undersized pipe	$ 1,981,350		
CLB42		From Sunnyview Rd. near Evergreen Ave. south to Evergreen Ave. near Market St.	Replace undersized pipe	$ 2,363,170	Yes	State Fair coordination, LWI implications, Silverton Rd. CIP G.O. Bond F (2000-01)
CLB43		From Sunnyview Rd. near Evergreen Ave. south to Evergreen Ave. near Market St.	Replace undersized pipe	$ 497,080		
CLB44		From Evergreen Ave. and Market St. south to D St. and Park Ave.	Replace undersized pipe	$ 748,510	Yes	Silverton Rd. CIP G.O. Bond F (2000-01)

City of Salem
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Table 6-8
Upper Claggett Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
CLB45		Along Lansing Ave. south from Silverton Rd. to Sorenson Ct.	Replace undersized pipe	$ 155,295	Yes	Silverton Rd. CIP G.O. Bond F (2000-01)
CLB46		Along Park Ave. south from Silverton Rd. to Dawn St.	Replace undersized pipe	$ 1,418,140	Yes	Flooding at Waldo Middle School, Silverton Rd. CIP G.O. Bond F (2000-01), Park Ave. CIP G.O. Bond F (2000-01)
CLB47		Along Lansing Ave. south from Sorensen Ct. to Rawlins Ave.	Replace undersized pipe	$ 804,270		Proposed Waldo School Park improvements
CLB48		Along Lansing Ave. south from Sunnyview Rd to Market St. NE	Replace undersized pipe	$ 121,771		
CLB49		West of I-5, east of Ellis Ave.	Replace undersized pipe	$ 86,700		ODOT
CLB50		East of I-5, Center St. to Manor Dr.	Replace undersized pipe	$ 1,140,360		
CLB51		East side, I-5 at Manor Dr.	Replace undersized pipe	$ 1,386,350		ODOT
CLB52		Center St. to Monroe - east of 36th	Replace undersized pipe	$ 1,173,510		Proposed neighborhood park west
CLB53		Along Center St. between 36th Ave and Lancaster Dr. NE	Replace undersized pipe	$ 295,800		Proposed neighborhood park south
CLB54		Along Lancaster Dr. from Amber St. south to State St.	Replace undersized pipe	$ 473,450		
CLB55		Along Center St. from Vinyard east to Oregon Ave. NE	Replace undersized pipe	$ 158,253		
CLB56		Salem Industrial Drive from Anunsen St. north to the Claggett Gravel Pit	Replace undersized culvert, Replace undersized culvert/pipe with new culvert/open channel	$ 853,400	Yes	Northgate Urban Renewal, Claggett Creek backwater, LWI implications
CLB57		Near Brooks Ave. and McDonald Way	Replace undersized pipe	$ 180,625		
CLB58		Along Portland Rd. near Beach Ave. NE	Replace undersized pipe	$ 161,704		Heavy roots
CLB59		Along 17th St. south from Silverton Rd. to Sunnyview Rd. NE	Replace undersized pipe	$ 891,126		State Fair coordination, LWI implications
CLB60		Claggett Gravel Pit: Claggett Creek upstream of Salem Parkway	New detention facility	$ 3,170,500	Yes	Northgate Urban Renewal, LWI implications, proposed park
			Subtotal	$ 38,138,559	-	
			Small conveyance improvement allowance	$ 1,906,928	-	This allowance is 5% of the subtotal.
			Total ($)	**$ 40,045,487**		

1. INCLUDES ALLOWANCES FOR PERMITTING, ACQUISITION, PREDESIGN, AND FINAL DESIGN (15%), ADMINISTRATION (6%), CONSTRUCTION MANAGEMENT (9%) AND CONTINGENCY (40%).

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Table 6-9
West Bank Basin DSIP Project List

DSIP Proj. ID	City of Salem CIP ID	Location	Recommended Improvement	Total1	Early Action Item?	Comments
WBB1		Wallace Rd between Orchard Hts and Taybin Rd	Replace undersized pipe	$ 224,315		
WBB2		From Wallace Rd and Glen Creek Rd to Gerth Ave and 9th	Replace undersized pipe	$ 1,181,238	Yes	Street CIP G.O. Bond F (2000-01, 2004-05) , bad pipe, alignment, debris, proposed Walker School Park
WBB3		From Cascade Drive to 9th and Gerth	Replace undersized pipe	$ 229,692	Yes	Adverse grade
WBB4		8th Ave between Gerth Ave and Rosemont Ave	Replace undersized pipe	$ 381,480	Yes	High water complaints
WBB5		Senate St between 6th Ave and the Willamette River	Replace undersized pipe	$ 725,084		Heavy roots, silt, gravel, bad joints
WBB6		Culvert across the Salem-Dallas Hwy, near Moores Wy	Replace undersized pipe	$ 238,000		ODOT coordinations, LWI implications
WBB7		Culvert across Eola Dr near the intersection of Eola Dr and Turnage St	Replace undersized culvert	$ 81,294		Street CIP (2004-05)
WBB8		Culvert across Jasper Wy near intersection with Eola Dr	Replace undersized culvert	$ 8,628		
WBB9		Along Eola Dr between Gehlar Rd and Sunwood Dr	Replace undersized pipe	$ 91,452		Street CIP (2004-05)
WBB10		Barberry St between 23rd Ct and Eola Dr	Replace undersized pipe	$ 101,065		Street CIP (2004-05)
WBB11		Eola Dr near intersection with Sunnwood Dr	Add detention capacity at Woodhaven Detention Facility	$ 748,850	Yes	
			Subtotal	$ 4,011,097	-	
			Small conveyance improvement allowance	$ 200,554.87	-	This allowance is 5% of the subtotal.
			Total ($)	**$ 4,211,652**		

1. INCLUDES ALLOWANCES FOR PERMITTING, ACQUISITION, PREDESIGN, AND FINAL DESIGN (15%), ADMINISTRATION (6%), CONSTRUCTION MANAGEMENT (9%) AND CONTINGENCY (40%).

backwaters, and woody debris cover areas), and attention to stream shading through selected tree planting, native brush cover and habitat areas.

As discussed in Section 5, it was determined that a planning level model was appropriate for the DSIP and Master Plan. Consequently, except as required for connectivity or where an existing drainage problem has been observed, relatively smaller pipes (36 inches in diameter or smaller) and comparable open ditches were not included in the model. Therefore, the DSIP project development process did not identify drainage improvements for these small conveyance system components. However, a need for such improvements exists. Therefore, an allowance of 5% was added to the project total within each drainage basin (refer to Tables 6-1 through 6-9) for such small conveyance improvements.

DRAINAGE SYSTEM IMPROVMENTS PRIORITIES

This Drainage System Improvement Plan represents a major investment by the City to efficiently manage stormwater quantity and quality and protect and enhance the urban environment. To implement the plan, the City must ensure that funding is available when needed. It is not necessary, desirable, or possible to complete all of the DSIP projects immediately.

There are several reasons to implement the DSIP projects over time, which will spread out the costs. First, phasing projects will prevent abrupt rate increases, never popular with the utility ratepayers or the City. As customers see the benefits of early projects, they will be more likely to support subsequent bond issues. In addition, deferring projects allows people and commercial/industrial developments that arrive in the future to help pay their own way. Moreover, the implications and requirements of the Stormwater NPDES, ESA and TMDL programs are still unfolding, and will not likely be fully known until the Willamette River TMDL's are established. Also, the Corps of Engineers Section 205 Study of the Mill Creek/Shelton Ditch system is not scheduled to be completed until the last half of 2001. Thus a considerable amount of additional information and direction will be forthcoming within the next three years that will have a significant influence on the DSIP project priorities.

The Stormwater Management Program Plan identified several "Early Action Items" (refer to Section 4, Policy 13) which the City believes must be carried forward with early implementation. In addition, a review of the DSIP projects in light of the priority criteria (refer to Section 4) identified several projects which reflect existing problems, represent high flood risk, low relative cost, and are relatively easy to implement; these projects warrant "early action" priority. Several other projects warrant "early action" priority because they need to be done in advance or in conjunction with street improvement projects. Such "early action" projects are identified in Tables 6-1 through 6-9. The remaining DSIP projects will be appropriately prioritized once the stormwater management funding picture becomes clearer and associated regulatory program requirements are known.

COST

Table 6-10 summarizes the total cost/drainage by modeled basin and City wide for the recommended drainage system improvements. The Lower Claggett, Pettijohn Laurel, and Willamette Slough basins were not modeled (refer to Section 2, "Basin/Watershed Descriptions" for discussion) and are therefore not included in the Table 6-10 cost summary. These costs should be revised as necessary as further analyses are performed, and the requirements associated with the Stormwater NPDES, ESA, and TMDL programs are identified.

Table 6-10
DSIP Cost Summary/Basin

Basin Name	Number of Projects	Number of Detention Projects	Cost	Comments
Battle Creek Basin	22	2	**$ 15,798,000**	
Croisan Creek Basin	15	1	**$ 8,764,000**	
East Bank Basin	17	0	**$ 7,794,000**	
Glenn Gibson Basin	23	6	**$ 13,945,000**	
Little Pudding Basin	44	0	**$ 30,604,000**	The Little Pudding basin is very expensive because there are many undersized channels and the basin slope is relatively flat.
Mill Creek Basin	39	0	**$ 20,987,000**	Reflects the tributary drainage systems within Salem's UGB. Full recommendation pending Section 205 Study.
Pringle Creek Basin	58	3	**$ 61,413,000**	The Pringle Creek basin is very expensive because there are many undersized channels and bridges and the basin slope is relatively flat.
Upper Claggett Creek Basin	60	1	**$ 40,045,000**	The Upper Claggett Creek basin is very expensive because there are many undersized pipes and channels and the basin slope is relatively flat.
West Bank Basin	11	1	**$ 4,212,000**	
Subtotal	**289**	**14**	**$ 203,562,000**	
System Inventory/Monitoring Program/Modeling	-	-	**$ 3,000,000**	This allowance is based on a preliminary estimate of the cost to monitor water quality and quantity, update the system inventory, and upgrade the model.
Water Quality Facilities	-	-	**$ 4,071,000**	This allowance is 2% of the subtotal.
Stream/ Habitat Improvements	-	-	**$ 6,107,000**	This allowance is 3% of the subtotal.
Total			**$ 216,740,000**	