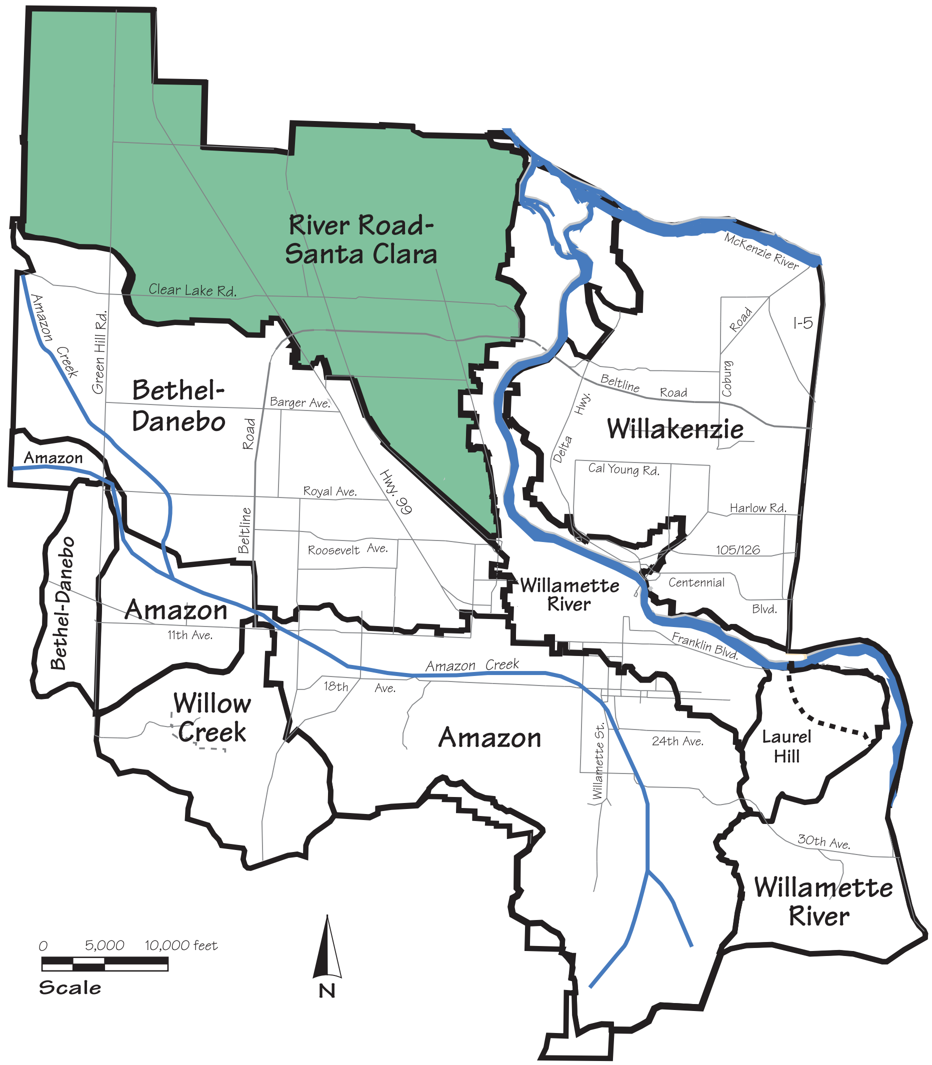
City of Eugene

River Road-Santa Clara

Volume VIII of VIII



September 2012

Prepared by:
City of Eugene
URS Corporation
Lane Council of Governments

Local Stormwater Planning Can Make a World of Difference

CITY OF EUGENE
STORMWATER
MANAGEMENT PROGRAM

Stormwater Basin Master Plan

Volume VIII of VIII

River Road – Santa Clara

September 2012

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Brown and Caldwell
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ACKNOWLEDGEMENTS

The River Road – Santa Clara Stormwater Basin Master Plan represents the culmination of a long term planning effort by a multi-agency team consisting of representatives from the City of Eugene, Lane County, URS Corporation, Brown & Caldwell Consultants, and Lane Council of Governments (LCOG).

The project team would like to gratefully acknowledge the efforts of the many city, county and consultant staff that provided input for and review of this document.

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The information published in this report is subject to revision. Please contact the City of Eugene's Engineering Division for potential changes before proceeding with any engineering design that uses the information published herein.

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The Context

The River Road – Santa Clara stormwater basin, located in the northwest corner of the Eugene-Springfield metropolitan area, is generally bounded by the Willamette River on the east, the Bethel-Danebo drainage basin on the south and the Metro Plan boundary on the west and north. The basin is the second largest of Eugene's stormwater basins at 10,458 acres in size, with about 58 percent (6,071 acres) of its area within the Eugene urban growth boundary (UGB) and the remaining 42% located outside of the urban growth boundary. The basin includes five major drainage systems: the A1 Channel, Highway 99, Flat Creek, Spring Creek, and the Willamette Overflow (also referred to as the East Santa Clara Waterway). These waterways flow in a north-northwesterly direction and drain to the Willamette River either directly (Flat Creek, Spring Creek, East Santa Clara Waterway) or indirectly via Amazon Creek and the Long Tom River (A1 Channel, Highway 99).

Inside the UGB, the predominant land uses in the basin are low and medium-density residential (2,558 acres) and industrial/commercial (747 acres). Outside of the UGB, the predominant land uses are government, including the Eugene airport (960 acres) and agriculture (2,433 acres).

The River Road – Santa Clara basin is unique in many ways, including it's patchwork of City/County jurisdictional areas: 1,802 acres located inside Eugene city limits; 4,270 acres outside city limits and inside the UGB; and 4,387 acres outside of the UGB. It is also one of the most complex basins in terms of stormwater management. Results of the stormwater assessment for this basin revealed:

- A discontinuous stormwater system comprised of pipes, drywells, ditches and waterways
- Historic use of drywells for managing stormwater drainage
- Very flat topography
- Shallow groundwater levels
- Rapidly draining soils in some areas
- Rural "country" feel in some areas, with large residential lots and curbless streets

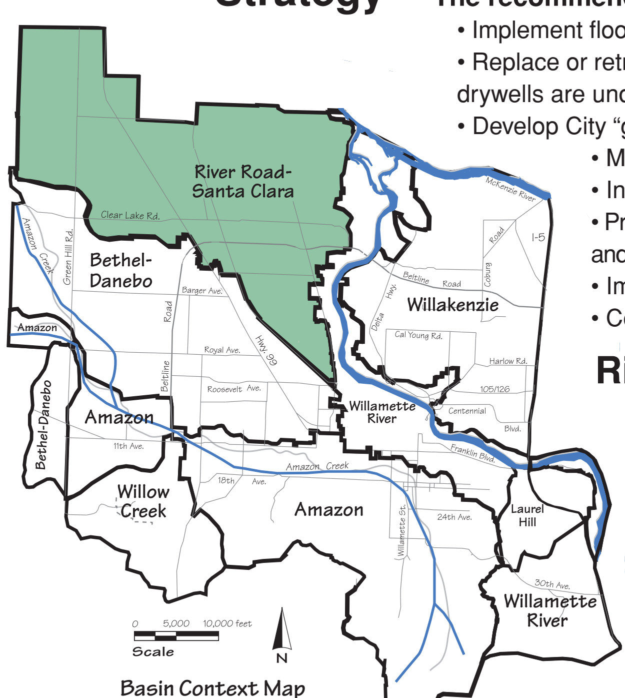
City and County Jurisdictions

Given the mixed jurisdictional nature of the River Road-Santa Clara basin, the City and County will ultimately view and implement strategies and opportunities differently. Through a "basin partnership," the jurisdictions will work together for the best benefit of all. This executive summary attempts to outline some of these opportunities.

Strategy

The recommended strategy for this basin is:

- Implement flood control capital projects to address predicted flooding problems in specific areas.
- Replace or retrofit existing public drywells to meet Safe Drinking Water Act requirements (private drywells are under the authority of DEQ).
- Develop City "green street" concepts for local street improvements.
- Minimize future pollutants through City's on-site stormwater development standards.
- Increase City's implementation of low impact development practices.
- Protect water quality by relying on Goal 5 natural resource protections for certain waterways and by filling the gaps in protection on specific waterway segments not protected by Goal 5.
- Implement City's *Stream Corridor Acquisition Plan*.
- Continue to provide flood protection services basin wide.



Basin Context Map

River Road–Santa Clara Basin Facts:

- Almost all of the basin (99%) has slopes of 5% or less.
- Ranks 1st among the City's major basins in total length of open waterways (48 miles within the basin boundary) and 2nd in extent of open drainage system per square mile of basin area (3.0 miles/square mile), relative to other basins.
- Impervious surface area inside the UGB is projected to increase from 37.5% to 50.1% at buildout.
- The Willamette River, to which runoff from River Road – Santa Clara drains directly or indirectly, is listed by the Oregon DEQ as water quality limited for temperature, bacteria and mercury.
- Approximately 25% of the basin drains to drywells (19% public, 81% private).

Comprehensive Plan

Cleaner, Safer, Healthier Environment

Adoption of the Comprehensive Stormwater Management Plan (CSWMP) in November 1993 ushered in a new vision for managing the City of Eugene's stormwater program. In addition to protecting the community from flooding problems, CSWMP expanded the program to include protection of stormwater water quality and related natural resources.

Basin Planning

Bringing CSWMP into Focus

Basin Planning is one of many action items for implementing CSWMP. The basin planning process includes assessing existing conditions, identifying stormwater system problems and opportunities, and recommending management strategies for implementing several CSWMP policies. Each of the City's seven drainage basins offers unique conditions and opportunities for implementing capital projects and development standards. Basin planning, therefore, is a refinement of CSWMP's broader policy direction and represents what is feasible and practical to implement at the stormwater system level.

Other Activities

In addition to Basin Planning, many other city and county activities are conducted to enhance water quality, protect stormwater-related natural resources, and prevent flooding. A few examples include:

- Erosion control for construction activities
- Education and outreach
- Stormwater system maintenance
- Street sweeping
- Volunteer programs
- Vegetation management

Green Infrastructure

Green Infrastructure uses the beneficial flood control and water quality treatment characteristics of the natural landscapes to help meet stormwater management objectives. When linked with the constructed system, the two work together to form a coordinated drainage system of streams, ponds, streets, and pipes.

Why This Strategy?

Flood Control

- Capital projects are the most cost-effective solutions for correcting existing problems and are designed to address the incremental effects of new development.
- Low impact development practices are effective at reducing runoff volumes and minimizing problems associated with increased flows from new development.
- Flows from decommissioning of public drywells (see Water Quality below) will be accomodated through decommissioning capital projects to match current drywell functions.

Water Quality

- *Pollution associated with new development:* Development standards are effective for addressing pollutants at their source. Implementing low impact development practices further enhances effectiveness.
- *Pollution associated with existing development:* Capital projects to retrofit the stormwater system in high pollutant source areas are effective in improving the current water quality condition.
- *Problems associated with public drywells*: Capital projects to replace or retrofit public drywells are the most effective solutions for meeting federal water quality regulations. Both the City and County registered their drywells with DEQ and have applied for a permit to manage the drywells until they can be authorized or decommissioned.
- *Gaps in water quality protections for certain waterways*: Water quality waterway protections to address gaps will result in a *system* of protected waterways.

Stormwater-Related Natural Resources

- Capital projects are the most viable method for addressing negative effects of high runoff volumes associated with existing developed areas.
- Relying on Goal 5 natural resource protections is an effective way to protect certain waterways for multiple benefits including natural resources and water quality benefits.
- Stream corridor acquisition can be used to protect a limited number of high-priority waterways.

More Information

Visit the City's website at **www.eugene-or.gov/pw** (follow the links to stormwater).
Contact Therese Walch, Water Resources Manager, at (541) 682-5549.

EUGENE

The Management Strategy

Flood Control

Issue:
Some areas do not meet existing drainage system conveyance standards.

Desired Outcome:
Flood protection needs are met basin-wide.

Actions: **Capital Projects – see map (red dots)**

- System improvements to enhance capacity: A1 tributary south of Irving Rd; Willamette Overflow upstream of Division Ave.
- Culvert replacements to improve capacity: various locations.
- Public drywell decommissioning projects (see Water Quality) will be designed to convey the 5-year storm to match existing drywell functions.

Stormwater Related Natural Resources

Issue:
Natural resources functions and values of streams, ponds, wetlands and waterways are important to the overall health of a watershed and would be at risk without adequate protection.

Desired Outcomes:
Maintain and improve the extent and quality of existing stormwater-related natural resources.

Actions: **Capital Projects**

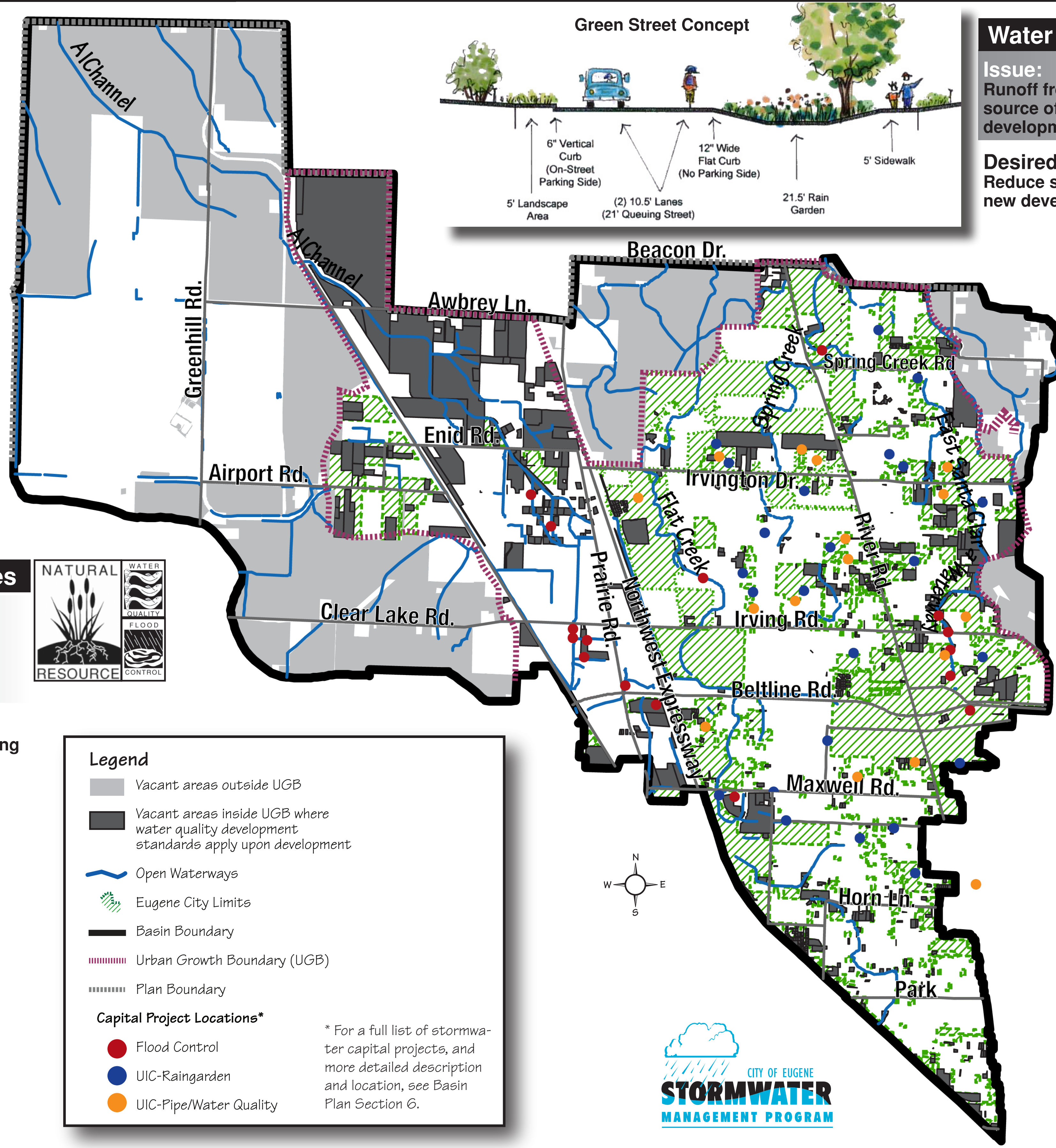
- Yearly City budget category – Streambank stabilization and outfall stabilization projects.

Development Standards:

- Support implementation of Goal 5 natural resource protections.

Acquisition:

- Acquire stream corridors according to the City's *Stream Corridor Acquisition Study.*



CITY OF EUGENE STORMWATER MANAGEMENT PROGRAM

Water Quality

Issue:
Runoff from existing development is a significant source of pollutants; Runoff from future development will increase pollutant discharges.

Desired Outcome:
Reduce stormwater pollution from existing land uses and from new development.

Actions: **Capital Projects**

- Yearly City budget category – Water quality facilities in high source areas.
- Yearly City budget category – Retrofit tip-ups.
- Yearly City budget categories – Outfall stabilization/stream bank stabilization.

Development Standards:

- New and significant development projects in Eugene are required to treat all runoff from City's water quality design storm.
- Increase City's implementation of low impact development practices through administrative adjustments, integration of LID practices with other initiatives, land use code amendments, and other program enhancements.

Green Street Concepts

- Develop green street alternatives, for use in local street improvements or for new City local streets that utilize rain gardens or piped systems to manage stormwater runoff from rights-of-way.

Issue: **Some existing public drywells have inadequate separation to seasonal high groundwater.**

Desired Outcomes: **Replace or retrofit existing public drywells consistent with Safe Drinking Water Act requirements.**

Actions: **Capital Projects–see map (blue & gold dots)**

- Decommission/Retrofit Public Drywells (33 "UIC Cluster" projects, to be implemented in partnership with Lane County) utilizing rain gardens or piped systems with pre-treatment facilities.
- DEQ has authority for private drywell systems.

Issue: **Gaps in protections exist for waterways that are tributary to those listed by the Oregon DEQ as "water quality impaired."**

Desired Outcomes: **Water quality functions on specific waterways of interest to water quality are protected by preventing piping/filling and further encroachment.**

Actions: **Development Standards**

- Fill the gaps in waterway protections on specific waterway segments currently not protected by Goal 5 natural resource protections.

Adoption of the City of Eugene's *Comprehensive Stormwater Management Plan* (CSWMP) in November 1993 marked a significant shift in the City's approach to stormwater management. In addition to drainage and flood control services, the stormwater program was expanded to include the protection and enhancement of stormwater quality and related natural resources. Since the previous *Storm Drainage Master Plan* (OTAK, 1990) was developed solely for the purpose of addressing drainage and flood control issues, an update of that Plan was necessary to bring it into compliance with current City policy. As a result, the City initiated a project to develop multiple-objective Stormwater Basin Master Plans.

In addition to CSWMP, other locally adopted policy documents were reviewed for applicability to the Basin Master Planning effort. The following were identified for containing policies related to and supportive of protection of water quality and related natural resources:

1) Eugene/Springfield Metro Area General Plan (1987 Update) in general and, specifically, the following refinement plans:

    - Bethel-Danebo, 1982
    - Eugene Downtown Plan, 1984
    - Eugene Parks and Recreation Plan, 1989
    - Jefferson/Far West, 1983
    - Public Facilities and Services Plan, December 2001
    - Laurel Hill, 1982
    - Riverfront Park Study, 1985
    - River Road Santa Clara Urban Facilities Plan, 1985
    - South Hills Study, 1974
    - Willakenzie Neighborhood, 1991
    - Willow Creek, 1982

2) Eugene Growth Management Study, 1998

The overall goal of the Stormwater Basin Master Plans was to provide a stormwater management strategy for each basin that proactively addresses the multiple objectives of CSWMP. In addition to flood control, these multiple objectives include:

- Protect and improve water quality.
- Protect natural resources that provide beneficial stormwater functions.
- Use best management practices that promote a green infrastructure.
- Address the unique qualities of each drainage basin.
- Meet federal, state, and local laws and policies (including CSWMP, the Clean Water Act, the Endangered Species Act, the Safe Drinking Water Act and State Underground Injection Control Rules – for these broader topics and other issues, please refer to Volume I).
- Complement other existing stormwater best management practices (BMPs) that are part of the City's stormwater program.
- Balance responsibilities community-wide.

- Provide a dynamic and flexible program that can be refined based on a changing regulatory climate.

This report represents the final River Road Santa Clara Basin Plan, Volume VIII of an eight-volume set. The Initial Study Towards the Development of an Integrated Stormwater Management Strategy for the River Road Santa Clara Basin (Initial Study) was developed in 2002, and held in draft form pending resolution of inter-jurisdictional issues as well as additional information gathering and analysis. In 2004, subsequent to entering into an Intergovernmental Agreement (IGA), the City of Eugene and Lane County commenced with a joint effort to finalize the Initial Study. Outreach to the River Road and Santa Clara Community Organizations was conducted periodically throughout the process. This report incorporates feedback received from these initial public outreach efforts.

The City completed the other seven volumes of the Stormwater Basin Master Plan that summarize and document integrated strategies for each of the other basins in Eugene. Volume I provides an overview of the project, describes the process for developing integrated strategies, and summarizes the information that is presented in detail in the basin-specific volumes. Each of the six companion volumes covers a specific drainage basin as follows: *Volume II - Amazon Creek, Volume III - Bethel-Danebo, Volume IV – Laurel Hill, Volume V - Willakenzie, Volume VI - Willamette River, Volume VII - Willow Creek.* This document is *Volume VIII – River Road Santa Clara.*

NOTE: It should be noted that the term basin is typically used to refer to a defined surface area that drains to a common discharge point. However, for the purposes of this study, the term basin is used to refer to a specific planning or study area. While the planning or study areas were developed based on topography and drainage patterns, they may include several discharge points, or they may exclude specific tributary areas based on convenience for planning purposes. In some cases, portions of the basin were not included in the planning area as they are managed by other jurisdictions. The basin areas as defined in this plan are also further divided into major subbasins and subbasins as described in Section 3.0.

The overall process conducted to develop integrated strategies for each of the City's stormwater basins included in the Stormwater Basin Master Plans consisted of the following thirteen steps. The details regarding each of these steps are provided in Volume I of the City's Stormwater Basin Master Plans.

Step 1) Compile information regarding the unique characteristics of each basin that are related to the stormwater drainage system.
Step 2) Identify problems and opportunities associated with the stormwater drainage system with respect to flood control, water quality, natural resources, and maintenance.
Step 3) Develop potential solutions in the form of capital projects and development standards for addressing identified problems.
Step 4) Evaluate and compare potential solutions in terms of feasibility, costs, and effectiveness.
Step 5) Evaluate capital projects to address problems expected under existing conditions.

Step 6) Evaluate capital projects and development standards to address problems expected as a result of future build-out.
Step 7) Select an integrated stormwater management strategy based on the evaluations conducted in steps 5 and 6.
Step 8) Develop a maintenance strategy for the proposed solutions.
Step 9) Obtain feedback regarding integrated stormwater management strategies and the maintenance strategy from the public and refine the strategies as appropriate.
Step 10) Prioritize selected capital projects for implementation and conduct a financial analysis.
Step 11) Develop stormwater basin master plans to summarize the integrated stormwater management strategies including proposed capital projects and development standards.
Step 12) Develop an ordinance to implement the proposed development standards.
Step 13) Develop a best management practices manual to help guide developers in meeting the requirements of the development standards.

The process described above for developing integrated strategies for each of the stormwater basins, including River Road Santa Clara, is outlined in Figure 1-1.

Information updates related to this plan are provided at the end of this section. The integrated basin strategy specific to the River Road-Santa Clara basin is described in the following sections. In order to complete the Initial Study for River Road Santa Clara, some additional analysis was necessary to address the unique challenges represented by the mix of City and County jurisdictional areas, the large number of sub-dividable lots and unimproved streets, and federal Safe Drinking Water Act regulations related to underground injection controls which are predominant in the basin. Thus, additional steps were needed and are outlined in Figure 1-2.

Section 2.0 of this report provides a summary of the specific characteristics in the River Road Santa Clara basin (from Step 1). Sections 3.0, 4.0, and 5.0 provide summaries of the flood control, water quality and natural resources evaluations, respectively (from Steps 2 and 3). These evaluations provide a list of identified problems, and potential solutions in the form of capital projects and development standards. Section 6.0 describes implementation of the integrated stormwater management strategy for the River Road Santa Clara basin.

Information Updates (June 2012)

Eugene's Stormwater Basin Plans are used for background/contextual information, development of capital improvement programming, contextual support for proposed development standards, and for evaluating technical information about the stormwater system. Since the drafting of the Stormwater Basin Master Plan for River Road-Santa Clara, several other efforts have been initiated or are planned to begin within the next year or so that have a relationship to stormwater management and in some cases further the goals of the Stormwater Basin Master Plans including for River Road – Santa Clara. This section describes these other efforts and their status.

Envision Eugene, Followed by Area Plan for River Road/Santa Clara
Envision Eugene is our community's process for determining the best way to accommodate growth projected over the next 20 years. The Envision Eugene process began with a broad spectrum of community input in 2010, followed by a draft proposal and technical analysis in 2011 and draft recommendations published in March 2012. The Envision Eugene process established seven "pillars" which reflect the values of the community and serve as the foundation from which the draft recommendation emerged. Recommendations include a proposed urban growth boundary and strategies for accommodating growth. Under the pillar: "Protect, Repair and Enhance Neighborhood Livability," Strategy 4 is to: "Create neighborhood plans to address unique situations and impacts in different neighborhoods." Strategy 4b in particular is most relevant to River Road/Santa Clara:

> Complete area planning for the River Road and Santa Clara neighborhoods to address impacts of increasing urbanization. Base future planning efforts on previous work done under the River Road/Santa Clara Transition Project and Final Report, June 2006, and the Santa Clara-River Road Outreach and Learning (SCRROL) project, 2012. Begin this planning process immediately following local adoption of Envision Eugene.

On June 13, 2012, the Eugene City Council passed the following motion which reflects the current status of the Envision Eugene process:

> *"Move to direct the City Manager to prepare, for a formal adoption process, planning documents to establish a new Urban Growth Boundary based on recommendations in the Technical Components Document (Attachment A), as revised,* ***and that carry forward the pillars and strategies [emphasis added]*** *described in the Envision Eugene Draft Proposal, March 14, 2012."*

In effect, this means that the community visioning and strategy refinement phases are complete, and the formal adoption process and implementation work is underway. The adoption process will include decision-making by the Eugene City Council and the Lane County Board of Commissioners. Implementation of the area planning strategy for the River Road and Santa Clara neighborhoods, to address impacts of increasing urbanization, will begin following adoption of Envision Eugene. For additional information about Envision Eugene, including the seven pillars and related strategies, how to get involved, and up-to-date status of the process, see City's web page at www.envisioneugene.org.

Eugene's Municipal Stormwater Permit
Stormwater discharges from municipal stormwater systems are regulated under the federal Clean Water Act via a permit program which, in Oregon, is administered by the Oregon Department of Environmental Quality (DEQ). Eugene's National Pollution Discharge Elimination System Municipal Separate Storm Sewer Permit (or "MS4 permit") was first issued in 1994, which prompted the City to adopt the comprehensive stormwater policy, CSWMP, described previously in Section 1. Eugene's permit was issued under Phase I of the program, and is therefore called a MS4 Phase I permit. The City's MS4 permit was re-issued in 2004, and again most recently in December 2010. The goal of the MS4 permit program is to reduce stormwater pollution and help improve the condition of the nation's water bodies. Eugene's permit is designed to reduce

pollution from Eugene's municipal stormwater system and protect and improve the water quality of our local waterways, including Amazon Creek and the Willamette River. Adaptive management to continually improve the effectiveness of the City's stormwater program and further reduce stormwater pollution is a regulatory expectation and is an on-going part of the City's stormwater program. Adaptive management coupled with the Issuance of the 2010 MS4 permit will result in additional refinements to the City's stormwater program, including in the following areas:

- Stormwater Development Standards - As described in Action 4.3.2. of this plan, development standards for water quality were adopted City-wide in June 2006. Stormwater Development Standards apply to all new development and re-development that adds or replaces 1,000 square feet or more of impervious surface area. Acceptable stormwater management facility types along with siting and design criteria are included in the City's Stormwater Management Manual (SWMM). The current SWMM leaves the choice of facility type up to the applicant, as long as siting and design criteria are met. In response to the 2010 MS4 permit, Eugene's Stormwater Development Standards will need to be modified to prioritize low impact development techniques and green infrastructure facilities (for example: vegetated stormwater planters, rain gardens and swales) over mechanical treatment approaches (for example: prefabricated underground water quality treatment manholes) for managing stormwater. Making these changes will involve revising Eugene City Code and the SWMM. Draft revisions are under development for public review beginning in fall 2012, and adoption by the City Council in fall 2013. More information about the proposed Stormwater Development Standards changes will be posted on the City's web page by fall 2012.
- Retrofit Strategy – Under the 2010 MS4 permit, the City is required to develop a strategy to retrofit its municipal stormwater system to further reduce pollution in runoff from existing developed areas. Over the past 20 years, Eugene has implemented many environmental restoration and stormwater system retrofit projects, developed concepts for additional retrofit projects (including via the Stormwater Basin Plans), and in a limited capacity worked with property owners to encourage retrofitting stormwater systems on private property. The City's retrofit strategy will be reviewed and refined as necessary to meet the 2010 permit conditions. Public input will be solicited on the City's retrofit strategy in approximately spring 2013. For more information and an up-to-date status on development of the City's retrofit strategy, see City's web site: http://www.eugene-or.gov. Go to Services > Stormwater > Stormwater Planning, Permits and Regulations > NPDES.

Lane County's Municipal Stormwater Permit

Lane County received its first MS4 permit in 2007. Lane County's permit was issued under Phase II of the program, and is therefore called a MS4 Phase II permit. The permit required Lane County to establish a stormwater program for the regulated area corresponding to the area between the city limits of Eugene and Springfield and the cities' Urban Growth Boundaries (UGB). Lane County was required to establish a stormwater program for the regulated area to address the following minimum control measures:

NPDES Six Minimum Control Measures:

- Public Education & Outreach
- Public Involvement & Participation
- Illicit Discharge & Elimination
- Construction Site Stormwater Control
- Post-Construction Stormwater Management
- Pollution Prevention in Municipal Operations

Lane County provides stormwater services in accordance with its Stormwater Management Plan (SWMP). Many of the services in the River Road-Santa Clara area are provided by the City of Eugene on behalf of Lane County through Inter-governmental Agreements (IGAs). Lane County's SWMP was updated in July of 2011 and a new Stormwater IGA with the City of Eugene was approved in December 2011. Lane County's current NPDES was to expire on December 31, 2011 but has been administratively extended by the DEQ until a new permit is negotiated and issued.

Drywell Elimination Program

The regulatory drivers for eliminating most or all public drywells are described in this Basin Plan in Section 4.1.2. Approximately half of the City of Eugene's publicly owned and managed drywells, and most of Lane County's owned and managed drywells, are in the River Road-Santa Clara area. At the time of this information update, the Oregon DEQ has not yet issued any WPCF permits in Oregon, with the exception of City of Portland's permit. While permit conditions are not finalized, based upon the latest draft WPCF permit template, the City of Eugene is proceeding with its strategy, described in Section 4.3 of this Plan, to eliminate public drywells. Once a permit is issued, the City will re-evaluate and refine its strategy if necessary. The County is currently prioritizing risk levels for its drywells and is reevaluating its drywell management/decommissioning strategy with regard to changes in the latest draft WPCF permit template. Where the City and County have drywells in the same area, the agencies will continue to seek ways to partner on projects for the sake of efficiency and cost-effectiveness.

Capital project concepts identified in the document to address UIC decommissioning are simply starting points for the project design and implementation. Final designs are likely to differ from conceptual design concepts based on changing circumstances and additional information gathered during the design process. The South of Horn Lane UIC cluster, for example, identified on-street raingardens as the conceptual decommissioning strategy. However at this time, large-scale street improvements are not likely in the near future for this area, and other options such as individual rain gardens will need to be considered. As another example, one of the City's first UIC capital projects to be constructed (A1-8-UIC, Escalante, further described in the following paragraph) was conceptually identified as a piped decommissioning project. However, through the dynamic design process a more advantageous solution was developed resulting in a neighborhood vegetated swale as the final design.

Capital projects A1-3-UIC, A1-4-UIC (Shirley 1&2), and A1-8-UIC (Escalante) were selected for implementation by the City of Eugene first because they include drywells with the least vertical separation to seasonal high groundwater and thus pose the highest relative risk to groundwater quality. As with all capital projects when they are selected for implementation, the planning-level concepts were viewed from a more detailed perspective taking into account neighborhood input, stormwater characteristics (e.g. soil types, slopes, catchment area), system design opportunities and constraints, and cost effectiveness. Final design for both projects includes constructing a piped conveyance system which will collect the stormwater runoff from these two areas and, in each case, direct it to a neighborhood vegetated infiltration facility. In the case of the Shirley project, the infiltration facility will be located in Ferndale Park and has been designed to meet multiple objectives including consistency with park planning objectives. Designs for these two initial projects have been finalized and construction is scheduled for summer/fall 2012. For more information about the City's drywell elimination program, see City's web site: http://www.eugene-or.gov. Go to Departments > Public Works > Public Works Projects > Drywell Decommissioning.

Street Design Standards

Low impact development ("green streets"), the Pedestrian & Bicycle Master Plan "tool box" the update of the Transportation System Plan and the Envision Eugene strategies are driving the need to review and update the City's street standards. The green street concepts developed as part of the River Road – Santa Clara Basin Plan (Figures 4-5 through 4-10) will be utilized inasmuch as they illustrate potential configurations for incorporating vegetated stormwater facilities that infiltrate runoff from the adjacent right of way. The Basin Plan concepts are simply meant to help inform the street design standards update, and do not, in and of themselves, translate directly to new standards. Updating the street design standards is included in the Engineering Division's FY13 work plan.

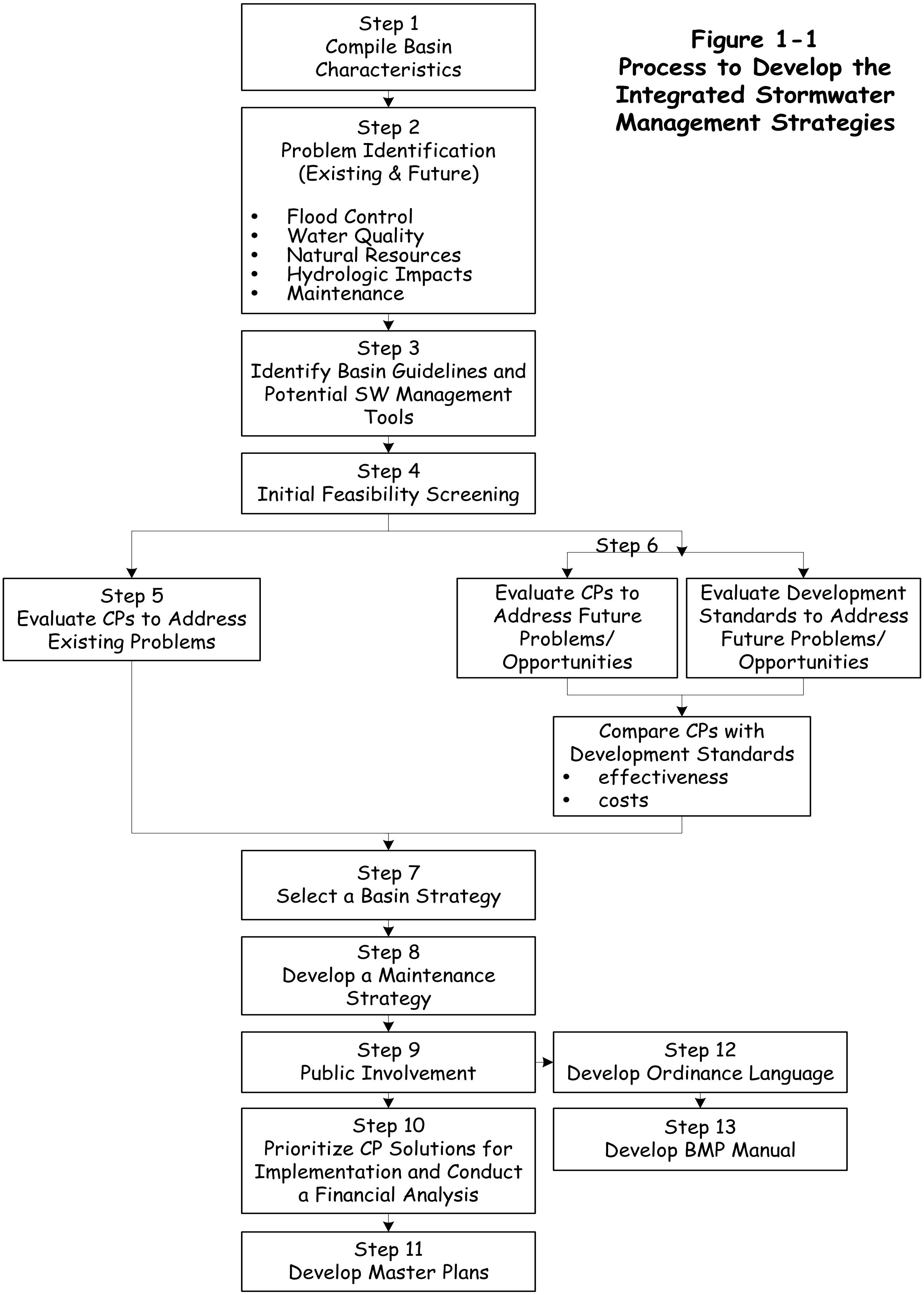
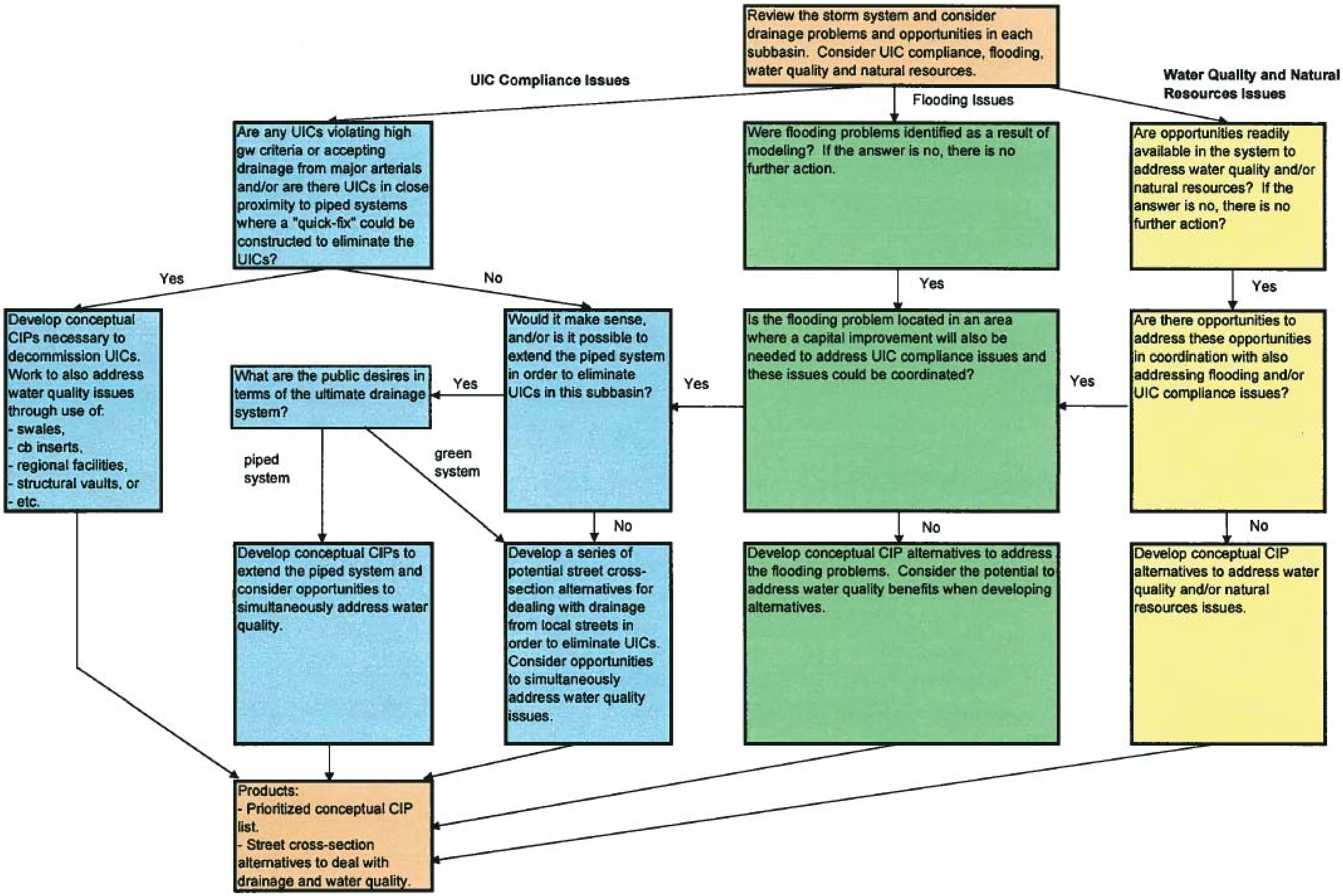


Figure 1-1
Process to Develop the Integrated Stormwater Management Strategies

Figure 1-2
CIP/Master Planning Phase



This section provides background information regarding the existing physical characteristics of the River Road Santa Clara basin. This information was used to assess opportunities and constraints for meeting the multiple-objective goals of this study. Specifically this section includes the following information for the River Road Santa Clara Basin: location and area; climate; land use and surface cover; land form; topography and slopes; surface water features and drainage system; water quality; rare, threatened and endangered plants, animals and communities; soils; groundwater; and recreational and educational facilities.

2.1 Location and Area

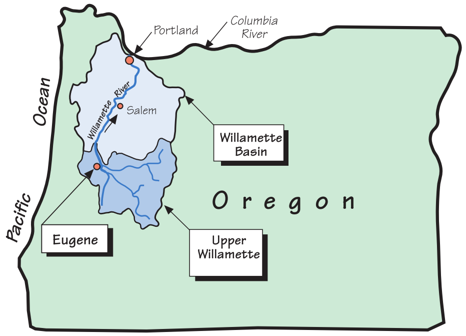
2.1.1 Regional Drainage Context

Eugene is located in the western third of the Upper Willamette Drainage Basin as shown on Figure 2-1. Drainage in the southern Willamette Valley is a combination of natural and built systems that have evolved over time. The natural system is composed of rivers, waterways, and a series of interconnected ponds and wetlands. Historically, the natural system had an extensive floodplain that typically experienced over-bank flooding every 1-2 years. The built drainage system includes a series of dams, pipes, and waterways that were built to contain over-bank flooding, and to retain water for recreational and irrigation purposes. The primary drainage features of the Upper Willamette Drainage Basin are: Main Stem of the Willamette River, Middle Fork of the Willamette River, Coast Fork of the Willamette River, McKenzie River, Amazon Creek, Coyote Creek, and the Long Tom River. From 1940 to 1960, the U.S. Army Corps of Engineers built nine dams on this system.

The cities of Cottage Grove, Creswell, and Springfield are all upstream from the City of Eugene and contribute urban runoff to the regional drainage system. Runoff from Cottage Grove, Creswell, and South Springfield flows through Eugene via the Willamette River. Approximately 4,800 acres of west Springfield's drainage area, as shown on Figure 2-2, discharges urban runoff into the Q Street Floodway, which is within Eugene's public drainage system. Eugene's public drainage system refers to the system of stormwater facilities (i.e., pipes, ditches, open waterways) that Eugene is responsible for operating and maintaining.

2.1.2 City of Eugene

The City of Eugene is currently responsible for managing the stormwater quantity, quality, and related natural resources for the drainage area within its city limits. The area outside of the City limits but within the urban growth boundary (UGB) is expected to be annexed into the city as urban development occurs. Therefore, this basin plan study includes both the current city limits and the Lane County area within the UGB. The *Eugene-Springfield Metro Area General Plan (Metro Plan)* boundary covers the city limits, the UGB and, in some cases, areas beyond the UGB. For the purposes of characterizing the study area in this chapter, the area covered includes the *Metro Plan* boundary.



Drainage Basin Key

Willamette Region Location Map

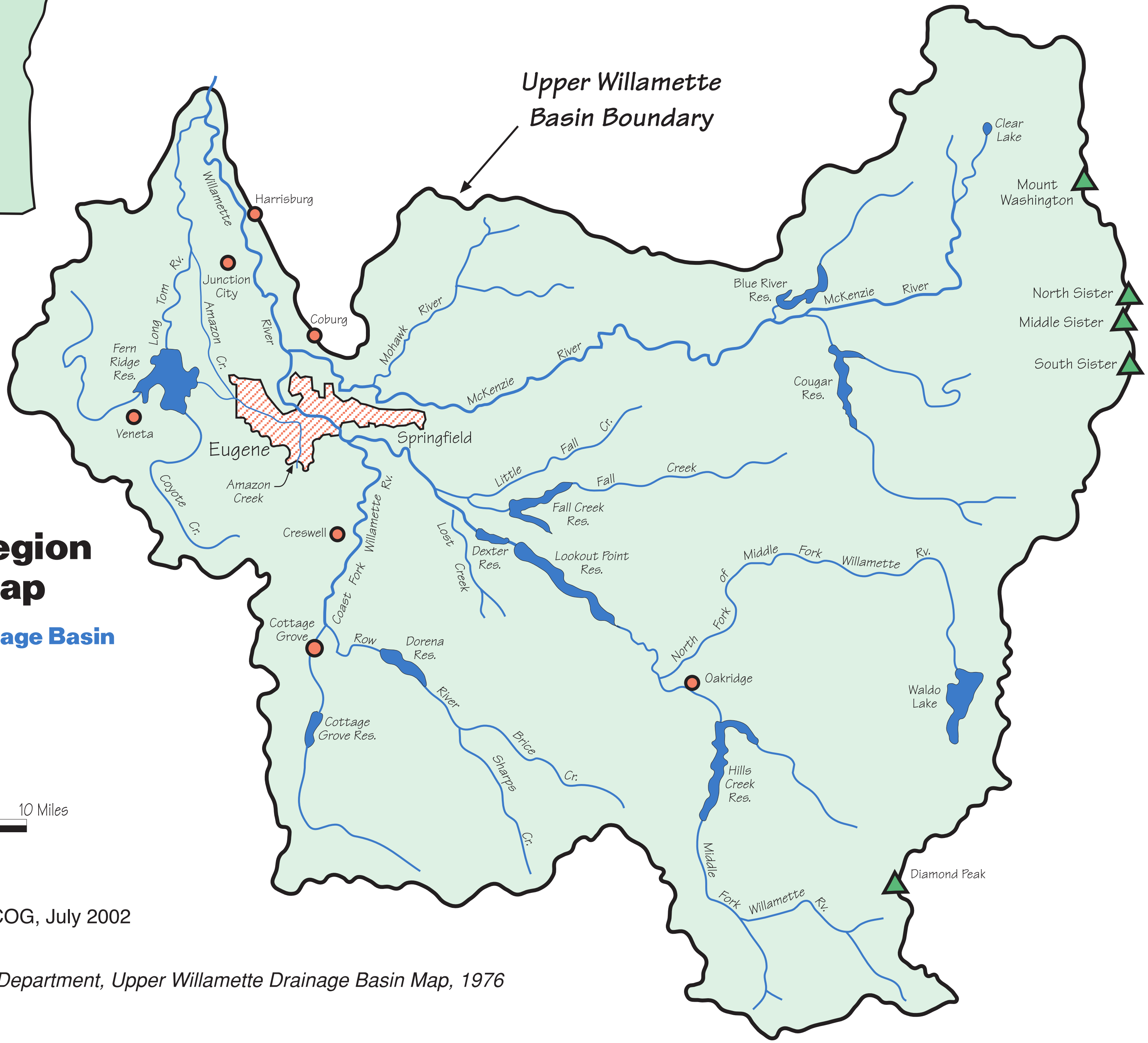
Upper Willamette Drainage Basin

Figure 2-1

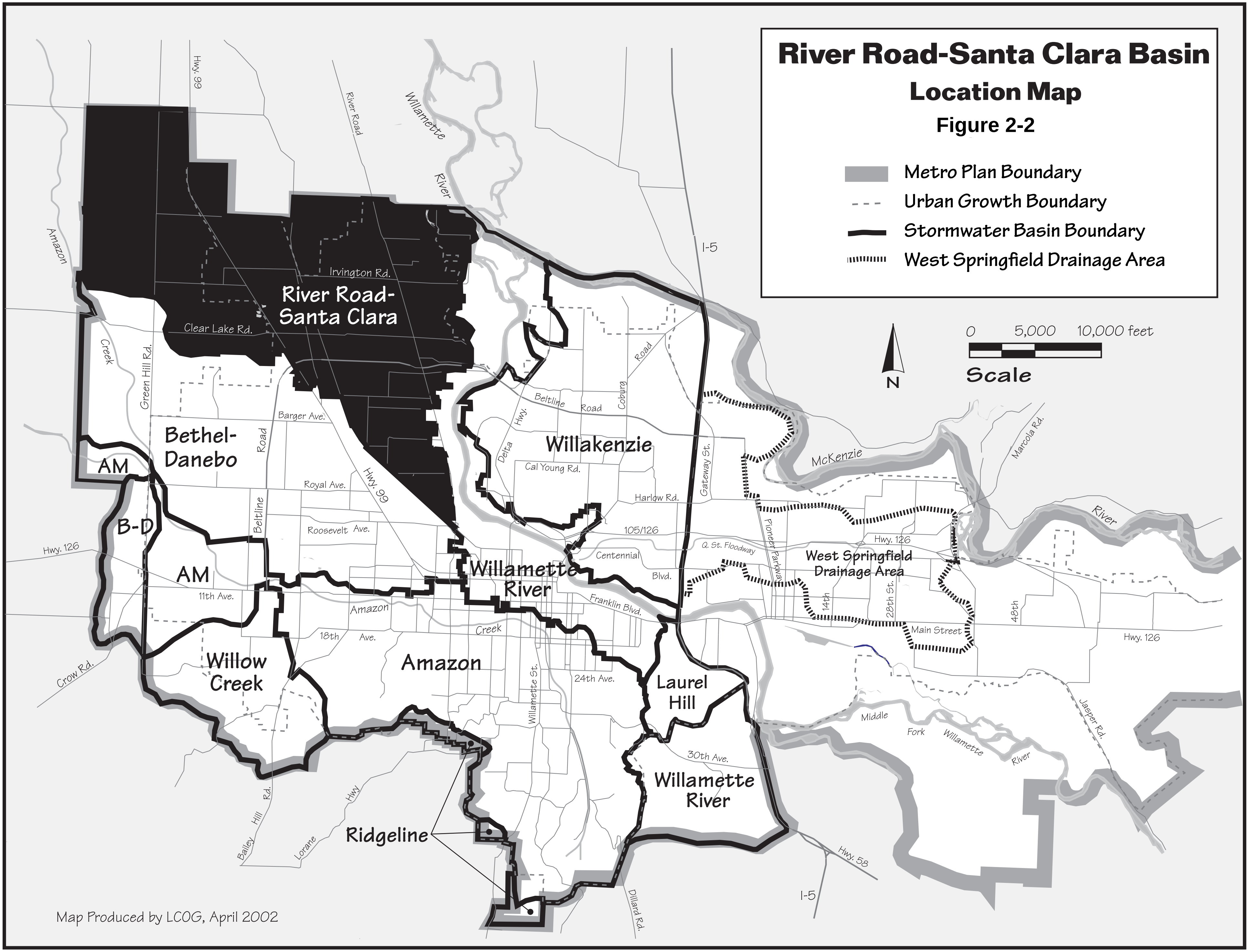
N

0 5 10 Miles
Scale

Map Produced by LCOG, July 2002



Source: Water Resources Department, Upper Willamette Drainage Basin Map, 1976


River Road-Santa Clara Basin
Location Map
Figure 2-2
Metro Plan Boundary
Urban Growth Boundary
Stormwater Basin Boundary
West Springfield Drainage Area
0 5,000 10,000 feet
Scale
N
River Road-Santa Clara
Bethel-Danebo
Willakenzie
AM
B-D
AM
Willamette River
Willow Creek
Amazon
Laurel Hill
Willamette River
West Springfield Drainage Area
Ridgeline
Hwy. 99
River Road
Willamette
River
Amazon
Creek
Green Hill Rd.
Irvington Rd.
Clear Lake Rd.
Barger Ave.
Road
Royal Ave.
Hwy. 99
Beltline
Roosevelt Ave.
Hwy. 126
11th Ave.
Amazon
18th Ave.
Creek
Crow Rd.
Bailey Hill Rd.
Lorane Hwy
Willamette St.
24th Ave.
30th Ave.
Dillard Rd.
I-5
Beltline Road
Delta Hwy.
Coburg Road
Cal Young Rd.
Harlow Rd.
105/126
Centennial Blvd.
Franklin Blvd.
Gateway St.
Q. St. Floodway
Pioneer Parkway
McKenzie
River
Marcola Rd.
Hwy. 126
14th
28th St.
48th
Main Street
Hwy. 126
Middle Fork Willamette River
Jasper Rd.
Hwy. 58
I-5
Map Produced by LCOG, April 2002

2.1.3 River Road Santa Clara Basin

As shown on Figure 2-2, the River Road Santa Clara basin forms the northwest corner of the Eugene-Springfield metropolitan area, and is generally bounded by the Willamette River on the east, the Bethel-Danebo drainage basin on the south and the *Metro Plan* boundary on the west and north. The basin is 10,458 acres in size with about 58 percent (6,071 acres) located within the Eugene urban growth boundary (UGB).

2.2 Climate

The climate in the study area is primarily affected by humid air masses from the west and south, and infrequent influxes of cold, continental air masses from the east. As a result, the year-round climate in Eugene is moderate with relatively cool, wet winters, and warm, dry summers. Average minimum winter temperatures are in the mid-30s with extremes seldom dropping below 10 degrees Fahrenheit (-12.2 Celsius). Average maximum summer temperatures are in the low 80's (26.7 to 28.9 Celsius) with extremes seldom exceeding 100 degrees Fahrenheit (37.8 Celsius). Snowfall constitutes only 2 percent of the annual precipitation in Eugene. Winter snow does not accumulate; however, quick snow melt can contribute to flooding problems throughout the Eugene area.

The National Weather Service records rainfall information at the Mahlon Sweet Airport in Eugene. Average annual precipitation is approximately 46 inches with 86 percent occurring from October to May. Figure 2-3 presents the average monthly rainfall distribution based on the airport's 48-year rainfall record from 1949-1997.

Figure 2-3
Average Monthly Rainfall

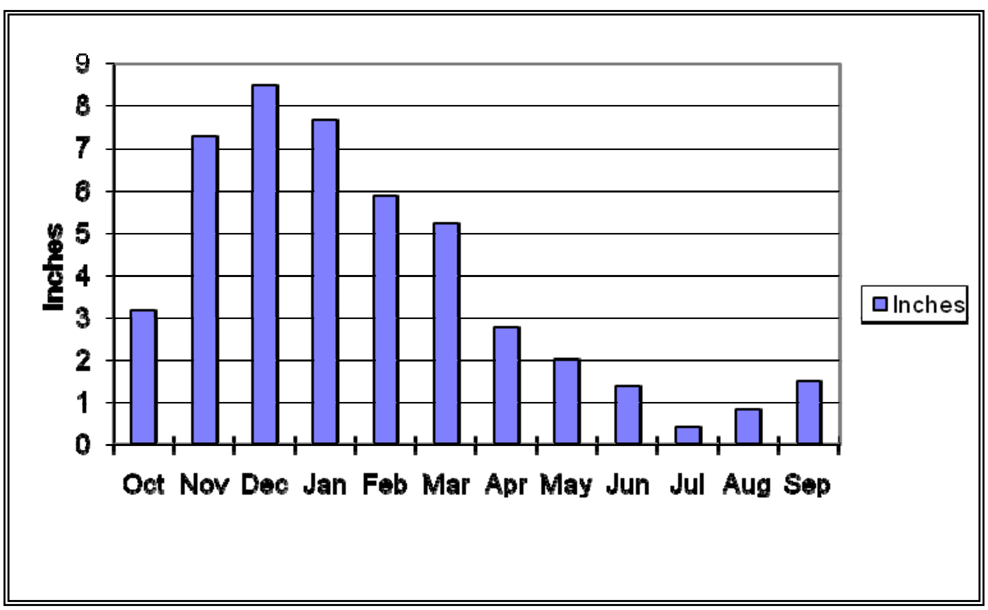


Table 2-1 characterizes a typical storm event for the Eugene area based on the historic 48-year precipitation record measured at the Eugene Airport:

Table 2-1
Average Storm Event

Storm Event Parameter	Average
Volume	0.67 inches
Duration	16.9 hours
Intensity	0.042 inches per hour

Since 1992, rainfall information has been recorded at six rain-gage stations within the Eugene city limits. Comparison of that data with the National Weather Service's Eugene Airport data indicates a significant difference between the two, with the airport data approximately 30 percent higher. For additional information regarding this issue, see Section 3.1.2 and Appendix A of Volume I.

Historically, performance of the City's drainage system has been very good. For example, the City's system handled the February 1996 storm event with very few problems even though this event caused widespread flooding in the Willamette River Valley.

2.3 Land Use and Surface Cover

The conversion from undisturbed to developed land uses can significantly affect the quantity and quality of stormwater runoff. Runoff volumes and velocities increase as impervious surface areas increase. Likewise, stormwater quality decreases due to nonpoint source pollution from roadways and urban land uses such as commercial, industrial, and residential. The purpose of this section is to describe existing land use and impervious surface conditions within the basin and to forecast changes in these conditions due to buildout of remaining vacant lands within the UGB according to *Metro Plan* designations. Existing land use data presented in Map 1 are based upon the current use of the property as depicted on the Land Use Parcel Data GIS layer as of January 2007. Buildout data presented in Map 2 are based on *Metro Plan* designations. It was assumed that 15% of the area designated as "vacant" on the 2007 Land Use Parcel Data GIS layer would be for the creation of new streets. See maps at the end of Section 2.

2.3.1 Existing Land Use

As shown in Table 2-2, the predominant land uses in the basin are: agriculture (2,949 acres); low-medium density residential (2,658 acres); industrial/airport (1,447 acres); other undeveloped land (1,326 acres); street rights-of-way (1,197 acres); commercial (350 acres); and schools/churches/cemeteries (187 acres).

Table 2-2
Existing Land Use – River Road Santa Clara Basin

Land Use Categories	Acres	Percent Of Area
Inside UGB		
Agriculture	516	4.9%
Commercial	297	2.8%
Communication, Utilities	47	0.5%
Golf Courses	17	0.2%
Government	20	0.2%
Industrial	450	4.3%
Low-Med. Density Residential	2,558	24.5%
Med-High Density Residential	68	0.6%
Other Undeveloped Land	702	6.7%
Parks, Open Space, & Recreation	65	0.6%
Railroad	40	0.4%
Streets (R.O.W.)	1,106	10.6%
Schools, Churches, & Cemetaries	187	1.8%
Subtotal	**6,071**	**58.1%**
Outside UGB		
Agriculture	2,433	23.3%
Commercial	53	0.5%
Communication, Utilities	6	0.1%
Golf Courses	35	0.3%
Government	960	9.2%
Industrial	75	0.7%
Low-Med. Density Residential	99	0.9%
Med-High Density Residential	1	0.0%
Other Undeveloped Land	608	5.8%
Parks, Open Space, & Recreation	12	0.1%
Railroad	10	0.1%
Streets (R.O.W.)	91	0.9%
Timber	3	0.0%
Subtotal	**4,387**	**41.9%**
Grand Total	**10,458**	**100.0%**

Source: LCOG 2007 Parcel File

2.3.2 Buildout Land Use

The primary land use policies pertaining to the River Road Santa Clara basin are contained in the following locally adopted policy documents:

- *Eugene-Springfield Metro Area General Plan (1987)*
- *River Road Santa Clara Urban Facilities Plan (1988)*
- *Annexation and Urban Services Policy Agreement, City of Eugene and the Industrial Corridor Community Organization [ICCO], (April 1991)*

Lane County zoning applies to areas outside the UGB and City Codes apply within the UGB. Table 2-3 summarizes the buildout land use for the River Road Santa Clara basin.

2.3.2.1 Buildout Land Use Within the UGB

This area includes both the current city limits and the unincorporated UGB, totaling 6,071 acres (58% of basin). 1,217 acres are vacant and considered available for development. For the purposes of this report, the term "vacant acres" refers to lands within the UGB that are expected to develop to urban uses. As shown in Table 2-3, land use categories with significant remaining vacant acres include: industrial and commercial-industrial mixed (641 acres), low-density residential (326 acres), medium-density residential (32 acres), and commercial and residential-commercial mixed (20 acres).

2.3.2.2 Projected Land Use Outside the UGB

Forty-two percent of the River Road Santa Clara basin (4,387 acres) is located outside the UGB. All of the area outside the UGB in this basin will remain rural and land uses will be restricted to the Metro Plan designations as shown in Table 2-3. Areas outside the UGB are not permitted to develop to urban uses and, therefore, "vacant" acres do not apply here.

Table 2-3
Buildout Land Use General

General Plan Designation	Designated Acres	
	Total	Vacant* (2006) for Future Urban Development
Inside UGB		
Low-Density Residential	2,855	326
Medium-Density Residential	168	34
Commercial and Residential-Commercial Mixed Use	135	20
Industrial and Commercial-Industrial Mixed	1,459	641
Parks and Open Space	37	9
Government, Education, and Research	127	4
Agriculture and Agriculture/Airport Reserve	2	0.4
Streets (R.O.W.)**	1,288	183
Subtotal	6,071	1,217
Outside UGB		
Rural Residential	101	0
Low-Density Residential	0.2	0
Industrial and Commercial-Industrial Mixed	23	0
Government, Education, and Research	2,034	0
Parks and Open Space	7	0
Agriculture and Agriculture/Airport Reserve	2,114	0
Outside Metro Plan Boundary	16	0
Streets (R.O.W.)**	91	0
Subtotal	4,386	0
Grand Total	10,458	

Source: LCOG and City of Eugene Geographic Information System, 2006
*For purposes of this report, vacant acres apply to lands only within the urban growth boundary.
**Notes: Streets (Right of Way). The Metro Plan does not have a "Streets" Plan designation. This amount was estimated based on the difference between total designated area and total basin size. In undeveloped areas, 15 percent of the land area was put into the Streets (Right of Way) category to account for streets that will serve future designated development.

2.3.3 Surface Cover

Other than precipitation, surface cover is perhaps the single most influential factor that affects the volume, quality, and velocity of stormwater runoff and the ability to treat runoff through filtration and other natural processes. Pervious surfaces are undisturbed natural areas that retain native prairie or forest vegetation or lands in developed areas that are typically covered with lawn, agricultural fields, or pasture. In both cases, water is free to infiltrate into the ground. Undisturbed natural areas provide significant beneficial stormwater functions. They help reduce the volume and velocity of runoff by facilitating infiltration of precipitation into the groundwater. Stormwater quality is best in undisturbed natural areas. The vegetative cover associated with undisturbed natural areas is also important for stabilizing steep slopes and streambanks. The infiltration capacity of undisturbed areas may be reduced during conversion to urban lawns and agricultural crops. Stormwater quality may also be impacted by lawn care and agricultural practices. Pervious surfaces in developed areas provide stormwater benefits, although to a lesser degree than undisturbed natural areas.

In contrast, impervious surfaces are lands covered by hard surfaces such as rooftops, roads, and parking lots and allow little or no infiltration of water. Impervious surfaces are unable to absorb and infiltrate precipitation, which results in greater runoff volumes, higher but shorter duration peak flows, and higher concentrations of pollutants. The transition from undisturbed to developed land uses and densities involves a significant change from pervious to impervious surfaces. As a consequence, adequate facilities must be planned, constructed, and maintained to minimize drainage and flood problems and impacts to water quality and natural resources.

The purpose of this section is to describe existing surface cover conditions with data current to 2007, and as they are projected to exist at buildout of the River Road Santa Clara basin urban growth boundary (UGB).

2.3.3.1 Impervious Surfaces

Total impervious surface area for the study area was calculated using a set of impervious surface area factors (ISAF) that were applied to the existing and buildout land use data. To calculate total impervious surface area, the ISAF percentages were multiplied by the total land area in each of the land use categories.

The ISAFs used are provided in Volume I. These factors were derived through a process that used existing developed properties in Eugene to generate typical impervious percentages. Impervious surface area for residential, commercial, and industrial land uses had previously been digitized as the basis for calculating stormwater user fees. By using this data source, the resulting ISAFs have been calibrated specific to the City of Eugene and in some cases specific to the basin. The ISAFs for land use categories that were not previously digitized were derived through review of national standards and by calculating the impervious surface area on sample sites.

The amount of existing impervious surface area in the UGB portion of the River Road Santa Clara basin is estimated to be 2,277 acres or 37.5 percent of the basin's UGB area. [Note:

calculations for this data are available from the City of Eugene.] The majority of this impervious surface area is concentrated between Highway 99 (west) and the east boundary of the basin. Map 3 depicts the existing generalized impervious surface area in pink. Due to the map scale and data restrictions, developed lots are shown entirely in pink. These pink areas are a mix of impervious surface and pervious surfaces associated with the land use such as lawns, streetscapes, parking lot planting, and other landscaped areas.

Assuming that future growth in the basin will follow conventional stormwater management drainage practices and will develop according to the land use categories depicted on the Eugene-Springfield Metro Plan designations (see Map 2), the amount of impervious acres in the UGB portion of the basin is projected to increase to 3,044 acres, or 50 percent of the basin's UGB area at buildout. [Note: calculations for this data are available from the City of Eugene.]

2.3.3.2 Pervious Surfaces

Except for the impervious surface areas noted above, the rest of the basin remains in a pervious condition, consisting mostly in the form of prairie wetlands, forest, agriculture and lawns.

Overall, pervious area cover is expected to decrease from the current 62.5 percent of the UGB portion of the basin (3,794 acres) to 50 percent (3027 acres) at UGB buildout. For the purposes of this report, pervious surface areas were identified and grouped into *Forest Cover*, *Landscaping*, and *Other Vegetated Areas* (refer to Figure 2-4) for the following reasons:

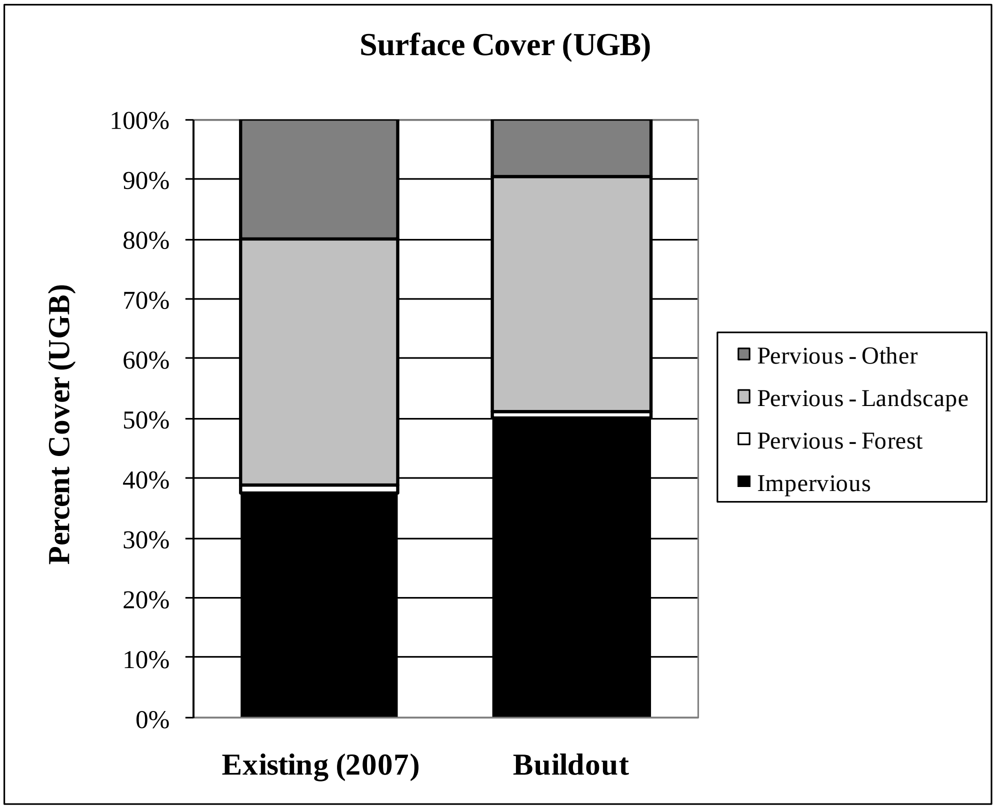
- <u>Forest Cover</u> is highly effective in reducing runoff volumes, and in preventing erosion (e.g., reduces soil impact by slowing down the velocity of precipitation and by intercepting up to 35 percent of it before hitting the ground) and stabilizing steep slopes (established root zones). Areas were included in this category if the forested area exceeded one acre in size. One percent of the River Road Santa Clara basin is currently in forest cover and at UGB buildout, forest cover would decrease to 0 percent.

- <u>Landscaping</u> areas, including lawns, streetscape and parking lot landscaping are associated with site improvements due to urban development. This category was distinguished to highlight both its positive and potential negative impacts on stormwater resources and is included in the area shaded pink on Map 3. Positive impacts include protection of surface soils, filtration of sediments, and some infiltration (although this is reduced from pre-development conditions). The use of chemical fertilizers, pesticides, and herbicides can cause negative impacts to water quality. The amount of landscaped area in the UGB is projected to decrease from the existing 41 percent to 39 percent at UGB buildout.

- <u>Other Vegetated Areas</u> are pervious surfaces not in *forest cover* or *landscaping* use, such as agricultural fields, pasture, vacant lots, prairie wetlands, and small clusters of trees (less than one acre). Similar to the landscaping category, these areas have both positive and negative impacts on stormwater resources. Agriculture and pasture uses can be significant contributors of pollutants in this category due to the use of chemical fertilizers, pesticides, herbicides, and fecal coliform due to grazing. This category is expected to decrease from 20 percent of the UGB to 9.7 percent at UGB buildout.

Figure 2-4 compares the percentage of existing and projected surface cover for the UGB portion of the River Road Santa Clara basin.

Figure 2-4
Surface Cover in the River Road Santa Clara Basin UGB



2.4 Landform, Topography, Slopes

Ninety-nine percent of the basin has slope in the 0%-5% category. The following table is keyed to Map 4, Slope and Topography, and indicates the amount of acres affected by varying categories of slope steepness.

Table 2-4
River Road Santa Clara Basin Slope Distribution

Location	Slope Distribution (percent)					
	Slopes 0-5%	Slopes 6-10%	Slopes 11-15%	Slopes 16-25%	Slopes >25%	Total
Within UGB	99%	1%	0%	0%	0%	100%
Outside UGB	99%	1%	0%	0%	0%	100%
Total Basin	99%	1%	0%	0%	0%	100%

2.5 Surface Water Features and Drainage System

This section describes the existing drainage features of the basin including the City's stormwater facilities, open waterways, and wetlands. Refer to Map 5.

2.5.1 Waterways

Pre-settlement (prior to 1855) morphological conditions in the Willamette Valley reflected a network of shallow, broad swales that would often over-bank during storm events creating ponded conditions. Today, most of the drainages have been altered into narrow, deep and well-defined channels where the management objective of preventing over banking conditions has been accomplished for most small storm events.

Five major drainage systems exist in this basin including: the A-1 Channel, Flat Creek, Spring Creek, Highway 99 and the Willamette Overflow (also referred to as the East Santa Clara Waterway). Generally, these open waterways run in a northerly or northwesterly direction. Historically, most of these features meandered along the valley floor before reaching the Willamette River or Long Tom River. Some of these have been altered into narrow, deep and well defined channels designed to collect and convey runoff while others remain relatively undisturbed.

2.5.1.1 A-1 Channel

The A-1 Channel originates at the junction of Beltline Highway and the Northwest Expressway. It is the largest waterway in this basin flowing northwesterly about three miles through the Highway 99 Industrial Corridor. The channel is surrounded by residential use in the Santa Clara neighborhood changing to adjacent agricultural use as it leaves the UGB. The channel drains into Amazon Creek outside of the *Metro Plan* boundary. This channel was constructed by the Soil Conservation Service as part of the Lower Amazon and Flat Creek Watershed Improvement Projects primarily for flood control purposes. Vegetation lacks diversity along the channel contributing to poor wildlife habitat. The channel has high enhancement potential however, due to its connectivity with other waterways. The A-1 Channel is listed as a riparian resource site (refer to E60: A-1 Channel) in the adopted 2007 Goal 5 Water Resources Conservation Plan, a refinement plan to the Eugene-Springfield Metro Plan. Protections for two of three identified segments of Site E60 in the form of the Water Resources Conservation Overlay Zone (Eugene Code 9.4910) were adopted by the City of Eugene in November 2005 (effective January 1, 2006) and Lane County in December 2006 (effective January 12, 2007), including setbacks of 20 feet from top of high bank.

2.5.1.2 Flat Creek

The southern portion of Flat Creek begins near the Northwest Expressway and Park Avenue and flows north towards Beltline Road. With development of Beltline Road and the Northwest Expressway, the natural Flat Creek drainage area south of Beltline Road was diverted into the A-1 Channel, and is no longer hydrologically linked to the northern portion of Flat Creek. The southern portion of Flat Creek includes riparian resource sites E61 (Middle Flat Creek) and E69

(South Flat Creek). Eight of the ten identified segments of Sites E61 and E69 are protected in the form of the Water Resources Conservation Overlay Zone adopted by the City of Eugene and Lane County, including setbacks ranging from 0 to 40 feet from top of high bank. Although not hydrologically linked with the southern portion, the northern portion of Flat Creek extends from Beltline Road and continues north where it exits the *Metro Plan* boundary near Beacon Drive. Eventually the creek joins the Willamette River by way of Ingram Slough near the community of Monroe. Unlike the A1 Channel, Flat Creek is a natural drainage feature and is identified for possible protection in the 1987 River Road Santa Clara Urban Facilities Plan (Environmental Design Element), a refinement plan to the Eugene-Springfield Metro Plan. More recently, Flat Creek is listed as a riparian resource site (refer to E59: Flat Creek) in the adopted 2007 Goal 5 Water Resources Conservation Plan, also a refinement plan to the Metro Plan. Six of seven identified segments of Site E59 are protected in the form of the Water Resources Conservation Overlay Zone adopted by the City of Eugene and Lane County, including setbacks ranging from 0 to 20 feet from top of high bank. The condition and function of Flat Creek within the UGB varies significantly with some segments relatively undisturbed and others significantly altered due to urban development property owner impacts.

2.5.1.3 Spring Creek

Spring Creek is about two miles long (within the UGB) and flows south-to-north beginning just north of Greenfield Avenue. It crosses River Road near Spring Creek Drive and continues north where it eventually joins the Willamette River nearly 3 miles north of the UGB. The creek flows through Awbrey Park and is adjacent to Spring Creek Elementary School serving both a stormwater and open space function. The creek is bordered by riparian vegetation, predominately Oregon ash and Bigleaf maple. Spring Creek is identified for possible protection in the 1987 River Road Santa Clara Urban Facilities Plan (Environmental Design Element), a refinement plan to the Eugene-Springfield Metro Plan. More recently, Spring Creek is listed as a riparian resource site (refer to E58: Spring Creek) in the adopted 2007 Goal 5 Water Resources Conservation Plan, also a refinement plan to the Metro Plan. Five of six identified segments of Site E58 are protected in the form of the Water Resources Conservation Overlay Zone adopted by the City of Eugene and Lane County, including setbacks ranging from 0 to 40 feet from top of high bank.

2.5.1.4 Willamette Overflow

The Willamette Overflow, also referred to as the “East Santa Clara Waterway” is a two mile long waterway located in the northeast portion of the basin and straddles the UGB. It has a relatively high wildlife value and is one of a few vegetated sloughs identified for potential protection in the River Road Santa Clara Urban Facilities Plan (Environmental Design Element), a refinement plan to the Eugene-Springfield Metro Plan. More recently, it is listed as a riparian resource site (refer to E57: East Santa Clara Waterway) in the adopted 2007 Goal 5 Water Resources Conservation Plan, also a refinement plan to the Metro Plan. Two of four identified segments of Site E57 are protected in the form of the Water Resources Conservation Overlay Zone adopted by the City of Eugene and Lane County, including setbacks ranging from 20 to 40 feet from top of high bank.

2.5.1.5 Highway 99

This drainage system mainly consists of a long roadside ditch along Highway 99. This ditch drains in a northwesterly direction and into the A-1 channel. The ditch is owned and maintained by the Oregon Department of Transportation.

2.5.2 Wetlands

Most wetland features within the basin are associated with riparian areas adjacent to creeks and open waterways. There are also a few wetland sites located primarily near the relatively undeveloped northern and western portions of the basin outside the UGB. About 281 acres of wetlands are identified in the basin in the National Wetland Inventory (NWI) which provides basic data about the general characteristics and extent of wetlands in the nation. The NWI identifies the general boundaries of wetlands; however, in many instances actual wetland boundaries are more extensive than what is identified. About 54 percent of the NWI wetlands in the basin are located outside the UGB, and the area outside the UGB represents about 42 percent of the total basin area.

A Local Wetland Inventory (LWI) was conducted in 2005, and the wetland sites evaluated for potential protection as part of the City and County's Goal 5 efforts. Several wetland sites in the River Road Santa Clara basin are identified in the adopted 2007 Goal 5 Water Resources Conservation Plan in the River Road Santa Clara basin and are protected in the form of the Water Resources Conservation Overlay Zone adopted by the City of Eugene and Lane, including setbacks ranging from 25 to 50 feet from the jurisdictional wetland boundary.

The River Road Santa Clara basin also includes several open water ponds; all located in the general vicinity of the Northwest Expressway and/or Highway 99 North. These ponds are identified in the adopted 2007 Goal 5 Water Resources Conservation Plan as Site E62: Northwest Expressway Ponds. The Northwest Expressway ponds are located just south of Maxwell Road and on both the east and west sides of the Northwest Expressway. The eastern pond (Dianna’s Pond) is within the River Road Santa Clara basin and is hydrologically connected with Upper (or South) Flat Creek. The pond is a former borrow pit that currently supports willow, black cottonwood, reed canary grass, rush and sedge as the predominant plant species. The southern and eastern arms of the pond have healthy riparian strips, while much of the rest of the banks are bare and eroding.

2.5.3 Public Piped Drainage System

Most of the existing development in this basin occurred prior to the City of Eugene having jurisdiction over urban land use requirements and, as a consequence, this basin lacks a stormwater pipe system found in the other basins. Only 94.5 miles of stormwater pipes exist in this basin and 43 of these miles are located outside the UGB, mostly serving Mahlon Sweet Airport. The piped system located within the UGB was constructed to serve more recent development that was required to annex and develop to City of Eugene standards. See Map 5.

2.5.4 Drywell Drainage System

Drywells are underground structures that collect stormwater runoff which is then discharged into the ground where it mixes with the groundwater. The River Road Santa Clara stormwater basin is unique compared to other Eugene-area basins in its frequent use of drywells for managing stormwater. Approximately 22% of the River Road Santa Clara stormwater basin currently drains to drywells. This area has historically utilized drywells because it lacks a continuous stormwater system and because the flatness of the topography and the relatively high permeability of the soils are conducive to stormwater management through this method. There are 785 known drywells in the River Road Santa Clara basin. Of those drywells, 634 (81%) are privately owned, 79 (10%) are owned by Lane County, and 72 (9%) are owned by the City of Eugene. Drywells come in numerous configurations which are collectively termed "Underground Injection Controls" or "UICs."

2.5.5 Maintaining the Drainage System

The Lane County Public Works Department, the Junction City Water Control District, and the City of Eugene share limited maintenance responsibilities in this basin. Lane County Public Works Department is responsible for stormwater facility maintenance in the unincorporated portions of this basin. This maintenance activity is limited to drainage problems that directly affect County right-of-way, such as roadside ditches, culverts, and bridge crossings. The Junction City Water Control District is responsible for maintenance of irrigation ditches, channels and waterways within the District's boundaries, which lie in the unincorporated areas north of Eugene in the Flat Creek, A, A-1 and A-2 Channel watershed boundaries. The City is responsible for maintaining areas that have been annexed to the City. The City and County share maintenance responsibilities in this basin which results in greater efficiencies for both jurisdictions.

2.5.6 Floodplain

A flood insurance study for the Federal Emergency Management Agency (FEMA) has been conducted within the River Road Santa Clara basin. As part of this study, areas subject to the 100-year flood event have been identified. One thousand two hundred seventy acres of floodplain have been mapped within the basin. There are approximately equal acres of floodplain within and outside the UGB. Most of the broad floodplain area is associated with the Willamette River in the northeast portion of the basin just outside the UGB. Ribbons of floodplain are also located adjacent to the five primary waterways that flow through the basin. (See Map 5) More detailed floodplain studies necessary to map floodway boundaries have not been conducted for this basin.

2.6 Water Quality

This section provides a description of water quality conditions in the River Road Santa Clara basin. Water quality conditions can vary dramatically depending on time of day, weather conditions, land use activities conducted in the watershed, and location in the water body. Therefore, without significant amounts of data, it is often difficult to adequately evaluate water quality conditions. It is even more difficult to evaluate the water quality impacts of stormwater runoff on receiving waters. Therefore, a variety of available sources of water quality-related information was reviewed in an attempt to provide a general picture of water quality conditions in the basin. The following sources of information were reviewed and are described below:

- Documented water quality problems based on existing chemical data, biological data, and field observations.
- Oregon Department of Environmental Quality's (DEQ's) designations of water quality limited water bodies.
- Natural and built environmental conditions that influence water quality.

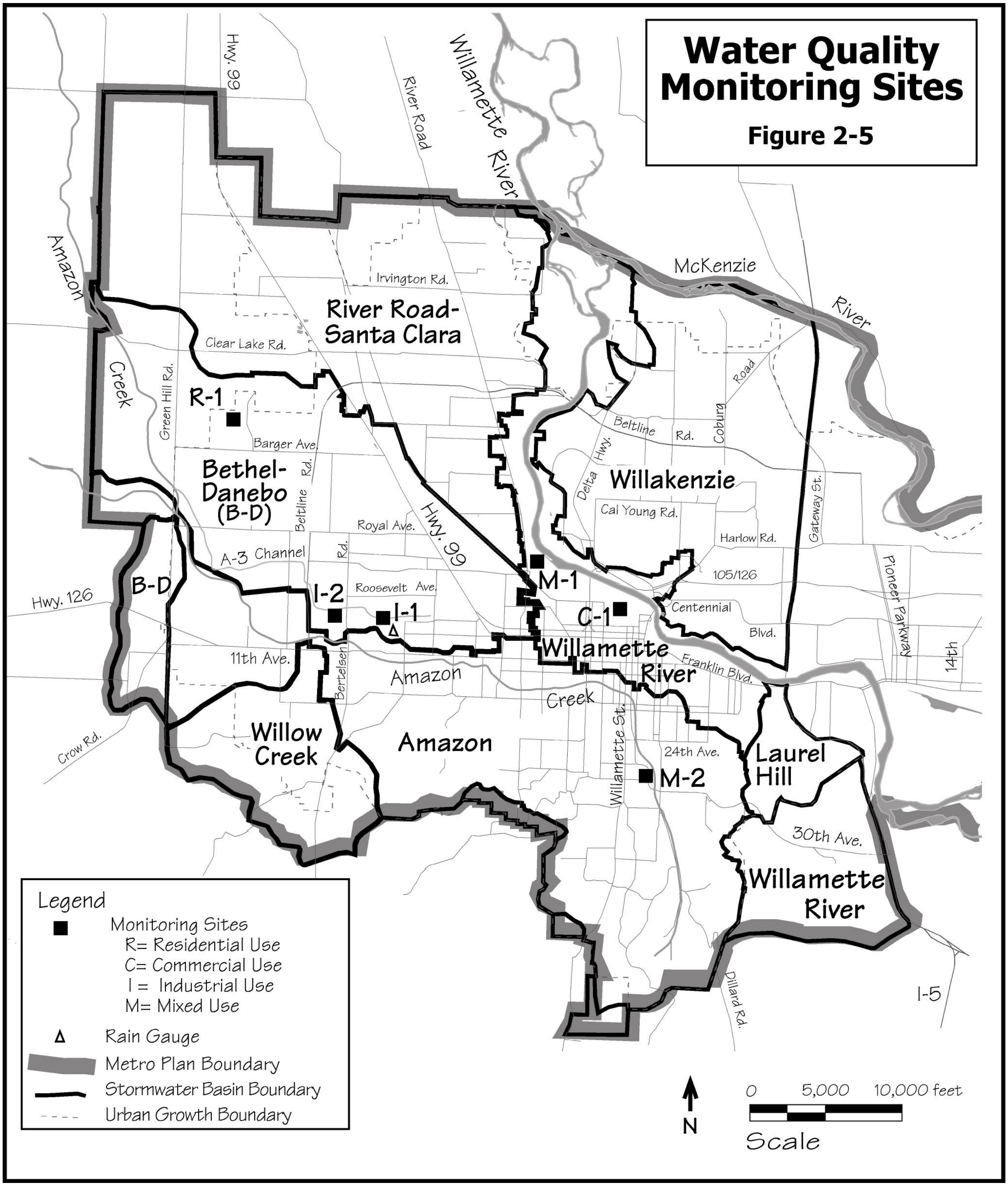
2.6.1 Documented Water Quality Problems

The following subsections describe the water quality problems that have been documented for the River Road Santa Clara basin in terms of chemical stormwater monitoring data, macroinvertebrate sampling, and field observations.

2.6.1.1 Chemical Stormwater Monitoring Data

The City collected and analyzed samples of stormwater runoff from 1992 to 1997 at 6 sampling stations in Eugene (see Figure 2-5). The 6 sampling stations were selected to represent runoff from various land uses. In 1998, the storm event monitoring at the 6 sampling stations was discontinued and a pilot project on the A3 Channel using a basin approach to water quality monitoring was implemented. The revised monitoring plan consisted of collecting monthly composite samples at the original industrial land use station on the A3 Channel (station I1) and collecting samples at selected high source areas in the piped system on the A3 Channel.

The following table provides a summary of the results collected during 1992 to 1997 from the 6 sampling stations. Table 2-5 includes a description of the problem pollutants, typical sources of the pollutants, specific results from Eugene, and potential problems associated with the pollutants. Although none of these data were collected from within the River Road Santa Clara basin, they provide general information regarding stormwater quality in Eugene and were used in this initial study towards the development of a stormwater basin master plan.



Water Quality Monitoring Sites

Figure 2-5

Table 2-5
Summary of Stormwater Quality Monitoring in Eugene

Pollutant	Description	Sources	Eugene's Results	Potential Problems
Bacteria	- Enterococcus, - Fecal coliform, and - Fecal streptococcus	- Animal Wastes (droppings from wild/domestic animals), - Human Wastes (leaking sanitary sewer pipes, and seepage from septic tanks).	**Results from almost all of the samples significantly exceeded the DEQ standard for water quality**.	These are commonly used indicators of pathogens. Water contact may cause eye and skin irritations and gastro-intestinal diseases if swallowed.
Heavy Metals	Antimony Arsenic Beryllium Cadmium Chromium Copper Lead Mercury Nickel Selenium Silver Thallium Zinc	- Vehicles (combustion of fossil fuels, improper disposal of car batteries, wear/tear of tires and brake pads), - Metal Corrosion, - Pigments for Paints, - Solder, - Fungicides, - Pesticides, - Wood Preservatives	Cadmium, chromium, copper, lead, nickel, and zinc were typically present in samples. **Copper, lead, and zinc in stormwater samples frequently exceeded DEQ standards for the protection of aquatic life.**	Heavy metals are toxic to freshwater aquatic ecosystems. These metals are considered to be the most significant toxic substances which are commonly found in urban stormwater runoff.
Oil & Grease	A broad group of pollutants including: - Animal fats, and - Petroleum products.	- Food Wastes (animal and vegetable fats from garbage), - Petroleum Products (gas, engine oil, lubricants, etc.).	**Two of fifty-three samples had concentrations which exceeded discharge limitations specified for industrial stormwater discharges (i.e., > 10 mg/L).**	These compounds can coat the surface of the water limiting oxygen exchange, clog fish gills, and cling to waterfowl feathers. When ingested these compounds can be toxic to birds, animals and other aquatic life.
Sediments	Sediments in the water are considered pollutants when they exceed natural concentrations and negatively affect water quality and/or beneficial uses of the water.	- Erosion from increased stream flows, - Construction site runoff, - Landscaping activities, - Agricultural activities, - Logging, - All other activities where the ground surface is disturbed.	**Excess levels were measured at all stations. Results from the urban sampling stations in Eugene were all 40% to 70% higher than results from an open space (i.e., undeveloped) sampling.**	Sediments cause increased turbidity, reduced prey capture for sight feeding predators, clogging of gills/filters of fish and aquatic insects, and blocked light which limits food production available for fish. Sediments also accumulate in stream bottoms which reduces the capacity of the stream (and hence increases the potential for flooding) and covers stream bottom habitats. Sediment also acts as a carrier of toxic pollutants such as metals and organics.
Nutrients	- Nitrate - Ammonia - Kjeldahl Nitrogen - Phosphorus - Orthophosphate	- Landscaping activities, - Yard debris, - Human wastes (leaks from septic tanks and sanitary sewers), - Animal wastes, - Vehicle exhausts, - Agricultural activities, - Detergents (car washing), - Food Processing	**The DEQ guidance value of 0.1 mg/L for total phosphorus was exceeded in 100% of the samples collected.**	Excess levels of nutrients can lead to eutrophication in downstream receiving waters. Problems include surface algal scums, odors, reduced oxygen levels, and dense mats of algae. In addition to water quality problems, these effects have a negative impact to the aesthetic quality of water bodies.
Organics	There are many organic compounds, however, the synthetic organics are of most concern and include: - Fuels - Solvents - Pesticides - Herbicides.	- Illegal dumping, - Illicit connections, - Spills, - Leaks from drums and storage tanks, - Landscaping activities - Agricultural activities.	Although sampling for these compounds was limited, **nine volatile organic compounds were detected (including one pesticide).**	Most synthetic organics are highly toxic to aquatic life at very low concentrations, and many are carcinogenic (cancer causing) or suspected carcinogens. Diazinon has been identified in many recent studies as one of the causes of toxicity in stormwater.

Table 2-5 (continued)

Pollutant	Description	Sources	Eugene's Results	Potential Problems
Litter and other Floatable Debris	- Plastics, - Paper products, - Yard debris, - Tires, - Metal, - Glass.	- Littering, - Dumping, - Spills.	Sampling for litter and floatables was not conducted, however, **specific problem dumping areas have been identified in Eugene** (see notes below).	These pollutants degrade the aesthetic quality of water bodies. In addition, they contribute pollutants as they decompose, and they can reduce the capacity of the water body. Excess yard debris contributes to high levels of nutrients and it reduces oxygen levels as it decomposes.

Based on results from the above monitoring program and the results from state-wide monitoring efforts (ACWA, 1997), industrial and commercial land uses have been identified as significant sources of stormwater pollutants (i.e., high source areas). In the River Road Santa Clara basin, the commercial and industrial areas are in the following locations:

- Along Highway 99.
- Along the Northwest Expressway.
- Along Prairie Rd.
- In the vicinity of the Beltline, River Road intersection.

2.6.1.2 Field Observations of Water Quality Problems

In addition to the information obtained from the stormwater monitoring data described above, specific water quality related problems/issues have been observed in this basin as follows:

- *Excessive Sediment:* Elevated levels of sediment have been observed in Spring Creek, potentially due to poor erosion control practices at construction sites.

- *Tip-ups:* Sediment and debris that has been observed to accumulate in tip-ups is likely getting flushed into downstream open waterways during larger storm events.

- *Debris in the Open Waterways:* Significant amounts of trash and debris are dumped into the open waterways in this basin and maintenance access is often limited for removing debris.

2.6.2 Oregon Department of Environmental Quality Water Quality Limited Designations [303(d) List]

The federal Clean Water Act requires states to maintain a list of water bodies that do not meet water quality standards. These standards are established to protect beneficial uses such as drinking water, fisheries, industrial water supply, recreational, and agricultural uses. This list is called the 303(d) list based on the section of the Clean Water Act that mandates this requirement. The list is meant only as a means of identifying water quality problems and not the causes.

States must monitor water quality and review available data and information to determine if the standards are being met. In Oregon, this responsibility is carried out by the Department of Environmental Quality (DEQ). If available data indicate a water body is not meeting water quality standards, and the data meet listing guidelines, DEQ must assume that the water body is water quality limited. Water bodies with no information, or information incompatible with the EPA guidelines, are not included on the 303(d) list. The 303(d) list is updated and revised every two years. Once a water body is included on the 303(d) list, DEQ is required to develop a total maximum daily load (TMDL) requirement for both point and non-point sources of the pollutants of concern. It is anticipated that DEQ will develop TMDL requirements for all designated water quality limited water bodies in the State of Oregon sometime within the next ten years.

No water bodies in the River Road Santa Clara basin appear on the 303(d) list. However, two subbasins drain to the Amazon Creek and all subbasins in River Road Santa Clara eventually drain to the Upper Willamette River. Amazon Creek appears on the 303(d) list for bacteria, arsenic and lead. The Willamette River appears on the 303(d) list for bacteria, temperature and mercury. A TMDL was issued for the Willamette River basin in September 2006 for bacteria, mercury, and temperature. Lane County and the City of Eugene have each developed TMDL implementation plans outlining specific actions and programs to address water quality problems in the Willamette Basin. Lane County's plan was approved by the DEQ on June 17, 2008. The City of Eugene's plan was approved on December 23, 2008.

2.6.3 Natural and Built Conditions

Evaluating the natural and built conditions that influence water quality can be useful in indirectly assessing water quality conditions in the basin. As urbanization occurs, negative impacts to the health of receiving waters result from changes in the quality of stormwater runoff. Natural features such as riparian areas, wetlands, and open drainage systems have the ability to treat stormwater pollutants, prevent waterway scour by slowing down runoff rates, settle out sediments, and protect stream banks from erosion. However, with research showing that water quality degradation occurs at relatively low levels of imperviousness (10-20 percent), the implications of development on water quality is significant.[1] Figures 2-6, 2-7, and 2-8 examine natural and built conditions relative to the other Eugene drainage basins.

[1] Tom Schueler, et al. *Site Planning for Urban Stream Protection: The Importance of Imperviousness*, 1995.

Figure 2-6
Extent of Open Drainage System in the River Road Santa Clara Basin (UGB)

Miles per Square Mile of Open Drainage System in the River Road Santa Clara Basin	River Road Santa Clara Basin Relative to the Range in Other Eugene Basins (miles/sq mile)
3.0	

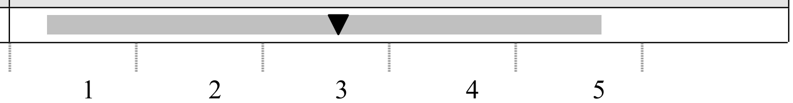
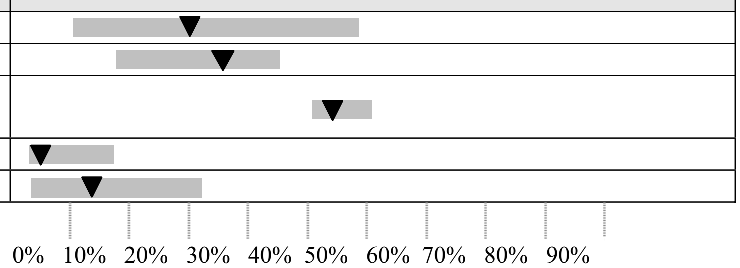


Figure 2-7
Extent of Area as a Percentage of the River Road Santa Clara Basin (UGB)

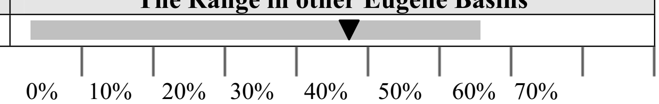
Factors	Percent in River Road Santa Clara Basin	River Road Santa Clara Basin Relative to The Range in other Eugene Basins
Remaining Vacant Lands*	**29%**	
Existing Impervious Surface Area	**34%**	
Projected Impervious Surface Area	**51%**	
Wetlands	**3%**	
100-Year Floodplain	**12%**	



Vacant land includes tax-lotted areas currently in vacant, agricultural, and timber uses.

Figure 2-8
Extent of 100-Year Floodway Fringe that is Vacant in the River Road Santa Clara Basin

Percent of 100-Yr. Floodway Fringe Vacant* in the River Road Santa Clara Basin	River Road Santa Clara Basin Relative to The Range in other Eugene Basins
44%	



Vacant land includes tax-lotted areas currently in vacant, agricultural, and timber uses.

2.6.4 Conclusions

A summary of the above findings suggest that degraded water quality conditions exist in the River Road Santa Clara basin as follows:

- Based on the analysis of stormwater runoff samples collected from Eugene and other urban areas in Oregon, the pollutants of concern that were identified are as follows:
  - Total Suspended Solids (TSS)
  - Nutrients
  - Heavy Metals
  - Bacteria
  - Oil and Grease
- Commercial and industrial areas have shown to be the most significant contributors of specific stormwater pollutants.

- The extent of the open drainage system in the basin on a miles per square mile basis is in the mid-range when compared with other Eugene drainage basins.
- At 34 percent, the basin currently has levels of imperviousness that are expected to degrade water quality. Projections at UGB buildout indicate that the impervious surface area will increase to 51 percent, which is the highest for all of the basins.

2.7 Rare, Threatened, and Endangered Plants, Animals, and Communities

Stormwater management decisions and practices can affect rare, threatened, and endangered plant and animal species. Local populations can be reduced or even eliminated as a result of decisions to pipe a waterway, install upstream detention, or to allow significant increases in runoff due to new development. The purpose of this chapter is to describe the known rare species and communities located in the River Road Santa Clara basin so that the details of these resources can be consulted prior to any final decisions. Review of the Oregon Natural Heritage Program database reveals no records of rare plant, animal, or community observations.

In March 1999, the National Marine Fisheries Service (NMFS) listed spring-run Chinook salmon as a threatened species under the Endangered Species Act (ESA). It includes all naturally spawned populations of Spring Chinook in the Clackamas River and in the Willamette River and its tributaries above Willamette Falls, Oregon. Because runoff from Eugene discharges either directly or indirectly to the Willamette River, the listing will affect the city's stormwater management program and practices. A species that is listed as *threatened* means it is *likely to become endangered within the foreseeable future throughout all or a significant portion of its range.* Protective regulations, known as 4(d) rules, have been developed that are *deemed necessary and advisable to provide for the conservation of the species*. These rules spell-out the *take* prohibitions that pertain to Spring Chinook and focus on the type of activities that are likely to lead to a "take." The City completed a review of its own processes, procedures, and development standards and identified those that may not be compatible with the 4(d) rules for potential adjustment. Lane County has established a Routine Road Maintenance Manual outlining procedures and standards for road maintenance activities designed to be compatible with the 4(d) rules.

2.8 Soils

Soil characteristics are important factors in predicting the amount, rate, and quality of stormwater runoff and for selecting management measures for addressing the effects of runoff. This section describes the key soil parameters relative to stormwater issues and the distribution of those parameters in the River Road Santa Clara basin. All soils data were obtained from the *USDA Soil Survey of Lane County*. Refer to Tables 2-6 to 2-8 and Maps 6 to 10 for a description of the soil mapping units and relevant stormwater related data found in River Road Santa Clara basin.

2.8.1 Permeability

Soil permeability measures the rate of water movement through the soil horizon. This factor is important in managing stormwater quantity and quality. Soils with slow permeability rates are more likely to result in higher stormwater runoff volumes than soils of high permeability. Under these conditions, larger and more extensive stormwater facilities are needed to accommodate new development where space permits. In more densely developed areas, slow permeable soils may be better suited to stormwater conveyance and storage facilities than infiltration facilities. Storage facilities could include detention ponds and treatment ponds where time is desired for settling and filtering purposes.

Compared with other Eugene basins, soil permeability in the River Road Santa Clara basin within the UGB is relatively high with 81% being moderately slow and 17% being moderate to very rapid. The following table displays the distribution of soil permeability for the basin.

Table 2-6
Soil Permeability in the River Road Santa Clara Basin

Location	Permeability (percent)							
	Very Rapid	Moderately Rapid	Moderate	Moderately Slow	Slow	Very Slow	No Data*	Total
Within UGB	4%	3%	10%	81%	0%	1%	1%	100%
Outside UGB	8%	2%	3%	74%	3%	8%	2%	100%
Total Basin	7%	3%	7%	78%	1%	3%	1%	100%

**Includes borrow pits and water features such as ponds Source: USDA Soil Survey of Lane County Area, Oregon, 1987.*

2.8.2 Runoff Potential

Soil groups have been rated according to their runoff potential under nonvegetated and saturated conditions without consideration of topographic conditions. Runoff potential measures a soil's capacity to permit infiltration and can be used to describe the degree of runoff expected during storm events. For example, soils rated with a low runoff potential are more likely to have high infiltration rates and, conversely, soils with a high runoff potential are more likely to have low infiltration rates. Hydrologic stormwater models often use this parameter in conjunction with slope and surface cover factors for estimating surface flows under undeveloped conditions.

As shown on Map 7, the River Road Santa Clara basin within the UGB contains soil groups with runoff ratings ranging from moderately low (16%), moderately high (71%) to "high" (11%). The following table displays the distribution of potential runoff qualities of the basin:

Table 2-7
Runoff Potential in the River Road Santa Clara Basin

Location	Medium	Low	Negligible	No Data*	Total
Within UGB	80.7%	17.3%	0.5%	1.4%	100%
Outside UGB	75.9%	22.5%	0.3%	1.3%	100%
Total Basin	78.7%	19.5%	0.4%	1.4%	100%

**Includes borrow pits and water features such as ponds*
Source:NRCS Soil Data, December 2006.

2.8.3 Erodible Soils

Highly erodible soils have significant stormwater management implications. If not properly protected during construction and land clearing activities, erosion and sedimentation from these soils can have the following negative effects:

- Reduction in the conveyance capacity of downstream stormwater facilities resulting in potential drainage and flooding problems.
- Reduction or elimination of aquatic habitat and covering or destroying of spawning beds.
- Water quality impacts due to pollutants that are attached to sediments.

The *Soil Survey of Lane County* indicates soils in this basin are generally not susceptible to high levels of erosion (See Map 8).

2.8.4 Unstable Slopes

Soils that are subject to slumping can present structural problems especially where extensive grading is made for roads and building pads.

The *Soil Survey of Lane County* indicates there are no soils in this basin subject to slumping.

2.8.5 Hydric Soils

Hydric soil is one of three criteria for determining the presence of wetlands; the other two being inundated or saturated soil conditions and the presence of hydrophytic vegetation. Federal and state regulations limit activities that can occur in wetlands, including the direct discharge of untreated stormwater runoff. The Oregon DEQ has not yet established such standards for discharging into wetlands.

The following table displays the percentage of hydric soils found in the basin. Hydric soils areas are located almost entirely west of the Northwest Expressway corresponding to historic low lying drainage areas (See Map 9).

Table 2-8
Hydric Soils in River Road Santa Clara Basin

Location	Hydric Soils (percent)
Within UGB	11%
Outside UGB	37%
Total Basin	22%

Source:USDA Soil Survey of Lane County Area, Oregon, 1987.

2.9 Groundwater

Two aspects related to groundwater need to be given special consideration when planning for stormwater management. The first relates to the regional aquifer that underlies much of the lower Willamette Valley basin. This aquifer is the source of drinking water for rural residents and several nearby communities (i.e., Springfield, Coburg, Junction City) and has also been investigated as a potential future source of water for Eugene. For this reason, consideration needs to be given to the effects that stormwater management can have on groundwater quality and quantity.

The second issue relates to depth to the water table. Map 11 shows the depth to high water table during the wet season. This information is linked to soil type and comes from the *USDA Soil Survey of Lane County*. During the course of the year, these elevations respond to rainfall amounts and, therefore, vary accordingly. As with hydric soil location, the Northwest Expressway is a definitive boundary where deeper water table elevations are found to the east and shallower depths to the west. As part of this study a more detailed analysis of high groundwater was conducted by reviewing well logs from the Oregon Water Resources department. The results of the evaluation showed that seasonal high groundwater levels are approximately 8 feet deep on average in this basin. A copy of study results is provided in Appendix E.

With regard to the issues of aquifer protection and depth to the water table, the numerous drywells used for stormwater management in this basin present a unique environmental problem because drywells have the potential to discharge surface water pollutants directly to groundwater without sufficient treatment.

Congress enacted groundwater protection rules in 1974 under the federal Safe Drinking Water Act (SDWA). The U.S. Environmental Protection Agency (EPA) administers these rules under Title 40 of the Code of Federal Regulations (CFR) Parts 144 -148. In Oregon, the EPA has delegated the regulation of groundwater protection rules to the Department of Environmental Quality (DEQ). The DEQ regulates this program for the EPA under the Oregon Administrative Rules (OAR) Chapter 340, Division 44.

As part of these groundwater protection rules, DEQ specifies a minimum of 10 feet of separation between the bottom of a drywell and the seasonal high groundwater. Due to high groundwater in a large portion of the River Road Santa Clara basin, most of the UICs in this area do not meet the necessary separation criteria and cannot, therefore, be Authorized by Rule by the DEQ. Both the City of Eugene and Lane County have registered their known UICs with the DEQ and have applied for a Water Pollution Control Facility (WPCF) permit to manage the UICs until they can be authorized or decommissioned. More detail regarding these regulations and strategies for compliance are provided in Section 4.0 of this document.

2.10 Existing and Planned Educational Facilities

The River Road Santa Clara basin currently has nine public schools (including two middle schools and one high school) and one private school. No additional schools are currently planned in the basin.

2.11 Existing and Planned Park and Recreational Facilities

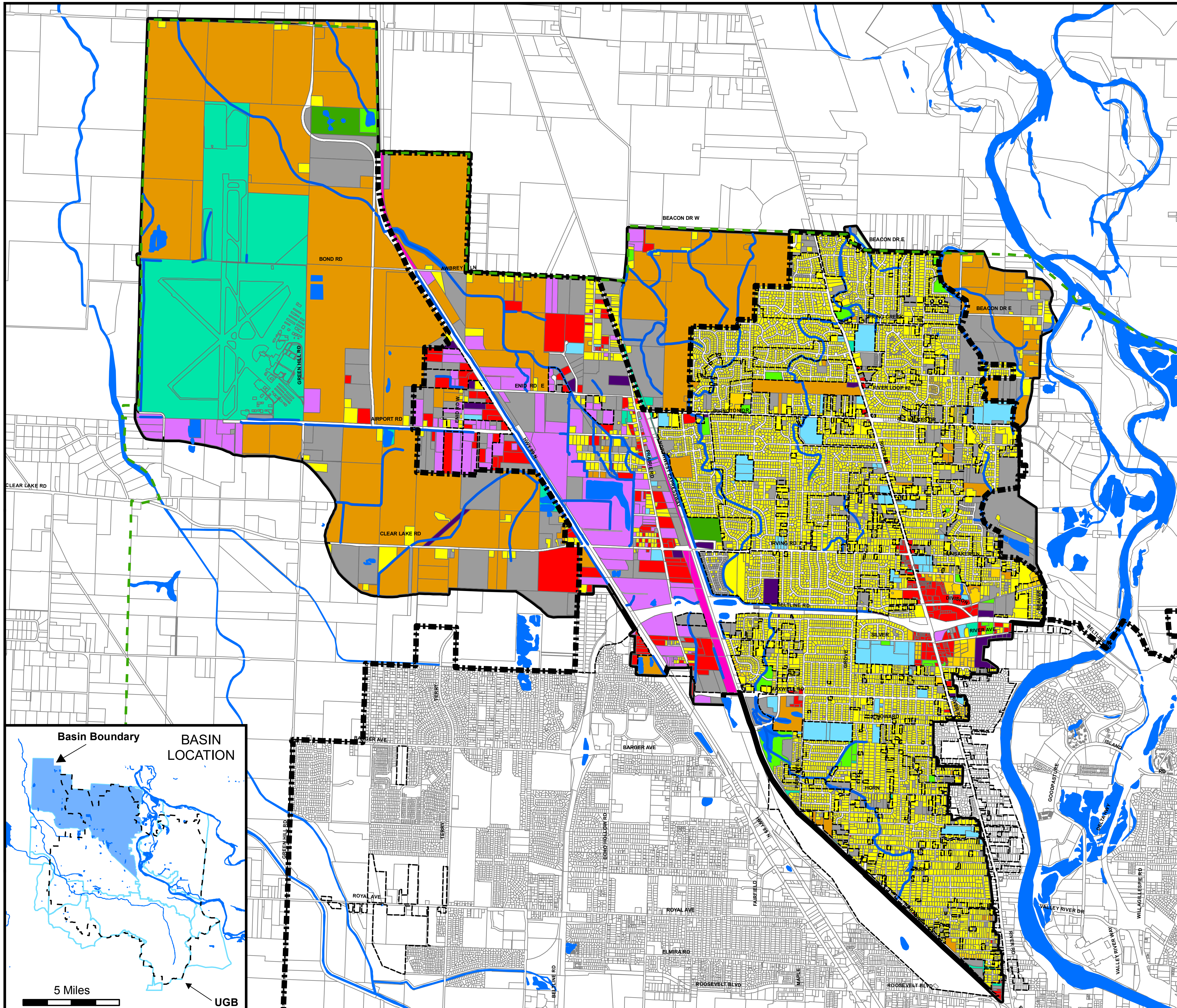
The River Road Santa Clara basin contains 69 acres of public park land spread over 13 separate park parcels (see Map 12). The two largest parks are Emerald Park (9.78 acres) and Walnut Grove (19.75).

Because of its environmental, historic and social significance, Walnut Grove Park is one of the few neighborhood parks in Eugene to be maintained as a natural environment. The plan for the park, which was developed in collaboration with area neighbors, emphasizes native plant and wildlife preservation and enhancement, passive recreation, and educational opportunities.

River Road Santa Clara basin is currently served with limited on-street bicycle lanes.

River Road - Santa Clara Basin

Existing Land Use *



LEGEND

- Low-Med. Density Residential
- Med.-High Density Residential
- Commercial (Services+Trade)
- Industrial (Except Sand & Gravel)
- Railroads
- Communication and Utilities
- Parks, Open Space, and Recreation (Except Golf)
- Golf Courses
- Schools, Churches, & Cemeteries
- Other Government
- Agriculture
- Timber
- Other Undeveloped
- Waterways and Ponds
- River Road/Santa Clara Basin Boundary
- Urban Growth Boundary
- Eugene City Limits
- Metropolitan Plan Boundary
- Streams and Channels in Basin

* Land Use Data Current to January 2007

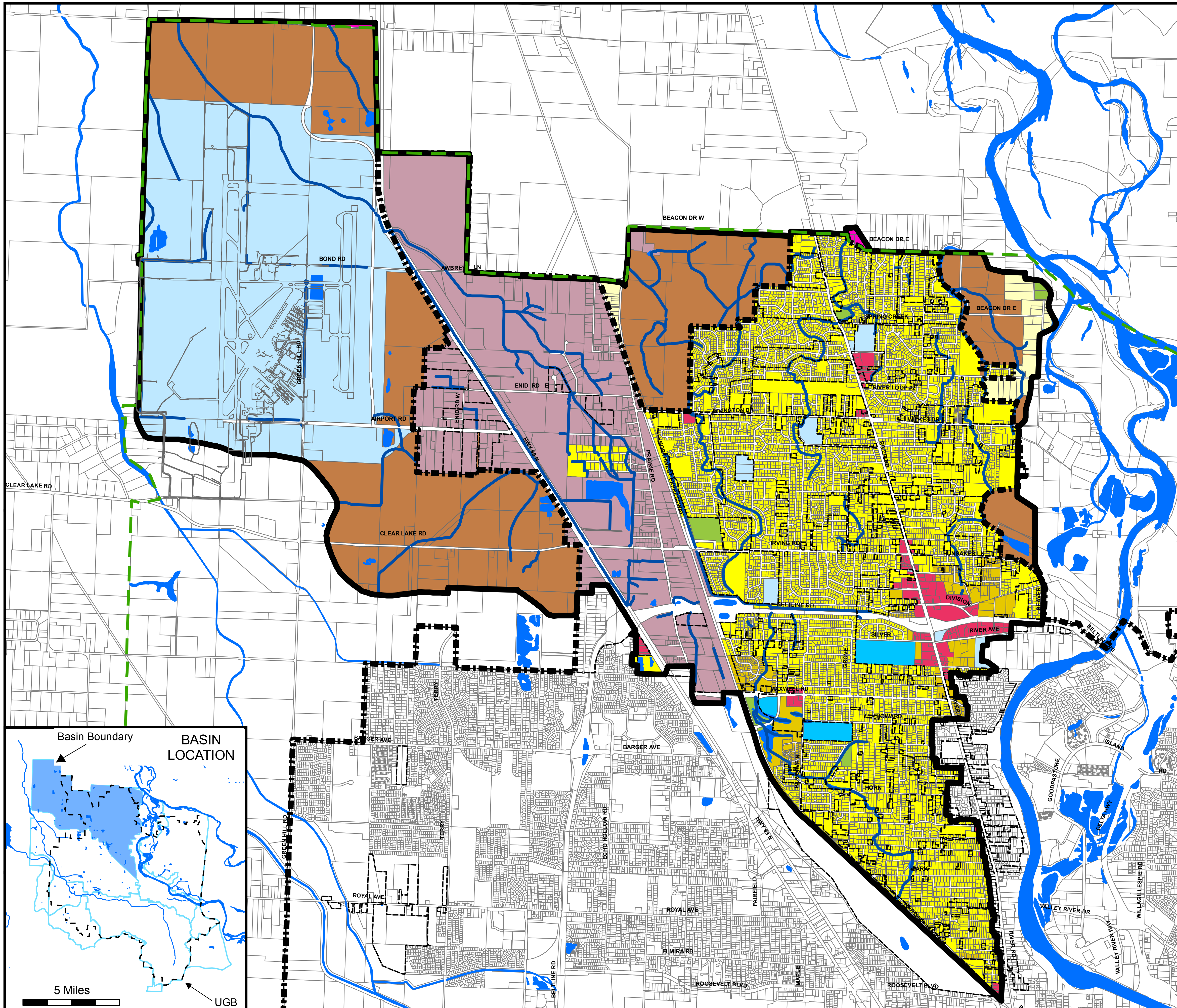
N

3,200 Feet

Map Produced by
Lane County Public Works GIS
October 2008

Map based on imprecise source data, subject to change

MAP 1



River Road - Santa Clara Basin

Projected Land Use *

LEGEND

- Rural Residential
- Low Density Residential
- Medium Density Residential and and MDR Mixed Use
- Commercial & Commercial - Residential Mixed Use
- Industrial & Commercial - Industrial Mixed Use
- Sand and Gravel
- Natural Resource, Parks, and Open Space
- Education and University Research
- Government
- Agricultural and Ag/Airport Reserve
- Waterways and Ponds
- River Road-Santa Clara Basin Boundary
- Urban Growth Boundary
- Eugene City Limits
- Streams and Channels in Basin
- Metropolitan Plan Boundary

* Projected Land Use according to Metro Area General Plan approved on April 8, 2004. Also reflects ammendments approved by individual jurisdictions.

N

3,200 Feet

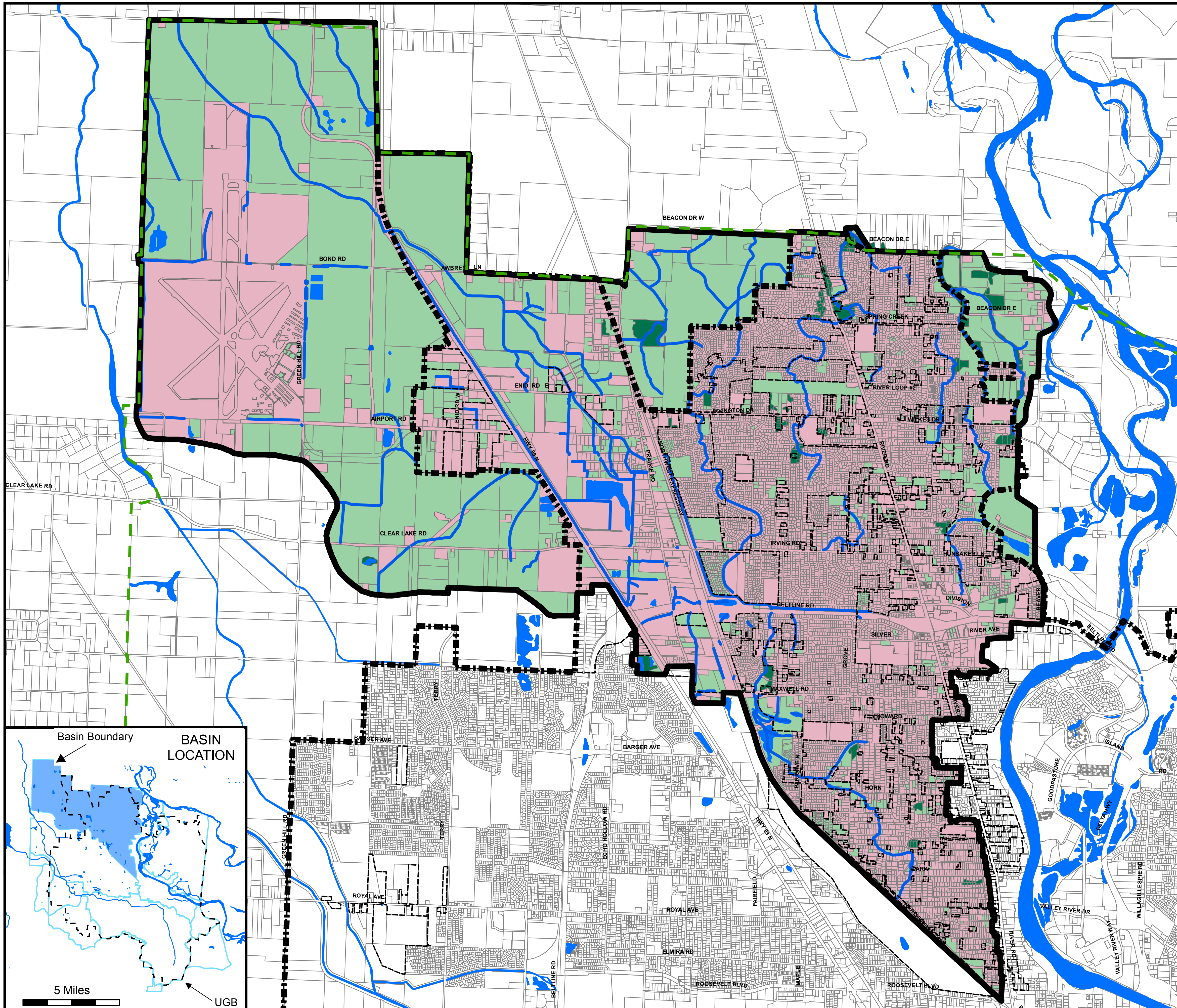
Map Produced by
Lane County Public Works GIS
December 2008

EUGENE

LANE COUNTY OREGON

Map based on imprecise source data, subject to change

MAP 2



River Road - Santa Clara Basin

Surface Cover*

LEGEND

- Pervious - Other Vegetated Areas
- Pervious - Generalized Forest Cover
- Impervious Surface Areas - includes percentage of pervious landscaped areas
- Waterways and Ponds
- River Road - Santa Clara Basin Boundary
- Urban Growth Boundary
- Eugene City Limits
- Waterways and Ponds
- Metropolitan Plan Boundary

* The Impervious Surface Areas category is derived from the 2007 Land Use layer, and includes all developed parcels and road right-of-way. The actual percentage of impervious surface present on each parcel varies by land use category (see table in text for breakdown). Generalized Forest Cover is based on 2004 color aerial photographs, and includes all forest patches over one acre in size.

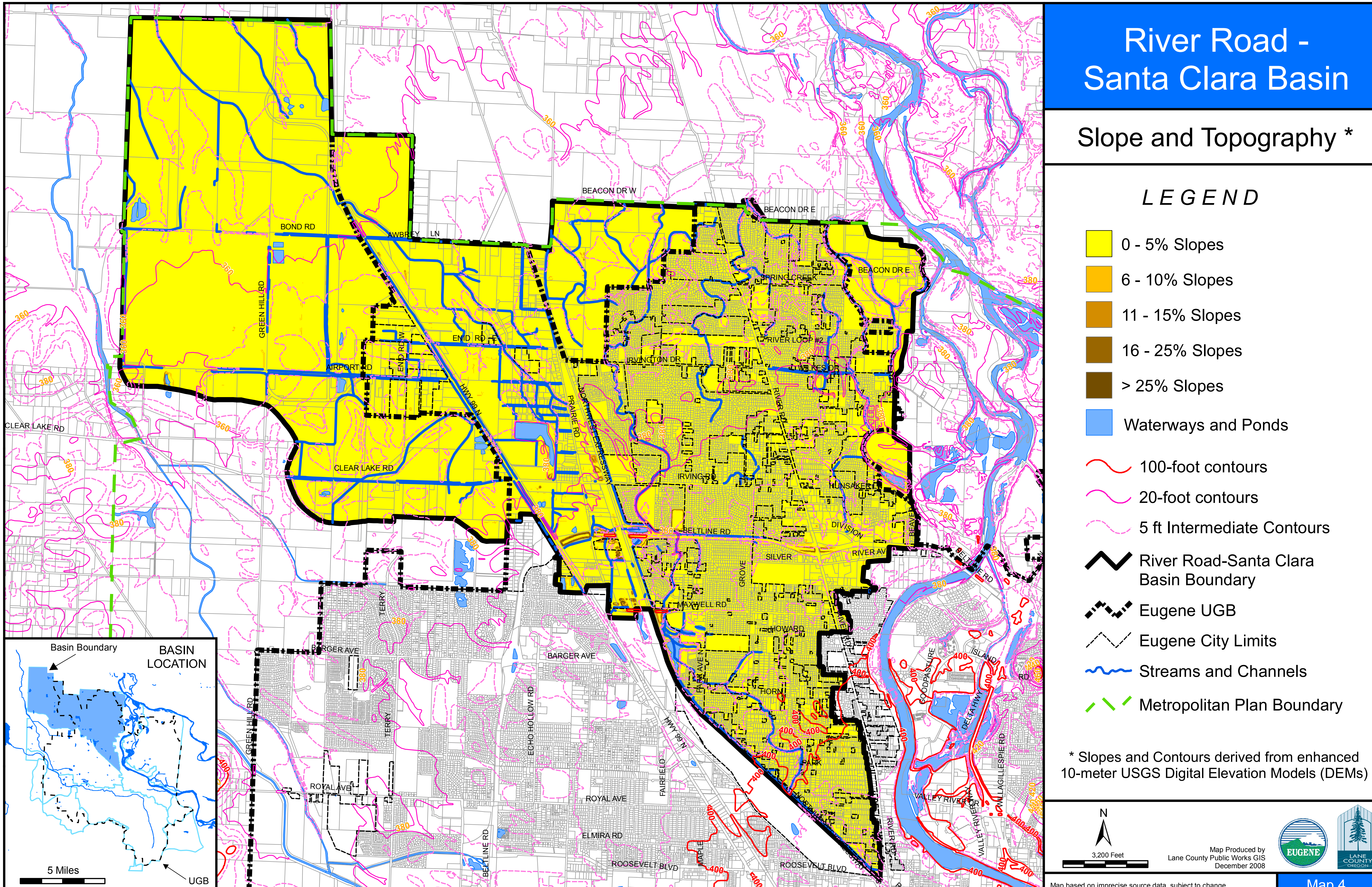
N

3,200 Feet

Map Produced by
Lane County Public Works GIS
December 2008

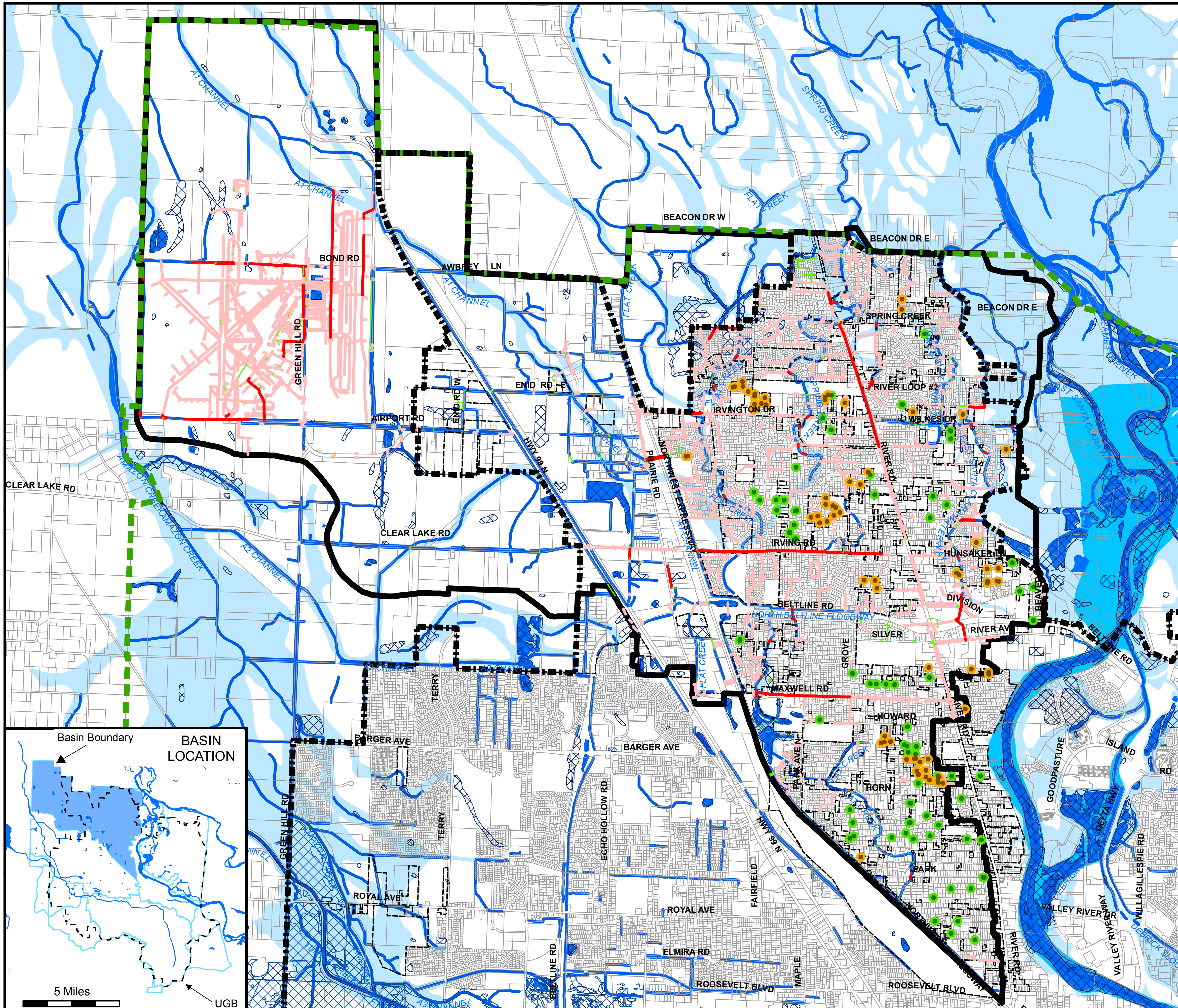
Map based on imprecise source data, subject to change

MAP 3


River Road - Santa Clara Basin
Slope and Topography *
LEGEND
0 - 5% Slopes
6 - 10% Slopes
11 - 15% Slopes
16 - 25% Slopes
> 25% Slopes
Waterways and Ponds
100-foot contours
20-foot contours
5 ft Intermediate Contours
River Road-Santa Clara Basin Boundary
Eugene UGB
Eugene City Limits
Streams and Channels
Metropolitan Plan Boundary
* Slopes and Contours derived from enhanced 10-meter USGS Digital Elevation Models (DEMs)
N
3,200 Feet
Map Produced by Lane County Public Works GIS December 2008
EUGENE
LANE COUNTY OREGON
Map based on imprecise source data, subject to change
Map 4
Basin Boundary
BASIN LOCATION
5 Miles
UGB
BEACON DR W
BEACON DR E
BOND RD
AWBREY LN
GREEN HILL RD
ENID RD
AIRPORT RD
HWY 99 N
PRAIRIE RD
IRVINGTON DR
RIVER LOOP #2
WILKES DR
SPRING CREEK
CLEAR LAKE RD
IRVING RD
HUNSAKER
DIVISION
BELTLINE RD
SILVER
RIVER AV
GROVE
MAXWELL RD
HOWARD
BARGER AVE
HORN
PARK
GOODPASTURE
ISLAND
DELTA HWY
VALLEY RIVER DR
GILLESPIE RD
TERRY
ECHO HOLLOW RD
ROYAL AVE
FAIRFIELD
ELMIRA RD
ROOSEVELT BLVD
BELTLINE RD
MAPLE
360
380
400

River Road - Santa Clara Basin

Surface Water and Drainage System Features



LEGEND

- 100-yr Floodplain (Hazard Zone A)*
- Floodway (from FEMA maps)
- Waterways and Ponds*
- Wetlands (from West Eugene Wetlands Plan & National Wetland Inventory)
- Storm Pipes 36" + in Basin
- Storm Pipes <36" in Basin
- Size Unknown
- City of Eugene Drywells
- Lane County Drywells
- River Road/Santa Clara Basin Boundary
- Urban Growth Boundary
- Eugene City Limits
- Metropolitan Plan Boundary
- Streams and Channels in Basin

** from City of Eugene Data*

N

3,200 Feet

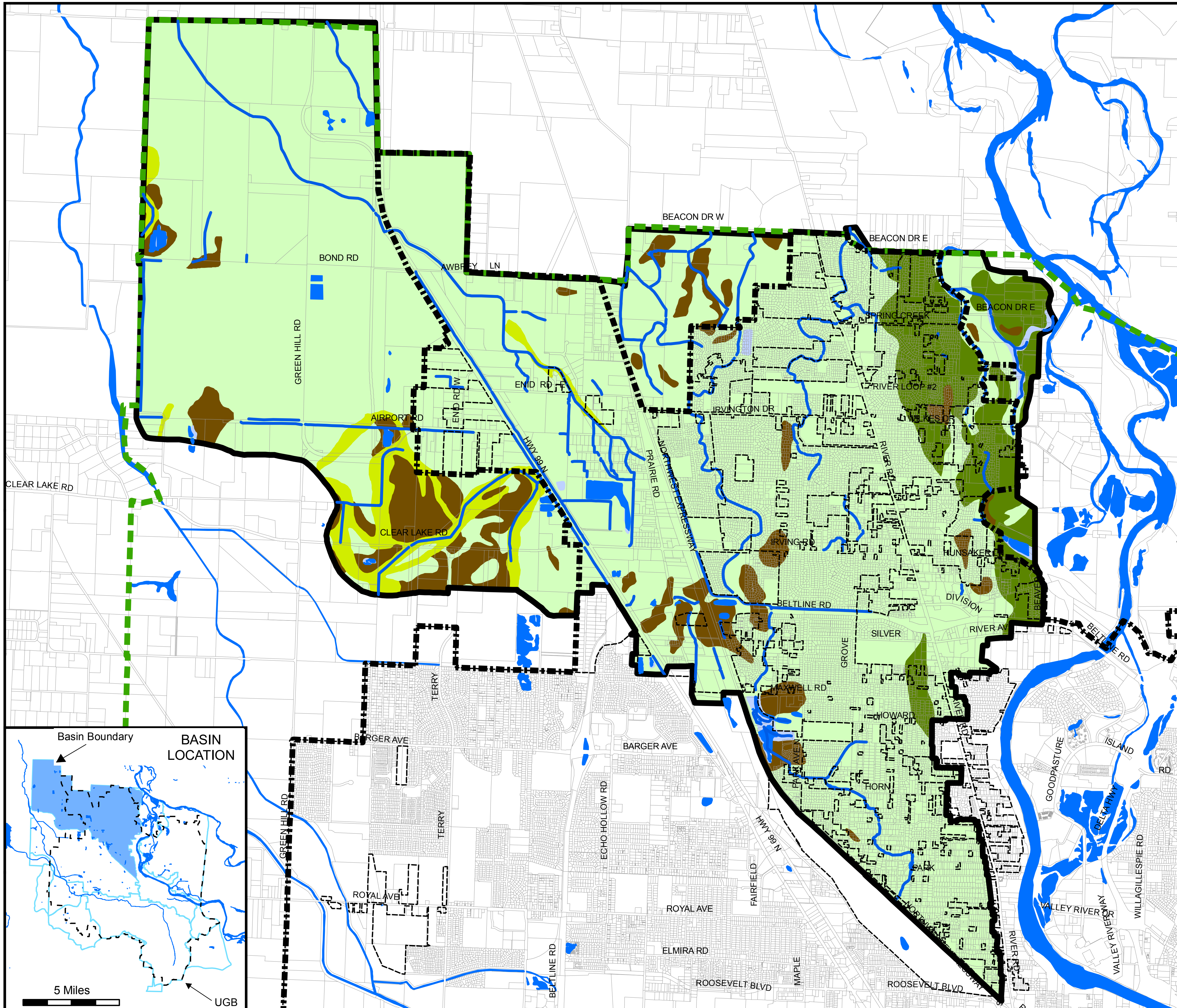
Map Produced by Lane County Public Works GIS December 2008

EUGENE

LANE COUNTY OREGON

Map based on imprecise source data, subject to change

MAP 5



River Road - Santa Clara Basin

Saturated Hydraulic Conductivity (Permeability)*

LEGEND

Saturated Hydraulic Conductivity (Ksat), Standard Classes

- Very Low
- Low
- Moderately Low
- Moderately High
- High
- Very High
- Pits & Water Bodies from Soil Layer (no data)
- Waterways and Ponds
- River Road-Santa Clara Basin Boundary
- Eugene UGB
- Eugene City Limits
- Streams and Channels
- Metropolitan Plan Boundary

* This Information was produced using the NRCS Soil Data Viewer Extension. NRCS defines Ksat as:

"Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture."

N

3,200 Feet

Map Produced by
Lane County Public Works GIS
January 2009

EUGENE

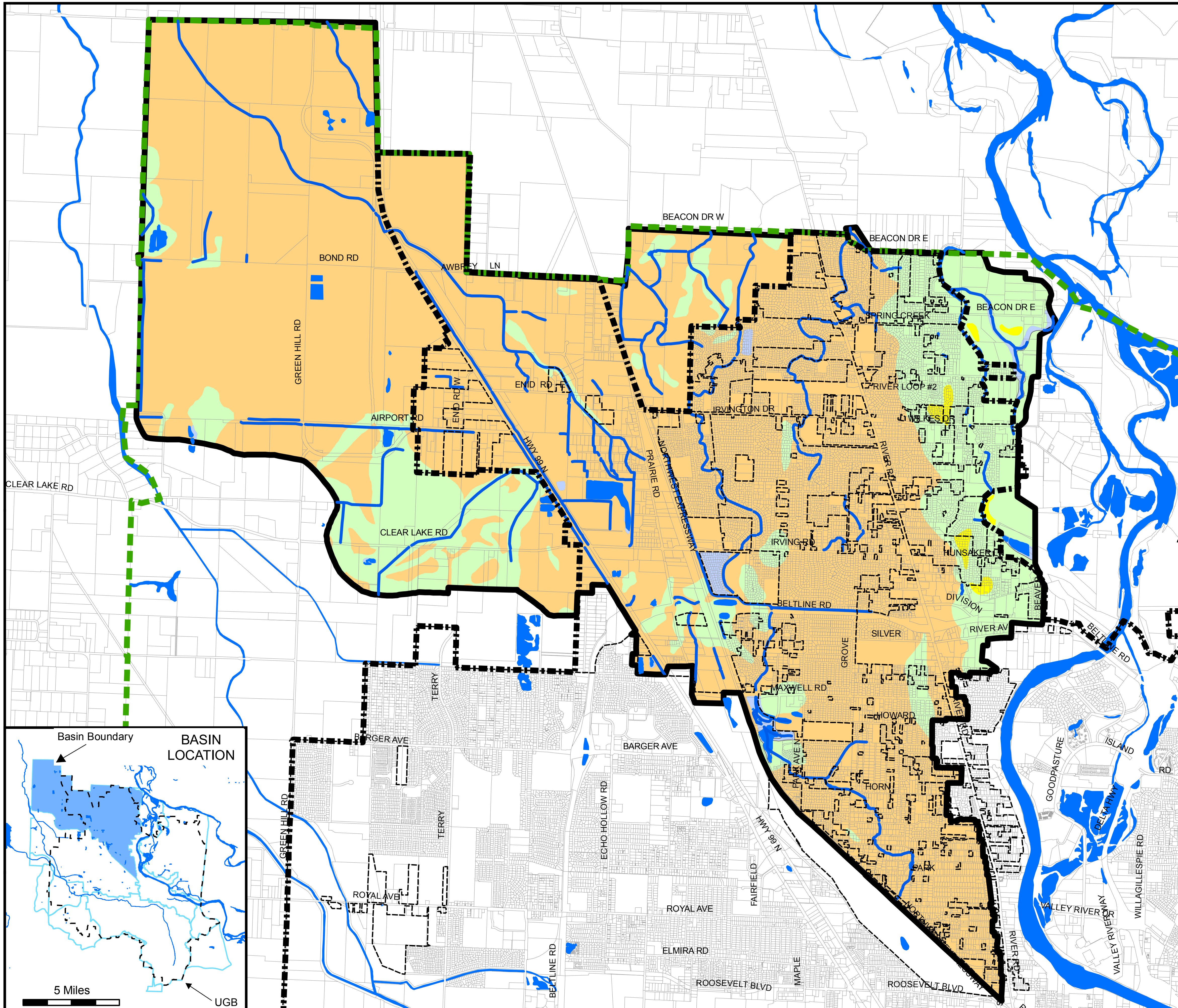
LANE COUNTY OREGON

Map based on imprecise source data, subject to change

Map 6

River Road - Santa Clara Basin

Soil Runoff Potential *



L E G E N D

- Negligible
- Low
- Medium
- Pits & Water Bodies from Soil Layer (no data)
- Waterways and Ponds
- River Road-Santa Clara Basin Boundary
- Eugene UGB
- Eugene City Limits
- Streams and Channels
- Metropolitan Plan Boundary

*Runoff categories furnished by NRCS. The runoff class is determined from the hydrologic group assigned to the soil map units in a field, and the average slope gradient. Hydrologic groups are groups of soils having similar runoff potential under similar storm and cover conditions. Soil properties that influence runoff potential are those that influence the minimum rate of infiltration for a bare soil after prolonged wetting and when not frozen. These properties are depth to a seasonally high water table, intake rate and permeability after prolonged wetting, and depth to a very slowly permeable layer.

N

3,200 Feet

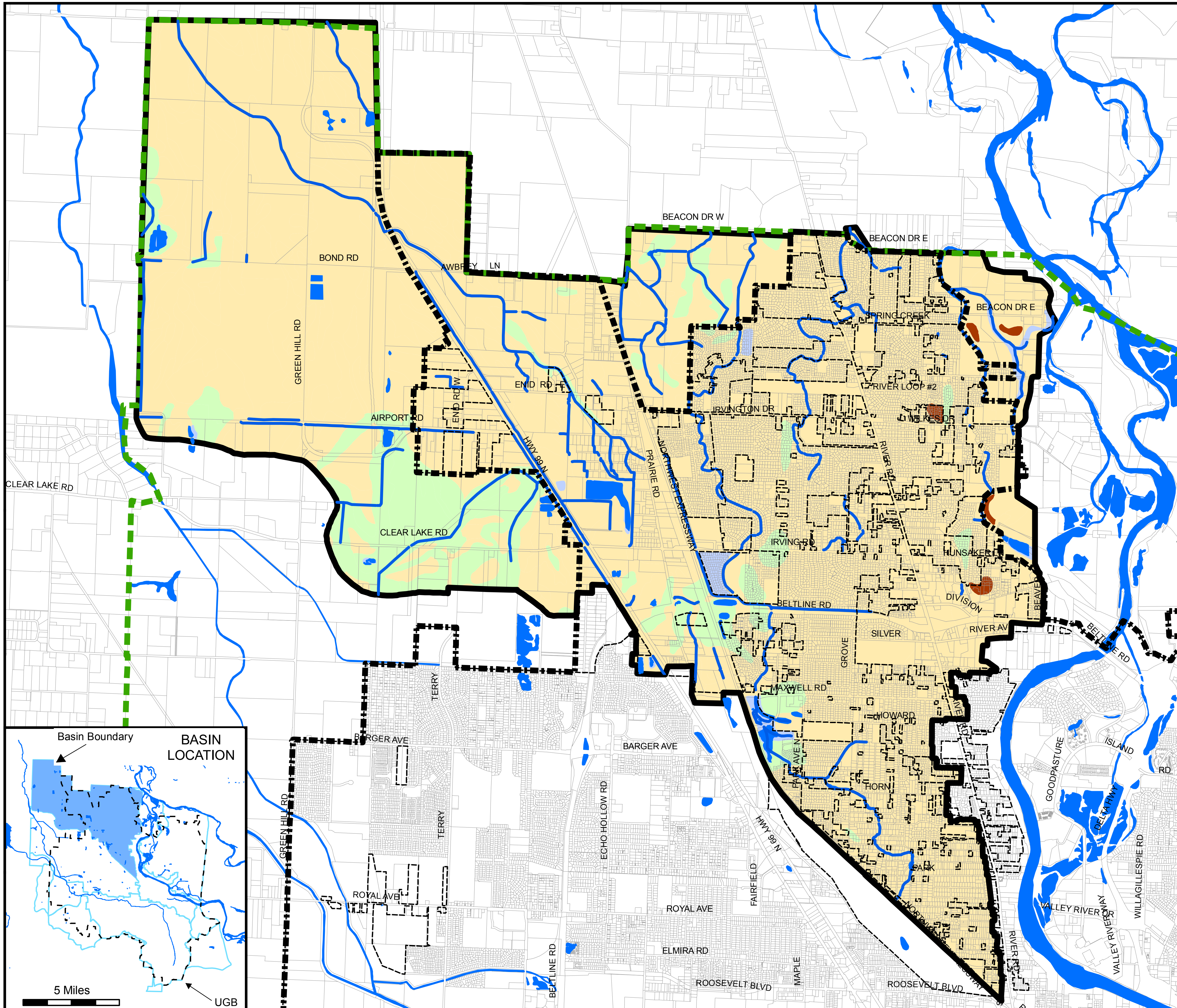
Map Produced by
Lane County Public Works GIS
January 2009

Map based on imprecise source data, subject to change

Map 7

River Road - Santa Clara Basin

Erodible Soils *



LEGEND

Soil loss in tons per acre per year

- Low - .02 to .10
- Moderately Low - .15 to .24
- Moderately High - .28 to .43
- High - .49 to .64
- Pits & Water Bodies from Soil Layer (no data)
- Waterways and Ponds
- River Road-Santa Clara Basin Boundary
- Eugene UGB
- Eugene City Limits
- Streams and Channels
- Metropolitan Plan Boundary

* This information was produced using the NRCS Soil Data Viewer Extension. NRCS defines whole soil erosion factors as:

"The average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69."

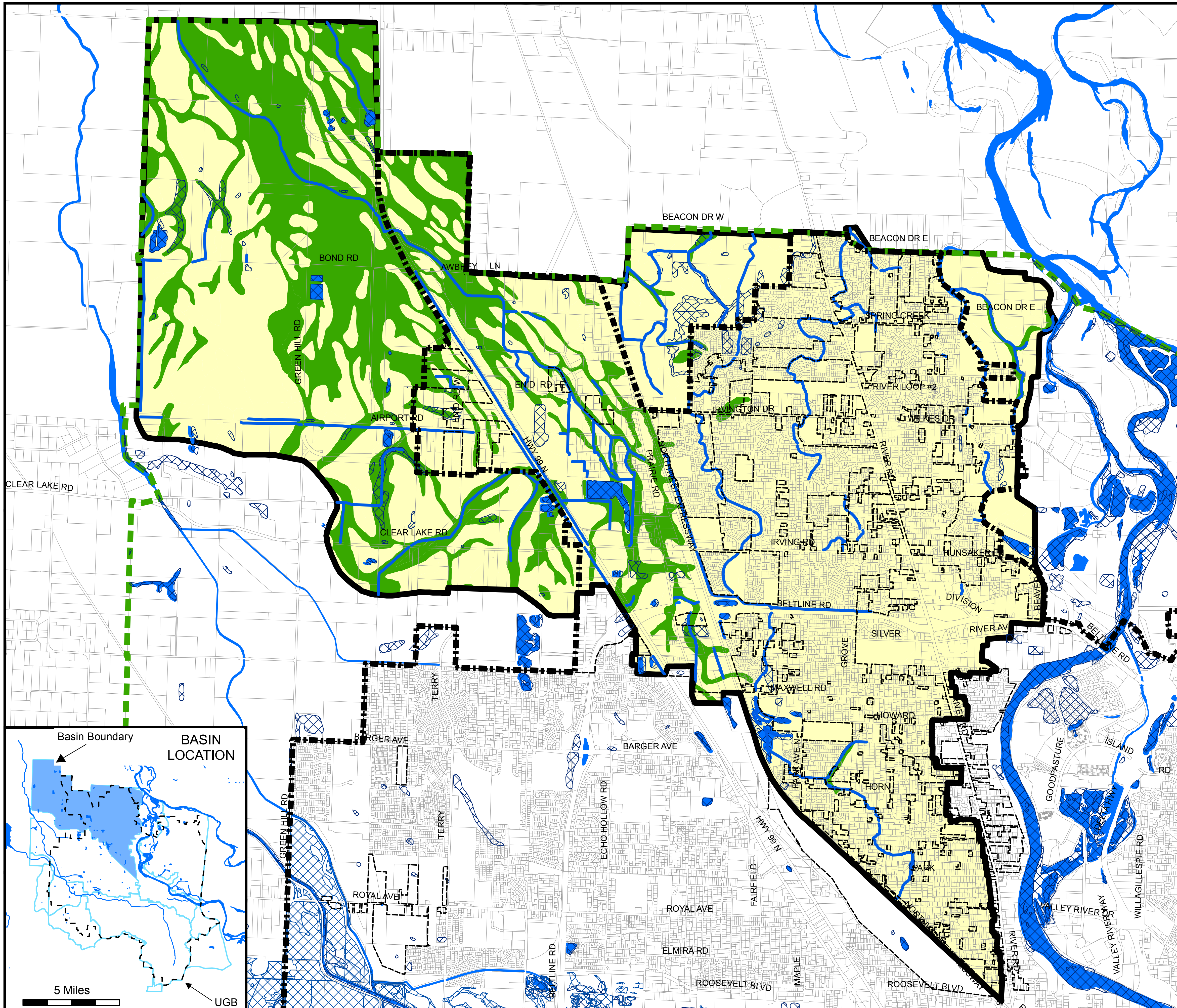
N

3,200 Feet

Map Produced by Lane County Public Works GIS January 2009

Map based on imprecise source data, subject to change

Map 8



River Road - Santa Clara Basin

Hydric Soils *

LEGEND

- Hydric Soils
- All Other Soils
- Wetlands (from West Eugene Wetlands Plan & National Wetland Inventory)
- Waterways and Ponds
- River Road-Santa Clara Basin Boundary
- Eugene UGB
- Eugene City Limits
- Streams and Channels
- Metropolitan Plan Boundary

* This information was produced using the NRCS Soil Data Viewer Extension. NRCS defines Hydric Soils as:

"Hydric soils are defined by the National Technical Committee for Hydric Soils (NTCHS) as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (Federal Register, 1994). Under natural conditions, these soils are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic vegetation."

Map Produced by
Lane County Public Works GIS
January 2009

EUGENE

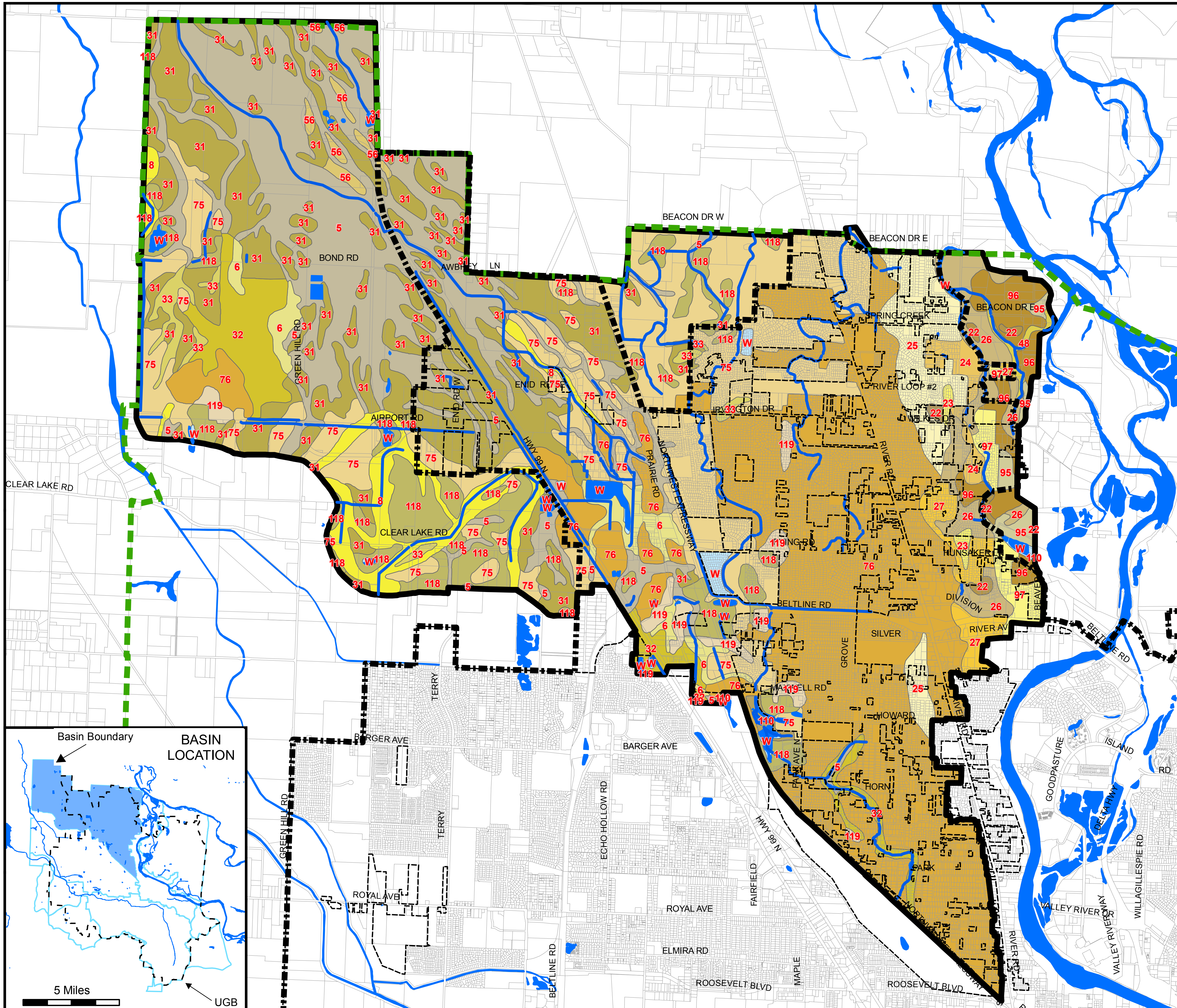
LANE COUNTY OREGON

Map based on imprecise source data, subject to change

Map 9

River Road - Santa Clara Basin

Soil Types *



LEGEND

- W, Water
- 5, Awbrig silty clay loam
- 6, Awbrig-Urban land complex
- 8, Bashaw clay
- 22, Camas gravelly sandy loam, occasionally flooded
- 23, Camas-Urban land complex
- 24, Chapman loam
- 25, Chapman-Urban land complex
- 26, Chehalis silty clay loam, occasionally flooded
- 27, Chehalis-Urban land complex
- 31, Coburg silty clay loam
- 32, Coburg-Urban land complex
- 33, Conser silty clay loam
- 48, Fluvents, nearly level
- 56, Holcomb silty clay loam
- 75, Malabon silty clay loam
- 76, Malabon-Urban land complex
- 95, Newberg fine sandy loam
- 96, Newberg loam
- 97, Newberg-Urban land complex
- 110, Pits
- 118, Salem gravelly silt loam
- 119, Salem-Urban land complex
- Soils subject to slumping (none indicated in this basin)
- Waterways and Ponds
- River Road-Santa Clara Basin Boundary
- Eugene UGB
- Eugene City Limits
- Streams and Channels
- Metropolitan Plan Boundary

* From USDA NRCS data

N

3,200 Feet

Map Produced by
Lane County Public Works GIS
January 2009

EUGENE

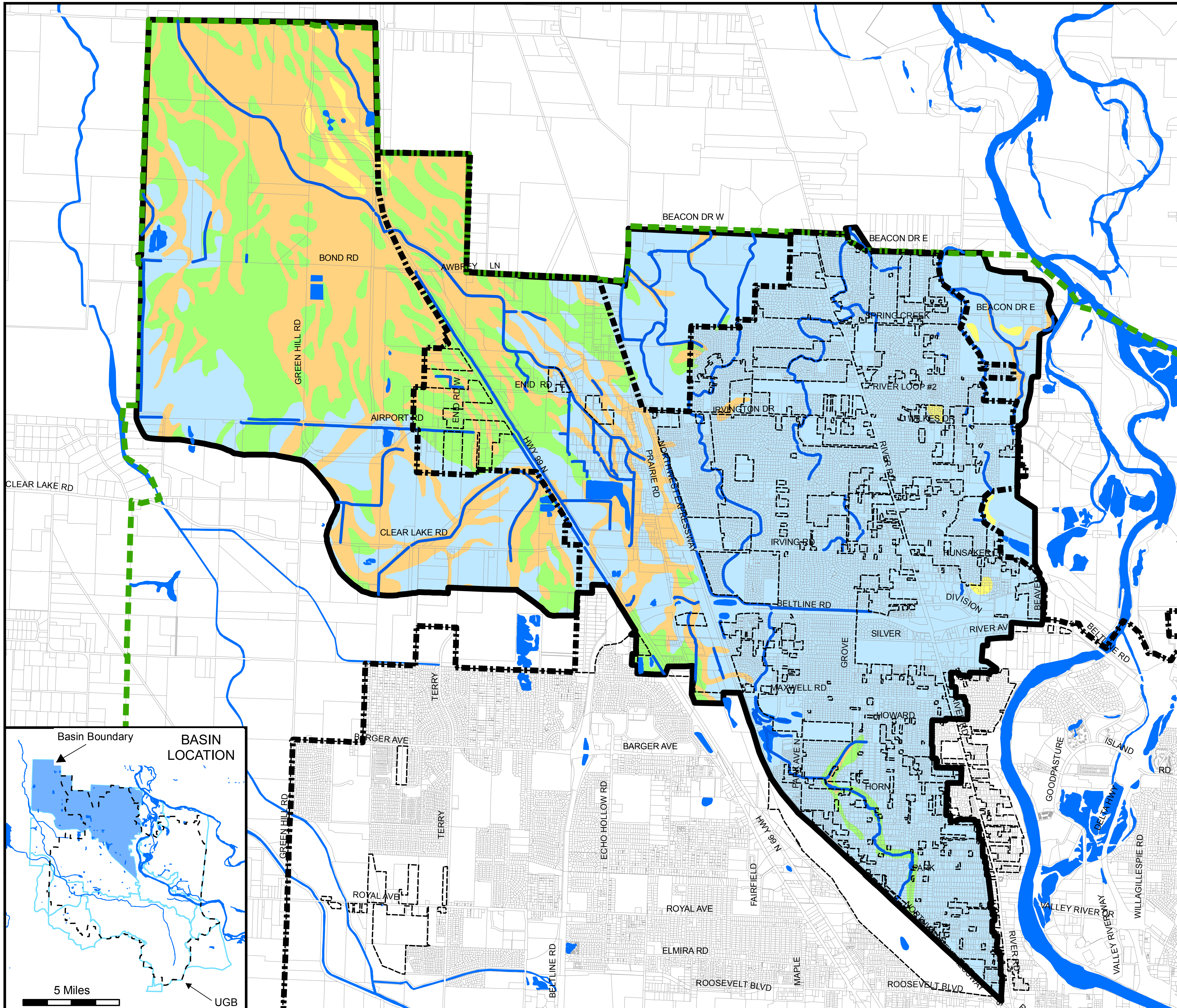
LANE COUNTY OREGON

Map based on imprecise source data, subject to change

Map 10

River Road - Santa Clara Basin

High Water Table *



LEGEND

- Shallow Water Table .82 ft (25 cm) or less
- Moderately shallow Water Table .82 to 1.64 ft (25 - 50 cm)
- Moderately Deep Water Table 1.64 to 6.56 ft (50 - 200 cm)
- Deep Water Table 6.56 ft (200 cm) or greater
- Waterways and Ponds
- River Road-Santa Clara Basin Boundary
- Eugene UGB
- Eugene City Limits
- Streams and Channels
- Metropolitan Plan Boundary

* This information was produced using the NRCS Soil Data Viewer Extension. NRCS defines "Depth to Water Table" as:

"Water table" refers to a saturated zone in the soil. It occurs during specified months. Estimates of the upper limit are based mainly on observations of the water table at selected sites and on evidence of a saturated zone, namely grayish colors (redoximorphic features) in the soil. A saturated zone that lasts for less than a month is not considered a water table.

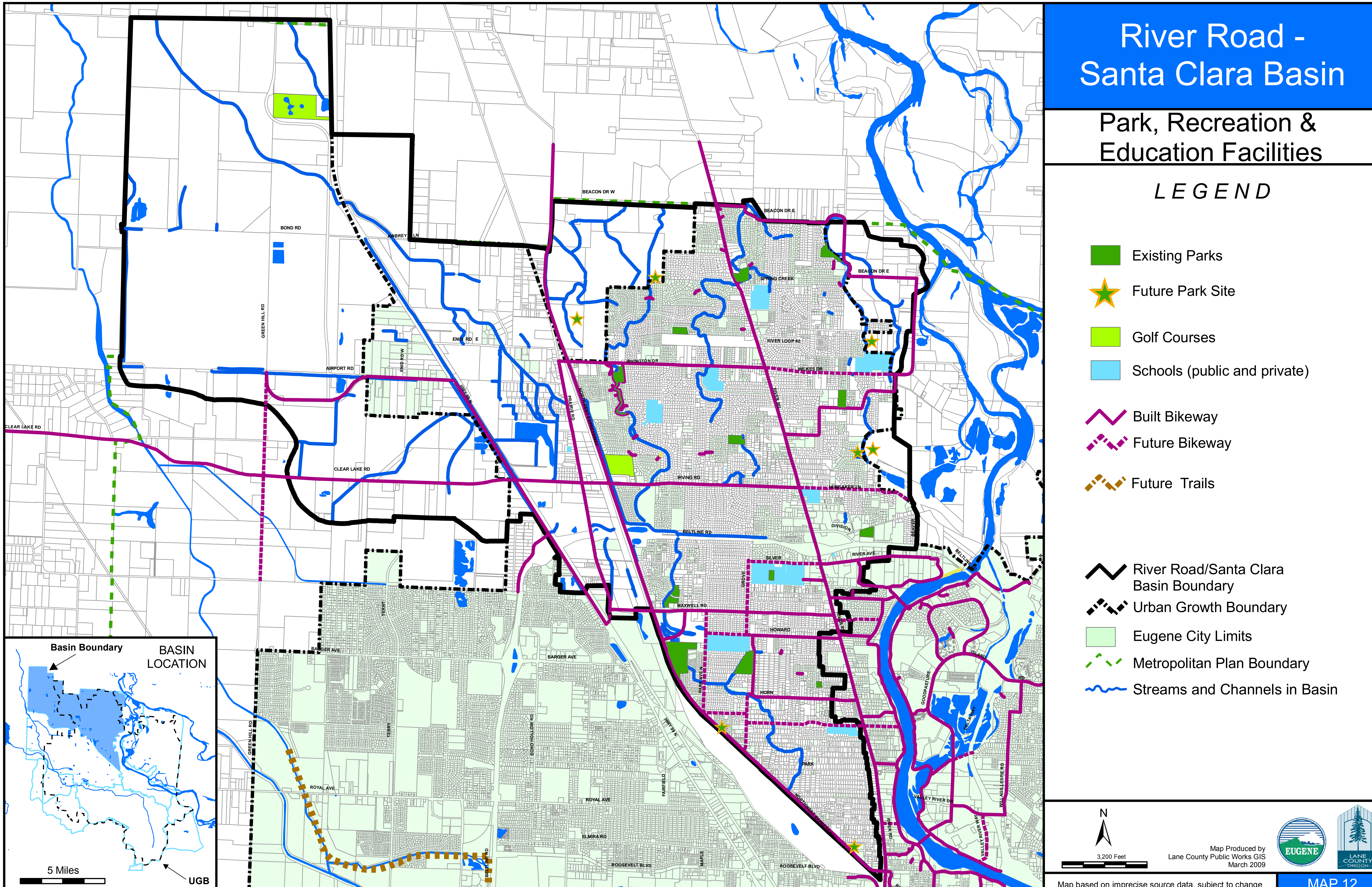
N

3,200 Feet

Map Produced by
Lane County Public Works GIS
March 2009

EUGENE

LANE COUNTY OREGON


River Road - Santa Clara Basin
Park, Recreation & Education Facilities
LEGEND
Existing Parks
Future Park Site
Golf Courses
Schools (public and private)
Built Bikeway
Future Bikeway
Future Trails
River Road/Santa Clara Basin Boundary
Urban Growth Boundary
Eugene City Limits
Metropolitan Plan Boundary
Streams and Channels in Basin
Basin Boundary
BASIN LOCATION
5 Miles
UGB
BEACON DR W
BEACON DR E
BOND RD
CLEAR LAKE RD
AIRPORT RD
IRVING RD
BELTLINE RD
MAXWELL RD
BARGER AVE
ROYAL AVE
ELMIRA RD
ROOSEVELT BLVD
RIVER RD
N
3,200 Feet
Map Produced by
Lane County Public Works GIS
March 2009
EUGENE
LANE COUNTY OREGON
Map based on imprecise source data, subject to change
MAP 12

In order to identify flood related problems and opportunities, a flood control evaluation was completed for the drainage system in the River Road Santa Clara basin that is described in Section 2.5 and illustrated on Map 5. A computer model was used to predict capacity deficiencies in the existing storm drainage system. Section 3.1 provides a brief description of the computer model and a summary of the hydrologic and hydraulic model input data. Section 3.2 describes the model validation process, and Section 3.3 provides a description of model results. Section 3.4 provides a general description of the identified flood-related problems. Section 3.5 describes the project alternatives and development standard alternatives that were selected to address the identified flooding problems.

3.1 Hydrologic/Hydraulic Model Development

To develop a flood control strategy for the River Road Santa Clara basin, a computer model was used to evaluate hydrologic/hydraulic conditions of the public storm drainage system. The storm system was evaluated under both existing and buildout land use conditions. The City of Eugene selected the XP-SWMM model software to conduct these analyses. In general, the evaluation concentrated on the conveyance capacity of the significant components of the public drainage system; typically, all storm sewer pipes with a diameter equal to or greater than 36” and the associated open waterways on the Willamette Overflow (also referred to as the East Santa Clara Waterway), Spring Creek, Flat Creek, and the A-1 Channel.

The River Road Santa Clara basin drainage system, including pipes, open channels and drywells, is shown on Figures 3-2 through 3-8. Figure 3-1 provides an index map that illustrates the relative locations of Figures 3-2 through 3-8 in the basin. Modeled drainage segments and locations of the proposed capital projects are also illustrated on Figures 3-2 through 3-8.

The City-wide storm drainage basin planning summary in Volume I contains detailed information regarding the process and sources of information that were used for identifying flooding problems and opportunities. Section 3 of Volume I specifically includes detailed information regarding the following:

- Model selection process.
- Sources of model input data.
- Design storm selection process.
- Model calibration (note: while Volume I contains calibration information that was applied City-wide during the development of the 2002 basin plans, a separate model validation was conducted that is specific to the River Road Santa Clara basin and is described in Section 3.2 of this plan).

This section of the River Road Santa Clara report provides a summary of the basin specific hydrologic and hydraulic data used in the models.

3.1.1 River Road Santa Clara Basin Hydrologic Data

The original River Road Santa Clara Study was an initial study towards development of a stormwater basin master plan and was created in 2002. The Study identified a number of hydrologic data gaps, specifically related to the subbasin delineations and locations of runoff nodes in the model (a runoff node is a point where runoff from a subbasin area enters the modeled system). Since the original Study was prepared, data gaps have been addressed by the City of Eugene and Lane County. Specifically, survey data collected by Lane County between October and December 2005 allowed for refinement of the original subbasin delineations and node locations in the model (described in more detail in Subsection 3.1.2 and in Appendix G). These refinements have been applied to the original model, and the following discussion summarizes the overall hydrologic input data in the refined model.

Hydrologic Data Based on the Piped and Surface Water Drainage System

The River Road Santa Clara basin was subdivided into five major subbasins. The major subbasin boundaries are presented in Figure 3-1. The five major subbasins were further divided into 75 subbasins for modeling purposes. The subbasin boundaries presented on Figures 3-2 through 3-8 were delineated based on both topography and the piped and open channel drainage system layout. The subbasin boundaries were digitized into the City's/County's GIS so that hydrologic data could be compiled for each subbasin.

Seven-character names were assigned to each subbasin. The first two characters represent a two-letter abbreviation for the major basin; in this case RS for River Road Santa Clara. The second two characters represent a two-letter abbreviation for the major subbasin. The 5 major subbasins in the River Road Santa Clara basin are as follows:

A1 = A-1 Channel Drainage System
FC = Flat Creek Drainage System
SC = Spring Creek Drainage System
WO = Willamette Overflow Drainage System (also referred to as the East Santa Clara Waterway)
99 = Highway 99

The last three characters of the subbasin name consist of numbers, starting with 010 and increasing in increments of 10 for each additional subbasin. For example, the first two subbasins in the Willamette Overflow major subbasin of the River Road Santa Clara basin are RSWO010 and RSWO020. In addition, each subbasin has an associated inlet node number. The hydrologic component (i.e., RUNOFF block) of XP-SWMM was used to generate a stormwater runoff hydrograph for each subbasin. This hydrograph was routed by the hydraulic component (i.e., the EXTRAN block) of XP-SWMM to model the storm drainage system. The subbasin inlet node is the point where the subbasin hydrograph enters the storm drainage system for routing.

The following parameters were required for each subbasin in the hydrology component of XP-SWMM:

1. Subbasin name or number.
2. Channel or pipe inlet node number into the storm drainage system.
3. Subbasin area (acres).
4. Hydraulically connected impervious percentage for both existing and future land use scenarios (percent).

5. Average ground slope (dimensionless, ft/ft).
6. Subbasin width (feet).
7. Manning's roughness coefficient for impervious areas.
8. Manning's roughness coefficient for pervious areas.
9. Depression storage for impervious areas (inches of water over subbasin).
10. Depression storage for pervious areas (inches of water over subbasin).
11. Green-Ampt soil infiltration parameters: average capillary suction (inches), saturated hydraulic conductivity (inches/hour), and initial moisture deficit (volume air/volume voids).

Table 3-1 (provided at the back of this section) includes the major hydrologic information for each of the River Road Santa Clara subbasins. Specifically, the tables provide the information for parameters 1 - 5 listed above and the expected increase in impervious surface under future conditions. More detailed hydrologic information, including information described for parameters 1 – 11, can be found in Appendix B.

The following subbasins were not included in the model for the reasons noted:

- The A-1 Channel subbasins A1-000 and A1-005 were excluded from the model since they are located outside the City limits and the Urban Growth Boundary.
- The Highway 99 major subbasin (including subbasins 99-010 and 99-020) were excluded since they drain to a roadside ditch along Highway 99N that is owned and maintained by the Oregon Department of Transportation.
- Flat Creek subbasin FC-000 was excluded from the model since it is located outside the City limits and the Urban Growth Boundary.
- Willamette Overflow subbasin WO-000 was excluded from the model since it is located outside the City limits and the Urban Growth Boundary.

Hydrologic Data Associated with Drywell Drainage Areas

After completing the subbasin delineations described above, a second step was conducted to delineate the portion of each subbasin where runoff is draining to drywells as opposed to the piped or surface conveyance system. Section 2.5.4 provides a description of the drywells in the River Road Santa Clara basin including 79 County wells, 72 City wells, and approximately 634 private drywells. At the time that this exercise was conducted, the GIS system for drywells was still under development and somewhat incomplete. Therefore, the delineation of drywell drainage areas included a subset (or approximately 759) of the total 785 drywells. For each subbasin that included some portion of area draining to drywells, the subbasin was subdivided into these two areas, and the hydrologic information described above (e.g., inlet node number, subbasin area, impervious percentage, etc.) was generated for both the subset of the subbasin draining to the drywells and the subset of the subbasin draining to the piped or surface conveyance system. The purpose of delineating these drywell areas individually was to simulate the effect of drywells in the hydrology portion of the XP-SWMM model and on the runoff calculations.

In order to develop a model that would simulate the infiltration characteristics associated with drywells, the drywells were modeled as storage nodes that would store runoff generated up to the 5-year, 25-hour (3.6 inches) storm event. This was based upon the City's design criteria for public drywells which includes that they serve an area no greater than 40 acres and infiltrate all of the runoff up to a 5-year, 24-hour event. In the model, when the capacity of the storage node was reached, the areas draining to drywells would begin to contribute additional runoff to the piped and surface water drainage system. The drywell storage nodes were sized using an iterative trial and error process until the 5-year, 24-hour event filled the storage volume but did not contribute runoff flows to the piped and surface stormwater drainage system.

As a result, two hydrologic modeling scenarios were developed for the River Road Santa Clara Basin:

1) One model scenario was developed that did not account for the infiltration associated with existing drywells.

2) The second model scenario was developed to account for the infiltration associated with existing drywells.

The purpose of developing both model scenarios was to evaluate the impacts that the drywells were having on the capacity of the piped and surface drainage system during the various design events. Decommissioning of the public drywells in this basin is ultimately required (see Section 4.0 for a summary of relevant requirements). Therefore, comparing the results from the two model scenarios provided useful information in order to better understand how decommissioning will impact the system and planned capital projects in terms of capacity and sizing.

3.1.2 River Road Santa Clara Basin Hydraulic Data

The primary purpose of the modeling was to evaluate the capacity of the existing storm drainage system. The evaluation of the storm drainage system included a hydraulic analysis of the major storm pipes, culverts, and open channels, which convey stormwater discharges. The original River Road Santa Clara Basin Plan, created in 2002, identified a number of hydraulic data gaps due to the multi-jurisdictional ownership of the drainage system and the lack of a comprehensive data set for the overall drainage system, a result of the multi-jurisdictional ownership. Data gaps have since been addressed by the City of Eugene and Lane County. Specifically, survey data collected by Lane County between October and December 2005 allowed for refinement of the piped and open channel segments of the drainage system (described further in this section and in Appendix G). These refinements have been applied to the original model, and the following parameters (i.e., model input data) were compiled for each pipe, culvert or open channel section:

1. Conduit name.
2. Upstream node number.
3. Downstream node number.
4. Conduit size (diameter for pipes and culverts; cross-section dimensions for open channels).
5. Conduit length.
6. Conduit material for pipes and culverts.
7. Upstream and downstream invert elevations.
8. Upstream and downstream ground surface elevations.

9. Channel roughness coefficients (for open channels).

For the River Road Santa Clara basin, the model was used to evaluate the capacity of approximately 160 open waterway and pipe segments under existing and future land use conditions. Table 3-2 (provided at the back of this section) provides the major hydraulic information for each of the modeled conduits in the 4 major subbasins evaluated within the River Road Santa Clara basin. Specifically, the table provides the information for parameters 1 – 6 listed above, in addition to the drainage area for each conduit, the relevant design storm, and the model results for the relevant design storm. Model results are presented in terms of peak flows and maximum water surface elevations. The results for all storm events that were run through the models (i.e., 10-year, 25-year, 50-year, and 100-year storms) can be found in Appendix B.

As discussed previously, due to the multi-jurisdictional ownership of the drainage system, the City did not have a comprehensive data set on the drainage system in this basin at the time the original River Road Santa Clara Basin Plan was completed. Since the original Plan was completed in 2002, the City and County partnered to develop this revised Plan, and the following areas were surveyed and updated in the original model, resulting in a more refined hydrologic and hydraulic data set and a more refined modeled system. A more detailed summary of major changes made to the model is provided in Appendix G. The refined model results were used for design of the capital projects described in Section 3.5.

- Willamette Overflow major subbasin:
  - A large elevation difference was noted between the inlet and outlet pipes to the manhole at node 58287, located east of River Road and north of Division on Figure 3-7. Hydraulic conditions at this location were field verified and surveyed.
  - The pipe system that conveys stormwater from Beltline Road to the Willamette Overflow drainage system, as shown on Figure 3-7, appeared to include pipes with a diameter equal to or greater than 36 inches, which would ordinarily be included in the model, but insufficient data were initially available for these pipes. Hydraulic conditions at this location were field verified and surveyed.
  - Field crews noted that fill had been placed in the open waterway between Division and Hunsaker, which blocks the waterway except under high flow conditions. This fill was not reflected in the original survey data so a revised survey of this open channel segment was conducted.

- Flat Creek major subbasin:
  - The hydrologic connection of subbasin FC-070 and Flat Creek was field verified.

- A-1 Channel major subbasin:
  - Hydraulic conditions in the pipe system along Irving Road that conveys stormwater to the A-1 Channel, shown on Figure 3-7, were unclear, and therefore the system was field verified and surveyed.
  - Drainage patterns in the A-1 Channel major subbasin, south of Beltline Road on Figures 3-7 and 3-8 were unclear. A number of drywells may result in less area that is directly connected with the A-1 channel. Hydrologic conditions at this location were field verified.

- The open waterway profile of the A-1 Channel between Bushnell Lane East and Irving Road (node 72730 to node 72797) on Figure 3-7 was unknown, and therefore the system was field verified and surveyed.
- Conditions of the western tributary of the A-1 Channel from node 72102 to 71215, shown on Figure 3-5, were unclear, and therefore the system was field verified and surveyed.

3.2 Model Validation Process

As described previously, an initial model calibration was applied City-wide during the development of the 2002 basin plans. However, a separate model validation was conducted specific to the River Road Santa Clara basin because of the unique conditions of the basin associated with fairly high permeability soils and the use of drywells to handle some of the drainage. In addition, photos from a large storm event were available from within the basin for use in validating the model.

Flow monitoring data were not available for a calibration process; therefore, a model validation process was conducted based on photos and observed freeboard elevations provided by the City. The information was provided from the Willamette Overflow subbasin in the Willamette Overflow Waterway at Lone Oak Way (node 74406) for three days of rainfall in 2005: December 28th, 30th, and 31st. Validation of the model was based on comparisons between model-simulated water surface elevations at node 74406 (converted to freeboard elevations) and the freeboard observed during the rainfall event(s), as provided below.

To start, the base hydrologic/hydraulic model that was used for the model validation process assumed that the drywells in the Willamette Overflow Basin were functioning as they were designed to infiltrate all of the runoff from the 5-year, 24 hour design storm (model scenario 2 from subsection 3.1.1). Another assumption in the base model was that the impervious percentages were equal to the mapped impervious percentages areas as opposed to using effective impervious percentage areas. The comparison between simulated and observed freeboard elevations revealed that the model-simulated freeboard was less than the observed freeboard (i.e. the model was conservative as it was simulating higher water surface elevations and hence, lower freeboards). Model parameters were adjusted in an attempt to reduce the differences between model-simulated and observed freeboard. These adjustments to the model input parameters were applied to the entire Willamette Overflow subbasin model, and the model was run for the period from December 27, 2005 to January 3, 2006 using real rainfall data. A summary of the daily rainfall depths that were used in the model validation is provided in Table 3-3 below. Several additional model runs were conducted to evaluate the model's sensitivity to changes in input parameters. The results of these sensitivity analyses indicated that the impervious percentage area was the most sensitive model input parameter.

Table 3-3
Rainfall Data Used for the Model Validation

Date	Daily Rainfall Total (inches)	Validation Conducted for Day? (Y/N)
December 27, 2005	1.25	N
December 28, 2005	0.88	Y
December 29, 2005	0.17	N
December 30, 2005	2.56	Y
December 31, 2005	0.94	Y
January 1, 2006	0.16	N
January 2, 2006	0.37	N
January 3, 2006	0.12	N
Total:	**6.45**	

Several combinations of model adjustments were evaluated to obtain the best match to observed conditions (i.e., to reduce differences between simulated and observed freeboard). The model adjustments that were evaluated during the model validation process are shown in Table 3-4. The best results (i.e., closest to observed data) were obtained when the model input parameters were adjusted to reflect the use of effective impervious percentage areas instead of mapped impervious percentage areas (i.e., lowering the impervious percentages). Effective impervious percentage areas were estimated based on Roger Sutherland's paper (provided as Appendix C) titled *Methodology for Estimating the Effective Impervious Area of Urban Watersheds* (1995). His method includes five different equations for estimating the effective impervious area from mapped impervious area. The five equations are based on how directly connected the mapped impervious areas are to the piped storm drainage system. Equation #1 (below) was used to calculate effective impervious area for the purpose of conducting this model validation.

- *Average subbasins which are predominately sewered with curbs and gutters, have no infiltration facilities, and the residential rooftops are not directly connected to the drainage system:*

$$\textit{Effective Imp.\%} = 0.1 * (\textit{Mapped Imp.\%})^{1.5}$$

Although the use of equation #1 (for average connected basins) and associated revised impervious surface estimates resulted in somewhat better model results (i.e., closest to observed data), the drainage area upstream of the calibration site was determined to be all curb and gutter, and the impervious area was estimated to be mostly connected. As the calibration data came from only one point in the basin, and as it was observed as opposed to measured, it was decided that it would be better to use the more realistic input parameters and err on the conservative side (i.e., model-simulated flows higher than observed flows). The entire River Road Santa Clara basin varies with respect to whether streets have curb and gutter, but without better calibration data the variations were not taken into account with the equation used to calculate effective impervious surface and thus accounted for in the model. In other words, one consistent equation was used to convert mapped impervious areas to effective impervious areas for the entire basin.

Therefore, the following model adjustments were recommended that are shown as shaded in Table 3-4.

Table 3-4
Model Adjustments and Associated Model Results for Node 74406

	Alternative Model Adjustments	Storm Event Date	Observed Freeboard (ft)	Simulated Freeboard (ft)	Difference (ft)
1	No initial Changes	12/28/2005	5.00	3.20	1.80
	No initial Changes	12/30/2005	9.00	4.47	4.53
	No initial Changes	12/31/2005	6.00	3.03	2.97
2	Imp. % Reduced using Average Formula*	12/28/2005	5.00	3.57	1.43
	Imp. % Reduced using Average Formula*	12/30/2005	9.00	5.75	3.25
	Imp. % Reduced using Average Formula*	12/31/2005	6.00	3.11	2.89
3	Imp. % Reduced using Low Formula**	12/28/2005	5.00	4.20	0.80
	Imp. % Reduced using Low Formula**	12/30/2005	9.00	6.17	2.83
	Imp. % Reduced using Low Formula**	12/31/2005	6.00	3.17	2.83
4	Saturated Hydraulic Conductivity Increase by 20%	12/28/2005	5.00	3.20	1.80
	Saturated Hydraulic Conductivity Increase by 20%	12/30/2005	9.00	4.47	4.53
	Saturated Hydraulic Conductivity Increase by 20%	12/31/2005	6.00	3.03	2.97
5	Basin width decrease by 50%	12/28/2005	5.00	3.20	1.80
	Basin width decrease by 50%	12/30/2005	9.00	4.47	4.53
	Basin width decrease by 50%	12/31/2005	6.00	3.03	2.97
6	Model includes only non Drywell areas	12/28/2005	5.00	3.20	1.80
	Model includes only non Drywell areas	12/30/2005	9.00	4.47	4.53
	Model includes only non Drywell areas	12/31/2005	6.00	3.06	2.94
7	Model includes only non Drywell areas with Imp. Reduced by Average Formula*	12/28/2005	5.00	3.57	1.43
	Model includes only non Drywell areas with Imp. Reduced by Average Formula*	12/30/2005	9.00	5.75	3.25
	Model includes only non Drywell areas with Imp. Reduced by Average Formula*	12/31/2005	6.00	3.14	2.86
8	Model includes only non-Drywell areas with Imp. Reduced by Low Formula**	12/28/2005	5.00	4.20	0.80
	Model includes only non-Drywell areas with Imp. Reduced by Low Formula**	12/30/2005	9.00	6.17	2.83
	Model includes only non-Drywell areas with Imp. Reduced by Low Formula**	12/31/2005	6.00	3.17	2.83

* For Average Connected Impervious Areas: Effective imp.% = 0.1 * (Mapped Imp.%)$^{1.5}$ (equation # 1 – Appendix C)

** For Low Connected Impervious Areas: Effective imp.% = 0.04 * (Mapped Imp.%)$^{1.7}$ (equation # 4 – Appendix C)

Based on the above information, the City and County agreed to move ahead with the #2 model adjustments from Table 3-4, which included reducing mapped impervious percentage areas using Equation #1. These model adjustments were applied basin-wide to the A-1 Channel, Spring Creek, Flat Creek, and the Willamette Overflow major subbasins.

3.3 Model Results

As described in Section 3.1 of Volume I (City-wide Study Methodology and Summary), models were run for the selected design storms, and model output was produced for peak flows and water surface elevations for both existing and future conditions. These results were used to identify capacity deficiencies in the system. Surcharging was considered to be acceptable and problems were only identified if the models indicated that water was exiting the system and onto the streets. For this basin, model results were produced for existing and future conditions for two scenarios as described in subsection 3.1.1: 1) the model scenario did not account for infiltration from the existing drywells in the model simulation; and 2) the model scenario did account for existing drywells in the model simulation.

Given new rules related to stormwater discharges to drywells (under the Safe Drinking Water Act), decommissioning of the public drywells in this basin will ultimately be required (with the possibility of some exceptions depending on confirmed groundwater levels). Therefore, the model scenario without the incorporation of drywells was used to evaluate the capacity of the drainage system when public drywells are ultimately decommissioned. It should be noted that private drywells are under the authority of the Oregon Department of Environmental Quality (ODEQ) and any decommissioning associated with private drywells (if required) would be directed by ODEQ. Of the 785 drywells in the basin, 634 (81 %) are privately owned, 79 (10%) are owned by Lane County, and 72 (9%) are owned by the City of Eugene. Section 4.0 of this plan provides more detail regarding the Safe Drinking Water Act and associated DEQ requirements for stormwater discharges to drywells.

As mentioned in Section 3.1, the model simulation that accounted for drywells was based on an incomplete dataset at the time and included a portion (approximately 759) of the total 785 drywells. It was anticipated that the modeling results would show that the existing drywells are providing some relief with respect to capacity deficiencies. However, the comparison of model results between both scenarios (with and without drywells) for the 10-year and 25-year design events did not show significant differences with respect to identified flooding problems. Based on a more detailed review of the results, it was assumed that this occurred for the following two reasons:

1. The drywells were only designed to infiltrate runoff from up to the 5-year storm event and the design events modeled to identify flooding issues were the 10-year and 25-year events. The accommodation of the flows from the 5-year storm had minimal impacts with respect to flows from the larger storms when comparing the two model scenarios.
2. Only 22% of the total modeled drainage area was estimated to be draining to drywells (following this analysis, the number was updated to 25%). Therefore, the majority of the drainage area was already accommodated via the pipe and surface storm drainage system and not highly impacted by infiltration associated with drywells for the larger storms.

Because the drywells were not shown to provide significant benefits with respect to resolving capacity deficiencies for the larger storms; and given that the public drywells will eventually need to be decommissioned; and given that the City and County do not have authority over the private drywells, a decision was made to continue with the flood control evaluation and the identification of capital projects using the model that did not include the infiltration of runoff associated with existing drywells. The hydraulic model results are summarized by conduit in Table 3-2 for the system design storm, and full model results are provided in Appendix B.

3.4 Flooding Problems Identified by the Model

This section provides a general description of model-identified flooding problems. The model results are summarized in Table 3-2 and include both peak flows and water surface elevations for the relevant design storm under both existing and buildout conditions. The last columns in the table indicate the design event and land use condition when certain conduits are expected to be deficient and the associated capital project that addresses the deficiency (discussed in more detail in Section 3.5). For pipe segments and roadway crossings, surcharging was considered to be acceptable, and flooding problems were only identified if the models predicted water getting out of the system and into the streets. For open waterways, deficiencies were identified when the depth of the design flow was predicted to exceed the tops of the channel banks.

In general, very few flooding problems were identified in the River Road Santa Clara basin. Specifically, one flooding problem is expected to occur in the Flat Creek drainage system during existing land use conditions. Nineteen open channel and 17 pipe segments were identified as deficient for their respective design storms in the remaining three drainage systems (i.e., A-1 Channel, Spring Creek, and Willamette Overflow). Eighteen of the 19 open channel segments and eleven of the 17 pipe segments are expected to be deficient under existing land use conditions. Additionally, one open channel and six pipe segments are expected to be deficient under buildout conditions. Each of these problems is listed in Section 3.5 in association with the proposed capital project to address the problem.

In addition to flooding problems associated with predicted capacity deficiencies, decommissioning of drywells would result in the need for an alternative drainage system to handle or convey the 5- year flows that are currently discharging to drywells. Management strategies to address this issue are described in Section 3.5 and 3.6 as well.

3.5 Development of the Flood Management Strategy

As shown in the stormwater basin master planning process flow chart in Figure 1-1, Step 1 included a compilation of basin characteristics. These basin characteristics are summarized in Section 2.0 of this document. Step 2 in the process includes problem identification under both existing and future land use conditions, focusing on the major components of the public drainage system. These results are provided in Section 3.4 above. The next step includes the development of potential stormwater management tools (i.e., capital projects or development standards) to address the identified problems. This section describes the capital project and development standard alternatives that were considered to address the identified flooding problems.

3.5.1 Capital Projects to Address Capacity Deficiencies

All flooding problems (i.e., capacity deficiencies) identified through modeling and proposed capital projects (CPs) to address these problems are referenced in Table 3-2 and presented in Table 3-5. Prior to this study, design standards for flood protection levels in Eugene were based on the previous storm drainage master plan (OTAK 1990). The 1990 plan includes varying degrees of protection depending on the size of the drainage area, type of system (open channel or pipe), and type of roadway (local collector vs. major arterial). Depending upon these factors, the standards for designing CIPs ranged from the 5-year to the 50-year recurrence interval storm. For this plan, the City elected to retain the flood protection levels listed in the 1990 plan with the exception that the minimum level of protection would be the 10-year as opposed to the 5-year storm (see Section 3.1.4, Table 3-1 of Volume 1 for exceptions). Flooding problems were identified for the open waterways and the pipe system and CIPs were developed based on the relevant design storm as listed in Table 3-2. A flooding problem was identified for an open waterway if the water depth exceeded the top of bank elevation. For the pipe system, surcharging was allowed, however, if the water entered the street a flooding problem was identified. In all, 10 flood control CPs focused on existing culvert replacement and upsizing of the culverts are proposed. Two CPs are proposed that include regrading of the existing channel to improve conveyance capacity. Three CPs are associated with providing storage to relieve predicted capacity issues and one CP is associated with additional survey efforts.

Table 3-5
Capacity Deficiencies Identified Through Modeling and Proposed Capital Projects to Address Them

Selected Flood Control Capital Project Name	Selected Flood Control Capital Project Description	Conduits Addressed with Capital Project
A1 Channel		
A1-1	Regrade the existing open channel segment (RSA1090B) from node 72789 to 78790 (18’).	RSA1090B, RSA1090C1 and C2, and RSA1090D
A1-2	Upsize and replace the existing 36” CMP culvert (RSA1090A) with a 48” CMP culvert.	RSA1090A, RSA1090B, RSA1090C1 and C2, and RSA1090D
A1-3	Construct storage facilities at nodes 72782 and 72102 to provide a total of 85 acre-ft of storage.	RSA1090A, RSA1090B, RSA1090C1 and C2, RSA1090D, RSA1090E1, E2, and E3, RSA1090F, RSA1080B, RSA1060H, RSA1060M, RSA1060O, RSA1060Q, RSA1060U, RSA1100B.1, RSA1100C, RSA1100D.1, RSA1100E, RSA1100F.1, RSA1100G, RSA1100H, and RSA1100K
A1-4	Upsize and replace the existing 24” CMP culvert (RSA1100I) with a 36” CMP culvert.	RSA1100I.1, RSA1100J, RSA1110A1 and A2

Selected Flood Control Capital Project Name	Selected Flood Control Capital Project Description	Conduits Addressed with Capital Project
A1-5	Upsize and replace the existing 3-24” CMP culverts (RSA1090E) with a 2’ x 8’ box culvert.	RSA1090E1, E2, and E3, RSA1090F, RSA1100B.1, RSA1100C, RSA1100D.1, RSA1100E, RSA1100F.1, RSA1100G, and RSA1100K
A1-6	Upsize and replace the existing 24” CMP culvert (RSA1060L) with a 2’ x 4’ box culvert.	RSA1060U, RSA1080B, RSA1090A.1, RSA1060M, RSA1060Q and RSA1060U
A1-7	Upsize and replace the existing 18” and 24” CSP culverts (RSA1060G) with a 2’ x 4.5’ box culvert.	RSA1060H, RSA1060U, RSA1080B, RSA1090A.1
A1-8	Install a storage CP at nodes 72725 and 59020 to provide approximately 135 acre-ft of storage.	RSA1160B, RSA1160D, RSA1160F, RSA1160H
A1-9	Conduct survey of open channel segments	RSA1160D, RSA1160H, RSA1080B
Flat Creek		
FC-1	Upsize and replace the existing 3-12” CSP culverts (RSFC050D) with a 1.5’ x 5.0’ box culvert.	RSFC050E
Spring Creek		
SC-1	Upsize and replace the existing 2-30” CSP culverts (RSSC050B) with a 12’ long pedestrian bridge.	RSSC040B
Willamette Overflow		
WO-1	Upsize and replace the existing 18” CMP culvert (RSWO070D) with a 66” CSP culvert.	RSWO070D.1, RSWO070E
WO-2	Upsize and replace the existing 36” CSP culvert (RSWO110A) with a 60” CSP culvert.	RSWO110B.1, RSWO110C.1
WO-3	Upsize and replace the existing 48” CSP culvert (RSWO080A) with a 66” CSP culvert.	RSWO090A, RSWO090Aa, RSWO090B, RSWO090C, RSWO090F, RSWO090H
WO-4	Regrade the existing open channel segments (RSWO090Aa, RSWO090B, RSWO090C, and RSWO090D) from node 74405 to 78833 (724’).	RSWO090A, RSWO090Aa, RSWO090B, RSWO090C, RSWO090F, RSWO090H
WO-5	Install a storage CP at node 77703 to provide approximately 124 acre-ft of storage.	RSWO070D.1, RSWO070E, RSWO090A, RSWO090Aa, RSWO090B, RSWO090C, RSWO090F, RSWO090H, RSWO110B.1, RSWO110C.1

For more detail regarding each of these projects, capital project fact sheets are provided in Appendix A.

3.5.2 Selected Projects to Address Flows Associated With Drywell Decommissioning

As stated previously, DEQ is expected to require decommissioning of all the public drywells in the basin (more detail is provided in Section 4.0). As a result, alternative systems will be necessary to handle the flows (up to the 5-year, 24 hour design event) that were previously handled through drywells. The drywell drainage areas were reviewed, and three project options were developed to handle the flows from these areas as follows:

1) Piped Option – If the drywell is located in close proximity to an existing storm drainage pipe and the pipe has the capacity to handle the flow, a new piped system would be constructed as necessary to route the drywell flows to the existing piped system.

2) Surface Infiltration/Rain Garden Option – If the drywell is located in an area where flow is not able to be routed to an existing piped system, flows would be routed to an area where a vegetated infiltration/rain garden type facility would be constructed to handle flows. Infiltration of municipal stormwater runoff that occurs through the ground surface as opposed to the subsurface is not regulated under the Safe Drinking Water Act.

3) On-Street Rain Garden Option – In areas where street improvements are planned, right-of-way plans/cross-sections that include street side rain gardens for the storage and infiltration of runoff could be used to handle flows from the right-of-way (ROW). For this option, properties adjacent to the R.O.W. would be required to deal with their individual drainage on-site in accordance with requirements for stormwater in the City of Eugene Code (Chapter 9, Section 9.6791(3)).

Many of the drywells are concentrated in various portions of the basin. Therefore, prior to selecting an option for the individual drywells, drywells located in close proximity to each other where flows were proposed to be managed in accordance with the same option as defined above, were grouped into drywell "clusters". This grouping of drywells was conducted because some of the management options could be applied and constructed in a manner to address a "cluster" of drywells. A total of 39 drywell clusters were delineated, as illustrated on the Stormwater Management Strategy Development map in Appendix H and listed in Table 3-6 below. Table 3-6 also lists the CPs associated with each drywell cluster to address decommissioning of the drywells. A capital project fact sheet including a map, estimated costs, and conceptual design assumptions is provided for each of these projects in Appendix A, and the location of each of these projects is also shown in Figures 3-2 through 3-8. The project options were selected for each cluster to maximize water quality benefits while addressing the flows associated with decommissioning. See Section 4.0 – Water Quality Evaluation for more detail regarding the development of each of these projects.

Table 3-6
Capital Project Options Selected to Address Decommissioning of Drywells (UICs)*

CP/ Cluster Number	# of County Drywells Addressed by the CP	# of City Drywells Addressed by the CP	CP Project Option Selected	CP/ Cluster Name
Willamette Overflow Major Subbasin				
WO-1-UIC		2	Piped	Green UIC Cluster
WO-2-UIC		4	Rain Garden/Infiltration Facility	Corliss/ Carolyn/ Onyx UIC Cluster
WO-3-UIC	4	6	Rain Garden/Infiltration Facility	Autumn, Ross, Moore/Oak UIC Cluster
WO-4-UIC		1	Piped	Taz UIC
WO-5-UIC	3		Rain Garden/Infiltration Facility	Silver Meadows UIC Cluster
WO-6-UIC	3		Piped	Poplar UIC Cluster
WO-7-UIC		1	Piped	Kendra UIC
WO-8-UIC	1	1	Piped	Kent UIC Cluster
WO-9-UIC		1	Rain Garden/Infiltration Facility	Baywood UIC
WO-10-UIC		1	Rain Garden/Infiltration Facility	Greenwood UIC
WO-11-UIC	1		Rain Garden/Infiltration Facility	Warrington UIC
A-1 Channel Major Subbasin				
A1-1-UIC A1-2-UIC	7		Piped	Crocker 1 and 2 UIC Cluster
A1-3-UIC A1-4-UIC		10	Piped	Shirley 1 and 2 UIC Cluster
A1-5-UIC	4		Piped	Hamilton UIC Cluster
A1-6-UIC	2		Piped	Bushnell UIC Cluster
A1-7-UIC	8	14	Rain Garden/Infiltration Facility	Anderson UIC Cluster
A1-8-UIC		4	Rain Garden/Infiltration Facility	Escalante UIC Cluster
A1-9-UIC	1		Piped	Greenleaf UIC Cluster
A1-10-UIC	4		Rain Garden/Infiltration Facility	Grove UIC Cluster
A1-11-UIC		3	Rain Garden/Infiltration Facility	Exeter UIC Cluster
A1-12-UIC	1		Rain Garden/Infiltration Facility	Brentwood UIC Cluster
A1-13-UIC		2	Piped	Korbel UIC Cluster
A1-14-UIC	1		Rain Garden/Infiltration Facility	Howard UIC
A1-15-UIC	26	1	On-Street Rain Gardens	South of Horn Lane UIC Cluster
Spring Creek Major Subbasin				
SC-1-UIC SC-2-UIC SC-3-UIC	2	3	Piped	Zinnia 1, 2, and 3 UIC Cluster
SC-4-UIC		1	Piped	Countryside Cluster
SC-5-UIC	1	3	Piped	Lodenquai UIC Cluster
SC-6-UIC	2		Rain Garden/Infiltration Facility	Byron UIC Cluster
SC-7-UIC	1		Rain Garden/Infiltration Facility	Stark UIC Cluster
SC-8-UIC	2		Rain Garden/Infiltration Facility	Castrey UIC Cluster
SC-9-UIC		2	Rain Garden/Infiltration Facility	Calumet UIC Cluster

CP/ Cluster Number	# of County Drywells Addressed by the CP	# of City Drywells Addressed by the CP	CP Project Option Selected	CP/ Cluster Name
Flat Creek Major Subbasin				
FC-1-UIC FC-2-UIC FC-3-UIC		12	Rain Garden/Infiltration Facility	Willowbrook 1, 2, and 3 UIC Cluster
FC-4-UIC	5		Rain Garden/Infiltration Facility	Maesner UIC Cluster
Total Drywells:	**79**	**72**		

* In the regulatory context, drywells are referred to as Underground Injection Controls (UICs). The terms drywell and UIC are used interchangeably in this document.

3.5.3 Selected Development Standard Alternatives

As part of the Storm Drainage Master Plans that were completed in 2002, detailed analyses were conducted with regards to the potential implementation of development standards to address identified flooding issues (i.e., capacity deficiencies). For each of the basins, the estimated costs to address flooding problems through public capital projects was compared with the estimated costs to address flooding problems through a combination of both capital projects and the implementation of on-site controls required for private development.

As a result of these analyses, development standards to address capacity deficiencies (through on-site controls for private development) were not selected for implementation (see Section 3.3 of the Eugene Stormwater Basin Master Plan, Volumes II-VII for more information). The reason for this decision was that most of the identified flooding problems were anticipated to occur as a result of existing developed conditions. While future development would exacerbate some of the problems, a capital project would already be required to address existing condition flooding, and increasing the size of the capital project to address flows from future development was more cost effective than requiring developers to address the issue through on-site storage requirements. For this basin, the conclusions from this previous analysis were assumed to apply.

Note: It should be noted that in the City and County, stormwater system improvements are currently designed to meet conveyance design criteria based upon the size of the drainage area and the type of system (closed or open) being improved. Conveyance design criteria will still apply to new development and re-development, to provide the appropriate level of protection from the risk of flooding and a consistent level of service city-wide. See Eugene Stormwater Basin Master Plan, Volume I Sections 3.1.4 and 4.3.2 for more information.

TABLE 3-1
MAJOR HYDROLOGIC INPUT/OUTPUT DATA FOR THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM

Subbasin Name	Inlet Node	Subbasin Area (acres)	Impervious Area (%)					Average Subbasin Slope (ft/ft)	Subbasin Width (ft)	Subbasin Peak Flow (cfs) Existing Land Use Conditions					Subbasin Peak Flow (cfs) Future Land Use Conditions				
			Existing Land Use		Future Land Use		Increase in the Impervious Area Percentage [1]			10-Year	25-Year-W[2]	25-Year-S[3]	50-Year	100-Year	10-Year	25-Year-W[2]	25-Year-S[3]	50-Year	100-Year
			Mapped	Effective	Mapped	Effective													
River Road-Santa Clara - A1-Channel																			
RSA1-010	72757	34.6	3.7	0.7	35.4	21.1	20.4	0.025	2540	11	4	8	13	19	15	12	12	25	33
RSA1-020	72757	87.3	13.0	4.7	14.8	5.7	1.0	0.014	1446	12	7	10	16	22	12	8	11	18	24
RSA1-030	72744	239.8	24.3	12	37.1	22.6	10.6	0.016	11160	73	44	61	103	139	87	70	76	149	191
RSA1-050	72746	65.4	15.5	6.1	56.3	42.2	36.1	0.007	1543	8	5	7	11	15	24	31	22	47	56
RSA1-060	72740	152.8	36.8	22.3	49.4	34.7	12.4	0.016	20023	76	57	63	140	180	82	77	70	171	212
RSA1-070	72742	63.6	29.3	15.9	51.0	36.4	20.5	0.015	2570	18	13	15	28	37	26	27	23	51	63
RSA1-080	72748	73.1	50.4	35.8	54.0	39.7	3.9	0.021	2693	30	31	26	58	71	32	34	28	63	77
RSA1-090	72788	50.0	37.9	23.3	54.4	40.1	16.8	0.024	3434	17	13	11	29	37	21	22	16	44	54
RSA1-100	72784	82.1	49.1	34.4	51.5	37	2.6	0.043	3276	19	31	20	52	61	20	34	21	56	66
RSA1-110	72103	57.8	54.3	40	55.2	41	1.0	0.043	2500	16	26	16	44	52	16	26	17	45	53
RSA1-120	72102	91.4	32.8	18.8	54.1	39.8	21.0	0.050	4154	12	19	12	34	42	25	40	26	70	82
RSA1-130	72737	107.1	36.0	21.6	45.3	30.5	8.9	0.023	7687	41	29	33	67	88	46	39	38	84	107
RSA1-140	69264	54.3	38.1	23.5	39.3	24.6	1.1	0.017	3325	21	16	17	35	45	21	16	17	36	46
RSA1-150	72797	73.5	43.9	29.1	49.4	34.7	5.6	0.043	2701	14	24	15	41	48	17	28	18	49	57
RSA1-160	72733	106.5	40.1	25.4	43.1	28.3	2.9	0.022	6146	23	30	19	53	64	25	34	21	59	71
RSA1-170	72736	98.9	45.5	30.7	47.7	32.9	2.2	0.017	5947	33	35	28	66	79	34	37	30	69	84
RSA1-180	72101	78.8	42.7	27.9	43.5	28.7	0.8	0.014	2650	20	25	18	43	51	20	25	18	44	52
RSA1-190	72100	59.6	43.6	28.8	43.6	28.8	0.0	0.011	1623	15	19	13	32	38	15	19	13	32	38
RSA1-200	72725	42.2	40.2	25.5	50.1	35.5	10.0	0.042	1297	8	12	8	21	26	11	17	11	29	34
RSA1-210	59021	99.0	45.6	30.8	46.0	31.2	0.4	0.006	4869	27	34	24	58	69	27	35	24	59	69
RSA1-220	85032	53.8	45.9	31.1	46.8	32	0.9	0.005	1315	13	19	12	28	33	13	19	12	29	34
RSA1-230	72723	86.7	34.3	20.1	38.8	24.2	4.1	0.030	4686	13	19	12	35	43	15	23	15	42	50
RSA1-240	72719	169.1	38.4	23.8	42.2	27.4	3.6	0.015	4837	126	49	40	86	104	45	55	44	96	115
RSA1-245	72719	566.3	40.1	25.4	42.5	27.7	2.3	0.014	9500	41	168	127	274	326	135	182	136	298	348
RSA1-270	74040	28.3	46.8	32	47.1	32.3	0.3	0.008	4532	6	10	6	17	20	6	10	6	17	20
RSA1-280	74030	39.2	45.2	30.4	45.3	30.5	0.1	0.004	3610	12	14	11	25	30	12	14	11	25	30
RSA1-290	74020	48.4	43.3	28.5	44.3	29.5	1.0	0.013	2809	15	16	13	29	35	15	16	13	30	36
River Road-Santa Clara - Flat Creek																			
RSFC-010	70197	51.3	44.0	29.2	44.1	29.3	0.1	0.024	2500	16	17	13	32	38	16	17	13	32	38
RSFC-020	72767	84.7	42.8	28	46.8	32	4.0	0.015	3743	25	27	22	50	60	27	31	24	56	67
RSFC-030	72761	104.2	41.9	27.1	45.1	30.3	3.2	0.016	5722	36	33	30	65	81	38	37	32	71	88
RSFC-040	75659	35.9	42.1	27.3	43.7	28.9	1.6	0.013	1700	10	11	9	20	25	10	12	9	21	26
RSFC-050	72799	42.8	36.9	22.4	42.9	28.1	5.7	0.013	1680	10	11	9	20	24	12	14	10	24	29
RSFC-060	72800	46.2	44.8	30	44.8	30	0.0	0.010	2412	11	15	10	26	30	11	15	10	26	30
RSFC-070	72794	30.2	35.7	21.3	38.2	23.6	2.3	0.016	2903	8	7	6	15	18	9	8	6	16	20
River Road-Santa Clara - Spring Creek																			
RSSC-010	72013	50.5	38.2	23.6	43.1	28.3	4.7	0.024	2938	16	14	14	29	36	18	17	15	33	41
RSSC-035	76560	51.9	44.8	30	45.8	31	1.0	0.009	1200	14	18	12	29	34	14	18	13	29	35
RSSC-040	72008	42.8	38.1	23.5	40.1	25.4	1.9	0.027	1869	10	11	8	21	25	10	12	8	22	26
RSSC-050	72030	54.4	43.3	28.5	44.9	30.1	1.6	0.013	2656	12	17	11	30	35	13	18	12	32	37
RSSC-060	79470	114.1	41.4	26.6	47.9	33.1	6.5	0.013	4948	26	34	22	60	70	31	42	27	73	84
RSSC-070	76587	40.4	47.2	32.4	47.5	32.7	0.3	0.009	1941	12	15	10	25	30	12	15	10	26	30
RSSC-080	76564	100.3	41.2	26.4	45.9	31.1	4.7	0.008	1424	20	29	19	44	51	24	35	22	50	58

TABLE 3-1
MAJOR HYDROLOGIC INPUT/OUTPUT DATA FOR THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM

Subbasin Name	Inlet Node	Subbasin Area (acres)	Impervious Area (%) Existing Land Use Mapped	Existing Land Use Effective	Future Land Use Mapped	Future Land Use Effective	Increase in the Impervious Area Percentage [1]	Average Subbasin Slope (ft/ft)	Subbasin Width (ft)	Subbasin Peak Flow (cfs) Existing Land Use Conditions 10-Year	25-Year-W[2]	25-Year-S[3]	50-Year	100-Year	Subbasin Peak Flow (cfs) Future Land Use Conditions 10-Year	25-Year-W[2]	25-Year-S[3]	50-Year	100-Year
RSSC-090	72004	82.8	43.3	28.5	43.6	28.8	0.3	0.020	3761	28	27	24	53	65	28	28	24	53	66
RSSC-100	72002	66.4	40.6	25.9	43.0	28.2	2.3	0.013	2722	19	20	17	37	45	20	22	18	40	48
RSSC-110	72770	95.9	27.3	14.3	42.5	27.7	13.4	0.010	2777	17	16	14	30	38	26	30	23	52	62
RSSC-120	72000	323.9	40.8	26.1	43.4	28.6	2.5	0.014	4475	65	94	60	145	169	71	103	66	157	182
River Road-Santa Clara - Willamette Overflow																			
RSWO-010	99820	54.8	11.3	3.8	27.5	14.4	10.6	0.034	4578	1	2	1	5	10	5	9	6	16	22
RSWO-020	99827	27.5	39.7	25	45.4	30.6	5.6	0.015	2261	5	8	5	13	16	6	9	6	16	19
RSWO-030	99827	47.8	36.3	21.9	42.8	28	6.1	0.018	2282	7	12	7	20	24	9	15	9	25	30
RSWO-035	99827	110.8	39.9	25.2	44.5	29.7	4.5	0.014	4687	19	31	20	51	59	22	37	23	60	69
RSWO-040	73907	25.4	37.1	22.6	38.0	23.4	0.8	0.024	5712	4	6	4	13	17	4	7	4	13	18
RSWO-045	73910	44.7	36.0	21.6	43.7	28.9	7.3	0.027	3000	7	11	7	18	20	9	14	9	24	27
RSWO-050	72081	80.0	25.3	12.7	39.0	24.4	11.7	0.019	3396	7	11	7	19	21	13	22	14	36	41
RSWO-060	72080	37.9	4.0	0.8	12.5	4.4	3.6	0.025	1817	0	0	0	1	1	1	2	1	3	4
RSWO-070	74013	66.1	31.4	17.6	41.4	26.6	9.0	0.022	5273	8	13	8	22	26	12	20	12	33	38
RSWO-080	74004	55.4	51.8	37.3	54.6	40.3	3.0	0.008	3737	20	23	17	42	50	21	25	18	45	53
RSWO-090	74405	34.2	44.9	30.1	45.8	31	0.9	0.022	3460	7	11	7	20	24	7	12	7	21	24
RSWO-100	58315	15.2	40.3	25.6	40.4	25.7	0.1	0.009	3030	6	5	5	11	14	6	5	5	11	14
RSWO-110	58311	49.4	57.7	43.8	64.7	52	8.2	0.012	2980	19	24	17	43	50	22	29	20	49	58
RSWO-120	77703	30.9	56.5	42.5	57.3	43.4	0.9	0.044	2010	14	17	13	31	37	14	17	13	31	37
RSWO-130	77703	136.9	50.6	36	52.2	37.7	1.7	0.010	4533	38	55	37	91	107	40	58	39	95	111
RSWO-140	77703	30.6	59.4	45.8	62.2	49.1	3.3	0.033	1773	12	16	10	29	34	13	17	11	31	36

Note.
1. Increase in effective impervious percentage from existing land use conditions to future land use conditions.
2. W = Winter
3. S = Summer

TABLE 3-2
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Peak Flow (cfs) For Design Storm		Water Surface Elevation For Design Storm (ft)				When Deficient	CIP # to Address Problems
								Existing Land Use		Future Land Use			
	US	DS				Existing	Future	US	DS	US	DS		
A-1 Channel													
RSA1010A	72757	72745	Bridge	42	25	419	465	356.5	355.6	356.6	355.7		
RSA1010B	72744	72757	Natural	2400	25	405	449	359.9	356.5	360.1	356.6		
RSA1030A	72743	72744	Natural	4200	25	358	386	367.6	359.9	367.8	360.1		
RSA1030B.1	72742	72743	Bridge	32	25	356	385	367.8	367.6	367.9	367.8		
RSA1030BRD	72742	72743	Roadway	32		0	0	367.6	367.6	367.8	367.8		
RSA1030C	73394	72744	Natural	1633	10	6	14	362.7	359.8	362.8	359.9		
RSA1030D	75021	73394	Natural	1016	10	7	14	366.6	362.7	366.7	362.8		
RSA1030Da.	75020	75021	24" x 141" CMP Culvert	96	10	7	14	367.3	366.6	367.7	366.7		
RSA1030DaR	75020	75021	Roadway	96		0	0	366.6	366.6	366.7	366.7		
RSA1030Db	73395	75020	Natural	522	10	7	15	367.3	367.3	367.7	367.7		
RSA1030E	72747	73395	Natural	1633	10	8	24	368.8	367.3	369.0	367.7		
RSA1030F1	72746	72747	14" CSP Culvert	55	10	4	7	369.9	368.8	371.2	369.0		
RSA1030F2	72746	72747	24" CSP Culvert	55	10	4	16	369.9	369.5	371.2	370.3		
RSA1030FRD	72746	72747	Roadway	55		0	0	368.8	368.8	369.0	369.0		
RSA1060A	71215	72742	Natural	1140	25	343	368	369.0	367.8	369.2	367.9		
RSA1060B	72741	71215	Natural	560	25	321	346	370.1	369.0	370.2	369.2		
RSA1060C	72740	72741	Bridge	39	25	321	346	370.3	370.1	370.5	370.2		
RSA1060D	72739	72740	Natural	1000	25	280	297	372.0	370.3	372.1	370.5		
RSA1060E	72738	72739	Natural	500	25	260	275	372.4	372.0	372.5	372.1		
RSA1130A1	72737	72738	72" CSP Culvert	600	25	86	91	373.1	372.4	373.2	372.5		
RSA1130A2	72737	72738	72" CSP Culvert	600	25	88	93	373.1	372.4	373.2	372.5		
RSA1130A3	72737	72738	72" CSP Culvert	600	25	86	91	373.1	372.4	373.2	372.5		
RSA1130ARD	72737	72738	Roadway	600		0	0	372.4	372.4	372.5	372.5		
RSA1130B	70756	72737	Natural	2145	25	239	252	377.6	373.1	377.7	373.2		
RSA1140A	72796	70756	Natural	1155	25	228	241	378.4	377.6	378.5	377.7		
RSA1140B.1	69264	70756	36" CSP Culvert	839	10	21	21	379.8	377.4	380.0	377.5		
RSA1140BRD	69264	70756	Roadway	839		0	0	377.4	377.4	377.5	377.5		

TABLE 3-2
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Peak Flow (cfs) For Design Storm		Water Surface Elevation For Design Storm (ft)				When Deficient	CIP # to Address Problems
								Existing Land Use		Future Land Use			
	US	DS				Existing	Future	US	DS	US	DS		
RSA1270A.1	74046	72796	60" CSP Culvert	160	10	25	25	378.2	378.2	378.3	378.3		
RSA1270ARD	74046	72796	Roadway	160		0	0	378.2	378.2	378.3	378.3		
RSA1270B.1	74044	74046	60" CSP Culvert	463	10	25	25	378.2	378.2	378.3	378.3		
RSA1270BRD	74044	74046	Roadway	463		0	0	378.2	378.2	378.3	378.3		
RSA1270C.1	74042	74044	60" CSP Culvert	412	10	25	26	378.2	378.2	378.3	378.3		
RSA1270CRD	74042	74044	Roadway	412		0	0	378.2	378.2	378.3	378.3		
RSA1270D.1	74040	74042	60" CSP Culvert	409	10	26	26	378.2	378.2	378.4	378.3		
RSA1270DRD	74040	74042	Roadway	409		0	0	378.2	378.2	378.3	378.3		
RSA1280A.1	74034	74040	60" CSP Culvert	216	10	21	22	378.3	378.2	378.4	378.4		
RSA1280ARD	74034	74040	Roadway	216		0	0	378.3	378.3	378.4	378.4		
RSA1280B.1	74032	74034	60" CSP Culvert	269	10	21	22	378.3	378.3	378.4	378.4		
RSA1280BRD	74032	74034	Roadway	269		0	0	378.3	378.3	378.4	378.4		
RSA1280C.1	74031	74032	60" CSP Culvert	1331	10	22	22	378.3	378.3	378.4	378.4		
RSA1280CRD	74031	74032	Roadway	1331		0	0	378.3	378.3	378.4	378.4		
RSA1280D.1	74030	74031	60" CSP Culvert	1012	10	24	24	378.4	378.3	378.5	378.4		
RSA1280DRD	74030	74031	Roadway	1022		0	0	378.3	378.3	378.4	378.4		
RSA1290A.1	74026	74030	54" CSP Culvert	496	10	13	14	378.4	378.4	378.5	378.5		
RSA1290ARD	74026	74030	Roadway	496		0	0	378.4	378.4	378.5	378.5		
RSA1290B.1	74024	74026	48" CSP Culvert	182	10	14	14	378.5	378.4	378.6	378.5		
RSA1290BRD	74024	74026	Roadway	182		0	0	378.4	378.4	378.5	378.5		
RSA1290C.1	74022	74024	48" CSP Culvert	410	10	14	14	378.5	378.5	378.6	378.6		
RSA1290CRD	74022	74024	Roadway	410		0	0	378.5	378.5	378.6	378.6		
RSA1290D.1	74020	74022	42" CSP Culvert	880	10	14	15	379.2	378.5	379.3	378.6		

TABLE 3-2
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Peak Flow (cfs) For Design Storm		Water Surface Elevation For Design Storm (ft)				When Deficient	CIP # to Address Problems
								Existing Land Use		Future Land Use			
	US	DS				Existing	Future	US	DS	US	DS		
RSA1290DRD	74020	74022	Roadway	880		0	0	378.5	378.5	378.6	378.6		
RSA1150A1	72797	72796	72" CSP Culvert	167	25	103	109	379.0	378.4	379.2	378.5		
RSA1150A2	72797	72796	72" CSP Culvert	155	25	104	111	379.0	378.4	379.2	378.5		
RSA1150ARD	72797	72796	Roadway	160		0	0	379.0	379.0	379.2	379.2		
RSA1150B	72734	72797	Natural	3273	25	199	210	382.8	379.0	382.9	379.2		
RSA1160A.1	72733	72734	Bridge	92	25	156	167	382.9	382.8	383.0	382.9		
RSA1160ARD	72733	72734	Roadway	92		0	0	382.8	382.8	382.9	382.9		
RSA1160B	72732	72733	Natural	165	25	152	161	382.8	382.7	382.9	382.8	10-yr Existing	A1-8
RSA1160C1	72731	72732	60" CSP Culvert	61	25	76	81	383.0	382.8	383.1	382.9		
RSA1160C2	72731	72732	60" CSP Culvert	61	25	76	81	383.0	382.8	383.1	382.9		
RSA1160CRD	72731	72732	Roadway	61		0	0	382.8	382.8	382.9	382.9		
RSA1160D	72730	72731	Natural	769	25	150	160	383.3	383.0	383.5	383.1	10-yr Existing	A1-8 and A1-9
RSA1160E1	72729	72730	72" CMP Culvert	89	25	74	79	383.5	383.3	383.8	383.5		
RSA1160E2	72729	72730	72" CMP Culvert	89	25	75	80	383.5	383.3	383.8	383.5		
RSA1160ERD	72729	72730	Roadway	89		0	0	383.3	383.3	383.5	383.5		
RSA1160F	71940	72729	Natural	1207	25	149	159	383.6	383.5	383.8	383.8	10-yr Existing	A1-8
RSA1160G.1	71941	71940	60" x 144" CMP Culvert	61	25	155	165	384.0	383.6	384.2	383.8		
RSA1160GRD	71941	71940	Roadway	61		0	0	383.6	383.6	383.8	383.8		
RSA1160H	72726	71941	Natural	650	25	159	170	384.1	384.0	384.4	384.2	10-yr Existing	A1-8 and A1-9
RSA1170A	72736	72734	Natural	610	10	76	79	382.7	382.6	382.8	382.8		
RSA1170B.1	72101	72736	60" CSP Culvert	140	25	25	25	382.7	382.7	382.8	382.8		
RSA1170BRD	72101	72736	Roadway	140		0	0	382.7	382.7	382.8	382.8		
RSA1170C	72735	72736	Natural	2200	10	18	18	384.0	382.7	384.0	382.8		
RSA1170D.1	72100	72735	36" CSP Culvert	150	25	19	19	385.1	384.0	385.1	384.0		
RSA1170DRD	72100	72735	Roadway	150		0	0	384.0	384.0	384.0	384.0		

TABLE 3-2
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Peak Flow (cfs) For Design Storm		Water Surface Elevation For Design Storm (ft)				When Deficient	CIP # to Address Problems
								Existing Land Use		Future Land Use			
	US	DS				Existing	Future	US	DS	US	DS		
RSA1200A1	72725	72726	60" CMP Culvert	200	25	69	74	384.7	384.1	385.1	384.4		
RSA1200A2	72725	72726	60" CMP Culvert	200	25	68	73	384.7	384.1	385.1	384.4		
RSA1200ARD	72725	72726	Roadway	200		0	0	384.1	384.1	384.4	384.4		
RSA1200B	72724	72725	Natural	950	25	142	151	384.8	384.7	385.1	385.1		
RSA1230A.1	72723	72724	60" CMP Culvert	136	25	158	168	387.6	384.8	388.1	385.1		
RSA1230ARD	72723	72724	Roadway	136		0	0	384.8	384.8	385.1	385.1		
RSA1230B	72722	72723	Natural	900	25	149	159	387.7	387.6	388.1	388.1		
RSA1230C	72721	72722	Natural	1400	25	172	185	387.8	387.7	388.2	388.1		
RSA1230D1	72720	72721	36" CSP Culvert	68	25	62	68	389.3	387.8	390.0	388.2		
RSA1230D2	72720	72721	36" CSP Culvert	68	25	62	68	389.3	387.8	390.0	388.2		
RSA1230D3	72720	72721	36" CSP Culvert	68	25	62	68	389.3	387.8	390.0	388.2		
RSA1230DRD	72720	72721	Roadway	68		0	0	387.8	387.8	388.2	388.2		
RSA1230E	72719	72720	Natural	900	25	198	217	389.4	389.3	390.1	390.0		
RSA1060F.1	85030	71215	48" CMP Culvert	30	10	23	27	368.8	368.8	369.0	368.9		
RSA1060FRD	85030	71215	Roadway	30		0	0	368.8	368.8	368.9	368.9		
RSA1060Fa	71214	85030	Natural	415	10	23	26	369.7	368.8	369.7	369.0		
RSA1060G1	71213	71214	18" CMP Culvert	31	10	12	13	371.6	369.7	371.8	369.7		
RSA1060G2	71213	71214	24" CMP Culvert	28	10	11	13	371.6	370.1	371.8	370.2		
RSA1060GRD	71213	71214	Roadway	31		0	0	369.7	369.7	369.7	369.7		
RSA1060H	71212	71213	Natural	1034	10	23	27	371.8	371.6	372.0	371.8	25-yr Winter Future	A1-7 & A1-3
RSA1060I1	71211	71212	18" CMP Culvert	42	10	11	13	372.4	371.8	372.7	372.0		
RSA1060I2	71211	71212	18" CMP Culvert	42	10	12	15	372.4	371.8	372.7	372.0		
RSA1060IRD	71211	71212	Roadway	42		0	0	371.8	371.8	372.0	372.0		

TABLE 3-2
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Peak Flow (cfs) For Design Storm		Water Surface Elevation For Design Storm (ft)				When Deficient	CIP # to Address Problems
								Existing Land Use		Future Land Use			
	US	DS				Existing	Future	US	DS	US	DS		
RSA1060J	71210	71211	Natural	712	10	24	28	373.5	372.4	373.6	372.7		
RSA1060S.1	85031	71210	36" x 72" CMP Culvert	18	10	32	33	373.8	373.5	373.9	373.6		
RSA1060Sa	71209	85031	Natural	586	10	32	33	374.0	373.8	374.0	373.9		
RSA1060SRD	85031	71210	Roadway	18		0	0	373.5	373.5	373.6	373.6		
RSA1060U	72749	71209	Natural	308	10	55	57	374.2	374.0	374.3	374.0	10-yr Existing	A1-6, A1-7 & A1-3
RSA1080A.1	72748	72749	48" CMP Culvert	40	10	55	57	374.9	374.2	375.0	374.3		
RSA1080ARD	72748	72749	Roadway	40		0	0	374.2	374.2	374.3	374.3		
RSA1080B	72791	72748	Natural	1857	10	29	32	375.7	374.9	375.9	375.0	10-yr Existing	A1-6, A1-7, A1-9 & A1-3
RSA1090A.1	72790	72791	36" CMP Culvert	438	10	29	31	378.7	375.7	379.3	375.9	25-yr Winter Future	A1-6, A1-7, A1-2 & A1-3
RSA1090ARD	72790	72791	Roadway	438		0	0	375.7	375.7	375.9	375.9		
RSA1090B	72789	72790	Natural	18	10	29	31	378.7	378.7	379.3	379.3	10-yr Existing	A1-1, A1-2 & A1-3
RSA1090C1	72788	72789	27" x 40" CMP Culvert	30	10	14	14	378.7	378.7	379.3	379.3	10-yr Existing	A1-1, A1-2 & A1-3
RSA1090C2	72788	72789	27" x 40" CMP Culvert	30	10	14	14	378.7	378.7	379.3	379.3	10-yr Existing	A1-1, A1-2 & A1-3
RSA1090CRD	72788	72789	Roadway	30		24	30	378.7	378.7	379.3	379.3		
RSA1090D	72787	72788	Natural	386	10	23	25	378.7	378.7	379.3	379.3	10-yr Existing	A1-1, A1-2 & A1-3
RSA1090E1	72786	72787	24" CMP Culvert	40	10	7	7	378.7	378.7	379.3	379.3	10-yr Existing	A1-5 & A1-3
RSA1090E2	72786	72787	24" CMP Culvert	40	10	7	7	378.7	378.7	379.3	379.3	10-yr Existing	A1-5 & A1-3
RSA1090E3	72786	72787	24" CMP Culvert	40	10	7	7	378.7	378.7	379.3	379.3	10-yr Existing	A1-5 & A1-3
RSA1090ERD	72786	72787	Roadway	40		19	23	378.7	378.7	379.3	379.3		
RSA1090F	72785	72786	Natural	772	10	26	28	378.7	378.7	379.3	379.3	10-yr Existing	A1-5 & A1-3
RSA1090G1	72784	72785	36" CMP Culvert	91	10	14	15	378.8	378.7	379.4	379.3		

TABLE 3-2
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Peak Flow (cfs) For Design Storm		Water Surface Elevation For Design Storm (ft)				When Deficient	CIP # to Address Problems
								Existing Land Use		Future Land Use			
	US	DS				Existing	Future	US	DS	US	DS		
RSA1090G2	72784	72785	36" CMP Culvert	91	10	14	15	378.8	378.7	379.4	379.3		
RSA1090GRD	72784	72785	Roadway	91		0	0	378.7	378.7	379.3	379.3		
RSA1100A	72783	72784	Natural	19	10	14	17	378.8	378.8	379.4	379.4		
RSA1100B.1	72782	72783	24" x 42" CMP Culvert	858	10	13	17	379.0	378.8	379.6	379.4	25-yr Winter Future	A1-5 & A1-3
RSA1100BRD	72782	72783	Roadway	800		0	0	378.8	378.8	379.4	379.4		
RSA1100C	72781	72782	Natural	9	10	13	16	379.1	379.0	379.6	379.6	10-yr Existing	A1-5 & A1-3
RSA1100D.1	72780	72781	30" CSP Culvert	24	10	13	16	379.1	379.1	379.7	379.6	25-yr Winter Future	A1-5 & A1-3
RSA1100DRD	72780	72781	Roadway	24		0	0	379.1	379.1	379.6	379.6		
RSA1100E	72793	72780	Natural	133	10	12	15	379.1	379.1	379.7	379.7	10-yr Existing	A1-5 & A1-3
RSA1100F.1	72792	72793	30" CSP Culvert	30	10	13	17	379.2	379.1	379.9	379.7	25-yr Summer Future	A1-5 & A1-3
RSA1100FRD	72792	72793	Roadway	30		0	0	379.1	379.1	379.7	379.7		
RSA1100G	72779	72792	Natural	135	10	13	17	379.2	379.2	379.9	379.9	10-yr Existing	A1-5 & A1-3
RSA1100K	72798	72779	Natural	740	10	6	16	379.2	379.2	379.9	379.9	10-yr Existing	A1-5 & A1-3
RSA1100L.1	72102	72798	36" CMP Culvert	292	10	12	25	379.8	379.2	381.0	379.9		
RSA1100LRD	72102	72798	Roadway	292		0	0	379.2	379.2	379.9	379.9		
RSA1100H	72778	72779	Natural	50	10	13	13	379.2	379.2	379.9	379.9	10-yr Existing	A1-3
RSA1100I.1	72777	72778	24" CMP Culvert	70	25	21	20	381.8	379.6	382.0	380.2	50 ex	A1-4
RSA1100IRD	72777	72778	Roadway	70		0	0	379.6	379.6	380.2	380.2		
RSA1100J	72776	72777	Natural	180	10	15	15	380.3	380.3	380.8	380.8	10-yr Existing	A1-4
RSA1110A1	72103	72776	30" CSP Culvert	280	25	13	13	382.1	381.8	382.2	382.0	25-yr Summer Existing	A1-4
RSA1110A2	72103	72776	30" CSP Culvert	280	25	13	13	382.1	381.8	382.2	382.0	25-yr Summer Existing	A1-4
RSA1110ARD	72103	72776	Roadway	280		0	4	382.1	382.0	382.2	382.0		
RSA1060K	71208	72740	Natural	800	10	25	26	372.3	370.2	372.3	370.3		
RSA1060L	71207	71208	24" CMP Culvert	40	10	8	8	373.5	372.3	373.6	372.3		
RSA1060M	71210	71207	Natural	550	10	10	10	373.5	373.5	373.6	373.6	10-yr Existing	A1-6 & A1-3

TABLE 3-2
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Peak Flow (cfs) For Design Storm		Water Surface Elevation For Design Storm (ft)				When Deficient	CIP # to Address Problems
								Existing Land Use		Future Land Use			
	US	DS				Existing	Future	US	DS	US	DS		
RSA1060N.1	72754	72739	36" CMP Culvert	25	10	20	22	372.0	371.8	372.2	371.9		
RSA1060NRD	72754	72739	Roadway	25		0	0	371.8	371.8	371.9	371.9		
RSA1060O	72753	72754	Natural	320	10	21	22	372.7	372.0	372.7	372.2	100 EX	A1-6 & A1-3
RSA1060P.1	72752	72753	26" x 42" CMP Culvert	40	10	21	22	373.4	372.7	373.4	372.7		
RSA1060PRD	72752	72753	Roadway	40		0	0	372.7	372.7	372.7	372.7		
RSA1060Q	72751	72752	Natural	330	10	21	23	373.5	373.4	373.5	373.4	10-yr Existing	A1-6 & A1-3
RSA1060R.1	72750	72751	36" CMP Culvert	40	10	22	23	373.9	373.5	374.0	373.5		
RSA1060RRD	72750	72751	Roadway	40		0	0	373.5	373.5	373.5	373.5		
RSA1060T	71209	72750	Natural	270	10	22	23	374.0	373.9	374.0	374.0		
RSA1160I.1	59020	72726	60" CMP Culvert	1081	10	37	37	384.3	383.9	384.4	384.1		
RSA1160IRD	59020	72726	Roadway	1081		0	0	384.3	384.3	384.4	384.4		
RSA1210A.1	59021	59020	54" CSP Culvert	560	10	38	38	384.6	384.3	384.7	384.4		
RSA1210ARD	59021	59020	Roadway	560		0	0	384.3	384.3	384.4	384.4		
RSA1210B.1	59112	59021	48" CSP Culvert	1506	10	12	12	384.7	384.6	384.8	384.7		
RSA1210BRD	59112	59021	Roadway	1506		0	0	384.7	384.7	384.8	384.8		
RSA1210C.1	85032	59112	36" CSP Culvert	33	10	13	13	384.8	384.7	384.8	384.8		
RSA1210CRD	85032	59112	Roadway	33		0	0	384.7	384.7	384.8	384.8		
Flat Creek													
RSFC010A	99329	70197	Natural	850	10	57	60	368.0	367.8	368.0	367.8		
RSFC010B1	99330	99329	41' x 60" CMP Culvert	92	10	28	29	368.2	368.0	368.3	368.0		
RSFC010B2	99330	99329	41' x 60" CMP Culvert	92	10	29	31	368.2	368.0	368.3	368.0		
RSFC010BRD	99330	99329	Roadway	92		0	0	368.0	368.0	368.0	368.0		
RSFC020A	72768	99330	Natural	750	10	57	60	368.4	368.2	368.4	368.3		
RSFC020B1	72767	72768	36" CSP Culvert	72	10	28	30	368.7	368.4	368.8	368.4		

TABLE 3-2
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Peak Flow (cfs) For Design Storm		Water Surface Elevation For Design Storm (ft)				When Deficient	CIP # to Address Problems
								Existing Land Use		Future Land Use			
	US	DS				Existing	Future	US	DS	US	DS		
RSFC020B2	72767	72768	36" CSP Culvert	72	10	29	30	368.7	368.4	368.8	368.4		
RSFC020BRD	72767	72768	Roadway	72		0	0	368.4	368.4	368.4	368.4		
RSFC020C	72766	72767	Natural	200	10	41	43	369.0	368.7	369.0	368.8		
RSFC020D1	72765	72766	36" CSP Culvert	68	10	18	19	369.2	369.0	369.3	369.0		
RSFC020D2	72765	72766	36" CSP Culvert	68	10	23	24	369.2	369.0	369.3	369.0		
RSFC020DRD	72765	72766	Roadway	68		0	0	369.0	369.0	369.0	369.0		
RSFC020Da	76952	72765	Natural	233	10	41	43	369.3	369.2	369.4	369.3		
RSFC020Db.	76953	76952	50" x 76" CMP Culvert	63	10	41	43	369.5	369.3	369.6	369.4		
RSFC020DbR	76953	76952	Roadway	63		0	0	369.5	369.5	369.6	369.6		
RSFC020E	72764	76953	Natural	809	10	41	42	369.7	369.5	369.8	369.6		
RSFC020F1	72763	72764	36" x 48" CMP Culvert	65	10	14	15	369.9	369.7	370.0	369.8		
RSFC020F2	72763	72764	36" x 48" CMP Culvert	65	10	12	13	369.9	369.7	370.0	369.8		
RSFC020F3	72763	72764	36" x 48" CMP Culvert	65	10	14	14	369.9	369.7	370.0	369.8		
RSFC020FRD	72763	72764	Roadway	65		0	0	369.7	369.7	369.8	369.8		
RSFC020G	72762	72763	Natural	800	10	42	44	370.1	369.9	370.2	370.0		
RSFC030A1	72761	72762	82" x 84" CSP Culvert	55	10	22	23	370.2	370.1	370.2	370.2		
RSFC030A2	72761	72762	82" x 84" CSP Culvert	55	10	22	23	370.2	370.1	370.2	370.2		
RSFC030ARD	72761	72762	Roadway	55		0	0	370.1	370.1	370.2	370.2		
RSFC030B	72244	72761	Natural	1456	10	18	19	371.0	370.2	371.0	370.2		
RSFC050A	75660	72244	Natural	1294	10	19	20	373.3	371.0	373.3	371.0		
RSFC050B1	75659	75660	24" CSP Culvert	61	10	6	7	373.6	373.3	373.7	373.3		
RSFC050B2	75659	75660	24" CSP Culvert	61	10	7	7	373.6	373.3	373.7	373.3		
RSFC050B3	75659	75660	24" CSP Culvert	61	10	6	6	373.6	373.3	373.7	373.3		

TABLE 3-2
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Peak Flow (cfs) For Design Storm		Water Surface Elevation For Design Storm (ft)				When Deficient	CIP # to Address Problems
								Existing Land Use		Future Land Use			
	US	DS				Existing	Future	US	DS	US	DS		
RSFC050BRD	75659	75660	Roadway	61		0	0	373.6	373.6	373.7	373.7		
RSFC050C	78673	75659	Natural	1056	10	13	13	376.6	373.6	376.7	373.7		
RSFC050D1	75654	78673	12" CSP Culvert	25	10	6	6	378.4	376.6	378.5	376.7		
RSFC050D2	75654	78673	12" CSP Culvert	25	10	3	4	378.4	377.8	378.5	377.8		
RSFC050D3	75654	78673	12" CSP Culvert	25	10	3	4	378.4	377.8	378.5	377.8		
RSFC050DRD	75654	78673	Roadway	25		0	0	376.6	376.6	376.7	376.7		
RSFC050E	72799	75654	Natural	1016	10	15	16	378.4	378.4	378.5	378.5	10-yr Existing	FC-1
RSFC060A.1	72800	72799	30" CSP Culvert	56	10	12	11	378.5	378.4	378.5	378.5		
RSFC060ARD	72800	72799	Roadway	56		0	0	378.4	378.4	378.5	378.5		
RSFC060B	72795	72800	Natural	850	10	6	6	378.5	378.5	378.5	378.5		
RSFC070A.1	72794	72795	30" CSP Culvert	45	5	8	9	378.5	378.5	378.5	378.5		
RSFC070ARD	72794	72795	Roadway	45		0	0	378.5	378.5	378.5	378.5		
Spring Creek													
OFALL#1	72014	76427	Natural	200	25	158	178	362.8	362.8	362.8	362.8		
RSSC010A1	72013	72014	48" x 72" CMP Culvert	51	25	79	89	363.5	362.8	363.7	362.8		
RSSC010A2	72013	72014	48" x 72" CMP Culvert	51	25	79	89	363.5	362.8	363.7	362.8		
RSSC010ARD	72013	72014	Roadway	51		0	0	362.8	362.8	362.8	362.8		
RSSC010B	85033	72013	Natural	150	25	148	167	363.6	363.5	363.8	363.7		
RSSC010D	79483	85033	Natural	392	25	148	167	363.7	363.7	363.9	363.9		
RSSC010Da1	79482	79483	68" x 144" Box Culvert	38	25	74	83	363.7	363.7	364.0	363.9		
RSSC010Da2	79482	79483	68" x 144" Box Culvert	38	25	75	84	363.7	363.7	364.0	363.9		
RSSC010DaR	79482	79483	Roadway	38		0	0	363.7	363.7	363.9	363.9		
RSSC010Db	72012	79482	Natural	1620	25	150	171	364.2	363.7	364.4	364.0		
RSSC010E.1	72011	72012	Natural	13	25	153	174	364.2	364.2	364.5	364.4		
RSSC010ERD	72011	72012	Roadway	13		0	0	364.2	364.2	364.4	364.4		

TABLE 3-2
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Peak Flow (cfs) For Design Storm		Water Surface Elevation For Design Storm (ft)				When Deficient	CIP # to Address Problems
								Existing Land Use		Future Land Use			
	US	DS				Existing	Future	US	DS	US	DS		
RSSC035A	76560	72011	42" CSP Culvert	127	10	14	14	364.2	364.1	364.4	364.3		
RSSC035ARD	76560	72011	Roadway	127		0	0	364.1	364.1	364.3	364.3		
RSSC010F	72010	72011	Natural	100	25	144	164	364.2	364.2	364.5	364.5		
RSSC010G.1	72009	72010	Natural	12	25	144	164	364.4	364.2	364.7	364.5		
RSSC010GRD	72009	72010	Roadway	12		0	0						
RSSC010H	72008	72009	Natural	300	25	144	165	364.7	364.4	365.0	364.7		
RSSC040D	72033	72008	Natural	800	10	12	12	365.1	364.6	365.2	364.8		
RSSC040E.1	72032	72033	40" x 54" CMP Culvert	90	10	12	13	366.3	365.1	366.4	365.2		
RSSC040ERD	72032	72033	Roadway	33		0	0	365.1	365.1	365.2	365.2		
RSSC040F	72031	72032	Natural	530	10	12	13	367.1	366.3	367.1	366.4		
RSSC050A1	72030	72031	48" CMP Culvert	50	10	6	7	367.1	367.1	367.1	367.1		
RSSC050A2	72030	72031	48" CMP Culvert	50	10	6	6	367.1	367.1	367.1	367.1		
RSSC050ARD	72030	72031	Roadway	33		0	0	367.1	367.1	367.1	367.1		
RSSC040A	72007	72008	Natural	120	25	130	149	365.1	364.7	365.3	365.0		
RSSC040B1	72006	72007	30" CSP Culvert	12	25	55	55	367.0	365.1	367.2	365.3	10-yr Existing	SC-1
RSSC040B2	72006	72007	30" CSP Culvert	12	25	55	56	367.0	365.1	367.2	365.3	10-yr Existing	SC-1
RSSC040BRD	72006	72007	Roadway	12		20	40	367.0	367.0	367.2	367.1		
RSSC040C	72005	72006	Natural	800	25	130	149	367.4	367.0	367.6	367.2		
RSSC060A.1	79470	72005	42" CSP Culvert	383	10	53	61	368.6	367.3	369.2	367.5		
RSSC060ARD	79470	72005	Roadway	383		0	0	367.3	367.3	367.5	367.5		
RSSC060B.1	76587	79470	54" CSP Culvert	2906	10	31	33	370.5	368.6	370.7	369.2		
RSSC060BRD	76587	79470	Roadway	2906		0	0	368.6	368.6	369.2	369.2		
RSSC070A.1	76569	76587	48" CMP Culvert	919	10	20	23	371.3	370.5	371.5	370.7		
RSSC070ARD	76569	76587	Roadway	919		0	0	370.5	370.5	370.7	370.7		
RSSC080A.1	76564	76569	36" CSP Culvert	69	10	20	24	371.6	371.3	371.8	371.5		

TABLE 3-2
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM

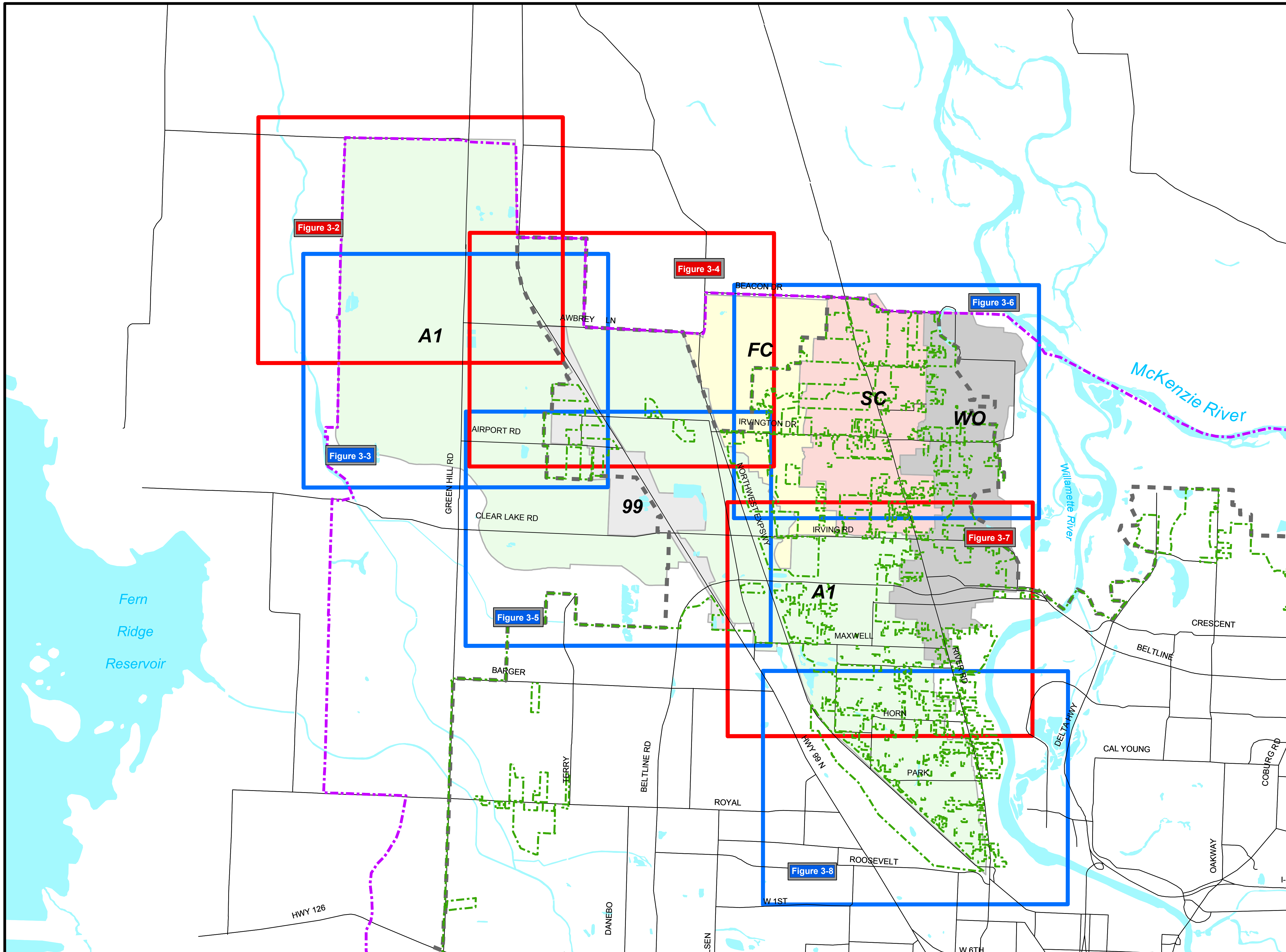
Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Peak Flow (cfs) For Design Storm		Water Surface Elevation For Design Storm (ft)				When Deficient	CIP # to Address Problems
								Existing Land Use		Future Land Use			
	US	DS				Existing	Future	US	DS	US	DS		
RSSC080ARD	76564	76569	Roadway	69		0	0	371.3	371.3	371.5	371.5		
RSSC090A1	72004	72005	48" x 84" Box Culvert	92	10	40	45	367.4	367.3	367.5	367.5		
RSSC090A2	72004	72005	48" x 84" Box Culvert	92	10	40	45	367.4	367.3	367.5	367.5		
RSSC090ARD	72004	72005	Roadway	92		0	0	367.3	367.3	367.5	367.5		
RSSC090B	72003	72004	Natural	2880	10	61	69	370.2	367.4	370.5	367.5		
RSSC100A1	72002	72003	48" CMP Culvert	85	10	32	37	370.5	370.2	370.9	370.5		
RSSC100A2	72002	72003	48" CMP Culvert	85	10	32	37	370.5	370.2	370.9	370.5		
RSSC100ARD	72002	72003	Roadway	85		0	0	370.2	370.2	370.5	370.5		
RSSC100B	75387	72002	Natural	1238	10	54	63	370.6	370.5	370.9	370.9		
RSSC100C.1	75386	75387	48" x 96" Box Culvert	92	10	59	70	370.6	370.6	370.9	370.9		
RSSC100CRD	75386	75387	Roadway	92		0	0	370.6	370.6	370.9	370.9		
RSSC100D	72770	75386	Natural	371	10	61	72	370.6	370.6	371.0	370.9		
RSSC110A	72001	72770	Natural	1700	10	56	60	370.7	370.6	371.0	371.0		
RSSC110B.1	72000	72001	72" CMP Culvert	61	10	65	71	371.3	370.7	371.5	371.0		
RSSC110BRD	72000	72001	Roadway	61		0	0	370.7	370.7	371.0	371.0		
Willamette Overflow													
RSWO010A	99820	72088	Natural	1050	25	109	129	370.7	370.7	370.7	370.7		
RSWO020A.1	99827	99820	36" CSP Culvert	675	5	31	37	372.7	370.7	373.5	370.7	25-yr Summer Existing	OK design=5-yr
RSWO020ARD	99827	99820	Roadway	675		0	0	372.7	372.7	373.5	373.5		
RSWO010B	72086	99820	Natural	1950	10	85	91	370.8	370.7	370.8	370.7		
RSWO040A1	72085	72086	72" CMP Culvert	61	10	7	8	371.1	370.8	371.2	370.8		
RSWO040A2	72085	72086	72" CMP Culvert	61	10	5	7	371.1	370.8	371.2	370.8		
RSWO040A3	72085	72086	60" CMP Culvert	61	10	73	76	371.1	370.8	371.2	370.8		
RSWO040ARD	72085	72086	Roadway	61		0	0	370.8	370.8	370.8	370.8		
RSWO040B	73907	72085	Natural	570	10	85	91	371.2	371.1	371.3	371.2		

TABLE 3-2
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Peak Flow (cfs) For Design Storm		Water Surface Elevation For Design Storm (ft)				When Deficient	CIP # to Address Problems
								Existing Land Use		Future Land Use			
	US	DS				Existing	Future	US	DS	US	DS		
RSWO040C.1	73910	73907	60" CMP Culvert	760	10	83	89	375.1	371.2	375.7	371.3		
RSWO040CRD	73910	73907	Roadway	760		0	0	371.2	371.2	371.3	371.3		
RSWO045A	72084	73910	Natural	570	10	81	87	375.2	375.1	375.7	375.7		
RSWO045B1	72083	72084	72" CMP Culvert	68	10	42	45	375.3	375.2	375.8	375.7		
RSWO045B2	72083	72084	72" CMP Culvert	68	10	40	43	375.3	375.2	375.8	375.7		
RSWO045BRD	72083	72084	Roadway	68		0	0	375.2	375.2	375.7	375.7		
RSWO045C	72082	72083	Natural	850	10	83	90	375.7	375.3	376.1	375.8		
RSWO050A1	72081	72082	72" CSP Culvert	46	10	41	45	375.8	375.7	376.1	376.1		
RSWO050A2	72081	72082	72" CSP Culvert	46	10	43	47	375.8	375.7	376.1	376.1		
RSWO050ARD	72081	72082	Roadway	46		0	0	375.7	375.7	376.1	376.1		
RSWO050B	70615	72081	Natural	1353	10	83	88	377.4	375.8	377.5	376.1		
RSWO050C	72080	70615	Natural	141	10	83	88	378.2	377.4	378.3	377.5		
RSWO060A	74014	72080	Natural	693	10	83	88	378.2	378.2	378.3	378.3		
RSWO060B	74013	74014	Natural	420	10	85	89	378.2	378.2	378.3	378.3		
RSWO070A	74009	74013	Natural	288	10	83	84	378.5	378.2	378.6	378.3		
RSWO070B1	74008	74009	48" CSP Culvert	501	10	29	29	380.2	378.5	380.2	378.6		
RSWO070B2	74008	74009	48" CSP Culvert	501	10	27	27	380.2	378.5	380.2	378.6		
RSWO070B3	74008	74009	48" CSP Culvert	501	10	28	28	380.2	378.6	380.2	378.6		
RSWO070BRD	74008	74009	Roadway	501		0	0	378.5	378.5	378.6	378.6		
RSWO070C	74007	74008	Natural	826	10	83	85	381.1	380.2	381.2	380.2		
RSWO070D.1	74006	74007	18" CMP Culvert	253	10	9	9	386.7	381.1	386.7	381.2	10-yr Existing	WO-1 & WO-5
RSWO070DRD	74006	74007	Roadway	250		75	77	386.7	386.4	386.7	386.4		
RSWO070E	74005	74006	Natural	296	10	83	85	386.7	386.7	386.7	386.7	10-yr Existing	WO-1 & WO-5
RSWO080A.1	74004	74005	48" CSP Culvert	43	10	83	85	387.5	386.7	387.5	386.7		
RSWO080ARD	74004	74005	Roadway	43		0	0	386.7	386.7	386.7	386.7		

TABLE 3-2
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Peak Flow (cfs) For Design Storm		Water Surface Elevation For Design Storm (ft)				When Deficient	CIP # to Address Problems
								Existing Land Use		Future Land Use			
	US	DS				Existing	Future	US	DS	US	DS		
RSWO090A	78833	74004	Natural	197	10	69	70	387.5	387.5	387.5	387.5	10-yr Existing	WO-3, WO-4, & WO-5
RSWO090Aa	74003	78833	Natural	208	10	68	70	387.5	387.5	387.6	387.5	10-yr Existing	WO-3, WO-4, & WO-5
RSWO090B	75433	74003	Natural	153	10	68	69	387.6	387.5	387.6	387.6	10-yr Existing	WO-3, WO-4, & WO-5
RSWO090C	74001	75433	Natural	112	10	68	69	387.6	387.6	387.6	387.6	10-yr Existing	WO-3, WO-4, & WO-5
RSWO090D	74405	74001	Natural	251	10	67	68	387.6	387.6	387.6	387.6		
RSWO090E.1	74406	74405	84" x 120" CMP Culvert	71	10	63	64	387.6	387.6	387.7	387.6		
RSWO090ERD	74406	74405	Roadway	71		0	0	387.6	387.6	387.7	387.7		
RSWO090F	76415	74406	Natural	146	10	63	64	387.6	387.6	387.7	387.7	10-yr Existing	WO-3 & WO-5
RSWO090G.1	76414	76415	84" x 120" CMP Culvert	57	10	63	64	387.6	387.6	387.7	387.7		
RSWO090GRD	76414	76415	Roadway	57		0	0	387.6	387.6	387.7	387.7		
RSWO090H	58287	76414	Natural	116	10	62	64	387.6	387.6	387.7	387.7	10-yr Existing	WO-3 & WO-5
RSWO110A.1	58310	58287	36" CSP Culvert	47	10	62	64	389.2	387.6	389.3	387.7		
RSWO110ARD	58310	58287	Roadway	26		0	0	387.6	387.6	387.7	387.7		
RSWO110B.1	58311	58310	54" CSP Culvert	387	10	62	64	389.7	389.2	389.9	389.3	10-yr Future	WO-2 & WO-5
RSWO110BRD	58311	58310	Roadway	388		0	1	389.2	389.2	389.9	389.8		
RSWO110C.1	58315	58311	27" CSP Culvert	1155	10	5	7	389.6	389.7	389.9	389.9	10-yr Future	WO-2 & WO-5
RSWO110CRD	58315	58311	Roadway	1154		0	4	389.6	389.7	389.9	389.9		
RSWO140	77703	58311	54" CSP Culvert	544	10	64	66	390.3	389.7	390.5	389.9		



River Road/ Santa Clara Basin Drainage System

INDEX MAP

This index map shows the layout of the River Road/Santa Clara basin for the seven geographic areas depicted on Figures 3-2 through 3-8. These figures contain detailed drainage system information for areas within the city limits and urban growth boundary (UGB).

LEGEND

Eugene City Limits
Urban Growth Boundary
Eugene Plan Boundary

Basin Map Coverage
(Alternating color borders to distinquish overlapping areas.)

River Road/Santa Clara Basin Major RR-SC Subbasins

99 = Highway
A1 = A1 Channel
FC = Flat Creek
SC = Spring Creek
WO = Willamette Overflow

N W E S

EUGENE

LANE COUNTY OREGON

1 inch = 0.8 mile
0.4 0 0.4 0.8 Miles

Produced by Lane County Public Works GIS - March 2009
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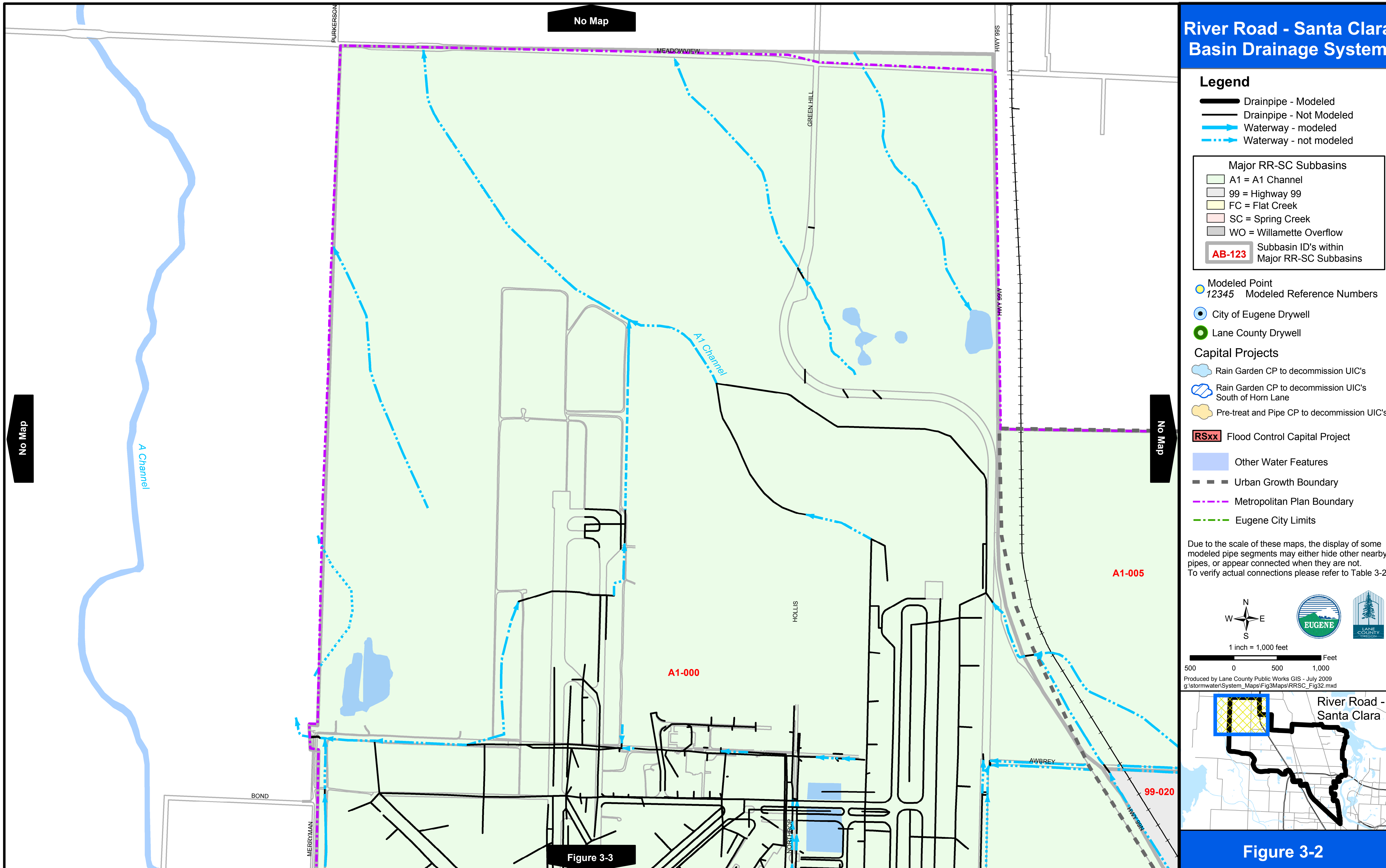
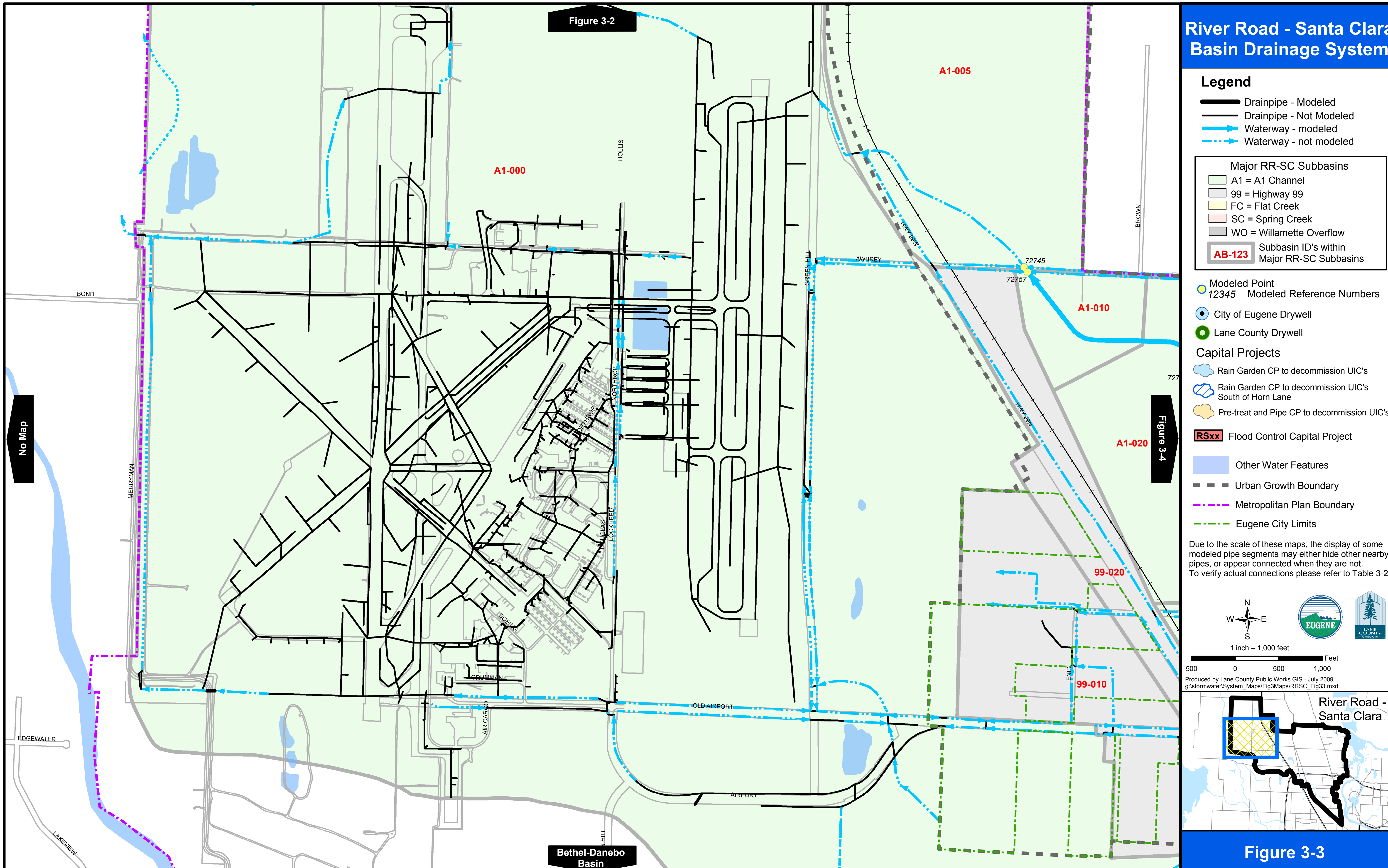
Figure 3-1


River Road - Santa Clara Basin Drainage System
Legend
Drainpipe - Modeled
Drainpipe - Not Modeled
Waterway - modeled
Waterway - not modeled
Major RR-SC Subbasins
A1 = A1 Channel
99 = Highway 99
FC = Flat Creek
SC = Spring Creek
WO = Willamette Overflow
AB-123
Subbasin ID's within Major RR-SC Subbasins
Modeled Point
12345 Modeled Reference Numbers
City of Eugene Drywell
Lane County Drywell
Capital Projects
Rain Garden CP to decommission UIC's
Rain Garden CP to decommission UIC's South of Horn Lane
Pre-treat and Pipe CP to decommission UIC's
RSxx
Flood Control Capital Project
Other Water Features
Urban Growth Boundary
Metropolitan Plan Boundary
Eugene City Limits
Due to the scale of these maps, the display of some modeled pipe segments may either hide other nearby pipes, or appear connected when they are not.
To verify actual connections please refer to Table 3-2.
N
W
E
S
1 inch = 1,000 feet
Feet
500
0
500
1,000
Produced by Lane County Public Works GIS - July 2009
g:\stormwater\System_Maps\Fig3Maps\RRSC_Fig32.mxd
EUGENE
LANE COUNTY OREGON
River Road - Santa Clara
Figure 3-2
No Map
No Map
No Map
Figure 3-3
PURKERSON
MEADOWVIEW
GREEN HILL
HWY 99S
HWY 99W
A Channel
A1 Channel
HOLLIS
A1-000
A1-005
99-020
AWBREY
BOND
MERRYMAN
NORTHROP
HWY 99N



River Road - Santa Clara Basin Drainage System
Legend
Drainpipe - Modeled
Drainpipe - Not Modeled
Waterway - modeled
Waterway - not modeled
Major RR-SC Subbasins
A1 = A1 Channel
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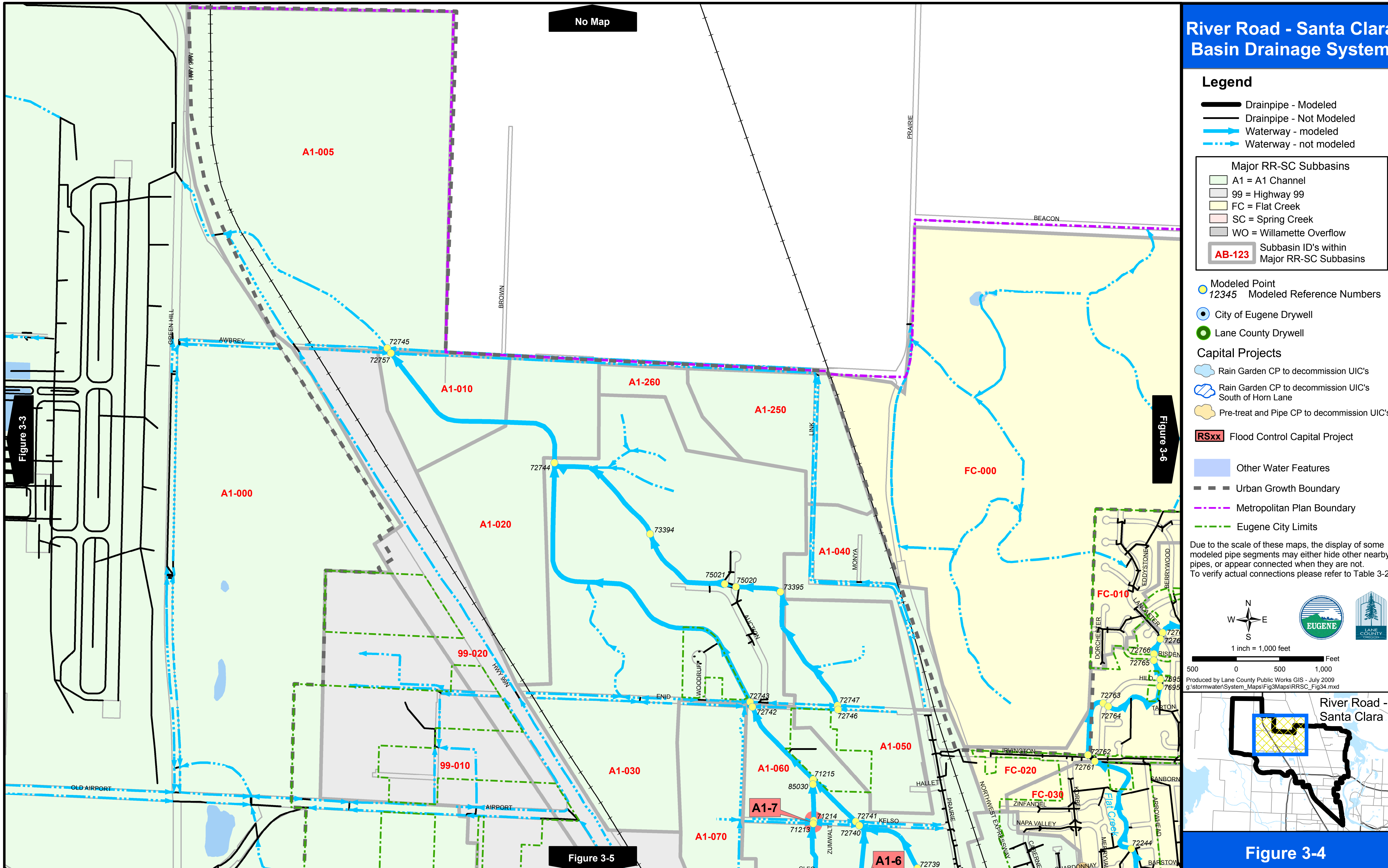
N
W
E
S
1 inch = 1,000 feet
500
0
500
1,000
Feet
EUGENE
LANE COUNTY OREGON
Produced by Lane County Public Works GIS - July 2009
g:\stormwater\System_Maps\Fig3Maps\RRSC_Fig33.mxd
River Road - Santa Clara
Figure 3-2
No Map
Figure 3-4
Bethel-Danebo Basin
A1-000
A1-005
A1-010
A1-020
99-020
99-010
72745
72757
HOLLIS
BOND
MERRYMAN
AWBREY
GREEN HILL
HWY 99N
BROWN
NORTHROP
DOUGLAS
LOCKHEED
BOEING
GRUMMAN
AIR CARGO
OLD AIRPORT
AIRPORT
ENID
EDGEWATER
LAKEVIEW

Figure 3-3


River Road - Santa Clara Basin Drainage System
Legend
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N
W
E
S
1 inch = 1,000 feet
500 0 500 1,000 Feet
EUGENE
LANE COUNTY OREGON
Produced by Lane County Public Works GIS - July 2009
g:\stormwater\System_Maps\Fig3Maps\RRSC_Fig34.mxd
River Road - Santa Clara
Figure 3-4
No Map
Figure 3-3
Figure 3-5
Figure 3-6
A1-005
A1-010
A1-260
A1-250
A1-000
A1-020
A1-040
FC-000
FC-010
99-020
99-010
A1-030
A1-060
A1-050
FC-020
FC-030
A1-070
A1-7
A1-6
AWBREY
BEACON
ENID
OLD AIRPORT
AIRPORT
KELSO
IRVINGTON
HALLET
PRAIRIE
BROWN
GREEN HILL
HWY 99W
HWY 99N
NORTHWEST EXPRESSWAY
Flat Creek
72745
72757
72744
73394
75021
75020
73395
72743
72742
72747
72746
71215
85030
71214
71213
72741
72740
72739
72763
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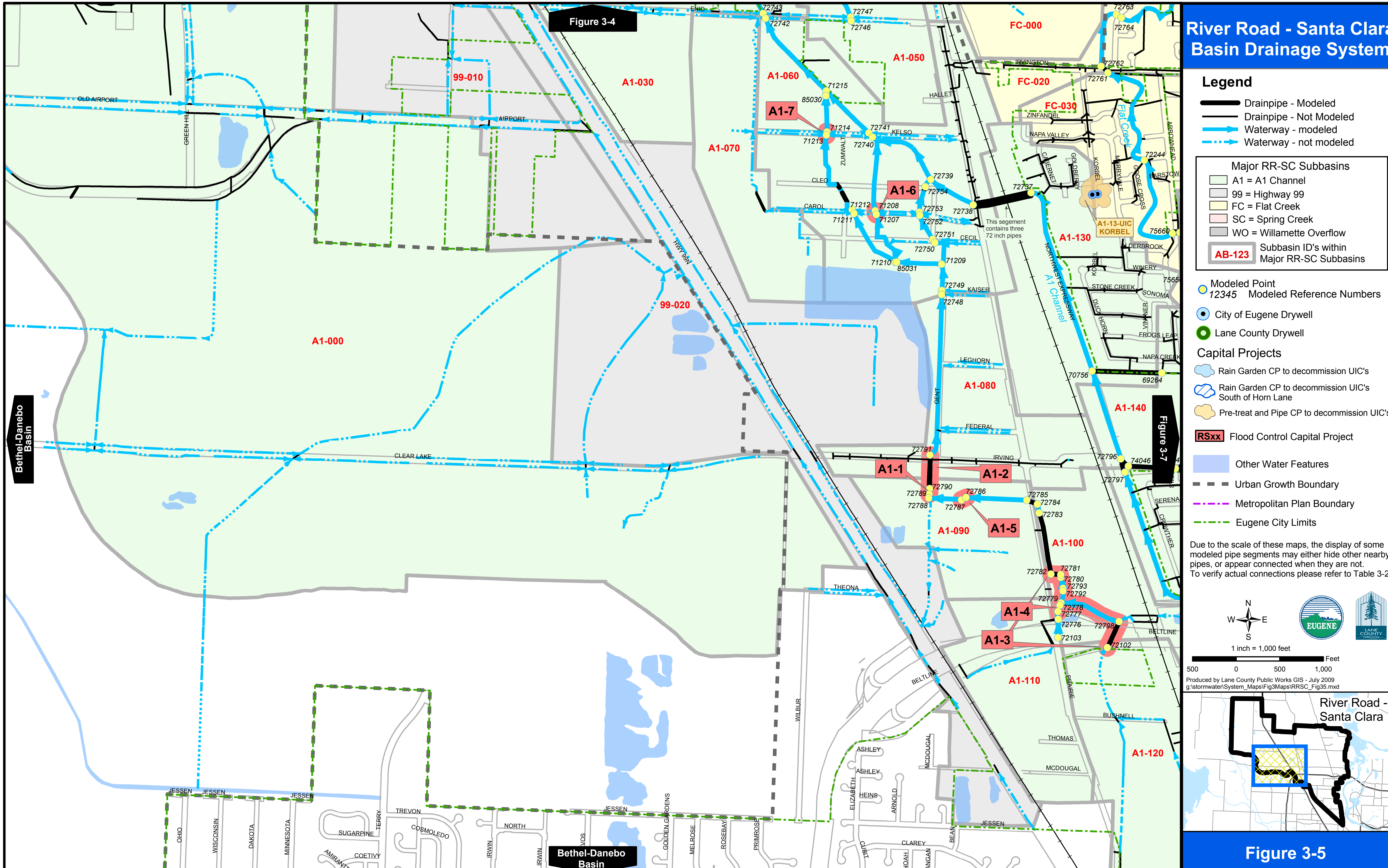
72762
72761
72766
72765
72244



River Road - Santa Clara Basin Drainage System
Legend
Drainpipe - Modeled
Drainpipe - Not Modeled
Waterway - modeled
Waterway - not modeled
Major RR-SC Subbasins
A1 = A1 Channel
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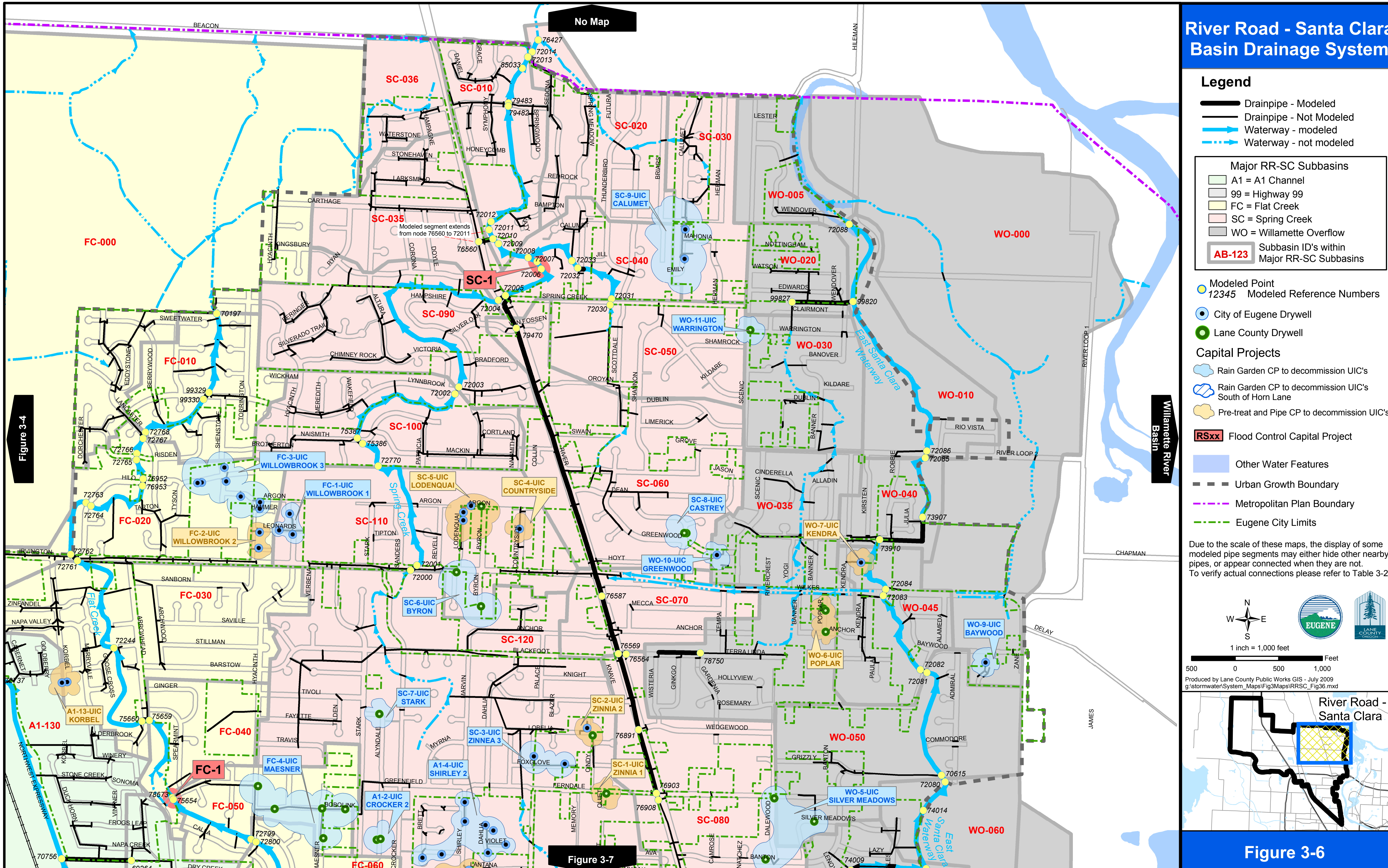
1 inch = 1,000 feet
500 0 500 1,000 Feet
Produced by Lane County Public Works GIS - July 2009
g:\stormwater\System_Maps\Fig3Maps\RRSC_Fig35.mxd
EUGENE
LANE COUNTY OREGON
River Road - Santa Clara
Figure 3-5
Figure 3-4
Figure 3-7
Bethel-Danebo Basin
A1-000
A1-030
A1-050
A1-060
A1-070
A1-080
A1-090
A1-100
A1-110
A1-120
A1-130
A1-140
99-010
99-020
FC-000
FC-020
FC-030
A1-1
A1-2
A1-3
A1-4
A1-5
A1-6
A1-7
A1-13-UIC KORBEL
This segement contains three 72 inch pipes
A1 Channel
Flat Creek
OLD AIRPORT
AIRPORT
CLEAR LAKE
IRVING
BELTLINE
JESSEN
HWY 99N
NORTHWEST EXPRESSWAY



River Road - Santa Clara Basin Drainage System
Legend
Drainpipe - Modeled
Drainpipe - Not Modeled
Waterway - modeled
Waterway - not modeled
Major RR-SC Subbasins
A1 = A1 Channel
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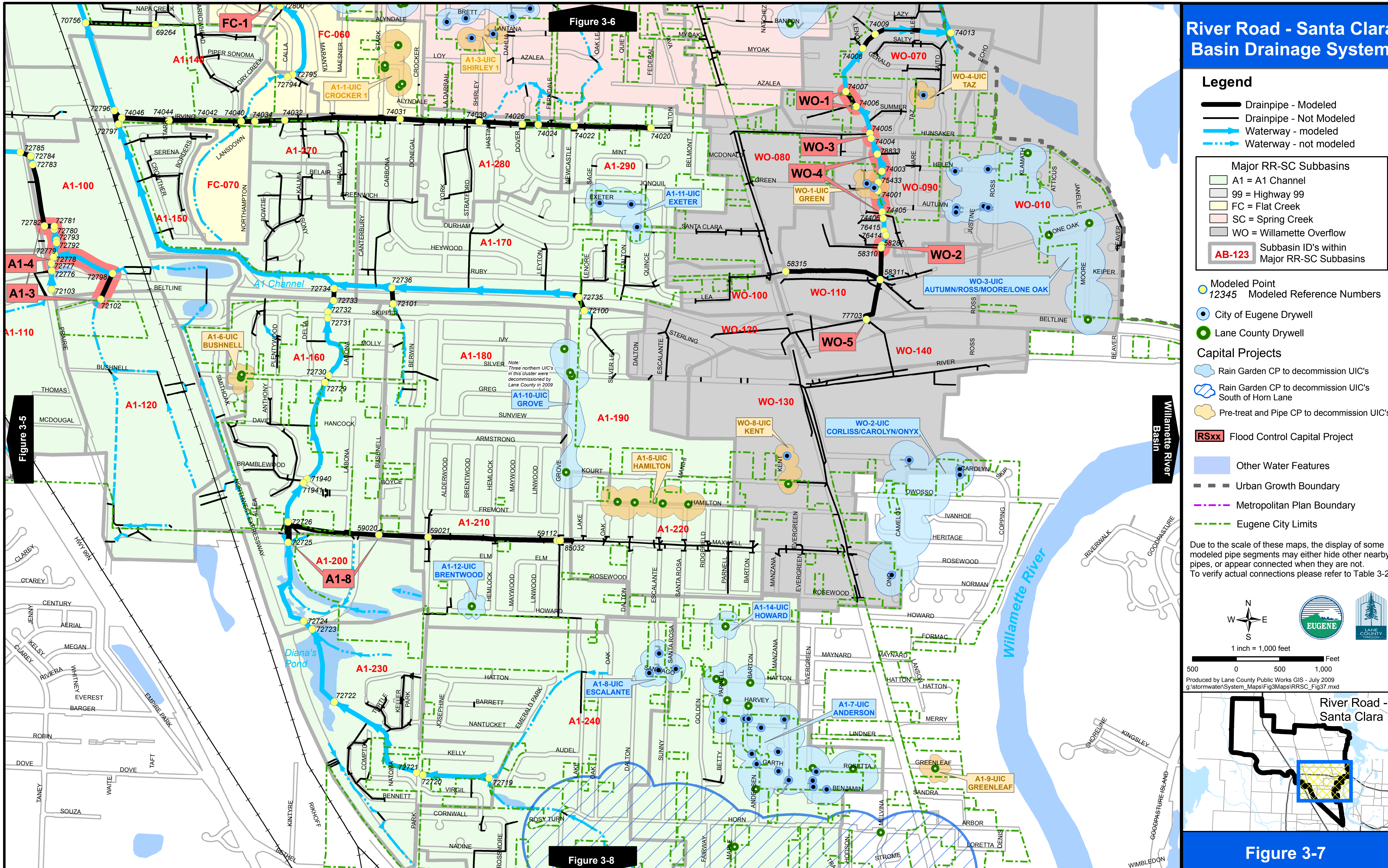
1 inch = 1,000 feet
500 0 500 1,000 Feet
Produced by Lane County Public Works GIS - July 2009
g:\stormwater\System_Maps\Fig3Maps\RRSC_Fig36.mxd
River Road - Santa Clara
No Map
Figure 3-4
Figure 3-7
Willamette River Basin
Modeled segment extends from node 76560 to 72011
SC-1
FC-1
Spring Creek
Flat Creek
East Santa Clara Waterway
FC-000
FC-010
FC-020
FC-030
FC-040
FC-050
FC-060
A1-130
SC-010
SC-020
SC-030
SC-035
SC-036
SC-040
SC-050
SC-060
SC-070
SC-080
SC-090
SC-100
SC-110
SC-120
WO-000
WO-005
WO-010
WO-020
WO-030
WO-035
WO-040
WO-045
WO-050
WO-060

Figure 3-6



River Road - Santa Clara Basin Drainage System
Legend
Drainpipe - Modeled
Drainpipe - Not Modeled
Waterway - modeled
Waterway - not modeled
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Metropolitan Plan Boundary
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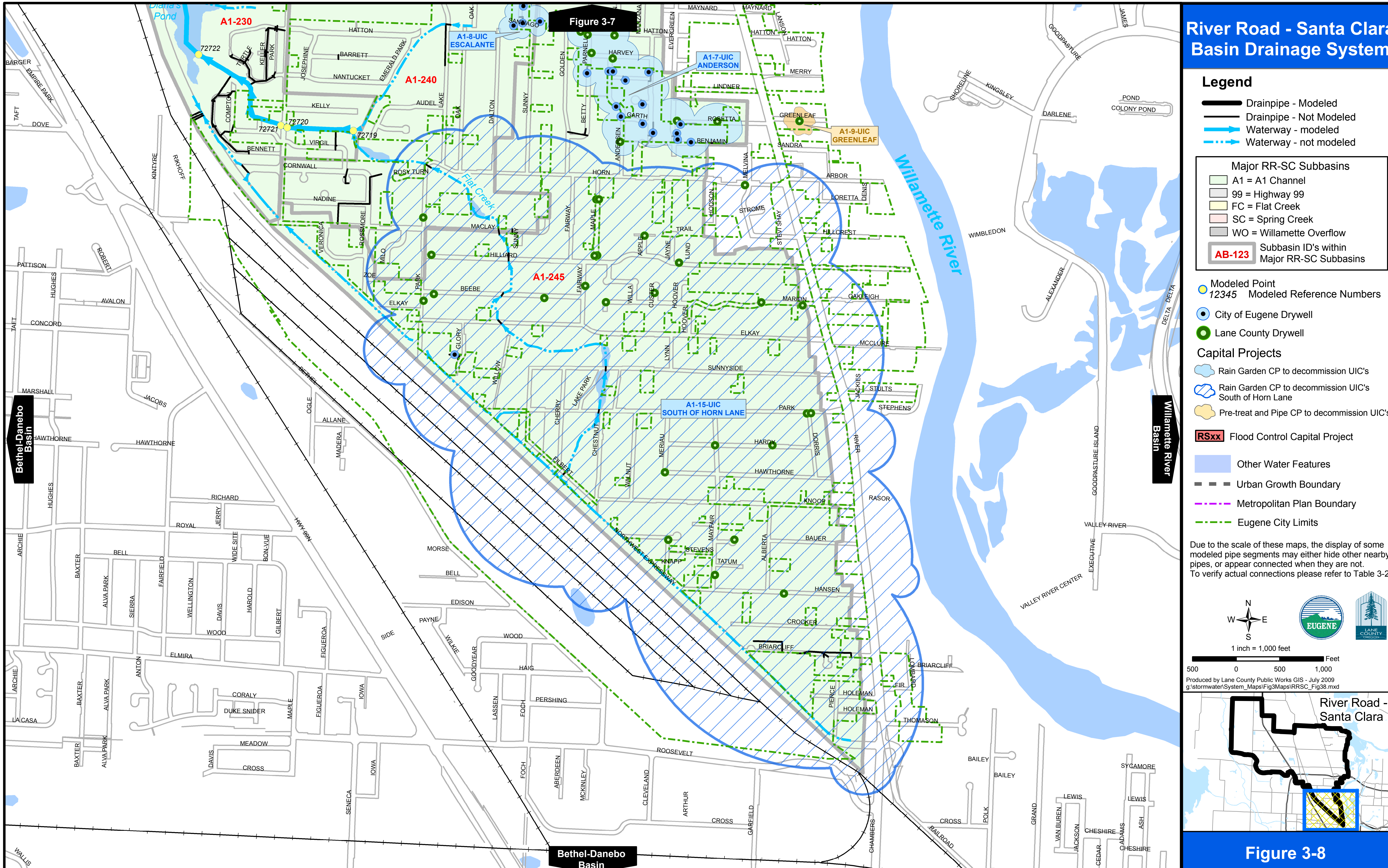
1 inch = 1,000 feet
500 0 500 1,000 Feet
Produced by Lane County Public Works GIS - July 2009
g:\stormwater\System_Maps\Fig3Maps\RRSC_Fig37.mxd
River Road - Santa Clara
Figure 3-6
Figure 3-5
Figure 3-8
Willamette River Basin
A1 Channel
Diana's Pond
Willamette River
Figure 3-7



River Road - Santa Clara Basin Drainage System
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Drainpipe - Not Modeled
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Waterway - not modeled
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1 inch = 1,000 feet
500 0 500 1,000
Feet
Produced by Lane County Public Works GIS - July 2009
g:\stormwater\System_Maps\Fig3Maps\RRSC_Fig38.mxd
River Road - Santa Clara
Figure 3-7
Bethel-Danebo Basin
Willamette River Basin
Willamette River
Flat Creek
Diana's Pond
A1-230
A1-240
A1-245
A1-8-UIC ESCALANTE
A1-7-UIC ANDERSON
A1-9-UIC GREENLEAF
A1-15-UIC SOUTH OF HORN LANE
72722
72721
72720
72719

Figure 3-8

While a very general characterization of water quality in this basin is described in Section 2.6, this section includes discussion of water quality in more detail. Section 4.1 starts off by providing detailed information related to regulatory drivers associated with water quality in the basin. Section 4.2 provides a description and results of the processes that were used to evaluate water quality with respect to both surface and groundwater discharges. And, finally, Section 4.3 describes the capital project alternatives and development standards that were considered and selected to address the identified water quality issues.

4.1 Regulatory Drivers Related to Water Quality

Two federal acts, the Clean Water Act (CWA) and the Safe Drinking Water Act (SDWA), regulate the discharge of urban stormwater runoff. The CWA regulates discharges of urban stormwater to surface waters, and the SDWA regulates the discharges of urban stormwater to the subsurface or groundwaters. This section describes each of these regulatory drivers with respect to stormwater management in the River Road Santa Clara basin.

4.1.1 Stormwater Discharges to Surface Waters

In the early 1990s, the Federal Clean Water Act required municipalities with populations greater than 100,000 to apply for and obtain a National Pollutant Discharge Elimination System (NPDES) permit for their stormwater discharges. In Oregon, this program was delegated to the Oregon Department of Environmental Quality (DEQ). As a result, DEQ directed jurisdictions in six Oregon urban areas to apply for and obtain a Phase I municipal NPDES stormwater permit. The City of Eugene was one of the jurisdictions required to obtain a Phase I permit. In December 1999, EPA adopted rules to implement “Phase II” of the stormwater program. Phase II expanded the stormwater permitting program to include smaller communities located in U.S. census-defined urban areas. Lane County was included as one of the smaller jurisdictions required to obtain a Phase II MS4 NPDES permit. The City of Eugene obtained its first Phase I permit in November, 1994; and Lane County received its Phase II permit in January, 2007. In the River Road Santa Clara Stormwater Basin, Lane County’s Phase II MS4 NPDES permit covers the areas inside the UGB not covered by the City of Eugene’s Phase I NPDES permit.

The municipal NPDES stormwater permits initially required municipalities to perform a review of their stormwater systems including mapping, outfall inventories, and for the Phase I communities, monitoring of stormwater quality. Based on the results of this review, jurisdictions were then required to develop a Stormwater Management Plan (SWMP). The SWMPs were required to include specific categories of Best Management Practices (BMPs) that should be implemented to reduce the discharge of pollutants to the “maximum extent practicable”. Categories of BMPs included those that addressed public education, public involvement, elimination of illicit discharges, construction site erosion controls, post-construction development standards, and operations and maintenance practices. In addition, the Phase I permits require municipalities to look for opportunities to retrofit their existing systems to address water quality. The development of this basin plan represents one of the City’s BMPs that is identified and listed in their required SWMP. The basin plan also represents a BMP in Lane County’s SWMP.

The other Clean Water Act program related to urban stormwater discharges is the total maximum daily load (TMDL) program. The Oregon Department of Environmental Quality (DEQ) has the responsibility for developing water quality standards that protect beneficial uses of rivers, streams, lakes, and estuaries. Once standards are established, the state monitors water quality and reviews available data and information to determine if these standards are being met and water is protected. Section 303(d) of the Federal Clean Water Act requires each state to develop a list of water bodies that do not meet the standards. The list serves as a guide for developing and implementing watershed pollution reduction plans to achieve water quality standards and protect beneficial uses. These watershed pollution reduction plans are referred to as TMDLs. With respect to the River Road Santa Clara basin, the tributaries in the basin eventually drain to the Willamette River, and the Willamette River has an established TMDL for bacteria, mercury, and temperature. The City and the County have both submitted and obtained DEQ approval on their TMDL implementation plans (see Section 2.6.2). This basin plan and the water quality management measures proposed in Section 4.3 were developed with these regulatory drivers in mind and will help the City and County move in the direction of reducing pollutant loads, improving water quality, and supporting compliance with these regulations.

4.1.2 Stormwater Discharges to the Subsurface (i.e., through drywells)

As described in Section 2.5.4, a portion of stormwater runoff in the basin discharges to the subsurface through the use of drywells. Over the years, drywells have been a management strategy of choice for dealing with drainage in the River Road Santa Clara basin largely due to the flat topography, highly permeable soil conditions, and lack of a continuous storm drainage system. In the regulatory context, these drywells are referred to as Underground Injection Controls (UICs). Injection of water below ground, particularly to underground sources of drinking water, is strictly regulated under the Safe Drinking Water Act (SDWA). Injection systems fall into five classes (Class I-V). Class V is reserved for small injection systems, including stormwater disposal systems such as drywells. As with the CWA, implementation of the SDWA has been delegated to the Oregon Department of Environmental Quality (DEQ).

Infiltration has become increasingly more attractive as a management practice for addressing surface water quality concerns. Therefore, DEQ is concerned that stormwater disposal in underground systems will become more highly utilized. DEQ promulgated new state rules in 2001 to implement the SDWA. One of DEQ's intents in promulgating the new rules was to see that all stormwater management entities exercise the same care with respect to stormwater discharged to the ground that they do with stormwater discharged to surface waters under the NPDES permitting program. The 2001 rules require stormwater management entities to evaluate the quality of water disposed of in all facilities that have a "subsurface fluid distribution system", including dry wells/sumps and infiltration trenches. The program also requires comprehensive stormwater management plans that address: 1) the need for and effectiveness of pre-treatment before injection; 2) spill prevention and control measures designed to minimize immediate harm to underlying aquifers; 3) systematic monitoring and record keeping; and, 4) system performance evaluation. DEQ representatives noted that there are long-standing regulations against groundwater contamination, and that the 2001 UIC program rules were designed to assist stormwater managers in complying with these regulations.

As part of the process to implement the new rules, DEQ required UIC systems (i.e., drywells) to be registered with DEQ by December 31, 1999 (with amnesty for public systems until December 31, 2000). Stormwater UICs are prohibited unless they can be shown to meet criteria for being regarded as "exempt", "authorized by rule", or "authorized by a permit". These three categories of allowable stormwater UICs are described in more detail as follows:

Exempt – Stormwater UICs that are exempt include single residential roof drains and footing drains receiving only rainwater.

Authorized by Rule – Municipalities may apply to have stormwater UICs "rule authorized" if the following criteria are met:

a) No other waste is mixed with the stormwater.
b) Stormwater runoff is minimized.
c) No other disposal option is appropriate. An appropriate method shall protect groundwater quality and may consider management of surface water quality and watershed health issues.
d) No domestic drinking water supply wells are present within 500 feet.
e) No public drinking water supply wells are present within 500 feet or the 2 year time-of-travel whichever is more protective.
f) No soil or groundwater contamination is present.
g) The wells are not deeper than 100 feet and they do not discharge into groundwater or below the highest seasonal groundwater level.
h) A confinement barrier or a natural or engineered filtration medium is present between the base of the injection system and the highest seasonal groundwater level and prevents contaminants from reaching groundwater, or the owner or operator implements best management practices that prevent drainage into the injection system in the event of an accidental spill. (DEQ has suggested that they would like to see 10 feet of separation between the bottom of the drywell and the high groundwater).
i) Design and operation prevents accidental or illicit disposal and temporary blocking is available.

Authorized by Permit - Municipalities may apply to have their stormwater UICs covered by a water pollution control facilities (WPCF) permit. If UICs are not exempt or can not be rule authorized, the permit would provide a mechanism for the municipality to work with DEQ to develop a plan for these UICs, which could include retrofitting the UICs so that they meet "rule authorization" criteria or developing a plan for decommissioning UICs that can not be rule authorized. A WPCF permit would likely include significant requirements for monitoring.

The County evaluated their public drywells and had them registered with DEQ by December, 2001. The City evaluated their public drywells and had them registered with DEQ by November 2001. None of the City or County public drywells met the criteria for being exempt. An initial study conducted by the City as part of the UIC registration process also showed that only 16 (of 78) wells were not likely to be rule authorizable. However, based on more recent DEQ clarification/interpretation of rules with respect to criteria for separation distance to groundwater, it is unlikely that any of the drywells in the basin will meet criteria for rule authorization based on criteria g) and h) from above. An evaluation of the City and County drywells with respect to high groundwater and the presence of a filtration medium between the drywell bottom and the high groundwater was conducted for this basin plan and is provided in Appendix E. Seasonal high groundwater levels were found to be close to the surface in this basin (i.e., approximately 8 feet deep on average). Based on this evaluation, there are several drywells that are expected to be discharging directly to high groundwater, and there were not any drywells where a distance of 10 feet was expected between the bottom of the drywell and the high groundwater level. Therefore, it is likely that most or all of the County and City drywells will eventually require decommissioning. Both the County and City have applied for a WPCF permit with DEQ. A plan to decommission the drywells will be a part of the permit. The decommissioning plan will be based on the management alternatives evaluated and selected as part of this storm drainage master plan and as provided in Section 4.3. As decommissioning projects are being implemented, if further groundwater investigations reveal opportunities to rule authorize drywells, retaining and/or retrofitting selected drywells may be considered. As mentioned previously in Section 3, private drywells are under the authority of DEQ and any decommissioning associated with private drywells (if required) would be directed by DEQ.

4.2 Evaluation of Existing and Expected Future Water Quality Conditions

This section describes water quality conditions in the basin in terms of both pollutant loads and stream stability issues.

<u>Pollutant Loads</u>
To supplement the general water quality information provided in Section 2.6, pollutant loads for total suspended solids (TSS) were calculated for this basin. Although TSS has not been shown to directly relate to all other pollutants, it was used as a general indicator of other pollutants for the purposes of making relative comparisons. The relative values of the TSS load were used to evaluate the impact of drywells on water quality, as drywells infiltrate runoff resulting in a net pollutant load reduction, and to highlight those land uses and drainage areas that appear to contribute the largest pollutant load to receiving waters. The values were also used to evaluate the relative contribution and increase in pollutant loads expected from future development. The methods used to estimate pollutant loads are described in Volume I, Section 3.2.

The pollutant load estimates for the River Road Santa Clara basin are summarized in Figures 4-1 through 4-3 below. As mentioned in Section 2.6, these results are based on stormwater quality monitoring conducted in the City of Eugene. Although none of these data were collected from within the River Road Santa Clara Basin, they provide general information regarding stormwater quality in Eugene and were used in identifying a stormwater management strategy for this basin. The pollutant load estimates are based on the following assumptions: 1) new development would occur without the inclusion of water quality best management practices (consistent assumption used for the other basins, enabling comparison of pollutant estimates between basins): 2) during an average year, all flows from drywells (and, hence pollutant loads) would be infiltrated and would not discharge to surface waters; 3) all drywells were assumed to be located in residential areas; and 4) decommissioning of all drywells would result in those discharges being transferred, untreated, to surface waters. In general, pollutant loads in the River Road Santa Clara basin (based on 2007 land use data) could potentially increase by up to 85% as a result of future development and drywell decommissioning, if treatment and/or other forms of infiltration are not provided for flows associated with drywell decommissioning.

Figure 4-1
Estimated Total Suspended Solids Loads Per Year in the River Road Santa Clara Basin (UGB)

Estimated TSS Pounds Per Year in the River Road Santa Clara Basin	1,000 Pounds	River Road Santa Clara Basin Relative to the Range of TSS Pounds Per Year in Other Eugene Basins
From Existing Development (assuming drywells in place and functioning)	1,403	
Potential Increase from Development of Vacant Land	740	
Potential Increase from Drywell Decommissioning	434	
Total Buildout	2,597	

0 1,000 2,000 3,000 4,000 5,000

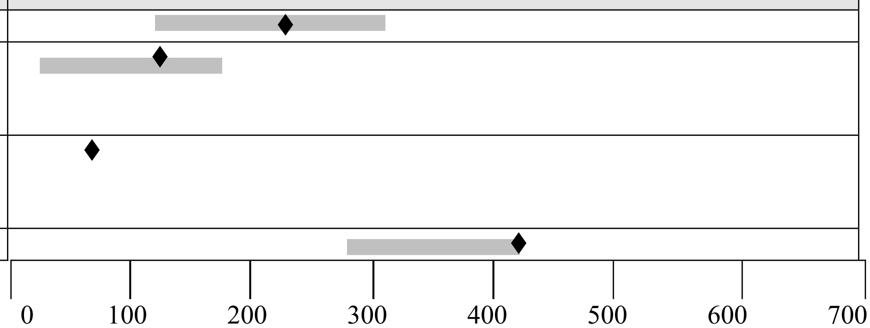
Figure 4-2
Estimated Increases in Total Suspended Solids Loads Associated with Future Buildout in the River Road Santa Clara Basin (within the UGB)

Estimated Increase in TSS Loads	Percent	River Road Santa Clara Basin Relative to the Range of Increase in TSS Loading in Other Eugene Basins
Potential Increase from Future Development	54	
Potential Increase from Drywell Decommissioning	20	
Total Potential Increase	85	

Percentage
0 25 50 75 100 125

Figure 4-3
Estimated Total Suspended Solids Loads Per Acre - Per Year
in the River Road Santa Clara Basin (within the UGB)

Estimated TSS Pounds Per Acre Per Year in the River Road Santa Clara Basin	Pounds per Acre per Year	River Road Santa Clara Basin Relative to the Range of TSS Pounds Per Acre Per Year in Other Eugene Basins
Existing Development	231	
Potential Increase from Development of Vacant Land	126	
Potential Increse from Drywell Decommissioning	71	
Total Buildout	428	



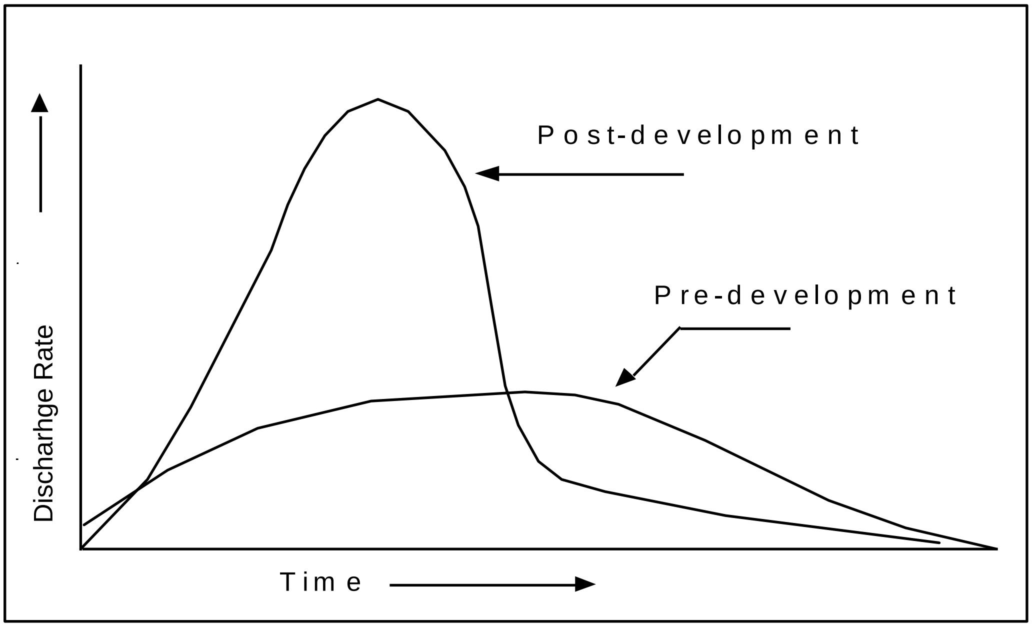
Note: The pollutant load estimates are based on the following assumptions: 1) new development would occur without the inclusion of water quality best management practices: 2) during an average year, all flows from drywells (and, hence pollutant loads) would be infiltrated and would not discharge to surface waters; 3) all drywells were assumed to be located in residential areas; and 4) decommissioning of drywells would result in those discharges being transferred, untreated, to surface waters.

Stream Stability

In addition to pollutant loads discharged to surface waters, an additional water quality issue is streambank erosion. As urbanization occurs, changes to the natural hydrology of an area are inevitable. Hydrologic changes associated with development include both an increase in the volume of runoff and an increase in the peak rate of runoff, as illustrated by the storm hydrograph comparison shown in Figure 4-4. These changes occur in response to site clearing, grading, and the addition of impervious surfaces and maintained landscapes. In addition to hydrologic changes associated with urbanization, activities within and adjacent to waterways such as vegetation removal, construction of retaining walls, weirs, fences, bridges and other features, can affect stream stability and, ultimately, water quality. Collectively, these activities can produce the following impacts to stream corridors:

- An increase in streambank and streambed erosion;
- Increased deposition of newly eroded debris and sediment, which reduces flood conveyance capacity;
- Damage to riparian habitat;
- Reduced streamflows during the dry season as a result of reduced infiltration and hence groundwater recharge;
- Increased water temperatures in the summer due to reduced and hence more shallow streamflows; and
- Increased maintenance needs and liabilities.

Figure 4-4
Comparison of Pre and Post-Development Hydrographs



While some of the waterways in River Road Santa Clara remain relatively undisturbed, many of these conditions have been observed in the basin. Many of the open channel systems in this basin are also lacking vegetated buffers, which is likely impacting stream temperatures. Section 4.3 provides a description of the water quality strategy developed to address both the potential increases in pollutant loads and stream stability issues.

4.3 Development of the Water Quality Strategy

As shown in the stormwater basin master planning process flow chart (Figure 1-1), Step 1 included a compilation of basin characteristics. These basin characteristics are summarized in Section 2.0 of this document. Step 2 in the process included problem identification under both existing and future land use conditions. The results of this step for water quality are provided in Sections 4.1 and 4.2 above. The next steps included the development of potential stormwater management tools (i.e., capital projects or development standards) to address the identified problems. This section describes the capital projects (CPs) and development standards that were considered to address the identified water quality problems.

4.3.1 Capital Project Alternatives

Identifying potential CPs to address water quality concerns is very different from identifying CPs to address flooding issues. With respect to flooding, specific capacity deficiencies are identified through modeling and CPs are proposed to address those deficiencies. With respect to water quality, pollutant discharges associated with urban runoff are ubiquitous. When the city-wide basin planning project was initiated, the focus of developing CP alternatives for water quality was on identifying the best opportunity areas for the siting of water quality CPs in developed areas that would not be affected by stormwater development standards except over the very long term through re-development, and developed areas with high pollutant source land uses such as commercial and industrial uses. This effort included identifying areas with the following characteristics: 1) largely developed areas with little remaining vacant land; 2) densely developed high pollutant source areas; 3) sufficient space available for a surface water quality facility; 4) the space that was available is publicly owned or vacant and potentially available for purchase; and 5) the location could potentially be used to construct a CP that addresses objectives in addition to water quality control (i.e., flood control, natural resources enhancement, recreation, education).

Given the differences in the River Road Santa Clara basin when compared to the other basins (i.e., the mix of County/City jurisdiction and the significant presence of drywells), the identification of water quality CPs was conducted somewhat differently from the previous basins. The development of water quality CPs was predominantly focused on water quality projects that could be implemented to deal with increases in runoff and pollutant loads associated with the decommissioning of public drywells. Approximately 151 public drywells (79 County and 72 City) will need to be decommissioned to comply with DEQ's UIC rules. Decommissioning of the drywells is expected to be a significant undertaking. Therefore CPs were developed to address the water quality objectives in parallel with the decommissioning effort, especially since the potential decommissioning of public drywells could result in a significant increase in pollutant loads to the surface water system (see Figure 4-2). These proposed CPs are described below under "Water Quality CPs Associated with UIC Decommissioning."
Additional water quality CPs were also developed to specifically target high pollutant source areas and stream stability problems that were described in Subsection 4.2 above. These proposed CPs are described below under "Other Water Quality CPs."

<u>Water Quality CPs Associated with UIC Decommissioning</u>
As described in Section 3.0, drywells located in close proximity to each other were grouped into drywell "clusters". This grouping of drywells was conducted because some of the decommissioning options could be applied and constructed in a manner to address a "cluster", as opposed to individual drywells. A total of 39 drywell clusters were identified. The drywell clusters are illustrated on the Stormwater Management Strategy Development map in Appendix H, and listed in Table 3-6, and the location of each of these clusters is also shown in Figures 3-2 through 3-8. As a result of the decommissioning of drywells, alternative systems will be necessary to handle the flows (up to the 5-year, 24 hour design event) that are currently being handled through drywells. CP options were selected for each drywell cluster with the intent of maximizing water quality benefits while addressing increases in flows from a flood control and conveyance standpoint. As described in Section 3.0, three project options were developed to handle the flows from these drywell drainage areas:

1) construct pipes to handle flows and route them to the nearest storm piped system – provide structural pre-treatment as part of the pipe retrofit (Pipe and Pre-treat Option);
2) direct drainage to a neighborhood-scale surface infiltration/rain garden facility for storage and infiltration (Surface Infiltration/Rain Garden Option); or
3) construct on-street rain gardens to handle right-of-way drainage as local street improvements are made (On-Street Rain Garden Option for Local Streets).

More detail regarding each of these three options and the methods that were used for developing the CP conceptual designs and costs is provided as follows:

1) Pipe and Pre-treat Option – All of the drywell clusters were reviewed in terms of selecting the best option for dealing with drainage resulting from decommissioning. Some of the drywells were located in very close proximity to an existing storm drainage pipe and directing the drainage to that pipe appeared to be the most cost-effective option. This option was selected for the following 16 drywell clusters (the list includes the CP IDs that were assigned). It should be noted that this is a planning level analysis and while preliminary invert elevations were confirmed, the project level engineering analysis and design will need to confirm the viability of piped options for decommissioning.

<u>Willamette Overflow Subbasin</u>
WO-1-UIC: Green UIC Cluster
WO-4-UIC: Taz UIC Cluster
WO-6-UIC: Poplar UIC Cluster
WO-7-UIC: Kendra UIC Cluster
WO-8-UIC: Kent UIC Cluster

<u>A1-Channel Subbasin</u>
A1-1-UIC: Crocker 1 UIC Cluster
A1-3-UIC: Shirley 1 UIC Cluster
A1-5-UIC: Hamilton UIC Cluster
A1-6-UIC: Bushnell UIC Cluster
A1-9-UIC: Greenleaf UIC Cluster
A1-13-UIC: Korbel UIC Cluster

<u>Spring Creek Subbasin</u>
SC-1-UIC: Zinnia 1UIC Cluster
SC-2-UIC: Zinnia 2 UIC Cluster
SC-4-UIC: Countryside UIC
SC-5-UIC: Lodenquai UIC Cluster

<u>Flat Creek Subbasin</u>
FC-2-UIC: Willowbrook 2 UIC Cluster

There were two methods used for developing conceptual pretreatment and pipe designs for this category of CPs. The first, and more simple method was used if the drywell or drywells were located in close proximity to an existing pipe system and within the delineated drainage subbasin for that piped system. Given that the XP-SWMM hydrologic model to estimate future flows was already run assuming no drywells (see Section 3.0), the hydrologic results from the model already included flows from the area that would be associated with drywell decommissioning. Therefore, the calculations that were performed to size the pretreatment and pipe system included 1) delineation of the sub-drainage area associated with the drywell; 2) estimation of flow from the sub-drainage area using the Rational Method; and 3) estimation of a pretreatment system size and pipe size (using Manning's equation) based on the calculated flow rate. In some cases, more detailed information was desired regarding the proposed pipe size and length. In these cases, a new pipe was actually included in the XP-SWMM model and iterative model runs were conducted to size the pipe as opposed to using the Rationale Method and Manning's equation. See the design assumptions section of each CP fact sheet in Appendix A for specific sizing methods for each individual CP.

The second method was used if routing of the drywell drainage area to the closest piped system would require a re-delineation of the existing subbasin boundaries. In other words, including a new pipe in the system would result in redirecting some flows into a different subbasin. In these cases, the drywell drainage area was delineated and subtracted from the existing subbasin and moved to the new subbasin that would incorporate the drainage. The model was then run to ensure that capacity would be available to handle the new drainage. Then, either the Rational Method/Manning's Equation, or if more detail was desired, an XP-SWMM model simulation was conducted to size the pretreatment system and pipe.

The CP fact sheets for each of these projects are provided in Appendix A. Construction and retrofit of the piped system provides an opportunity to provide for water quality treatment. Costs of the proposed pretreatment systems (i.e., underground structural devices to provide water quality treatment) are also included along with costs of the proposed pipe systems.

2) Surface Infiltration/Rain Garden Option – Given the flat topography and long distance to the closest piped system for some of the drywell clusters, alternative options were needed to address the decommissioning of drywell clusters in areas north of Horn Lane, where street improvements were not likely to occur in the near future. For these drywell clusters, the proposed option was to route the flows to an area where a neighborhood-scale vegetated infiltration/rain garden type facility could be constructed to handle flows. It should be noted that infiltration of municipal stormwater runoff that occurs through the surface of the ground as opposed to the subsurface is not considered to be a UIC and is therefore not regulated under the Safe Drinking Water Act.

For the modeling conducted and described in Section 3.0, drainage areas were initially delineated for the drywells that were included in the system at the time. The system included the 79 County wells, 46 of the 72 City wells, and 634 private wells. The system (drywell database) was under development and thus 26 of the existing City drywells were not included in this drywell drainage area delineation. These drywell drainage areas that were delineated represented areas draining to multiple drywells (i.e., clusters). Individual drywell drainage areas were not delineated. Based on this information, an average drainage area per drywell was estimated to be 2.70 acres. As drainage areas were only calculated for some of the drywell clusters, use of the average drainage area per drywell allowed for conceptual sizing, design and cost estimating for neighborhood-scale infiltration/rain garden facilities or CPs for all clusters on a normalized basis. Detail regarding the steps conducted to size the rain garden facilities for each cluster is provided as follows:

Step 1) Determine the number of drywells in the cluster.

Example: Number of Drywells in Cluster: 10

Step 2) A drainage area for each drywell cluster needing a surface infiltration/ rain garden CP was estimated based on the number of drywells in the cluster and assuming a 2.70 acre drainage area per drywell.

Example: Drainage Area Per Drywell: 2.7 acres
Total Drainage Area for Example Drywell Cluster: 10 x 2.7 = 27 acres

Step 3) Given the number of drywell clusters and the level of uncertainty associated with the defined drainage areas for each drywell cluster, site-specific rain garden designs (as described above for the on-street, rain garden option) were not developed. Instead, using one of the ROW rain garden configurations (from one of the initial on-street rain garden options), the total drainage area associated with one "rain garden unit" was determined to be 1.12 acres.

Step 4) Given the total drainage area for the drywell cluster, and the drainage area accommodated by one rain garden unit, the number of rain garden units required for treatment of the drywell cluster was estimated.

Example: # of Rain Garden Units Req'd: 27 acres ÷ 1.12 acres = 24 Rain Garden Units

Step 5) The on-street rain gardens were sized to treat only the ROW area within the drainage area. This represented approximately 19% of the entire unit drainage area or 0.21 acres of the 1.12 acres. It was assumed that drainage from the remaining portion of the drainage area would be treated on-site. The rain gardens within one "rain garden unit" were designed to be 12" deep with 3:1 horizontal to vertical side slopes. The 5-year, 24 hour design storm runoff volume from the ROW that would have to be managed by a rain garden was calculated to be approximately 2,120 cubic feet. Assuming a single, rectangular rain garden, the required surface area to manage the required volume of runoff from the 0.21 acres of ROW per rain garden unit is approximately 2,854 square feet. As a result, the rain garden total surface area required to treat runoff from the drywell cluster was estimated.

Example: Rain Garden Surface Area Per Rain Garden Unit: 2,854 ft2
Total Surface Area Req'd: 24 Rain Garden Units x 2,854 ft2 = 68,496ft2 (or 1.6 acres)

Step 6) Finally, assuming each rain garden unit has 2,854 square feet of rain garden, and that construction of one square foot of rain garden (with native soils) is approximately $8.00 (for non-engineered soils), the average cost of rain garden construction per drywell cluster was estimated. It should be noted that the installation of these neighborhood-scale rain gardens could also require land acquisition. The CP cost estimates for neighborhood-scale rain gardens do not include the piping that could potentially be necessary (in addition to the street gutter system) to route flows to the rain garden.

Example: *68,496ft2 x $8/ft2 = $547,968*

Note: If the actual ROW in the drainage area represents a higher or lower percentage of the drainage basin, the rain garden sizes would be somewhat higher or lower. <u>In addition, if engineered soils are used, a cost estimate of $29/square foot should be used (see Appendix D for unit cost tables). These methods for sizing rain gardens that are described above are rough estimates made for conceptual planning purposes.</u>

This neighborhood scale surface infiltration facility/rain garden option was selected for the following 22 drywell clusters (the list includes the CP IDs that were assigned):

<u>Willamette Overflow Subbasin</u>

WO-2-UIC	Corliss/ Carolyn/ Onyx UIC Cluster
WO-3-UIC	Autumn, Ross, Moore/Oak UIC Cluster
WO-5-UIC	Silver Meadows UIC Cluster
WO-9-UIC	Baywood UIC Cluster
WO-10-UIC	Greenwood UIC Cluster
WO-11-UIC	Warrington UIC Cluster

<u>A1- Channel Subbasin</u>

A1-2-UIC	Crocker 2 UIC Cluster
A1-4-UIC	Shirley 2 UIC Cluster
A1-7-UIC	Anderson UIC Cluster
A1-8-UIC	Escalante UIC Cluster
A1-10-UIC	Grove UIC Cluster
A1-11-UIC	Exeter UIC Cluster
A1-12-UIC	Brentwood UIC Cluster
A1-14-UIC	Howard UIC Cluster

<u>Spring Creek Major Subbasin</u>

SC-3-UIC	Zinnia 3 UIC Cluster
SC-6-UIC	Byron UIC Cluster
SC-7-UIC	Stark UIC Cluster
SC-8-UIC	Castrey UIC Cluster
SC-9-UIC	Calumet UIC Cluster

<u>Flat Creek Major Subbasin</u>

FC-1-UIC	Willowbrook 1 UIC Cluster
FC-3-UIC	Willowbrook 3 UIC Cluster
FC-4-UIC	Maesner UIC Cluster

A CP fact sheet for each of these projects is included in Appendix A. It should be noted that at the time of writing of this report, Lane county funding for CPs has not been identified.

3) On-Street Rain Garden Option for Local Streets – The South of Horn Lane drywell cluster includes a relatively large area with many drywells (26 County wells and 1 City well). Almost the entire area within the River Road Santa Clara basin and south of Horn Lane is drained through the use of drywells and informal surface infiltration, except for the area adjacent to and including River Road which is drained through a piped system. In addition, this area reflects a mix of County and City jurisdiction (sometimes on a lot-to-lot basis). As redevelopment and street improvements occur in this area, it is likely that City annexations will also occur. For this area, constructing pretreatment systems and pipes to discharge to the nearest surface drainage was considered to be infeasible due to the flat topography and lack of available capacity in the downstream system. The decommissioning option that was selected for this drywell cluster was to construct street side rain gardens for the storage and infiltration of runoff as local street improvements occur. For this option, individual properties adjacent to the right of way (ROW) would be required to manage their drainage on-site, in accordance with requirements for stormwater in the City of Eugene Code (Chapter 9, Section 9.6791(3)), and the street side rain gardens would be constructed to handle all runoff from the ROW (for a five-year design storm).

Six different concept options were evaluated in terms of providing street side rain gardens for handling drainage from local streets. Each option assumes a base 45-foot ROW width and various initial raingarden configurations. The six initial options were evaluated to determine the amount of additional ROW that would be required to accommodate runoff from the ROW during the 5-year design storm. The six initial options are described according to the following:

1. Shed Cross-Section, Reduced Parking Bays One Side, Sidewalk Opposite Side
2. Shed Cross-Section, Parking Bays One Side, Sidewalk Opposite Side
3. Crown Cross-Section, Reduced Parking Bays One Side, Sidewalk Opposite Side
4. Shed Cross-Section, On-Street Parking, Sidewalk One Side
5. Crown Cross-Section, On-Street Parking, Sidewalk Both Sides
6. Crown Cross-Section, On-Street Parking, Sidewalk One Side

Figures illustrating these six initial options are provided in Appendix F.

Each option was evaluated as one ROW unit, which includes four 50-foot wide residential lots on each side of the street and a base ROW width of 45 feet. For each option, the pervious and impervious areas associated with the ROW were computed, and the Santa Barbara Urban Hydrograph method was used to estimate the volume of runoff that would need to be accommodated by the rain gardens for a 5-year, 24-hour design storm of 3.6” using an SCS Type IA rainfall distribution. Rain garden sizing was based on guidance from Eugene’s manual (Eugene’s Stormwater Management Manual, 2006) for a rain garden facility. The rain gardens were assumed to be 12” deep with a 3:1 horizontal to vertical sideslope. By comparing the volume of runoff generated during the 5-year design storm with the volume of storage associated with the initial rain garden configurations, the initial rain garden configuration did not accommodate all of the volume of runoff as necessary. Therefore, the additional ROW width that would allow for expansion of the initial rain gardens to accommodate the total volume of runoff was determined. As the addition of ROW would also result in the addition of contributing area and runoff to the rain gardens, an iterative sizing process was conducted until the size of the rain gardens would also handle the increases in runoff associated with the expanding ROW. The results of this process and the associated increases in ROW width are summarized in Table 4-1 below for each of the six options.

As a result of this evaluation process and attempts to minimize the required ROW width, Concepts #2, #4, and #6 were selected for potential future implementation. Concepts #1, #3, and #5 were eliminated from further consideration for the following reasons:

Concept #1 – This ROW option was eliminated, as providing sidewalk directly adjacent to the street is not optimal from a safety standpoint.

Concept #3 – This ROW option was eliminated due to the significant amount of additional ROW width that would be required to accommodate a rain garden that would be large enough to manage the runoff from the ROW during the 5-year event.

Concept #5 – This ROW option was also eliminated due to the significant amount of additional ROW that would be required.

Final renderings of the three selected local street concepts (both plan views and cross-section views) including the required ROW widths are provided in Figures 4-5 through 4-10.
CP A1-15-UIC includes the development of street-side rain gardens, and it was selected to address drywell decommissioning for the drywell cluster south of Horn Lane. This project will provide water quality benefits in terms of preventing a significant increase in pollutant loads and hydrologic impacts that would be associated with decommissioning of drywells and routing discharges to surface waters. It should be noted that, while these street-side rain garden concept options for local street improvements were developed to address UIC decommissioning needs, these options are envisioned to be employed for various circumstances beyond UIC-related projects. Implementing the street-side rain garden concepts will require first making some changes to the City's Local Street Plan under a separate process subsequent to completion of the River Road Santa Clara Basin Plan. A decision flowchart was developed as part of this basin planning process, to illustrate the approach to managing stormwater runoff from sites, and where the street-side rain garden approach could be employed. In the broad sense, the approach to managing stormwater runoff from a site, and the potential application of the street-side rain garden concept options, will depend on whether a project is public or private, whether it is for an arterial or collector street, and whether it is for infill or new development. A decision flow chart for the project planning phase, to show where the new local street concepts could be employed, is provided in Figure 4-11.

During the conceptual development of CP A1-15-UIC, for decommissioning drywells south of Horn Lane, a timeline mandate for decommissioning was not known. It was assumed that UIC decommissioning could occur over a decades-long timeframe that could allow for decommissioning to occur in association with street improvements in annexed areas. The Department of Environmental Quality (DEQ) has more recently indicated that decommissioning of all non-compliant UICs will be required in a shorter timeframe – one that will likely require UICs in this area to be decommissioned using individual or clustered Surface Infiltration / Rain-Gardens (Option #2). Due to budget and time concerns for completing this document, The City of Eugene and Lane County have elected not redo the analysis on this UIC cluster at this time.

Table 4-1
Summary of Increased ROW Required for Six Different On-Street Rain Garden Options for Local Streets

ROW Options	Crown	Shed	Number of parking bays per unit	North-Side Sidewalk	North-Side Landscape	North-Side Rain garden	North-Side Curb	North-Side Parking Bays Included?	Travel Lanes	South-Side Parking Spaces Included	South-Side Curb	South-Side Landscape	South-Side Rain garden	South-Side Sidewalk	Base ROW Width	Additional ROW Required for Rain Gardens	Total ROW Required
1 - Shed with parking bays on south and sidewalk on north		X	2	5.0 feet	N/A	N/A	0.5 foot	No	20.0 feet	Yes (1)	0.5 foot	Intermittent	19.0 feet	N/A	45.0 feet	5.0 feet on south	50.0 feet
2 - Shed with parking bays on north and sidewalk on south		X	4	N/A	Intermittent	N/A	0.5 foot	Yes - 7.0 feet	20.0 feet	No	1.0 foot	Intermittent	11.5 feet	5.0 feet	45.0 feet	12.0 feet on south	57.0 feet
3- Crown with parking bays on north and sidewalk on south	X		2	N/A	Intermittent (2)	12.0 feet	0.5 foot	Yes (2)	20.0 feet	No	0.5 foot	Intermittent	7.0 feet	5.0 feet	45.0 feet	14.0 feet on north 6.5 feet on south	65.5 feet
4- Shed with on street parking on north and sidewalk on south		X	N/A	N/A	5.0 feet	N/A	0.5 foot	Not Bays - On-street only.	21.0 feet (3)	No	1.0 foot	Intermittent	12.5 feet	5.0 feet	45.0 feet	9.0 feet on south	54.0 feet
5 - Crown with parking bays and sidewalk on both sides of the street	X		4	5.0 feet	Intermittent	7.0 feet	0.5 foot	Yes (4)	20.0 feet	Yes (3)	0.5 foot	Intermittent	7.0 feet	5.0 feet	45.0 feet	20.0+ feet on north 20.0+ feet on south	85.0+ feet (5)
6 - Crown with on street parking on north and sidewalk on north	X		N/A	5.0 feet	Intermittent	8.75 feet	0.5 foot	Not Bays - On-street only.	21.0 feet (3)	No	1.0 foot	Intermittent	8.75 feet	N/A	45.0 feet	4.5 feet on north 2.0 feet on south	51.5 feet

1. For option #1, the parking spaces are staggered with rain gardens; therefore in areas where there is parking, the rain garden area would be 12' instead of 19' wide.
2. For option #3, the parking spaces are staggered with the landscaping; therefore, in the areas where there is no parking, the rain gardens would be 12.0 feet wide and in areas where there is parking, the parking is 7.0 feet wide and the landscaping is 5.0 feet wide.
3. A total travel lane width of 21.0 feet is anticipated to accommodate on-street parking on the north side of the street.
4. For option #5, the parking spaces are staggered with the rain gardens and therefore, the dimension has already been accounted for under the rain garden column.
5. For options #5, multiple iterations were conducted to determine the actual necessary ROW width. With an additional 40 feet of ROW (total), the volume requirements are still not met with the rain garden configuration, but it seems unlikely that additional ROW exceeding 40' would result in a feasible option.

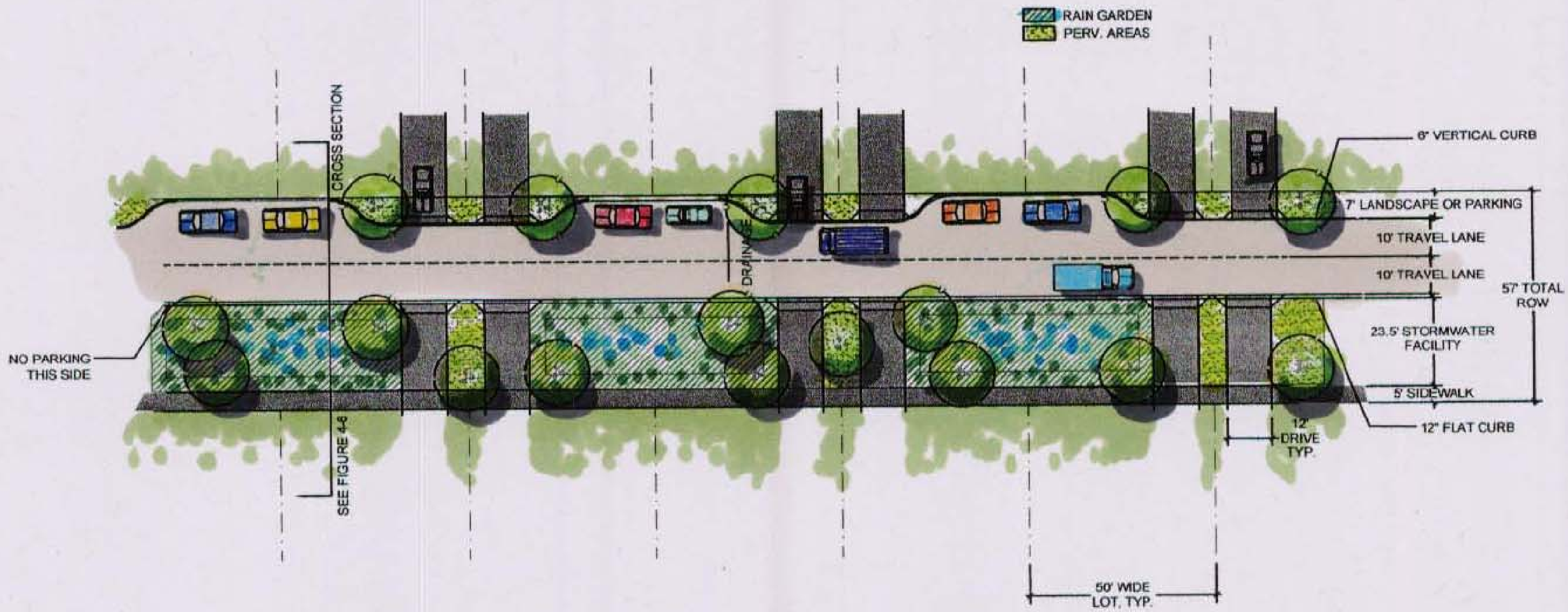


Figure 4-5: Original Green Street Concept #2 with Adjusted Right-of-Way (Plan View)
Shed Cross Section, Parking Bays One Side, Sidewalk Opposite Side

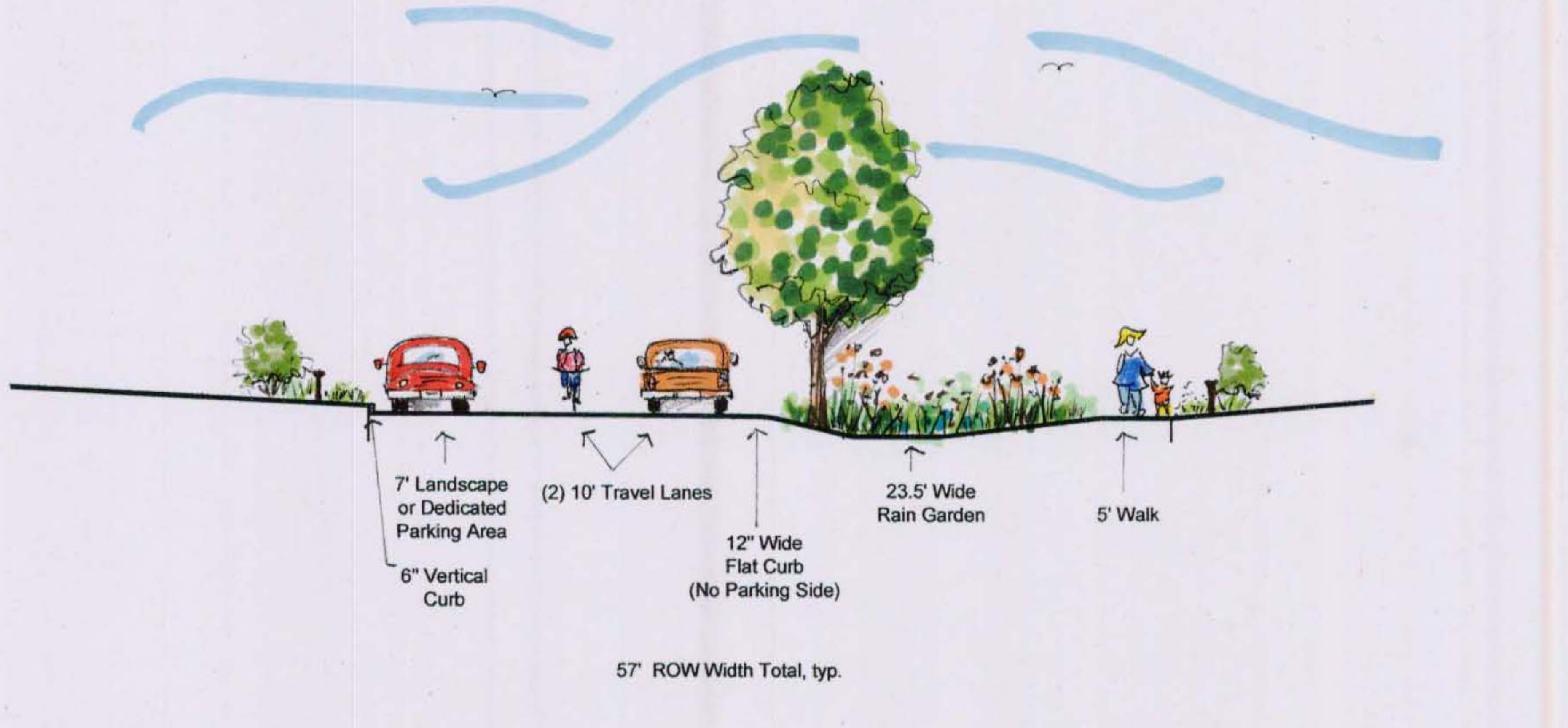


Figure 4-6: Original Green Street Concept #2 with Adjusted ROW (Section View)
Shed Cross-Section, Parking Bays One Side, Sidewalk Opposite Side

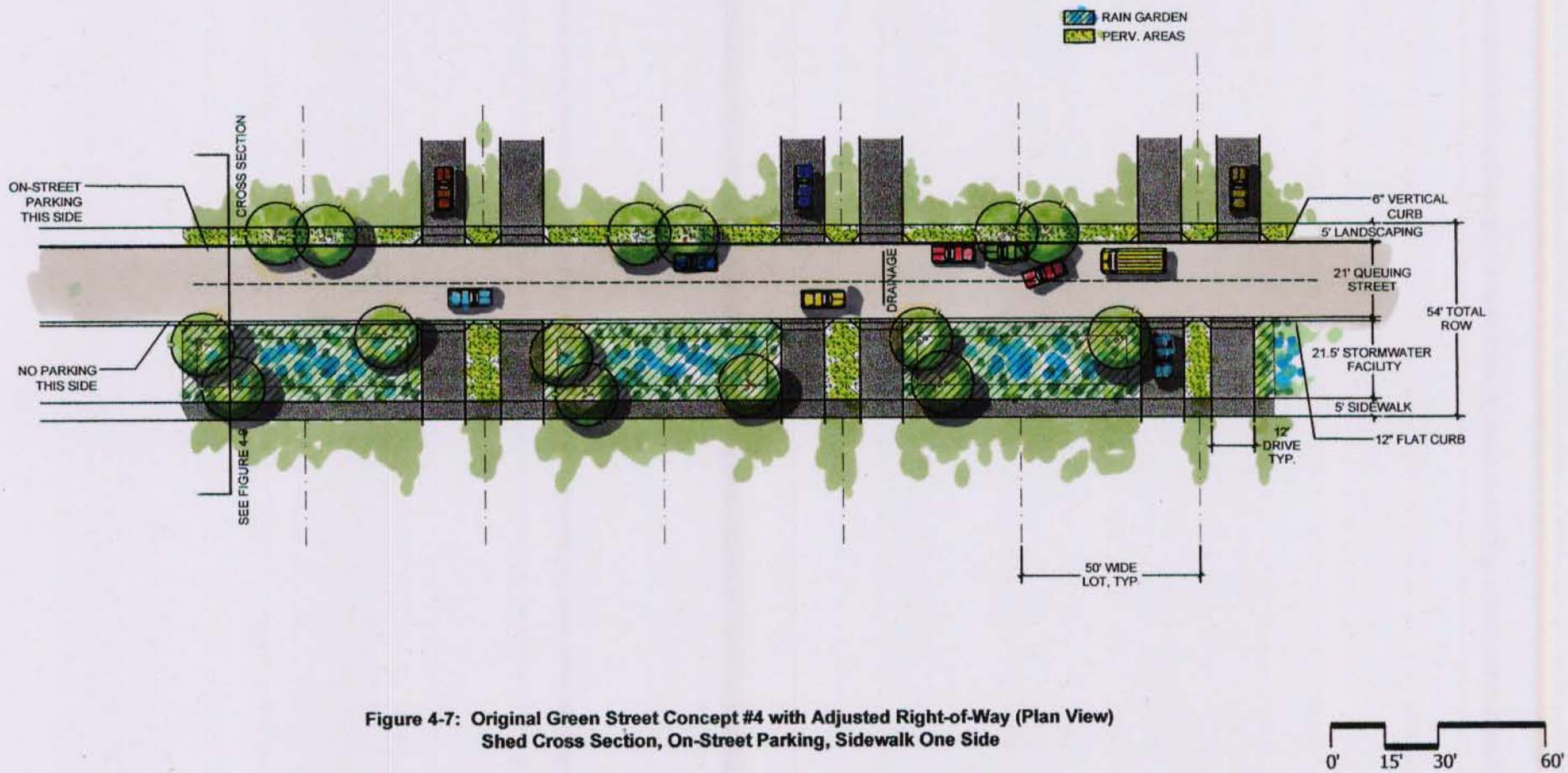


Figure 4-7: Original Green Street Concept #4 with Adjusted Right-of-Way (Plan View)
Shed Cross Section, On-Street Parking, Sidewalk One Side

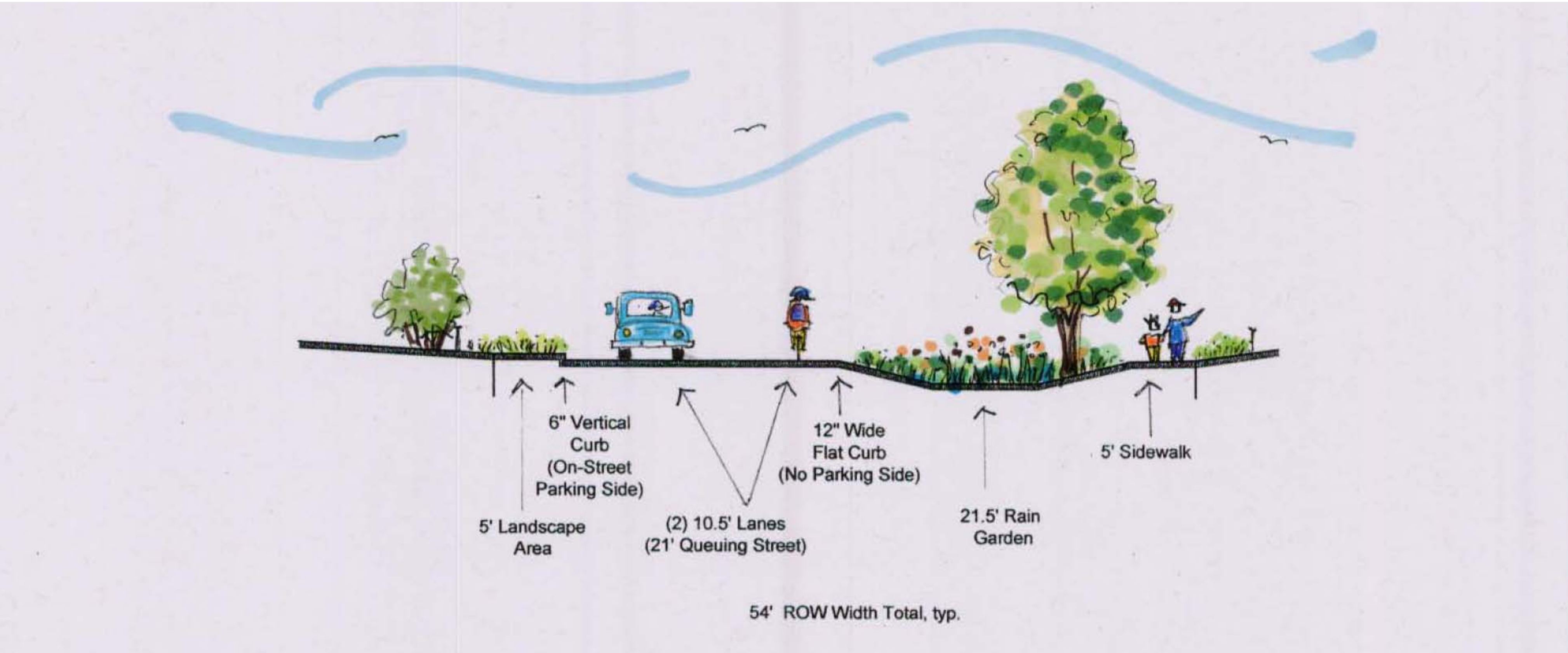


Figure 4-8: Original Green Street Concept #4 with Adjusted ROW (Section View)
Shed Cross-Section, On-Street Parking, Sidewalk One Side

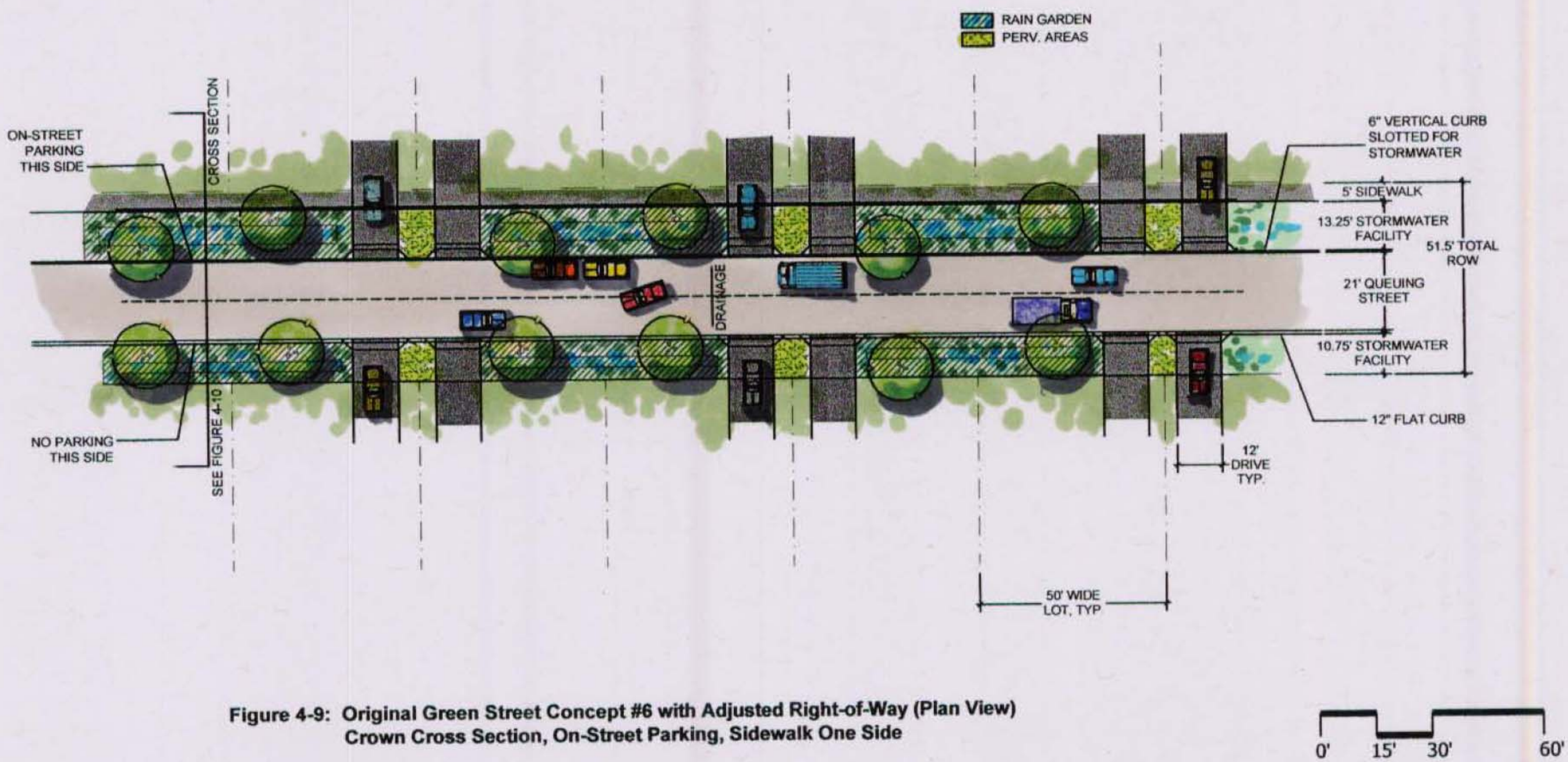
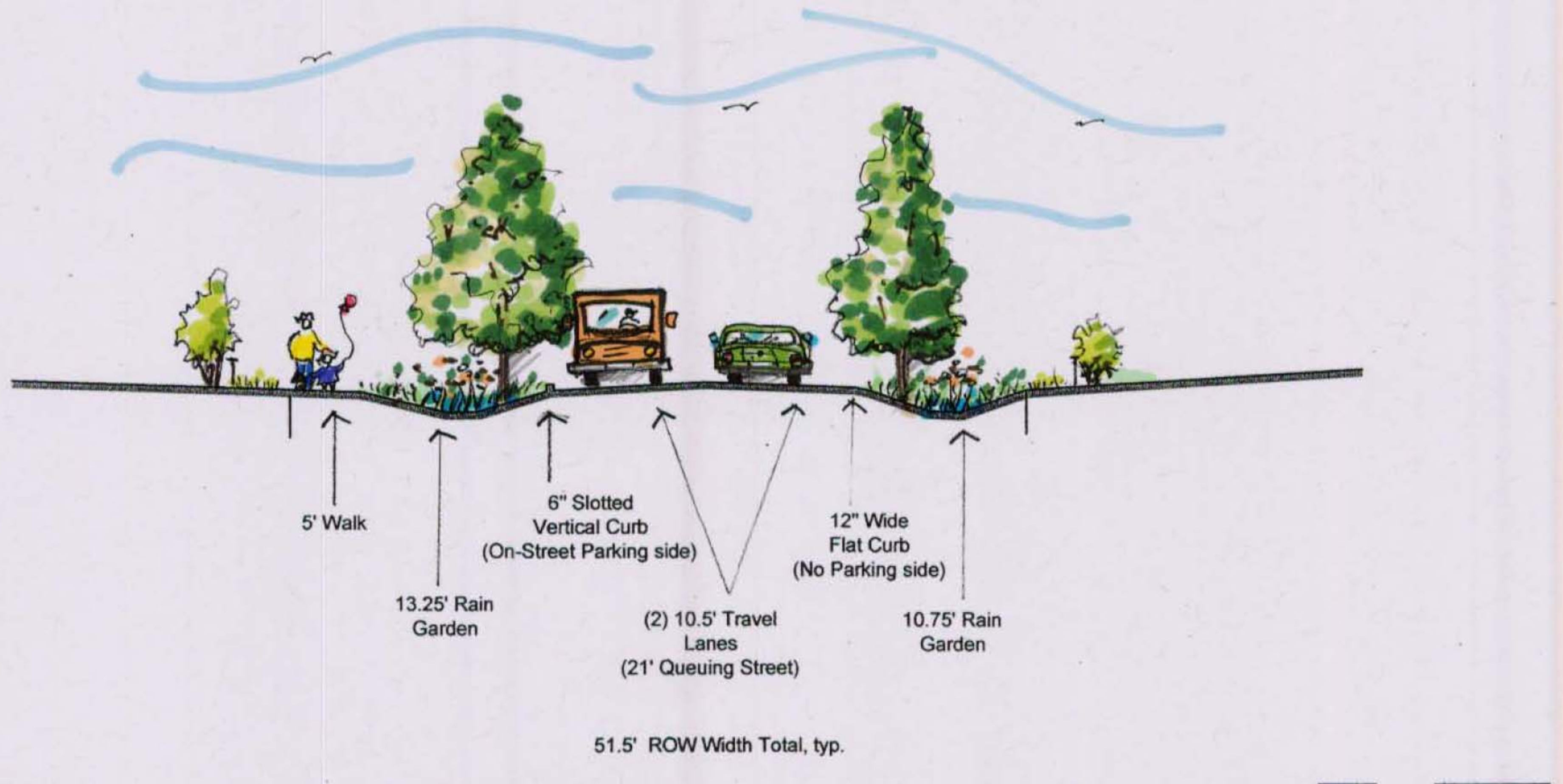
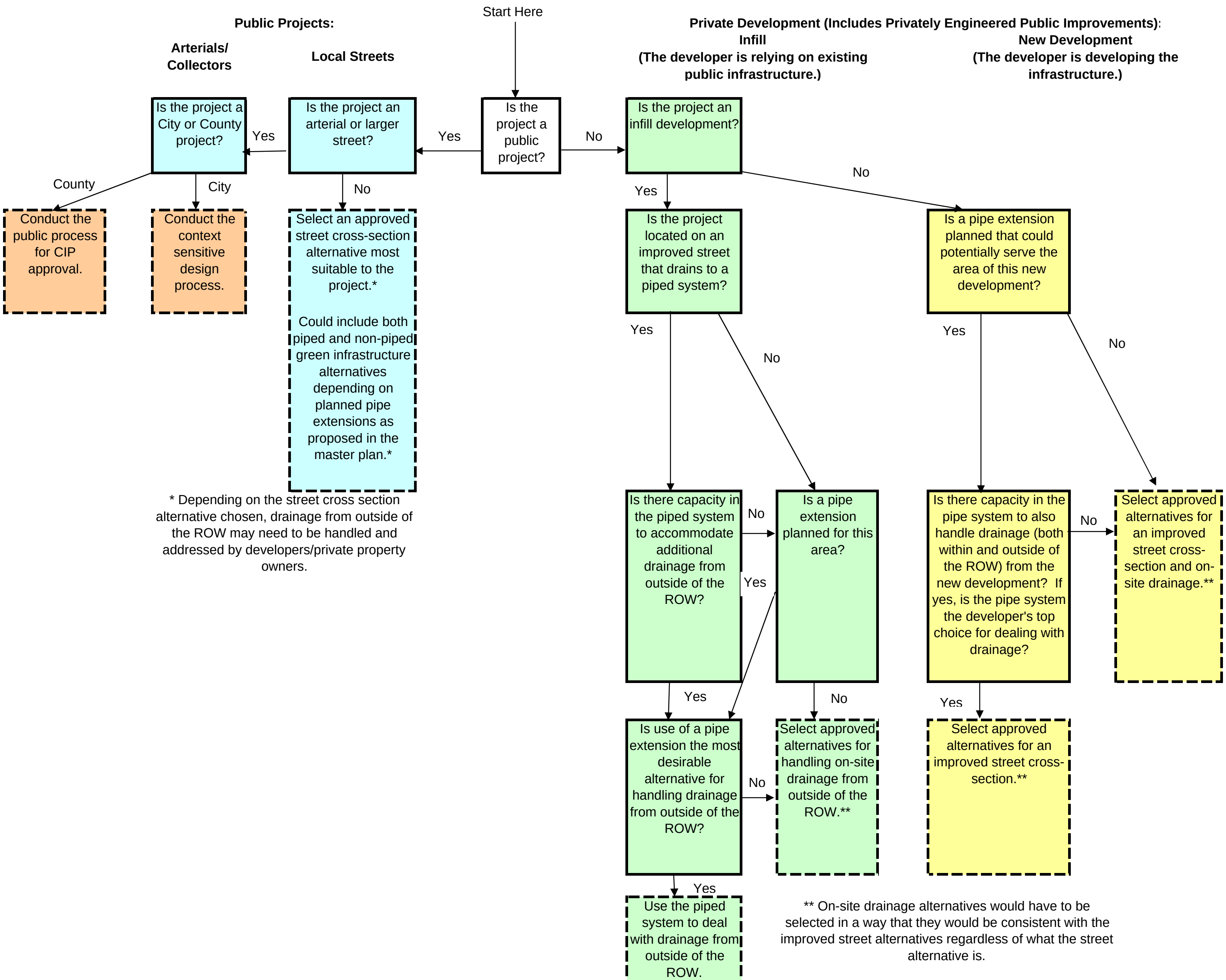


Figure 4-9: Original Green Street Concept #6 with Adjusted Right-of-Way (Plan View)
Crown Cross Section, On-Street Parking, Sidewalk One Side



Figured 4-10: Original Green Street Cross Section #6 with Adjusted ROW (Section View)
Crown Cross-Section, On-Street Parking, Sidewalk One Side

Figure 4-11
Destination Considerations for Project Planning Phase



Other Water Quality CPs
In addition to the three CP options described above (i.e., pre-treatment associated with piped retrofits, neighborhood-scale rain gardens, and street side rain gardens associated with street improvements), CPs were developed to address results of the pollutant loads evaluation and to address observed stream stability issues. The pollutant loads evaluation showed that commercial and industrial land uses discharge relatively higher pollutant loads when compared to residential and open land uses. Therefore, a list of projects was developed to retrofit the piped systems in these high source areas to include structural water quality facilities such as sedimentation manholes and select proprietary stormwater treatment devices that incorporate filtration to reduce the pollutant load. As part of the basin planning process, a City-wide annual budget line item was included to construct these types of projects.

RRSC-1 - Citywide Annual Budget Line Item – Stream Bank Stabilization: This proposed project alternative includes using bioengineering techniques to stabilize the creek bank at locations where problems have been observed or are expected to occur as a result of future development.

RRSC-2 - Citywide Annual Budget Line Item – High Source Areas: Single or multiple facilities may be appropriate for these high source areas, and the facilities should be selected and designed to treat the particular pollutant of concern based on specific site conditions. The following ten potential locations for these retrofits were identified:

- Willamette Overflow major subbasin
  1) Node 68485
     18" diameter pipe that runs south along River Road
  2) Nodes 58315, 58314, 58313 and 58312
     27" diameter pipe that runs east along Division Avenue
  3) Nodes 72406 and 66531
     24" diameter pipe that runs east along Division Avenue
  4) Node 58319
     12" diameter pipe along Division Avenue
  5) Node 67014
     15" diameter pipe south of Beltline Road

- Spring Creek major subbasin
  1) 48" pipe east of River Road, north of River Loop 2, south of Swain Lane

- Flat Creek major subbasin
  1) Nodes 72206, 72210, 72215, 72218, 72223
     24" diameter pipe south of Irvington Drive
  2) Node 72321
     18" diameter pipe along Zinfandel Lane
  3) Node 72326
     10" diameter pipe along Napa Valley Lane

- A-1 major subbasin
  1) Nodes 59020, 59021
     54" diameter pipe that runs west along Maxwell between Bushnell Ln. and N. Park Ave.

RRSC-3 - Citywide Annual Budget Line Item - Outfall Stabilization: This proposed project alternative would include identification and retrofit of storm drainage system outfalls, which are creating localized erosion and bank stability problems.

4.3.2 Development Standards to Address Water Quality

Stormwater Development Standards

Potential development standards were considered for addressing water quality problems as part of the 2002 City-wide basin master planning efforts. As a result, development standards for water quality were adopted City-wide in June 2006. The Stormwater Development Standards include regulations for locating, designing, constructing, and maintaining water quality facilities for new development and significant re-development. These standards apply within the city limits and to properties within the urban growth boundary (UGB) that develop and annex to the City. Eugene developed a Stormwater Management Manual (July 2006) to assist developers with the design, operations, and maintenance of approved stormwater facilities. Eugene's Stormwater Management Manual is a modified version of Portland's Stormwater Management Manual. The Portland Stormwater Management Manual was reviewed and edited for accuracy and consistency with the City of Eugene's regulatory structure and to reflect policies and the Stormwater Department Advisory Committee's recommendations for a water quality design storm (i.e. 1.4 inches for volume-based analyses, 0.22 in/hr for in-line flow-based systems and 0.13 in/hr for off-line flow-based systems), flow controls, and maintenance responsibilities for public and private facilities.

The Eugene Stormwater Management Manual provides developers and design professionals with specific tools to meet the City's requirements for reducing the impacts of stormwater runoff quantity and pollution resulting from new development. The Manual is to provide guidance for developers subject to the stormwater development standards adopted by City ordinance.

As an extension of stormwater development standards adoption, in September, 2008, the Eugene City Council reviewed and directed efforts to increase use of Low Impact Development practices for stormwater management through administrative adjustments, additional integration of LID practices with other initiatives, development of proposals for land use code amendments, and development of proposals for other program enhancements.

Implementation of the stormwater development standards is underway, including a 2008 update to the Stormwater Management Manual, plan review and inspection of private water quality facilities, and the incorporation of water quality facilities into public capital improvement project design. Following up from 2008 City Council direction related to increasing the use of LID practices, specific administrative adjustments, incentives and other LID-related actions are being identified and prioritized for implementation.

Water Quality Protected Waterways

Waterway protections for addressing water quality problems were also considered as part of the 2002 City-wide basin master planning efforts. In June 2006, the City initiated a proposal for protecting waterways for water quality purposes. Under the initial (2006) proposal, nearly 90 miles of waterways were proposed for protection, including 75-foot setback areas along each side of the waterways. The waterways originally identified for protection were determined to have a direct relationship to those that are on the State of Oregon's 303(d) list as water quality impaired.

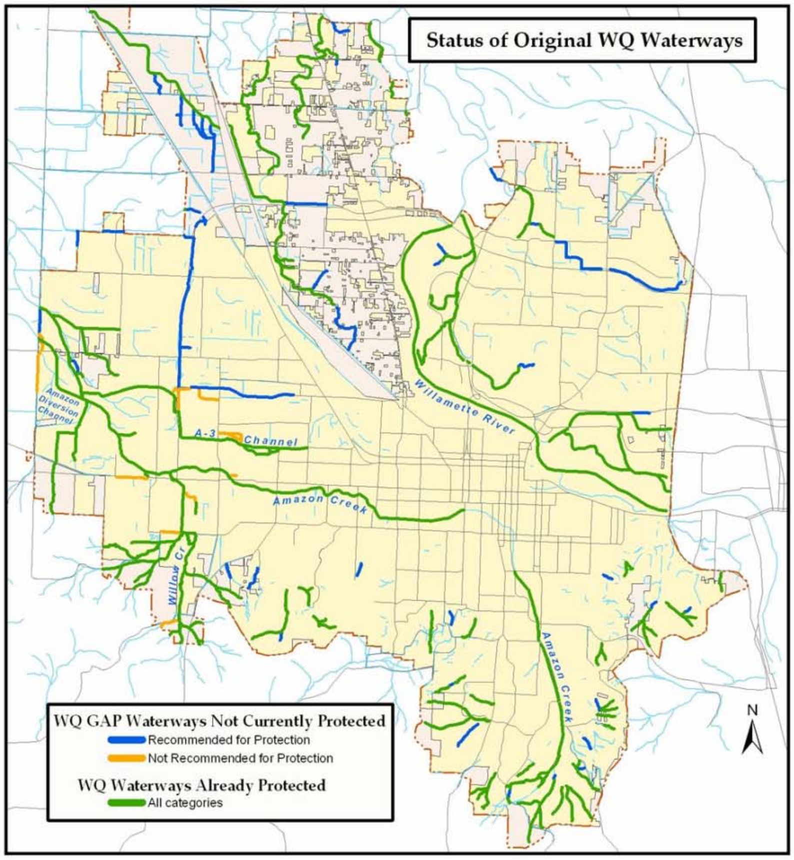
A public outreach process on the initial proposal was conducted including an open house where affected property owners, interested persons, and the general public attended and provided feedback. As a result of the issues raised, significant revisions were made to the proposal. The revised proposal would apply protections only to the original waterways of concern that have no existing protections under Goal 5 wildlife habitat regulations (Water Resources Conservation Overlay Zone, referred to in Section 2.5.1). The revised proposal recognized the significant incidental water quality protection already provided by the Goal 5/Water Resources Overlay Zone, and became a proposal to "fill the gaps" in protection on a system of waterways that are water quality impaired.

In March 2009, the Eugene City Council adopted the Water Quality Overlay Zone requirements, the revised waterway protection proposal, and the adopted regulations became effective on June 10, 2009. Approximately 13.5 miles of waterways are protected by the Water Quality Overlay Zone, including: 40-foot setbacks on each side of certain headwater streams (measured from the centerline of the waterway) and 25-foot setbacks on each side of all other specifically identified waterways (measured from the top of high bank). More specifically, the regulations:

- Establish a Water Quality Overlay Zone and related water quality protection measures;
- Apply the new zone to specifically identified lots within the Eugene city limits that contain or are adjacent to waterways identified for protection on the Water Quality Protected Waterways map; and
- Identify certain properties outside the city limits (inside the urban growth boundary) that contain or are adjacent to Water Quality Protected Waterways, and that will be rezoned to apply the Water Quality Overlay Zone upon annexation to the City of Eugene if and when annexation occurs.

Figure 4-12 provides an overview of the City's waterway protections, and the specifically identified Water Quality Protected Waterways. Some of the waterways affected by the new Water Quality Overlay Zone are located in the River Road Santa Clara basin, including portions of the Upper Flat Creek and tributaries to the A1 Channel.

Figure 4-12
Water Quality Protected Waterways Map



Postscript Note to Section 4.0: It should be noted that this basin stormwater management strategy was intended to focus on water quality management tools in the form of development standards and CPs. To comply with their respective National Pollutant Discharge Elimination System (NPDES) permits for stormwater discharges, both the City and the County have also been implementing a significant number of other stormwater quality management practices that will supplement this strategy and help to reduce the discharge of pollutants in stormwater. In addition to the proposed CPs and the City of Eugene's stormwater development standards implemented in 2006, these include BMPs under the following general categories:

- Illicit Discharge Detection and Elimination
- Operations and Maintenance and Good Housekeeping (e.g., street sweeping, catch basin cleaning, vegetation management, spill prevention and response)
- Public Education and Outreach
- Public Participation and Involvement
- Planning and Administration (e.g. basin planning, data management)
- Construction Site Management Controls

For purposes of the basin planning process, the term "natural resources" pertains specifically to the City's open waterways drainage system and the characteristics of it that provide or assist in providing beneficial stormwater functions such as: storm conveyance, flood storage, water quality preservation or treatment, aquatic and riparian habitat, and water temperature controls. These natural resources include the primary waterway corridors of Eugene and adjoining riparian and wetland areas, and headwater streams and wetlands. These characteristics are described in Section 2.0 of this report.

Section 5.1 describes the evaluation process used for the other six stormwater basins in Eugene, and partially completed for this River Road Santa Clara basin plan. Section 5.1 also describes the basin-specific problems and opportunities identified under existing and expected future conditions. A description of existing waterway protection measures, other related efforts underway, and gaps in stormwater related natural resources data is also included. Section 5.2 describes the alternatives selected for addressing these problems and opportunities.

5.1 Evaluation of Natural Resources Under Existing and Expected Future Conditions

The following provides the objectives, methods, and results of the stormwater related natural resources evaluation for the River Road Santa Clara basin.

Objectives of the evaluation

- Determine the extent of the open waterway drainage system that should be protected for beneficial stormwater functions.
- Determine where existing protection policies apply and where gaps exist.
- Determine where restoration efforts should be targeted to improve stormwater functions.
- Determine where intervention efforts are needed to correct streambank stability problems.
- Determine what other efforts are underway which may ultimately provide protection consistent with stormwater program objectives.

Methods used to conduct the evaluation

Several methods were used to conduct the natural resources evaluation for the River Road Santa Clara basin including the following:

- The following information was compiled and reviewed to assess the location, condition, and function of the River Road Santa Clara Basin waterway system. Most of the data were contained in the City's geographic information system (GIS):
  - Open waterway drainage system.
  - Draft inventory of the Eugene-Springfield Metropolitan Plan Natural Resources Study.
  - FEMA floodway and floodplain areas.
  - National wetland inventory.
  - Soil Survey of Lane County Area, Oregon (1987), Natural Resources Conservation Service.
  - Historic photos, hydric soils – to help reconstruct the historic drainage system (i.e., pre-settlement).
  - Areas with stormwater pipe system.

  - 1999 aerial photography of the River Road Santa Clara Basin.
- Site visits to collect and verify GIS information about select portions of the waterway system including location, size, condition, and function. For the site visits that were conducted, functions were evaluated using a modified version of the Oregon Freshwater Assessment Methodology (OFWAM). This method was modified to focus on the stormwater related benefits of natural resources.
- Eugene Public Works Department engineering and maintenance staff were interviewed as to their knowledge of the system.
- Property owners provided site specific information at public workshops and through other contacts.
- Policy plans were reviewed to determine where and how waterways were protected in the River Road Santa Clara Basin.
- Other City of Eugene and Metro area staff were consulted to identify other on-going efforts which may ultimately provide protection for waterways consistent with stormwater program objectives.

<u>Results of the evaluation</u>
The results are provided below in terms of both existing conditions and expected future conditions.

Existing Waterway System Conditions:
- Urbanization within the River Road Santa Clara basin has caused significant changes to the open waterway systems.
- There are about 48 miles of remaining open waterways in the basin, the majority of which are now protected through either FEMA Floodway restrictions, the City's Water Resources Conservation Overlay Zone (adopted in November 2005), or the City's Water Quality Overlay Zone (adopted in March 2009).
- While some of the remaining waterways are large conveyance channels characterized by a trapezoidal shape with moderate riparian functions, three of the basins waterways (Flat Creek, Spring Creek and the East Santa Clara Waterway) are somewhat more naturally configured with meanders and riparian vegetation.
- Significant channels include the Highway 99 Roadside Channel, A1 Channel, A2 Channel, North Beltline Floodway, Spring Creek, Flat Creek and the East Santa Clara Waterway.
- Efforts to protect, rehabilitate and/or restore the East Santa Clara waterway and its floodplain functions have occurred in the northern portion of the basin.

Expected Future Waterway System Conditions:
- Future conditions for some "privately owned and maintained" waterways would be expected to deteriorate without specific waterway protection policies and measures in this basin.
- Future conditions of "publicly owned and/or maintained" waterways are expected to remain the same or improve over existing conditions due to the City's commitment to environmentally friendly maintenance practices and increasing level of responsibility for managing the open waterway systems.

The remainder of this section provides additional context for the stormwater related natural resources evaluation:

Existing Protection Measures
- The Water Resources Conservation Overlay Zone (EC 9.4900) applies to waterways within the basin with significant natural resources habitat. The Water Resources Overlay Zone, while primarily aimed at protecting natural resources habitat, provides significant incidental water quality protection for these waterways.
- The Waterside Protection Overlay Zone (EC 9.4700) applies within the West Eugene Wetlands Plan boundary and provides protection for channels, setbacks and contiguous riparian areas. The West Eugene Wetlands boundary does not extend into the River Road Santa Clara basin.
- The Natural Resource Zone (EC 9.2500) is intended to protect outstanding natural resource areas in adopted plans (EC 9.2500). It currently does not apply to any specific property in the River Road Santa Clara basinbut could be used in the future as a waterway protection tool.
- The Planned Unit Development (EC 9.8300) provisions contain specific approval criteria for protecting significant natural resources. These criteria are to be balanced with other policy needs and standards and, therefore, offer some but no consistent protection standards for waterways.
- Site Review (EC 9.8425) provisions contain approval criteria that could be used for waterways protection if specifically identified for protection.
- The Water Quality Overlay Zone (EC 9.4770), adopted in March 2009 provides increased protection of waterways with water quality functions and a significant relationship to waterways listed as impaired under the federal Clean Water Act (see subsection 4.3.2 for more detail).

Other Related On-going Efforts
- Endangered Species/Salmon program developed strategies for responding to the *January 2001* listing of spring Chinook salmon. Strategies include incentives and regulatory measures for protection and restoration of salmon habitat in Eugene. Strategy options for Council consideration were developed.

Data Gaps
- There is little data as to existing aquatic habitat and species condition in the River Road Santa Clara basin waterways. This data would not only help further inform the condition of the waterways, but would also allow for better evaluation of the effects of any future capital improvements to these waterways.

5.2 Development of the Natural Resources Strategy

As shown in the stormwater basin master planning process flow chart in Figure 1-1, Step 1 included a compilation of basin characteristics. These basin characteristics are summarized in Section 2.0 of this document. Step 2 in the process included problem identification under both existing and future land use conditions. The results of this step for natural resources are described in Section 5.1. The next step included the development of potential stormwater management tools (i.e., capital projects or development standards) to address the identified problems and opportunities. Development of these stormwater management tools was the result of an all-day basin assessment meeting, attended by a large multi-disciplinary group of people including staff with experience in water quality, engineering, maintenance, natural resources, planning, and groundwater resources, and a half-day multi-disciplinary meeting focused on underground injection controls. In both instances, preliminary ideas were developed based on the goals and objectives of the project. This section describes the capital projects and development standards that were considered to address the identified stormwater-related natural resource problems and opportunities.

5.2.1 Capital Project Alternatives

The following capital projects were considered that would address stormwater related natural resources problems and opportunities:

<u>RRSC – 4 - Stream Corridor Acquisition</u> – Stream corridors and specific sites with relatively high stormwater values which are also at risk of future development would be identified for acquisition. The following corridor (shown on Figure 3-6) was identified for acquisition in the River Road Santa Clara Basin, in the 2000 Stream Corridor Acquisition Study:

- Willamette Overflow, also referred to as the East Santa Clara Waterway.

<u>*RRSC – 1 - Citywide Annual Budget Line Item – Streambank Stabilization</u> – This would be an annual budget line item for identifying and implementing streambank stabilization projects to help streams adjust to increased runoff volumes while limiting negative impacts associated with downcutting, sedimentation, and erosion. Where appropriate, bioengineering techniques would be used.

<u>*RRSC – 3 - Citywide Annual Budget Line Item – Outfall Stabilization</u> – This would be an annual budget line item for identifying and retrofitting storm drainage system outfalls which are creating localized erosion and bank stability problems.

* These two CPs were also listed in the water quality section (subsection 4.3.1). It should be noted that Lane County is limited by Road Fund constraints and by the inability to spend money outside of the County road right-of-way. In addition, at the time of writing of this report, Lane County funding for CPs has not been identified.

5.2.2 Development Standards Alternatives

The following development standards were considered for addressing identified stormwater related natural resources problems and opportunities in the River Road Santa Clara basin.

- *Water Quality Waterway Protections* – Using this approach, criteria would be established for identifying waterways of significance to protect for their water quality functions. See Section 4.3.2 for more detail about the Water Quality Protected Waterways.

- *Require BMPs to reduce pollutants associated with stormwater runoff from new development and significant redevelopment* – This standard would require new development and significant redevelopment to control the quality of stormwater runoff by selecting, designing, constructing, and maintaining a water quality facility. It also emphasizes techniques to address impacts to open channels associated with increased quantities of runoff. This standard is covered in Section 4.3.2 of this plan.

The purpose of this section is to summarize the flood control, water quality, and stormwater related natural resource elements of the integrated stormwater management strategy for the River Road Santa Clara basin as they were presented in Sections 3.0, 4.0, and 5.0 respectively. The capital project elements of the stormwater management strategy are shown on Figures 3-2 through 3-8. These CPs and development standard strategies are summarized in subsection 6.1. Subsection 6.2 provides a summary of strategy benefits and subsection 6.3 provides a summary of strategy implementation and costs.

6.1 CP and Development Standard Strategies

Flood Control Strategy

Two categories of flood control capital projects were identified for implementation. The first category of flood control CPs were identified to address predicted capacity deficiencies. These projects are listed as follows:

- A1-1: Open Channel Improvements: Regrade the existing open channel segment (RSA1090B) from node 72789 to 78790 (18’).
- A1-2: Flood Control (Culvert Replacement) at Irving Road and Gent Road: Upsize and replace the existing 36” CMP culvert (RSA1090A) with a 48” CMP culvert.
- A1-3: Flood Control (Storage) at Prairie Road and Beltline Road: Construct storage facilities at nodes 72782 and 72102 to provide a total of 85 acre-ft of storage.
- A1-4: Flood Control (Culvert Replacement) at Prairie Road and Beltline Road: Upsize and replace the existing 24” CMP culvert (RSA1100I) with a 36” CMP culvert.
- A1-5: Flood Control (Culvert Replacement) South of Irving Road: Upsize and replace the existing 3-24” CMP culverts (RSA1090E) with a 2’ x 8’ box culvert.
- A1-6: Flood Control (Culvert Replacement) at Carol Avenue: Upsize and replace the existing 24” CMP culvert (RSA1060L) with a 2’ x 4’ box culvert.
- A1-7: Flood Control (Culvert Replacement) at Kelso Street: Upsize and replace the existing 18” and 24” CSP culverts (RSA1060G) with a 2’ x 4.5’ box culvert.
- A1-8: Flood Control (Storage) at Maxwell Road West of N. Park Avenue: Construct storage facilities at nodes 72725 and 59020 to provide a total of approximately 135 acre-ft of storage.
- A1-9: A1 Channel Survey: Conduct survey of open channel segments to identify available storage above the top of banks.
- FC-1: Flood Control (Culvert Replacement) at Calla Street: Upsize and replace the existing 3-12” CSP culverts (RSFC050D) with a 1.5’ x 5.0’ box culvert.
- SC-1: Flood Control (Culvert Replacement) at Katy Lane: Upsize and replace the two existing 30” CSP culverts (RSSC050B) with a 12’ long pedestrian bridge.
- WO-1: Flood Control (Culvert Replacement) East of Azalea Dr.: Upsize and replace the existing 18” CMP culvert (RSWO070D) with a 66” CSP culvert.
- WO-2: Flood Control (Culvert Replacement) East of Edgewood Dr.: Upsize and replace the existing 36” CSP culvert (RSWO110A) with a 60” CSP culvert.
- WO-3: Flood Control (Culvert Replacement) East of Yvonne St.: Upsize and replace the existing 48” CSP culvert (RSWO080A) with a 66” CSP culvert.

WO-4: Open Channel Improvements: Regrade the existing open channel segments (RSWO090Aa, RSWO090B, RSWO090C, and RSWO090D) from node 74405 to 78833 (724').
WO-5: Flood Control (Storage) at River Ave.: Construct a storage facility at node 77703 to provide approximately 124 acre-ft of storage.

The second category of flood control capital projects were identified to address new flows to the system that would result from the decommissioning of public drywells. As these projects have a significant water quality component, and to avoid duplication, these CPs are listed below under the water quality strategy.

Water Quality Strategy

Capital Projects: Two categories of water quality capital projects were identified for implementation. The first category of water quality CPs was identified to prevent water quality impacts that would be associated with the decommissioning of drywells. If not addressed, these impacts would include an increase in pollutant loads and impacts to the stream channels associated with the increased flows. The projects to address/prevent these impacts are listed as follows:

WO-1-UIC: Green UIC Cluster Pipe and Pre-treat
WO-2-UIC: Corliss/ Carolyn/ Onyx UIC Cluster Rain Garden
WO-3-UIC: Autumn, Ross, Moore/Oak UIC Cluster Rain Garden
WO-4-UIC: Taz UIC Cluster Pipe and Pre-treat
WO-5-UIC: Silver Meadows UIC Cluster Rain Garden
WO-6-UIC: Poplar UIC Cluster Pipe and Pre-treat
WO-7-UIC: Kendra UIC Cluster Pipe and Pre-treat
WO-8-UIC: Kent UIC Cluster Pipe and Pre-treat
WO-9-UIC: Baywood UIC Cluster Rain Garden
WO-10-UIC: Greenwood UIC Cluster Rain Garden
WO-11-UIC: Warrington UIC Cluster Rain Garden
A1-1-UIC: Crocker 1 UIC Cluster Pipe and Pre-treat
A1-2 UIC: Crocker 2 UIC Cluster Rain Garden
A1-3-UIC: Shirley 1 UIC Cluster Pipe and Pre-treat
A1-4-UIC: Shirley 2 UIC Cluster Rain Garden
A1-5-UIC: Hamilton UIC Cluster Pipe and Pre-treat
A1-6-UIC: Bushnell UIC Cluster Pipe and Pre-treat
A1-7-UIC: Anderson UIC Cluster Rain Garden
A1-8-UIC: Escalante UIC Cluster Rain Garden
A1-9-UIC: Greenleaf UIC Cluster Pipe and Pre-treat
A1-10-UIC: Grove UIC Cluster Rain Garden
A1-11-UIC: Exeter UIC Cluster Rain Garden
A1-12-UIC: Brentwood UIC Cluster Rain Garden
A1-13-UIC: Korbel UIC Cluster Pipe and Pre-treat
A1-14-UIC: Howard UIC Cluster Rain Garden
A1-15-UIC: South of Horn Lane UIC Cluster Street-Side Rain Gardens

SC-1-UIC: Zinnia 1 UIC Clusters Pipe and Pre-treat
SC-2-UIC: Zinnia 2 UIC Clusters Pipe and Pre-treat
SC-3-UIC: Zinnia 3 UIC Cluster Rain Garden
SC-4-UIC: Countryside UIC Pipe and Pre-treat
SC-5-UIC: Lodenquai UIC Cluster Pipe and Pre-treat
SC-6-UIC: Byron UIC Cluster Rain Garden
SC-7-UIC: Stark UIC Cluster Rain Garden
SC-8-UIC: Castrey UIC Cluster Rain Garden
SC-9-UIC: Calumet UIC Cluster Rain Garden
FC-1-UIC: Willowbrook 1 UIC Cluster Rain Garden
FC-3-UIC: Willowbrook 3 UIC Cluster Rain Garden
FC-2-UIC: Willowbrook 2 UIC Cluster Pipe and Pre-treat
FC-4-UIC: Maesner UIC Cluster Rain Garden

The second category of water quality capital projects includes line items in the City's annual budget towards the construction of projects to address stream bank stabilization, the reduction of existing pollutant loads, and outfall stabilization. The three capital projects under this category are as follows:

RRSC-1 Stream Bank Stabilization – Use bioengineering techniques to stabilize the creek bank at locations where problems have been observed or are expected to occur as a result of future development.

RRSC-2 Structural Facilities to Reduce Pollutant Loads in High Source Areas – The following ten locations were identified as potential sites for locating underground structural water quality facilities:

1) Node 68485 - 18" diameter pipe that runs south along River Road
2) Nodes 58315, 58314, 58313 and 58312 - 27" diameter pipe that runs east along Division Avenue
3) Nodes 72406 and 66531 - 24" diameter pipe that runs east along Division Avenue
4) Node 58319 - 12" diameter pipe along Division Avenue
5) Node 67014 - 15" diameter pipe south of Beltline Road
6) 48" pipe east of River Road, north of River Loop 2, south of Swain Lane
7) Nodes 72206, 72210, 72215, 72218, 72223 - 24" diameter pipe south of Irvington Drive
8) Node 72321 - 18" diameter pipe along Zinfandel Lane
9) Node 72326 - 10" diameter pipe along Napa Valley Lane.
10) Nodes 59020, 59021 - 54" diameter pipe that runs west along Maxwell between Bushnell Ln. and N. Park Ave.

RRSC-3 Outfall Stabilization – Identify and retrofit storm drainage system outfalls which are creating localized erosion and bank stability problems.

Development Standards: Potential development standards were considered for addressing water quality problems associated with future development as part of the 2002 City-wide basin master planning efforts. As a result, development standards for water quality were adopted City-wide in June 2006. These standards apply within the city limits and to properties within the urban growth boundary (UGB) that develop and annex to the City. These standards require developers to implement water quality best management practices to treat runoff from their sites.
In addition, following up from 2008 City Council direction related to increasing the use of LID practices, specific administrative adjustments, incentives and other LID-related actions are being identified and prioritized for implementation.

On-Street Rain Garden Concept Options for Local Streets: Street-side rain garden concept options for local street improvements were developed to address UIC decommissioning needs as described in Section 4.3.1. However, these options are envisioned to be employed for various circumstances beyond UIC-related projects. Implementing the street-side rain garden concepts will require modifications to the City's Local Street Plan under a separate process subsequent to completion of the River Road Santa Clara Basin Plan.

Water Quality Protected Waterways Ordinance: New regulations went into effect on June 10, 2009 that provides protection of approximately 13.5 miles of waterways through the use of a Water Quality Overlay Zone. The new regulations fill gaps in protections on a set of waterways of significance to water quality, and acknowledge the significant incidental water quality protection already provided by the Goal 5 Water Resources Overlay Zone.

Natural Resources Management Strategy

The proposed strategy, similar to the strategy for the six other stormwater basins in Eugene, is focused on the protection and enhancement of open waterways for their stormwater functions and benefits. The strategy includes both a capital project and development standards component.

Capital Projects: Three capital projects have been identified for implementation in River Road Santa Clara as follows:

> RRSC – 4 - Stream Corridor Acquisitions: Acquire the Willamette Overflow, also referred to as the East Santa Clara Waterway Corridor.

Capital projects RRSC – 1 – Streambank Stabilization and RRSC – 3 – Outfall Stabilization will also provide natural resource benefits. These projects were listed as part of the water quality strategy and are not listed separately here to minimize duplication.

Development Standards: Part of the strategy includes support for existing waterway protection standards (i.e., Water Resources Conservation Overlay Zone, Natural Resource Zone, Planned Unit Development provisions, Site Review provisions as applicable). Another part of the strategy involves coordinating with other related on-going efforts (NR Study, ESA) to ensure that, ultimately, the stormwater functions and benefits of stream corridors are protected. Lastly, waterway protection will occur under the implementation of the June, 2009 ordinance that will include a Water Quality Overlay Zone (this is included above under the water quality strategy).

<u>Multiple Objective Stormwater Capital Improvement Program</u>

It should be noted that, in general, all stormwater capital projects, will consider flood control, water quality and natural resources protection and enhancement as project objectives when feasible and appropriate. All stormwater capital projects will conform to adopted code requirements for private development, including stormwater quality standards.

6.2 Summary of Strategy Benefits

The River Road Santa Clara integrated strategy, when finalized and implemented, is expected to provide the following benefits:

1. Provide the required level of flood protection basin-wide through capital projects.
2. Reduce existing pollutant loads through capital projects.
3. Reduce the potential for increased pollutant loads and erosive impacts to stream channels that would be associated with increased flows from drywell decommissioning.
4. Reduce pollutant loads associated with new developments through development standards.
5. Identify, protect and manage significant open waterways for their beneficial stormwater functions.
6. Address compliance issues associated with the Clean Water Act and Safe Drinking Water Act.

6.3 Summary of Strategy Implementation and Costs

For a description of implementation of water quality and stormwater related natural resources standards, refer to Volume I – Citywide Basin Master Plan Report.

This section provides a summary of the estimated costs for each of the capital projects in the River Road Santa Clara Basin. It also describes the approach for capital project implementation.

The list of capital projects in Table 6-1 is a summary of the full list of projects identified from the basin planning process, and includes planning level cost estimates. Appendix A contains a more detailed fact sheet for each capital project, which includes a description of the project and assumptions made for purposes of estimating costs. Unit cost tables utilized for these estimates are provided in Appendix D.

The actual cost split for each project between the City and Lane County will be determined on a project-by-project basis, and was not estimated as a part of this planning process. At the time of completion of this report, there is no identified funding mechanism in the County to pay for the County's portion of the capital improvement projects identified in this basin plan. The City will fund its portion of the projects identified in this basin plan primarily through a combination of stormwater user fees and systems development charges.

With respect to implementation of City of Eugene capital projects, the City will use its recently updated 2009 stormwater capital project prioritization criteria for initial prioritization of stormwater projects. Projects listed in the River Road Santa Clara Basin Plan will be added to the full list of City public projects, and then will be scored and ranked using the prioritization criteria. An overall prioritized project list will be established, from which an initial sub-set of projects will be selected for future six-year capital improvement program (CIP) development and review process. The CIP forecasts the City's capital needs over a six-year period based on various City-adopted long-range plans, goals and policies. Development of the City's CIP is typically a nine-month process, beginning in August of even-numbered years and ending the following spring with adoption by City Council. Following adoption of the CIP, the projects become the basis for preparation of the upcoming fiscal year's capital budget. The capital budget is submitted to the Budget Committee in the spring of each year following the CIP process, and adopted by the City Council in June. Projects in the second fiscal year of the CIP become the basis of the subsequent fiscal year's capital budget. The final list of projects identified in the CIP for implementation may be different than the initial list as a result of input from the CIP public involvement and budget adoption process.

Table 6-1
Summary of Capital Project Costs and Funding

Capital Project Identification	Total Estimated Capital Project Implementation Cost[1]
A-1 Channel	
A1-1 – A1 Open Channel Improvements	$7,500
A1-2 – Culvert Replacement at Irving Road and Gent Road	$131,400
A1-3 – Storage at Prairie Road and Beltline Road	$12,160,200
A1-4 – Culvert Replacement at Prairie Road and Beltline Road	$18,400
A1-5 – Culvert Replacement South of Irving Road	$26,400
A1-6 – Culvert Replacement at Carol Avenue	$21,600
A1-7 – Culvert Replacement at Kelso Street	$16,600
A1-8 – Storage at Maxwell Road	$16,879,800
A1-9 – A1 Channel Survey	$50,000[2]
A1-1-UIC – Pipe and Pre-treat Crocker 1 UIC Cluster	$530,000
A1-2-UIC – Rain Garden Crocker 2 UIC Cluster	$271,200
A1-3-UIC – Pipe and Pre-treat Shirley 1 UIC Cluster	$777,200
A1-4-UIC – Rain Garden Shirley 2 UIC Cluster	$1,070,600

1 Total estimated capital project implementation cost includes construction, site acquisition (if applicable), and engineering and administrative costs.
2 Reflects a baseline cost estimate for planning purposes only and is not included in the unit cost tables (Appendix D) nor CP fact sheets (Appendix A).

Capital Project Identification	Total Estimated Capital Project Implementation Cost[1]
A1-5-UIC – Pipe and Pre-treat Hamilton UIC Cluster	$540,600
A1-6-UIC – Pipe and Pre-treat Bushnell UIC Cluster	$197,400
A1-7-UIC Rain Garden Anderson UIC Cluster	$2,936,000
A1-8-UIC Rain Garden Escalante UIC Cluster	$537,700
A1-9-UIC – Pipe and Pre-treat Greenleaf UIC Cluster	$111,600
A1-10-UIC – Rain Garden Grove UIC Cluster	$537,700
A1-11-UIC – Rain Garden Exeter UIC Cluster	$404,400
A1-12-UIC – Rain Garden Brentwood UIC Cluster	$138,000
A1-13-UIC – Pipe and Pre-treat Korbel UIC Cluster	$140,400
A1-14-UIC – Rain Garden Howard UIC Cluster	$138,000
A1-15-UIC – South of Horn Lane Street-side Rain Gardens	$3,600,900
Subtotal:	**$41,243,600**
Flat Creek	
FC-1 - Flat Creek Flood Control at Calla Street	$13,400
FC-1-UIC – UIC Decommissioning Willowbrook 1 UIC Cluster	$404,400
FC-2-UIC – UIC Decommissioning Willowbrook 2 UIC Cluster	$135,300
FC-3-UIC – UIC Decommissioning Willowbrook 3 UIC Cluster	$937,400
FC-4-UIC – UIC Decommissioning Maesner UIC Cluster	$670,900
Subtotal:	**$2,161,400**
River Road Santa Clara	
RRSC-1 – River Road Santa Clara Streambank Stabilization	-
RRSC-2 – Water Quality Facilities for High Source Areas	-
RRSC-3 – River Road Santa Clara Outfall Stabilization	-
RRSC-4 – River Road Santa Clara Stream Corridor Acquisition	-
Subtotal:	-
Spring Creek	
SC-1 – Spring Creek Flood Control at Katy Lane	$18,000
SC-1-UIC – UIC Decommissioning Zinnia 1 UIC Cluster	$249,000
SC-2-UIC – UIC Decommissioning Zinnia 2 UIC Cluster	$263,400
SC-3-UIC – UIC Decommissioning Zinnia 3 UIC Cluster	$271,200
SC-4-UIC – UIC Decommissioning Countryside UIC Cluster	$436,000
SC-5-UIC – UIC Decommissioning Lodenquai UIC Cluster	$423,100
SC-6-UIC – UIC Decommissioning Byron UIC Cluster	$271,200
SC-7-UIC – UIC Decommissioning Stark UIC Cluster	$138,000
SC-8-UIC – UIC Decommissioning Castrey UIC Cluster	$271,200
SC-9-UIC – UIC Decommissioning Calumet UIC Cluster	$271,200
Subtotal:	**$2,612,300**
Willamette Overflow	
WO-1 – Willamette Overflow Flood Control East of Azalea Dr.	$145,600

Capital Project Identification	Total Estimated Capital Project Implementation Cost[1]
WO-2 – Willamette Overflow Flood Control East of Edgewood Dr.	$22,500
WO-3 – Willamette Overflow Flood Control East of Yvonne St.	$27,800
WO-4 – Willamette Overflow Open Channel Improvements	$521,200
WO-5 – Willamette Overflow Flood Control (Storage) at River Avenue	$15,630,200
WO-1-UIC – UIC Decommissioning Green UIC Cluster	$111,000
WO-2-UIC – UIC Decommissioning Corliss/Carolyn/Onyx UIC Cluster	$537,700
WO-3-UIC – UIC Decommissioning Autumn/Ross/Moore-Oak UIC Cluster	$1,337,100
WO-4-UIC – UIC Decommissioning Taz UIC Cluster	$124,500
WO-5-UIC – UIC Decommissioning Silver Meadows UIC Cluster	$404,400
WO-6-UIC – UIC Decommissioning Poplar UIC Cluster	$390,600
WO-7-UIC – UIC Decommissioning Kendra UIC Cluster	$75,600
WO-8-UIC – UIC Decommissioning Kent UIC Cluster	$397,000
WO-9-UIC – UIC Decommissioning Baywood UIC Cluster	$138,000
WO-10-UIC – UIC Decommissioning Greenwood UIC Cluster	$138,000
WO-11-UIC – UIC Decommissioning Warrington UIC Cluster	$138,000
Subtotal:	**$20,139,200**
TOTAL:	**$66,156,500**

Footnote to Summary of Strategy Implementation and Costs: Public outreach conducted in October 2009 included comments regarding the size and scope of the flood control capital projects based upon the basin planning modeling and recommended by the RR-SC Plan. The current model is the best fit based upon the best available information and professional engineering judgment, and is likely somewhat conservative for reasons notes in Section 3 as well as the degree of "informal" infiltration in the RR-SC basin. Resource and data limitations inherently limit the level of detail and resolution of the model, and further model refinement would not be appropriate in the absence of better data and additional resources to refine the model. The City and County believe that further refinement to the model based upon measured flow data would be beneficial to confirm capacity issues on the major system related to the larger capacity enhancement and storage CPs. Installation of a flow meter is planned in the RR-SC basin, and would realistically precede detailed design and implementation of these larger CPs.

APPENDIX A

CAPITAL PROJECT FACT SHEETS

Capital Project Fact Sheet

Basin Name: Santa Clara Basin

Project #: A1-1

Project Identifier	**A1-1**
Project Title	**A1 Channel Open Channel Improvement**

Project Location

The proposed CP is located in modeled drainage segment RSA1090B. The CP is proposed to reduce flooding in the segment itself and in the upstream open channel and piped system segments including RSA1090C and RSA1090D.

Subbasin	**RSA1090**
GIS U/S Node Location	**72789**
GIS D/S Node Location	**72790**
Drainage Area Served by Capital Project	**281.4** Acres
% Impervious (Existing Land Use)	**42.9**
% Impervious (Future Land Use)	**53.6**

Project Description

Regrade the existing Type I open channel segment RSA1090B. Maintain the existing upstream invert elevation of 374.27 and adjust the downstream elevation to eliminate the reverse grade in the channel.

Project Elements

18 LF – Open Channel Improvements (Type 1)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

Modeled flooding problems in this segment (RSA1090B) and upstream segments RSA1090C and RSA1090D were predicted for the 10-year existing condition storm event, due to lack of capacity in the existing open channel and observed backslope on channel segment.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Open Channel Improvements (Type 1)	Inspect sediment loading and vegetation, remove sediment and debris.

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Expected to reduce model-predicted flooding problems identified in this area.

Water Quality

N/A

Natural Resources

N/A

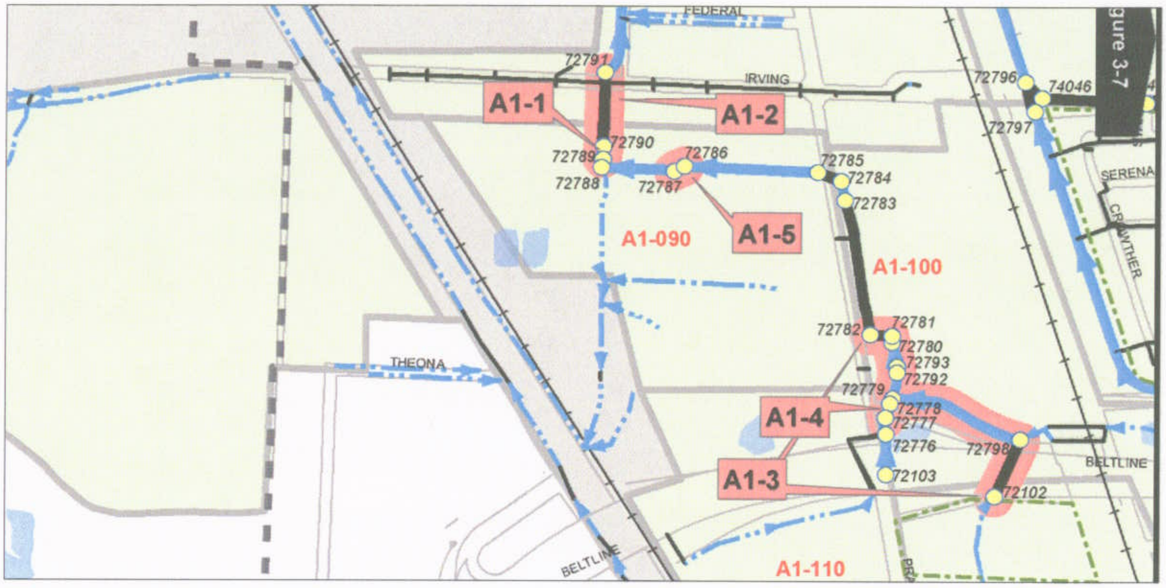
Costs

Construction Costs:	$6,300
Site Acquisition:	$0
Engineering / Administration:	$1,200
Capital Project Implementation Costs	**$7,500**
Annual Maintenance Costs	**$3,800**

Design Assumptions

Flood reduction in this reach and upstream open channel segments (RSA1090C and RSA1090D) would also be addressed by CP A1-2 and A1-3.

Project #: A1-1



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Project Identifier	**A1-2**
Project Title	**A1 Channel Culvert Replacement at Irving Road**

Project Location

The proposed CP is located in modeled drainage segment RSA1090A. The segment runs north-south, ending just south of the Irving Road and Gent Road intersection. The CP is proposed to reduce flooding in the segment itself and in the upstream open channel and piped system segments including RSA1090B, RSA1090C, and RSA1090D.

Subbasin	**RSA1090**
GIS U/S Node Location	**72790**
GIS D/S Node Location	**72791**
Drainage Area Served by Capital Project	**281.4** Acres
% Impervious (Existing Land Use)	**42.9**
% Impervious (Future Land Use)	**53.6**

Project Description

Replace the existing 36" CMP culvert (segment RSA1090A) with 438 ft. of 42" CSP.

Project Elements

438 Ft – 42" CSP (2-5 ft. cover)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

Modeled flooding problems in segment RSA1090A were predicted for the 25-year winter, future condition storm event, and modeled flooding problems in upstream segments RSA1090B, RSA1090C, and RSA1090D were predicted for the 10-year existing condition storm event, due to lack of capacity in the existing open channels and pipes.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
42" CSP (2-5 ft. cover)	N/A

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Expected to reduce model-predicted flooding problems identified in this segment and upstream.

Water Quality

N/A

Natural Resources

N/A

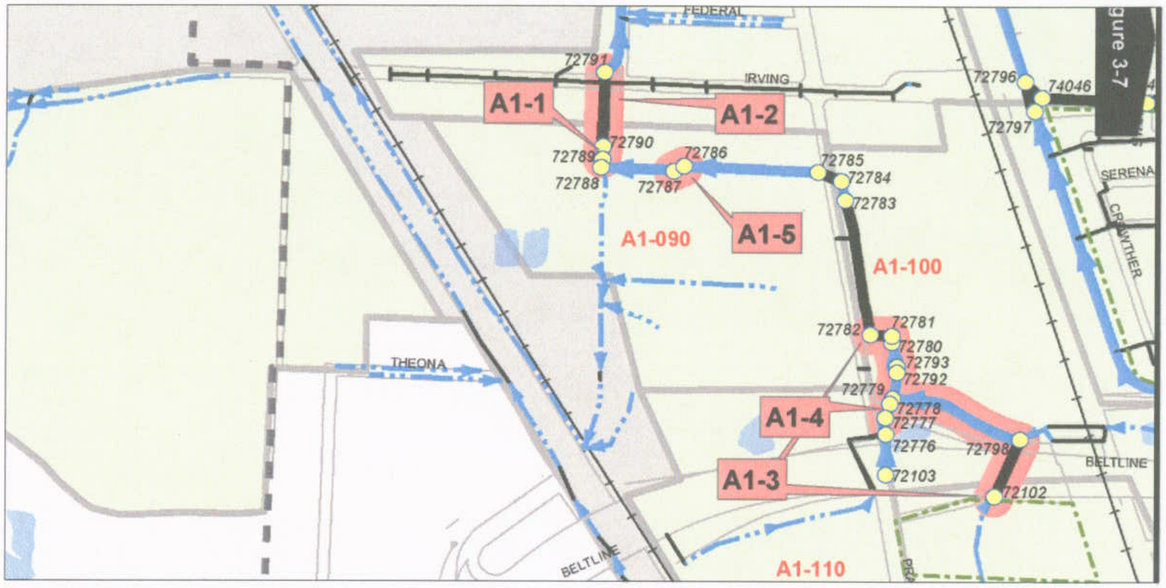
Costs

Construction Costs:	$109,500
Site Acquisition:	$0
Engineering / Administration:	$21,900
Capital Project Implementation Costs	**$131,400**
Annual Maintenance Costs	

Design Assumptions

Flood reduction in this segment and upstream open channel segments (RSA1090B, RSA1090C, and RSA1090D) would also be addressed by CP A1-1, A1-3, A1-6 and A1-7.

Project #: A1-2



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Project #: A1-3

Project Identifier	**A1-3**
Project Title	**A1 Channel Flood Control Facility at Prairie Road and Beltline Road**

Project Location

The proposed storage CP would be located at node 72782 and 72102. The CP includes 40 acre-feet of storage at node 72102 and 45 acre-feet of storage at node 72782. Storage associated with node 72102 would be located in tax lots 200 and 202. These tax lots are located south of Beltline and east of Prairie Road. Storage associated with node 72782 would be located in tax lot 4400. This tax lot is between Hwy 99N and Prairie Road, south of Irving Road.

Subbasin	**RSA1110 and RSA1120**
GIS U/S Node Location	**N/A**
GIS D/S Node Location	**72782 and 72102**
Drainage Area Served by Capital Project	**141.5** Acres
% Impervious (Existing Land Use)	**34.6**
% Impervious (Future Land Use)	**54.2**

Project Description

Construct 85 ac-ft of storage in two locations to minimize flow in downstream open channel system.

Project Elements

85 Ac-Ft – Flood Control Facility

Problems and/or Opportunities Addressed by the Capital Projects

Problems

Modeled flooding problems in segments RSA1060H, M, O, Q and U; RSA1080B; RSA1090 A through F, and RSA1100 B through K, were generally predicted for the 10-year existing condition storm event, due to lack of capacity in the existing open channel and pipe segments. Storage proposed to minimize flow in downstream system and reduce magnitude of open channel improvements (see A1-1).

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Flood Control Facility	Inspect and clean inlet and outlet, maintain vegetation, inspect sediment loading, remove sediment, remove debris, inspect and repair separation berm (if applicable).

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Expected to reduce model-predicted flooding problems in this area.

Water Quality

N/A

Natural Resources

N/A

Costs

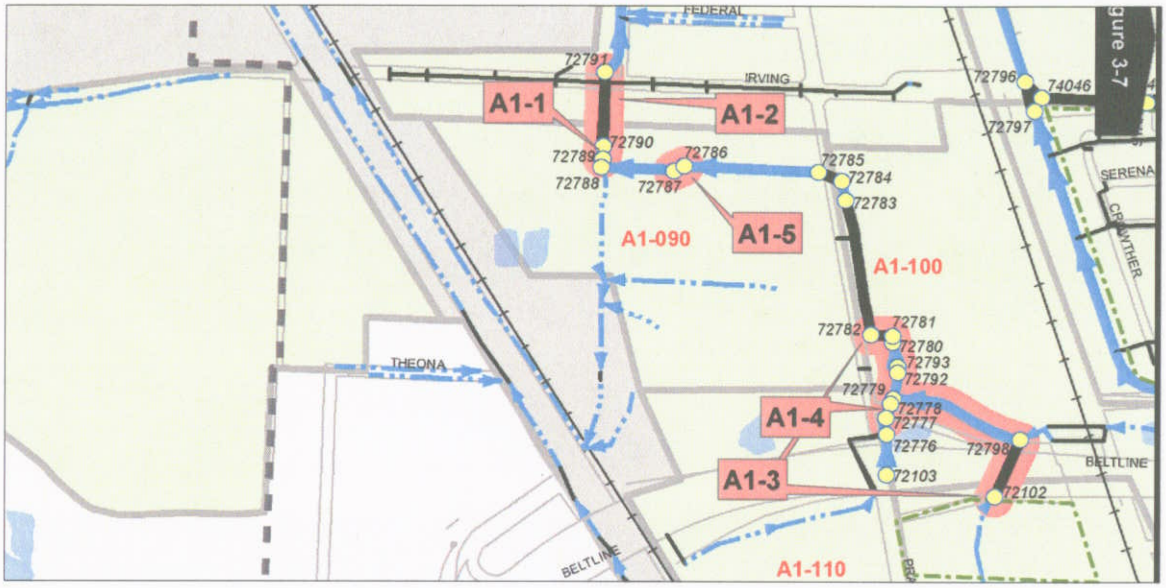
Construction Costs:	$5,074,500
Site Acquisition:	$5,059,000
Engineering / Administration:	$2,026,700
Capital Project Implementation Costs	**$12,160,200**
Annual Maintenance Costs	**$81,700**

Design Assumptions

Flood reduction in the downstream open channels would also be addressed by CP A1-1, A1-2, A1-5, A1-6, and A1-7.

Acquisition costs are based on an industrial land cost of $370,300/acre and calculated using the detention pond footprint area plus 5% for accessibility. An additional $4,000/project is included for administrative activities associated with land acquisition.

Project #: A1-3



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Project #: A1-4

Project Identifier	A1-4
Project Title	A1 Channel Culvert Replacement at Prairie Road and Beltline Road

Project Location

The proposed CP is located in modeled drainage segment RSA1100I. The segment runs north-south along Prairie Road, beginning just north of the Beltline Road and Prairie Road intersection. The CP is proposed to reduce flooding in the segment itself and in the upstream open channel segment RSA1100J and upstream piped segments RSA1110A1 and A2.

Subbasin	RSA1100
GIS U/S Node Location	72777
GIS D/S Node Location	72778
Drainage Area Served by Capital Project	57.8 Acres
% Impervious (Existing Land Use)	54.3
% Impervious (Future Land Use)	55.2

Project Description

Replace the existing 24" CMP culvert (segment RSA1100I) with 70 ft. of 36" CSP.

Project Elements

70 Ft – 36" CSP (2-5 ft. cover)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

Modeled flooding problems in this segment (RSA1100I) were predicted for the 50-year existing condition storm event; upstream open channel segment RSA1100J during the 10-year existing condition event; and upstream piped segment RSA1110A1 and RSA1110A2 during the 25-year, summer, existing condition event due to restriction and lack of capacity in the existing open channels and pipes.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
36" CSP (2-5 ft. cover)	N/A

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Expected to reduce model-predicted flooding problems identified in this segment and upstream.

Water Quality

N/A

Natural Resources

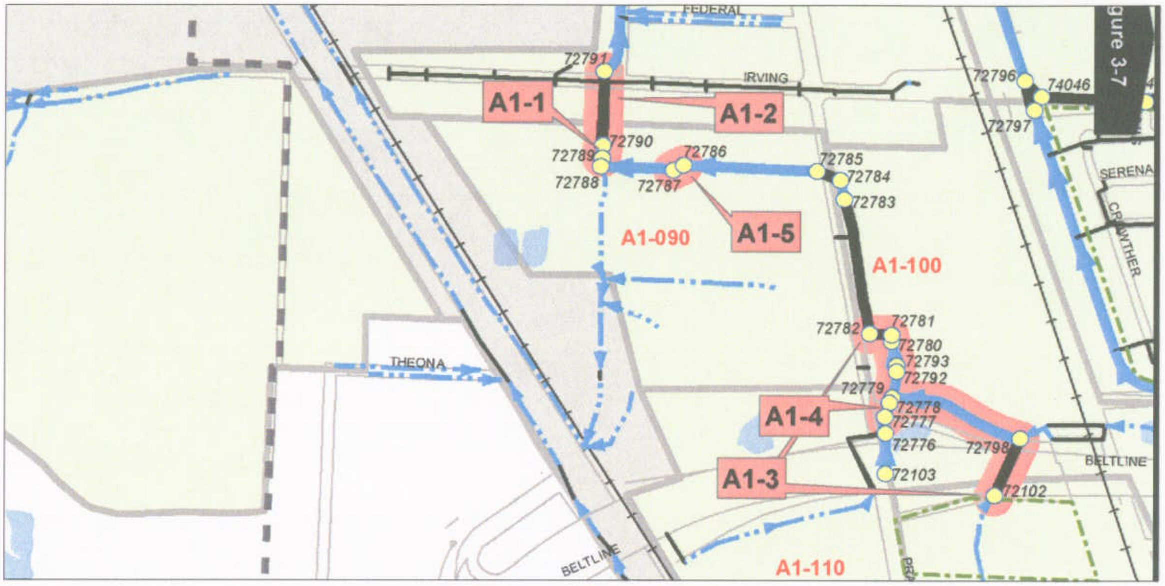
N/A

Costs

Construction Costs:	$15,400
Site Acquisition:	$0
Engineering / Administration:	$3,000
Capital Project Implementation Costs	**$18,400**
Annual Maintenance Costs	

Design Assumptions

Project #: A1-4



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Project #: A1-5

Project Identifier	**A1-5**
Project Title	**A1 Channel Culvert Replacement South of Irving Road**

Project Location

The proposed CP is located in modeled drainage segment RSA1090E. The segment runs east-west between Prairie Road and Gent Road, south of Irving Road. The CP is proposed to reduce flooding in the segment itself; in the upstream open channel segments RSA1090F, RSA1100C, E, G, and K; and upstream piped segments RSA1100B, D, and F.

Subbasin	**RSA1090**
GIS U/S Node Location	**72786**
GIS D/S Node Location	**72787**
Drainage Area Served by Capital Project	**231.3** Acres
% Impervious (Existing Land Use)	**44.0**
% Impervious (Future Land Use)	**53.5**

Project Description

Replace the three existing 24" CMP culverts (segment RSA1090E) with 40 ft. of a 2'x8' box culvert.

Project Elements

40 LF – 2' x 8' box culvert

Problems and/or Opportunities Addressed by the Capital Projects

Problems

Modeled flooding problems in segment RSA1090E were predicted for the 10-year existing condition storm event as a result of a restriction. Modeled flooding problems in upstream open channel segments RSA1090F, RSA1100C, E, G, and K were also predicted for the 10-year existing condition event, and upstream piped segments RSA1100B, D, and F during the 25-year, summer future condition storm event.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
2' x 8' box culvert	N/A

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Expected to reduce model-predicted flooding problems identified in this segment and upstream.

Water Quality

N/A

Natural Resources

N/A

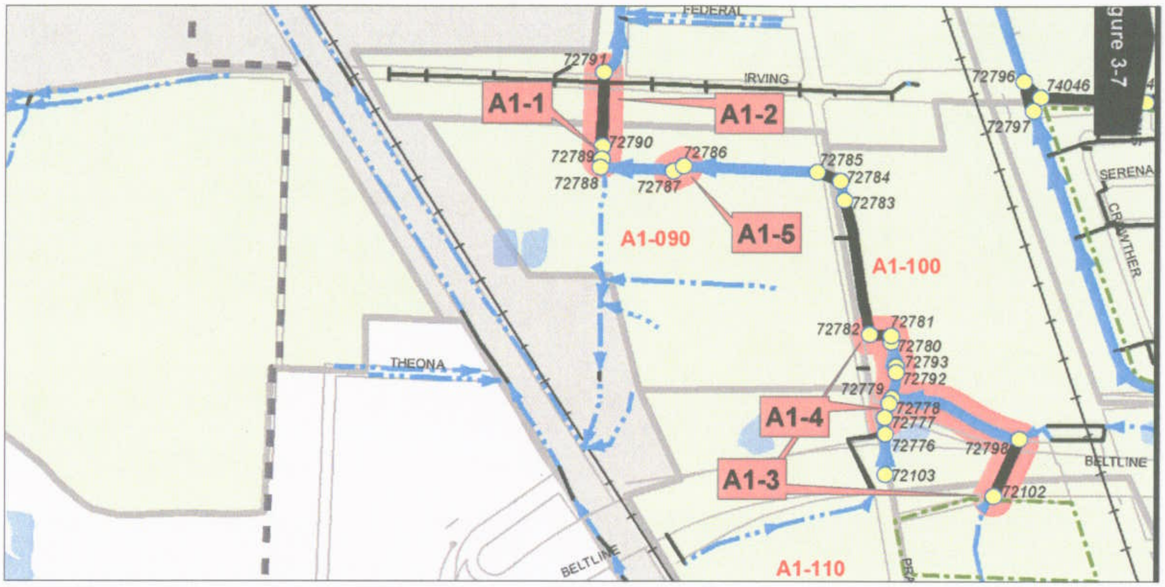
Costs

Construction Costs:	$22,000
Site Acquisition:	$0
Engineering / Administration:	$4,400
Capital Project Implementation Costs	**$26,400**
Annual Maintenance Costs	**$0**

Design Assumptions

Flood reduction in this segment and others specified would also be addressed by CP A1-3.

Project #: A1-5



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Project #: A1-6

Project Identifier	**A1-6**
Project Title	**A1 Channel Culvert Replacement at Carol Avenue**

Project Location

The proposed CP is located in modeled drainage segment RSA1060L. The segment runs north-south across Carol Avenue north of Cecil Avenue. The CP is proposed to reduce flooding in upstream open channel segments RSA1060M, Q and U and RSA1080B and upstream piped segments RSA1090A.

Subbasin	**RSA1060**
GIS U/S Node Location	**71207**
GIS D/S Node Location	**71208**
Drainage Area Served by Capital Project	**354.4** Acres
% Impervious (Existing Land Use)	**44.4**
% Impervious (Future Land Use)	**53.7**

Project Description

Replace the existing 24" CMP culvert (segment RSA1060L) with 40 ft. of 2' by 4' box culvert.

Project Elements

40 LF – 2' x 4' box culvert

Problems and/or Opportunities Addressed by the Capital Projects

Problems

Modeled flooding problems were predicted for upstream open channel segments RSA1060M, RSA1060Q, RSA1060U, and RSA1080B during the 10-year existing condition event, and upstream piped segment RSA1090A during the 25-year, winter future condition storm event.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
2' x 4' box culvert	N/A

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Expected to reduce model-predicted flooding problems identified upstream.

Water Quality

N/A

Natural Resources

N/A

Costs

Construction Costs:	$18,000
Site Acquisition:	$0
Engineering / Administration:	$3,600
Capital Project Implementation Costs	**$21,600**
Annual Maintenance Costs	**$0**

Design Assumptions

Flood reduction in the upstream segments specified would also be addressed by CP A1-2, A1-3, and A1-7.

Project #: A1-6

A1-050
A1-060
A1-070
A1-7
A1-6
FC-020
FC-030
A1-130
99-020
A1-13-UIC
KORBEL
IRVINGTON
HALLET
ZINFANDEL
NAPA VALLEY
KELSO
ZUMWALT
CLEO
CAROL
CECIL
KAISER
CABERNET
GOLDBERRY
KORBEL
BARSTOW
ARROWHEAD
GOOSE CROSS
STONE CREEK
SONOMA
WINERY
Flat Creek
A1 Chann
NORTHWEST EXPRESSW
HWY 99N
This segement contains three 72 inch pipes
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85030
71214
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72741
72740
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72752
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72244
75660

Project #: A1-7

Project Identifier	**A1-7**
Project Title	**A1 Channel Culvert Replacement at Kelso Street**

Project Location

The proposed CP is located in modeled drainage segment RSA1060G. The segment runs north-south across Kelso Street west of Zumwalt Street. The CP is proposed to reduce flooding in upstream open channel segments RSA1060H and U, RSA1080B, and upstream piped segment RSA1090A.

Subbasin	**RSA1060**
GIS U/S Node Location	**71213**
GIS D/S Node Location	**71214**
Drainage Area Served by Capital Project	**354.4** Acres
% Impervious (Existing Land Use)	**44.4**
% Impervious (Future Land Use)	**53.7**

Project Description

Replace the existing 18" and 24" CSP culvert (segment RSA1060G) with 31 ft. of 2' by 4.5' box culvert.

Project Elements

31 LF – 2' x 4.5' box culvert

Problems and/or Opportunities Addressed by the Capital Projects

Problems

Modeled flooding problems in upstream open channel segments RSA1060U and RSA1080B were predicted for the 10-year existing condition event, and were predicted for upstream open channel segment RSA1060H and piped segment RSA1090A during the 25-year, winter future condition storm event.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
2' x 4.5' box culvert	N/A

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Expected to reduce model-predicted flooding problems identified upstream.

Water Quality

N/A

Natural Resources

N/A

Costs

Construction Costs:	$13,900
Site Acquisition:	$0
Engineering / Administration:	$2,700
Capital Project Implementation Costs	**$16,600**
Annual Maintenance Costs	**$0**

Design Assumptions

Flood reduction in the upstream segments specified would also be addressed by CP A1-2, A1-3, and A1-6.

Project #: A1-7


A1-050
A1-060
A1-070
A1-7
A1-6
FC-020
FC-030
A1-130
99-020
A1-13-UIC KORBEL
IRVINGTON
HALLET
ZINFANDEL
NAPA VALLEY
KELSO
ZUMWALT
CLEO
CAROL
CECIL
KAISER
CABERNET
GOLDBERRY
KORBEL
MERRYVALE
GOOSE CROSS
BARSTOW
ARROWHEAD
WINERY
STONE CREEK
SONOMA
NORTHWEST EXPRESSWAY
Flat Creek
A1 Chann
HWY 99N
This segement contains three 72 inch pipes
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85030
71214
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72741
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72244

Project #: A1-8

Project Identifier	**A1-8**
Project Title	**A1 Channel Flood Control Facility at Maxwell Road West of N Park Avenue**

Project Location

The proposed storage CP would be located at node 72725 and 59020. The CP includes 53 acre-feet of storage at node 72725 and 81.8 acre-feet of storage at node 59020. Storage associated with node 72725 would be located in tax lot 2400 and storage associated with node 59020 would be located in tax lots 3800 and 3801. These tax lots are located south of Maxwell and east of N Park Ave.

Subbasin	**RSA1200 and RSA1160**
GIS U/S Node Location	**N/A**
GIS D/S Node Location	**72725 and 59020**
Drainage Area Served by Capital Project	**864.4** Acres
% Impervious (Existing Land Use)	**39.2**
% Impervious (Future Land Use)	**42.4**

Project Description

Construct 135 ac-ft of storage in two locations to minimize flow in downstream open channel system.

Project Elements

135 Ac-Ft – Flood Control Facility

Problems and/or Opportunities Addressed by the Capital Projects

Problems

Modeled flooding problems in segments RSA1160B, D, F and H are predicted for the 10-year existing condition storm event due to shallow depth of the existing open channel. Storage is proposed to minimize flow in downstream system because of the limited ability to modify open channel segments to reduce water surface elevation.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Flood Control Facility	Inspect and clean inlet and outlet, maintain vegetation, inspect sediment loading, remove sediment, remove debris, inspect and repair separation berm (if applicable).

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Expected to reduce model-predicted flooding problem identified in this area.

Water Quality

N/A

Natural Resources

N/A

Costs

Construction Costs:	$8,059,500
Site Acquisition:	$6,007,000
Engineering / Administration:	$2,813,300
Capital Project Implementation Costs	**$16,879,800**
Annual Maintenance Costs	**$129,800**

Design Assumptions

Flood reduction in downstream open channel segments RSA1160D and RSA1160H would also be addressed by CP A1-9.

Acquisition costs are based on an industrial land cost of $370,300/acre and calculated using the detention pond footprint area plus 5% for accessibility. An additional $4,000/project is included for administrative activities associated with land acquisition.

Project #: A1-8

ARMSTRONG
BRAMBLEWOOD
LABONA
BUSHNELL
BOYCE
ALDERWOOD
BRENTWOOD
HEMLOCK
MAYWOOD
LINWOOD
GROVE
FREMONT
LAKE
71940
71941
72726
72725
59020
59021
59112
85032
A1-210
A1-200
A1-8
ELM
A1-12-UIC
BRENTWOOD
HOWARD
NORTHWEST EXPRESSWAY
HWY 96N
72724
72723
Diana's
Pond
A1-230
HATTON
MEGAN
AERIAL
WHITNE

Project #: A1-9

Project Identifier	A1-9
Project Title	A1 Channel Survey

Project Location

The proposed survey would be conducted along A1 Channel segments RSA1160D and RSA1160H (in subbasin RSA1160), segment RSA1080B (in subbasin RSA1090) and RSA1060K (in subbasin RSA1060).

Subbasin	A1160, RSA1090, and RSA1060
GIS U/S Node Location	N/A
GIS D/S Node Location	N/A
Drainage Area Served by Capital Project	1470.6 Acres
% Impervious (Existing Land Use)	40.6
% Impervious (Future Land Use)	46.1

Project Description

Conduct survey of open channel segments RSA1160 D and H, RSA1080B, and RSA1060K. These segments were identified as requiring additional survey due to the fact that survey used for the modeling did not coincide with field observations. Also, the depth of the channel as modeled is less than the diameter of the adjacent culverts, which results in flooding conditions. Would like to get more information regarding available storage that exists in the system above the top of banks.

Project Elements

0 N/A – Survey

Problems and/or Opportunities Addressed by the Capital Projects

Problems

Modeled flooding problems in segments RSA1160D and H, RSA1080B, and RSA1060K were predicted for the 10-year existing condition storm event. Given the shallow depth of the existing open channel, flooding along segments is prevalent and (for RSA1160D and H), not completely addressed with other CPs. Survey is proposed because the survey used to conduct the modeling did not coincide with recent field observations and more information is desired regarding available storage in the system above the top of banks.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Survey	

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Verifies modeled system survey and obtains additional information regarding available storage.

Water Quality

N/A

Natural Resources

N/A

Costs

Construction Costs:	
Site Acquisition:	$0
Engineering / Administration:	
Capital Project Implementation Costs	
Annual Maintenance Costs	**$0**

Design Assumptions

Project #: A1-1-UIC

Project Identifier	A1-1-UIC
Project Title	Crocker 1 UIC Cluster - Pipe and Pre-treat

Project Location

The UICs associated with the Crocker UIC clusters run north-south, just east of Stark Street in the Spring Creek and Flat Creek subbasins. A total of seven county UICs are associated with this cluster.

This CP includes a water quality treatment facility and necessary piping to route runoff from the five southern UICs that comprise the Crocker 1 drainage to node 76483 on Irving Road (in the A1 Channel subbasin). Although included in the Flat Creek subbasin, this CP is classified as an A1 Channel CP because drainage from Crocker 1 is proposed for discharge in the A1 Channel.

Subbasin	RSFC060
GIS U/S Node Location	N/A
GIS D/S Node Location	76483
Drainage Area Served by Capital Project	14.4 Acres
% Impervious (Existing Land Use)	N/A
% Impervious (Future Land Use)	N/A

Project Description

Provide water quality treatment in the form of a StormFilter compost filter, and pipe drainage from the Crocker 1 UIC cluster to Irving Road (node 76483). The required piping for the Crocker 1 UIC cluster was estimated at 1060 feet of 36" CSP.

Project Elements

1 Ea – CSF 8x6 (max 11 cartridges)
1 Ea – CSF 16x8 (max 33 cartridges)
1060 Ft – 36" CSP (2-5 ft. cover)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
CSF 8x6 (max 11 cartridges)	Cartridge replacement by vendor.
CSF 16x8 (max 33 cartridges)	Cartridge replacement by vendor.
36" CSP (2-5 ft. cover)	N/A

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Provides treatment of the water quality design storm using an approved proprietary treatment system.

Natural Resources

N/A

Costs

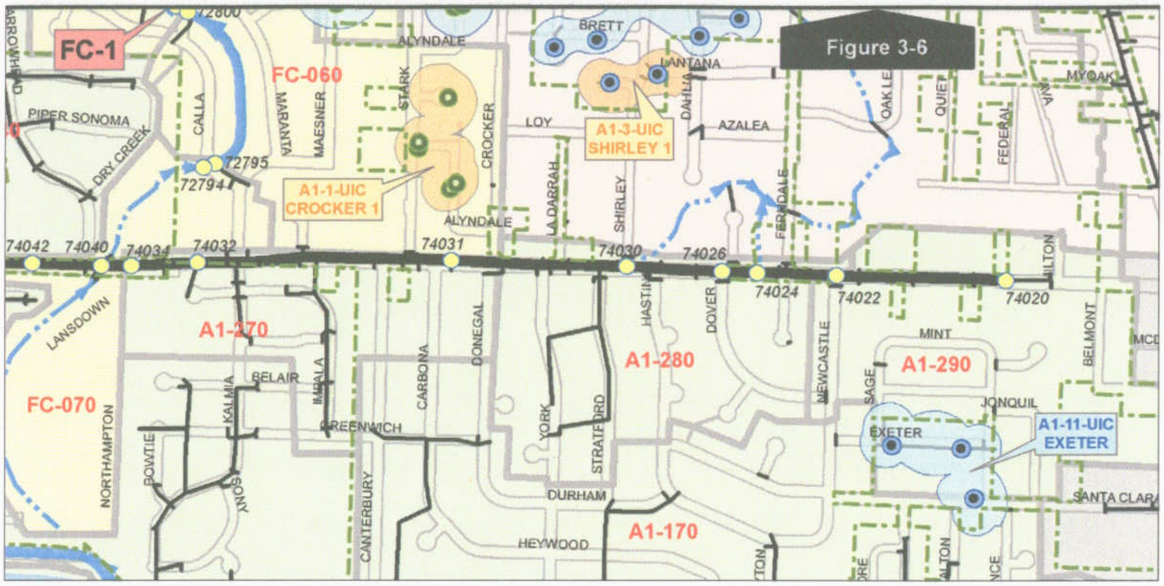
Construction Costs:	$441,700
Site Acquisition:	$0
Engineering / Administration:	$88,300
Capital Project Implementation Costs	**$530,000**
Annual Maintenance Costs	**$8,500**

Design Assumptions

StormFilter sizing assumes that two facilities would be needed to accommodate the number of required cartridges. Each facility would be offline and would operate at 7.5 gpm per cartridge. A total of 42 cartridges would be required for treatment of the water quality flow rate.

The drainage area was deliniated and the drainage configuration (pipe) associated with the Crocker 1 UIC cluster was included in the XP SWMM CP model.

Project #: A1-1-UIC



Project Identifier	**A1-2-UIC**
Project Title	**Crocker 2 UIC Cluster - Raingarden**

Project Location

The UICs associated with the Crocker UIC clusters run north-south, just east of Stark Street in the Spring Creek and Flat Creek subbasins. A total of seven county UICs are associated with this cluster.

Given design constraints, the UIC cluster was divided into two drainage areas (Crocker 1 and Crocker 2). This CP includes a raingarden to accommodate runoff from the two northern UICs that comprise the Crocker 2 drainage. Although included in the Spring Creek subbasin, this CP is classified as an A1 Channel CP because drainage from Crocker 1 is proposed for discharge in the A1 Channel.

Subbasin	**RSSC120**	
GIS U/S Node Location	**N/A**	
GIS D/S Node Location	**N/A**	
Drainage Area Served by Capital Project	**5.4 (estimated)**	Acres
% Impervious (Existing Land Use)	**N/A**	
% Impervious (Future Land Use)	**N/A**	

Project Description

Construct raingardens throughout the drainage area associated with the Crocker 2 UIC cluster. Preliminary estimates indicate that approximately 0.32 acres of raingarden would be required to manage treatment and runoff volumes associated with the 5-year, 24 hour storm event.

Project Elements

13758 SF – Raingarden (native soils)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Raingarden (native soils)	Litter and debris removal, reestablishment of vegetation

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Promotes stormwater treatment through filtration, sedimentation, infiltration, and vegetative uptake within the rain garden.

Natural Resources

N/A

Costs

Construction Costs:	$110,000
Site Acquisition:	$116,000
Engineering / Administration:	$45,200
Capital Project Implementation Costs	**$271,200**

Costs do not account for soil amendment.

Annual Maintenance Costs	**$17,800**

Design Assumptions

Because drainage areas were not delineated for all UIC cluster and original drainage area deliniation did not account for all UICs, a modified drainage area for each UIC cluster, assuming 2.7 acres area per UIC was used for sizing raingardens. Therefore, preliminary raingarden sizing for this UIC cluster assumes a drainage area of 5.4 acres. A more detailed deliniation of drainage area to the Crocker 2 UIC cluster would be needed prior to CP design.

Acquisition costs are based on a residential land cost of $337,600/acre and calculated using the raingarden footprint area plus 5% for accessibility. An additional $4,000/project is included for administrative activities associated with land acquisition.

Project #: A1-2-UIC

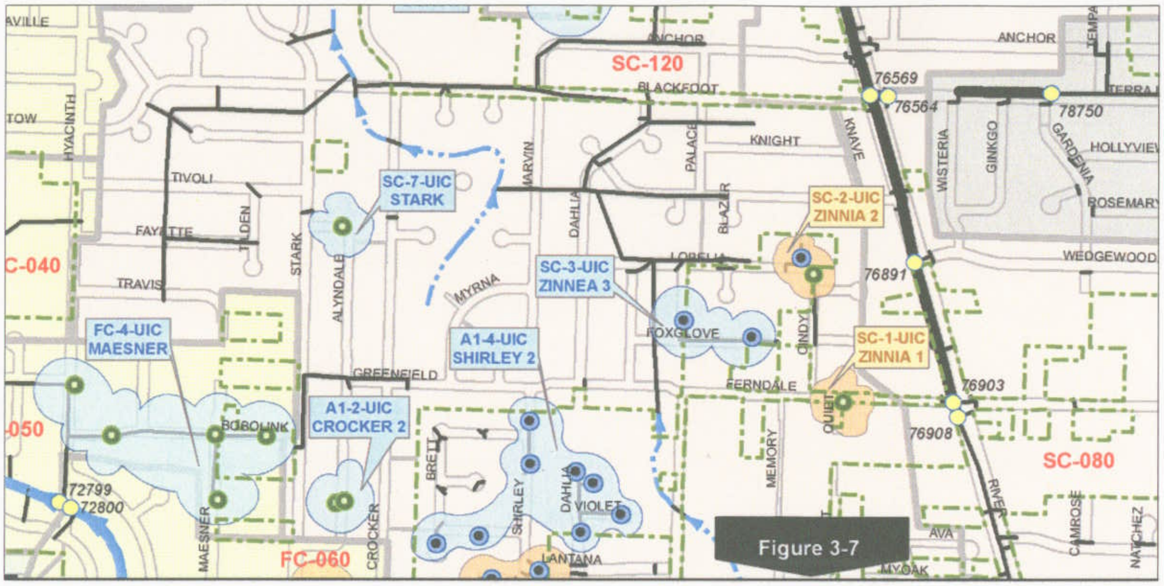


Figure 3-7

Project Identifier	**A1-3-UIC**
Project Title	**Shirley 1 UIC Cluster - Pipe and Pre-treat**

Project Location

The UICs associated with the Shirley UIC cluster are scattered east and west of Shirley Street, between Crocker Road and Ferndale Drive in the Spring Creek subbasin. Ten city UICs are associated with this cluster.

Given design constraints, the UIC cluster was divided into two drainage areas (Shirley 1 and Shirley 2). This CP includes a water quality treatment facility and necessary piping to route runoff from the two southern UICs (Shirley 1 drainage) to node 74030 on Irving Road (in the A1 Channel subbasin).

Subbasin	**RSSC120**
GIS U/S Node Location	**N/A**
GIS D/S Node Location	**74030**
Drainage Area Served by Capital Project	**20.1** Acres
% Impervious (Existing Land Use)	**N/A**
% Impervious (Future Land Use)	**N/A**

Project Description

Provide water quality treatment in the form of a StormFilter compost filter, and pipe drainage from the Shirley 1 UIC cluster to Irving Road (node 74030). The required piping for the Shirley 1 UIC cluster was estimated at 1090 feet of 2-30" CSP.

Project Elements

2180 Ft – 30" CSP (2-5 ft. cover)
2 Ea – CSF 16x8 (max 33 cartridges)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
30" CSP (2-5 ft. cover)	N/A
CSF 16x8 (max 33 cartridges)	Cartridge replacement by vendor.

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Provides treatment of the water quality design storm using an approved proprietary treatment system.

Natural Resources

N/A

Costs

Construction Costs:	$647,700
Site Acquisition:	$0
Engineering / Administration:	$129,500
Capital Project Implementation Costs	**$777,200**
Annual Maintenance Costs	**$12,800**

Design Assumptions

StormFilter sizing assumes that two facilities would be needed to accommodate the number of required cartridges. Each facility would be offline and would operate at 7.5 gpm per cartridge. A total of 59 cartridges would be required for treatment of the water quality flow rate.

The drainage area was deliniated and the drainage configuration (pipe) associated with the Shirley 1 UIC cluster was included in the XP SWMM CP model.

Project #: A1-3-UIC

Project #: A1-4-UIC

Project Identifier	A1-4-UIC
Project Title	Shirley 2 UIC Cluster - Raingarden

Project Location

The UICs associated with the Shirley UIC cluster are scattered east and west of Shirley Street, between Crocker Road and Ferndale Drive in the Spring Creek subbasin. Ten city UICs are associated with this cluster.

Given design constraints, the UIC cluster was divided into two drainage areas (Shirley 1 and Shirley 2). This CP includes a installation of a raingarden to manage runoff from the eight northern UICs (Shirley 2 drainage). Although included in the Spring Creek subbasin, this CP is classified as an A1 Channel CP because drainage from Shirley 1 is proposed for discharge in the A1 Channel.

Subbasin	RSSC120
GIS U/S Node Location	N/A
GIS D/S Node Location	N/A
Drainage Area Served by Capital Project	21.6 (estimated) Acres
% Impervious (Existing Land Use)	N/A
% Impervious (Future Land Use)	N/A

Project Description

Construct raingardens throughout the drainage area associated with the Shirley 2 UIC cluster. Preliminary estimates indicate that approximately 1.26 acres of raingarden would be required to manage treatment and runoff volumes associated with the 5-year, 24 hour storm event.

Project Elements

55033 SF – Raingarden (native soils)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Raingarden (native soils)	Litter and debris removal, reestablishment of vegetation

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Promotes stormwater treatment through filtration, sedimentation, infiltration, and vegetative uptake within the rain garden.

Natural Resources

N/A

Costs

Construction Costs:	$440,200
Site Acquisition:	$452,000
Engineering / Administration:	$178,400
Capital Project Implementation Costs	**$1,070,600**

Costs do not account for soil amendment.

Annual Maintenance Costs	**$71,500**

Design Assumptions

Because drainage areas were not delineated for all UIC cluster and original drainage area deliniation did not account for all UICs, a modified drainage area for each UIC cluster, assuming 2.7 acres area per UIC was used for sizing raingardens. Therefore, preliminary raingarden sizing for this UIC cluster assumes a drainage area of 21.6 acres. A more detailed deliniation of drainage area to the Shirley 2 UIC cluster would be needed prior to CP design.

Acquisition costs are based on a residential land cost of $337,600/acre and calculated using the raingarden footprint area plus 5% for accessibility. An additional $4,000/project is included for administrative activities associated with land acquisition.

Project #: A1-4-UIC

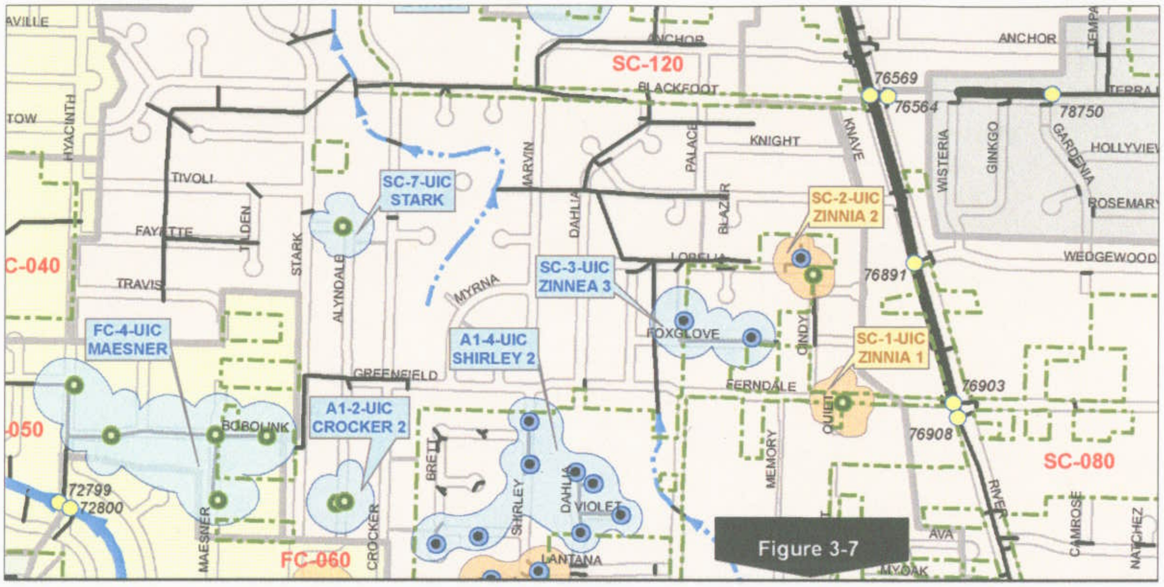


Figure 3-7

Project #: A1-5-UIC

Project Identifier	**A1-5-UIC**
Project Title	**Hamilton UIC Cluster - Pipe and Pre-treat**

Project Location

The UICs associated with the Hamilton UIC cluster are located along Hamilton Avenue south of Kourt Drive in the A1 Channel subbasin. Four county UICs are associated with this cluster.

The CP includes a water quality treatment facility and necessary piping to route drainage associated with the cluster to node 76744 on Maxwell Road.

Subbasin	**RSA1220 and RSA1190**
GIS U/S Node Location	**N/A**
GIS D/S Node Location	**76744**
Drainage Area Served by Capital Project	**13.9** Acres
% Impervious (Existing Land Use)	**N/A**
% Impervious (Future Land Use)	**N/A**

Project Description

Provide water quality treatment in the form of a StormFilter compost filter, and pipe drainage from the Hamilton UIC cluster to Maxwell Road (node 76744). The required piping for the Hamilton UIC cluster was estimated at 1100 feet of 36" CSP.

Project Elements

1100 Ft – 36" CSP (2-5 ft. cover)
1 Ea – CSF 8x6 (max 11 cartridges)
1 Ea – CSF 16x8 (max 33 cartridges)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
36" CSP (2-5 ft. cover)	N/A
CSF 8x6 (max 11 cartridges)	Cartridge replacement by vendor.
CSF 16x8 (max 33 cartridges)	Cartridge replacement by vendor.

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Provides treatment of the water quality design storm using an approved proprietary treatment system.

Natural Resources

N/A

Costs

Construction Costs:	$450,500
Site Acquisition:	$0
Engineering / Administration:	$90,100
Capital Project Implementation Costs	**$540,600**
Annual Maintenance Costs	**$8,500**

Design Assumptions

StormFilter sizing assumes that two facilities would be needed to accommodate the number of required cartridges. Each facility would be offline and would operate at 7.5 gpm per cartridge. A total of 41 cartridges would be required for treatment of the water quality flow rate.

The drainage area was deliniated and the drainage configuration (pipe) associated with the Hamilton UIC cluster was included in the XP SWMM CP model.

Project #: A1-5-UIC

Project #: A1-6-UIC

Project Identifier	A1-6-UIC
Project Title	Bushnell UIC Cluster - Pipe and Pre-treat

Project Location

The UICs associated with the Bushnell UIC cluster are located along Bushnell Lane east of Smithoak Street in the A1 Channel subbasin. Two county UICs are associated with this cluster.

The CP includes a water quality treatment facility and necessary piping to route drainage associated with the cluster east to node 72730 to the A-1 channel.

Subbasin	RSA1160
GIS U/S Node Location	N/A
GIS D/S Node Location	72730
Drainage Area Served by Capital Project	2.2 Acres
% Impervious (Existing Land Use)	N/A
% Impervious (Future Land Use)	N/A

Project Description

Provide water quality treatment in the form of a StormFilter compost filter, and pipe drainage from the Bushnell UIC cluster east to node 72730. The required piping for the Bushnell UIC cluster was estimated at 1015 feet of 18" CSP.

Project Elements

1 Ea – CSF 12x6 (max 11 cartridges)
1015 Ft – 18" CSP (2-5 ft. cover)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
CSF 12x6 (max 11 cartridges)	Cartridge replacement by vendor.
18" CSP (2-5 ft. cover)	N/A

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Provides treatment of the water quality design storm using an approved proprietary treatment system.

Natural Resources

N/A

Costs

Construction Costs:	$164,500
Site Acquisition:	$0
Engineering / Administration:	$32,900
Capital Project Implementation Costs	**$197,400**
Annual Maintenance Costs	**$2,100**

Design Assumptions

StormFilter sizing assumes that one facility would be needed to accommodate the number of required cartridges. The facility would be offline and would operate at 7.5 gpm per cartridge. A total of 7 cartridges would be required for treatment of the water quality flow rate.

The drainage area was deliniated and the drainage configuration (pipe) associated with the Bushnell UIC cluster was included in the XP SWMM CP model.

Project #: A1-6-UIC

Project #: A1-7-UIC

Project Identifier	A1-7-UIC
Project Title	Anderson UIC Cluster - Raingarden

Project Location

The UICs associated with the Anderson UIC cluster are scattered between Golden Avenue and Melvina Way, south of Howard Avenue in the A1 Channel subbasin. Eight county UICs and 14 city UICs are associated with this cluster.

The CP involves installation of raingardens.

Subbasin	RSA1245
GIS U/S Node Location	N/A
GIS D/S Node Location	N/A
Drainage Area Served by Capital Project	59.4 (estimated) Acres
% Impervious (Existing Land Use)	N/A
% Impervious (Future Land Use)	N/A

Project Description

Construct raingardens throughout the drainage area associated with the Anderson UIC cluster. Preliminary estimates indicate that approximately 3.47 acres of raingarden would be required to manage treatment and runoff volumes associated with the 5-year, 24 hour storm event.

Project Elements

151342 SF – Raingarden (native soils)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Raingarden (native soils)	Litter and debris removal, reestablishment of vegetation

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Promotes stormwater treatment through filtration, sedimentation, infiltration, and vegetative uptake within the rain garden.

Natural Resources

N/A

Costs

Construction Costs:	$1,210,700
Site Acquisition:	$1,236,000
Engineering / Administration:	$489,300
Capital Project Implementation Costs	**$2,936,000**

Costs do not account for soil amendment.

Annual Maintenance Costs	**$196,700**

Design Assumptions

Because drainage areas were not delineated for all UIC cluster and original drainage area deliniation did not account for all UICs, a modified drainage area for each UIC cluster, assuming 2.7 acres area per UIC was used for sizing raingardens. Therefore, preliminary raingarden sizing for this UIC cluster assumes a drainage area of 59.4 acres. A more detailed deliniation of drainage area to the Anderson UIC cluster would be needed prior to CP design.

Acquisition costs are based on a residential land cost of $337,600/acre and calculated using the raingarden footprint area plus 5% for accessibility. An additional $4,000/project is included for administrative activities associated with land acquisition.

Project #: A1-7-UIC

Project Identifier	A1-8-UIC
Project Title	Escalante UIC Cluster - Raingarden

Project Location

The UICs associated with the Escalante UIC cluster are along Escalante Street south of Howard Avenue in the A1 Channel subbasin. Four city UICs are associated with this cluster.

The CP involves installation of raingardens.

Subbasin	RSA1240
GIS U/S Node Location	N/A
GIS D/S Node Location	N/A
Drainage Area Served by Capital Project	10.8 (estimated) Acres
% Impervious (Existing Land Use)	N/A
% Impervious (Future Land Use)	N/A

Project Description

Construct raingardens throughout the drainage area associated with the Escalante UIC cluster. Preliminary estimates indicate that approximately 0.63 acres of raingarden would be required to manage treatment and runoff volumes associated with the 5-year, 24 hour storm event.

Project Elements

27517 SF – Raingarden (native soils)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	Annual Maintenance Activities
Raingarden (native soils)	Litter and debris removal, reestablishment of vegetation

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Promotes stormwater treatment through filtration, sedimentation, infiltration, and vegetative uptake within the rain garden.

Natural Resources

N/A

Costs

Construction Costs:	$220,100
Site Acquisition:	$228,000
Engineering / Administration:	$89,600
Capital Project Implementation Costs	**$537,700**

Costs do not account for soil amendment.

Annual Maintenance Costs	**$35,700**

Design Assumptions

Because drainage areas were not delineated for all UIC cluster and original drainage area deliniation did not account for all UICs, a modified drainage area for each UIC cluster, assuming 2.7 acres area per UIC was used for sizing raingardens. Therefore, preliminary raingarden sizing for this UIC cluster assumes a drainage area of 10.8 acres. A more detailed deliniation of drainage area to the Escalante UIC cluster would be needed prior to CP design.

Acquisition costs are based on a residential land cost of $337,600/acre and calculated using the raingarden footprint area plus 5% for accessibility. An additional $4,000/project is included for administrative activities associated with land acquisition.

Project #: A1-8-UIC

Project #: A1-9-UIC

Project Identifier	A1-9-UIC
Project Title	Greenleaf UIC Cluster - Pipe and Pre-treat

Project Location

The UIC associated with the Greenleaf UIC cluster is located outside of the River Road Santa Clara basin, east of River Road on Greenleaf Ave. No drainage area for this cluster was calculated for purposes of the CP because the drainage area is outside of the RR-SC basin. One county UIC is associated with this cluster.

The CP includes a water quality treatment facility and necessary piping to route drainage associated with the cluster east to node 59062 on River Road.

Subbasin	N/A	
GIS U/S Node Location	N/A	
GIS D/S Node Location	59062	
Drainage Area Served by Capital Project	2.7 (estimated)	Acres
% Impervious (Existing Land Use)	N/A	
% Impervious (Future Land Use)	N/A	

Project Description

Provide water quality treatment in the form of a StormFilter compost filter, and pipe drainage from the Greenleaf UIC cluster west to node 59062. The required piping for the Greenleaf UIC cluster was estimated at 220 feet of 18" CSP.

Project Elements

220 Ft – 18" CSP (2-5 ft. cover)
1 Ea – CSF 12x6 (max 11 cartridges)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
18" CSP (2-5 ft. cover)	N/A
CSF 12x6 (max 11 cartridges)	Cartridge replacement by vendor.

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Provides treatment of the water quality design storm using an approved proprietary treatment system.

Natural Resources

N/A

Costs

Construction Costs:	$93,000
Site Acquisition:	$0
Engineering / Administration:	$18,600
Capital Project Implementation Costs	**$111,600**
Annual Maintenance Costs	**$2,100**

Design Assumptions

StormFilter sizing assumes that one facility would be needed to accommodate the number of required cartridges. As no drainage area was delineated for the Greenleaf UIC cluster, an estimated drainage area of 2.7 acres (per the raingarden sizing) was assumed. The facility would be offline and would operate at 7.5 gpm per cartridge. A total of 8 cartridges would be required for treatment of the water quality flow rate.

Because no drainage area was deliniated for this UIC cluster, the drainage configuration (pipe) was not specifically included in the XP SWMM CP model for this cluster.

Project #: A1-9-UIC

Project #: A1-10-UIC

Project Identifier	A1-10-UIC
Project Title	Grove UIC Cluster - Raingarden

Project Location

The UICs associated with the Grove UIC cluster are located along Grove Street south of Beltline Road in the A1 Channel subbasin. Four county UICs are associated with this cluster.

The CP involves installation of raingardens.

Subbasin	RSA1180 and RSA1190
GIS U/S Node Location	N/A
GIS D/S Node Location	N/A
Drainage Area Served by Capital Project	10.8 (estimated) Acres
% Impervious (Existing Land Use)	N/A
% Impervious (Future Land Use)	N/A

Project Description

Construct raingardens throughout the drainage area associated with the Grove UIC cluster. Preliminary estimates indicate that approximately 0.63 acres of raingarden would be required to manage treatment and runoff volumes associated with the 5-year, 24 hour storm event.

Project Elements

27517 SF – Raingarden (native soils)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Raingarden (native soils)	Litter and debris removal, reestablishment of vegetation

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Promotes stormwater treatment through filtration, sedimentation, infiltration, and vegetative uptake within the rain garden.

Natural Resources

N/A

Costs

Construction Costs:	$220,100
Site Acquisition:	$228,000
Engineering / Administration:	$89,600
Capital Project Implementation Costs	**$537,700**
Annual Maintenance Costs	**$35,700**

Design Assumptions

Because drainage areas were not delineated for all UIC clusters (including this one) and original drainage area deliniation did not account for all UICs, a modified drainage area for each UIC cluster, assuming 2.7 acres area per UIC was used for sizing raingardens. Therefore, preliminary raingarden sizing for this UIC cluster assumes a drainage area of 10.8 acres. A more detailed deliniation of drainage area to the Grove UIC cluster would be needed prior to CP design.

Acquisition costs are based on a residential land cost of $337,600/acre and calculated using the raingarden footprint area plus 5% for accessibility. An additional $4,000/project is included for administrative activities associated with land acquisition.

Project #: A1-10-UIC

Project Identifier	A1-11-UIC
Project Title	Exeter UIC Cluster - Raingarden

Project Location

The UICs associated with the Exeter UIC cluster are located along Exeter Avenue and Quince Street in the A1 Channel subbasin. Three city UICs are associated with this cluster.

The CP involves installation of raingardens.

Subbasin	RSA1190
GIS U/S Node Location	N/A
GIS D/S Node Location	N/A
Drainage Area Served by Capital Project	8.1 (estimated) Acres
% Impervious (Existing Land Use)	N/A
% Impervious (Future Land Use)	N/A

Project Description

Construct raingardens throughout the drainage area associated with the Exeter UIC cluster. Preliminary estimates indicate that approximately 0.47 acres of raingarden would be required to manage treatment and runoff volumes associated with the 5-year, 24 hour storm event.

Project Elements

20637 SF – Raingarden (native soils)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Raingarden (native soils)	Litter and debris removal, reestablishment of vegetation

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Promotes stormwater treatment through filtration, sedimentation, infiltration, and vegetative uptake within the rain garden.

Natural Resources

N/A

Costs

Construction Costs:	$165,000
Site Acquisition:	$172,000
Engineering / Administration:	$67,400
Capital Project Implementation Costs	**$404,400**

Costs do not account for soil amendment.

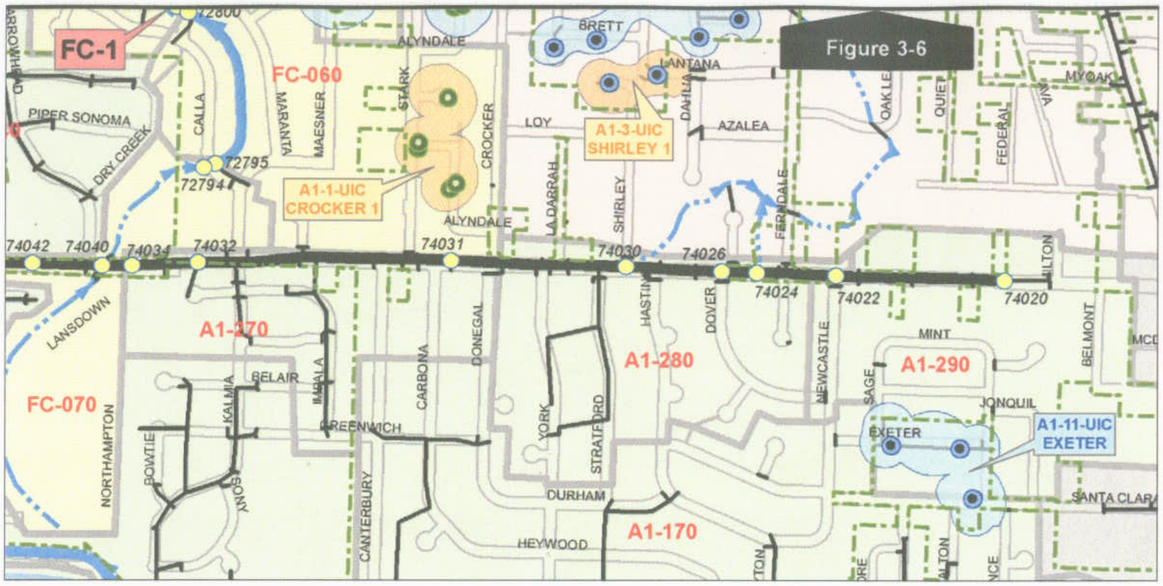
Annual Maintenance Costs	**$26,800**

Design Assumptions

Because drainage areas were not delineated for all UIC clusters and original drainage area deliniation did not account for all UICs, a modified drainage area for each UIC cluster, assuming 2.7 acres area per UIC was used for sizing raingardens. Therefore, preliminary raingarden sizing for this UIC cluster assumes a drainage area of 8.1 acres. A more detailed deliniation of drainage area to the Exeter UIC cluster would be needed prior to CP design.

Acquisition costs are based on a residential land cost of $337,600/acre and calculated using the raingarden footprint area plus 5% for accessibility. An additional $4,000/project is included for administrative activities associated with land acquisition.

Project #: A1-11-UIC



Project #: A1-12-UIC

Project Identifier	A1-12-UIC
Project Title	Brentwood UIC Cluster - Raingarden

Project Location

The UIC associated with the Brentwood UIC cluster is located on Brentwood Road just north of Howard Avenue in the A1 Channel subbasin. One county UIC is associated with this cluster.

The CP involves installation of raingardens.

Subbasin	RSA1210	
GIS U/S Node Location	N/A	
GIS D/S Node Location	N/A	
Drainage Area Served by Capital Project	2.7 (estimated)	Acres
% Impervious (Existing Land Use)	N/A	
% Impervious (Future Land Use)	N/A	

Project Description

Construct raingardens throughout the drainage area associated with the Brentwood UIC cluster. Preliminary estimates indicate that approximately 0.16 acres of raingarden would be required to manage treatment and runoff volumes associated with the 5-year, 24 hour storm event.

Project Elements

6879 SF – Raingarden (native soils)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Raingarden (native soils)	Litter and debris removal, reestablishment of vegetation

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Promotes stormwater treatment through filtration, sedimentation, infiltration, and vegetative uptake within the rain garden.

Natural Resources

N/A

Costs

Construction Costs:	$55,000
Site Acquisition:	$60,000
Engineering / Administration:	$23,000
Capital Project Implementation Costs	**$138,000**

Costs do not account for soil amendment.

Annual Maintenance Costs	**$8,900**

Design Assumptions

Because drainage areas were not delineated for all UIC clusters (including this one) and original drainage area deliniation did not account for all UICs, a modified drainage area for each UIC cluster, assuming 2.7 acres area per UIC was used for sizing raingardens. Therefore, preliminary raingarden sizing for this UIC cluster assumes a drainage area of 2.7 acres. A more detailed deliniation of drainage area to the Brentwood UIC cluster would be needed prior to CP design.

Acquisition costs are based on a residential land cost of $337,600/acre and calculated using the raingarden footprint area plus 5% for accessibility. An additional $4,000/project is included for administrative activities associated with land acquisition.

Project #: A1-12-UIC

Project #: A1-13-UIC

Project Identifier	A1-13-UIC
Project Title	Korbel UIC Cluster - Pipe and Pre-treat

Project Location

The UICs associated with the Korbel UIC cluster are located on Korbel Street, west of Merryvale Road in the Flat Creek and A1 Channel subbasins. Two city UICs are associated with this cluster.

The CP includes a water quality treatment facility and necessary piping to route drainage associated with the cluster to node 72223 (in the A1 Channel subbasin).

Subbasin	RSFC030 and RSA1130
GIS U/S Node Location	N/A
GIS D/S Node Location	72223
Drainage Area Served by Capital Project	1.4 Acres
% Impervious (Existing Land Use)	N/A
% Impervious (Future Land Use)	N/A

Project Description

Provide water quality treatment in the form of a StormFilter compost filter, and pipe drainage from the Korbel UIC cluster to node 72223. The required piping for the Korbel UIC cluster was estimated at 650 feet of 18" CSP.

Project Elements

650 Ft – 18" CSP (2-5 ft. cover)

1 Ea – CSF 8x6 (max 6 cartridges)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
18" CSP (2-5 ft. cover)	N/A
CSF 8x6 (max 6 cartridges)	Cartridge replacement by vendor.

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Provides treatment of the water quality design storm using an approved proprietary treatment system.

Natural Resources

N/A

Costs

Construction Costs:	$117,000
Site Acquisition:	$0
Engineering / Administration:	$23,400
Capital Project Implementation Costs	**$140,400**
Annual Maintenance Costs	**$1,100**

Design Assumptions

StormFilter sizing assumes that one facility would be needed to accommodate the number of required cartridges. The facility would be offline and would operate at 7.5 gpm per cartridge. A total of 5 cartridges would be required for treatment of the water quality flow rate.

The drainage area associated with the Korbel UIC cluster was deliniated for the XP SWMM CP model. However, the drainage configuration (pipe) was not included in the model because there appears to be a discrepancy in invert elevations between the model and as-builts in this location. Invert elevations would need to be surveyed for final design.

Project #: A1-13-UIC

Project #: A1-14-UIC

Project Identifier	A1-14-UIC
Project Title	Howard UIC Cluster - Raingarden

Project Location

The UIC associated with the Howard UIC cluster is located at the intersection of Howard and Parnell in the A1 Channel subbasin. One county UIC is associated with this cluster.

The CP involves installation of raingardens.

Subbasin	RSA1245
GIS U/S Node Location	N/A
GIS D/S Node Location	N/A
Drainage Area Served by Capital Project	2.7 (estimated) Acres
% Impervious (Existing Land Use)	N/A
% Impervious (Future Land Use)	N/A

Project Description

Construct raingardens throughout the drainage area associated with the Howard UIC cluster. Preliminary estimates indicate that approximately 0.16 acres of raingarden would be required to manage treatment and runoff volumes associated with the 5-year, 24 hour storm event.

Project Elements

6879 SF – Raingarden (native soils)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Raingarden (native soils)	Litter and debris removal, reestablishment of vegetation

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Promotes stormwater treatment through filtration, sedimentation, infiltration, and vegetative uptake within the rain garden.

Natural Resources

N/A

Costs

Construction Costs:	$55,000
Site Acquisition:	$60,000
Engineering / Administration:	$23,000
Capital Project Implementation Costs	**$138,000**

Costs do not account for soil amendment.

Annual Maintenance Costs	**$8,900**

Design Assumptions

Because drainage areas were not delineated for all UIC cluster (including this one) and the original drainage area deliniation did not account for all UICs, a modified drainage area for each UIC cluster, assuming 2.7 acres area per UIC was used for sizing raingardens. Therefore, preliminary raingarden sizing for this UIC cluster assumes a drainage area of 2.7 acres. A more detailed deliniation of drainage area to the Howard UIC cluster would be needed prior to CP design.

Acquisition costs are based on a residential land cost of $337,600/acre and calculated using the raingarden footprint area plus 5% for accessibility. An additional $4,000/project is included for administrative activities associated with land acquisition.

Project #: A1-14-UIC

Project #: A1-15-UIC

Project Identifier	A1-15-UIC
Project Title	South of Horn Lane UIC Cluster - On-Street Raingarden

Project Location

The UICs associated with the South of Horn Lane UIC cluster are located south of Horn Lane in the A1 Channel subbasin. 26 county UICs and one city UIC are associated with this cluster.

The CP involves installation of raingardens in conjunction with street improvements.

Subbasin	RSA1240 and RSA1245
GIS U/S Node Location	N/A
GIS D/S Node Location	N/A
Drainage Area Served by Capital Project	72.9 (estimated) Acres
% Impervious (Existing Land Use)	N/A
% Impervious (Future Land Use)	N/A

Project Description

Construct raingardens in conjunction with street improvements throughout the drainage area associated with the South of Horn Lane UIC cluster. Preliminary estimates indicate that approximately 4.26 acres of raingarden would be required to manage treatment and runoff volumes associated with the 5-year, 24 hour storm event.

Project Elements

185737 SF – Raingarden (native soils)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Raingarden (native soils)	Litter and debris removal, reestablishment of vegetation

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Promotes stormwater treatment through filtration, sedimentation, infiltration, and vegetative uptake within the rain garden.

Natural Resources

N/A

Costs

Construction Costs:	$1,485,800
Site Acquisition:	$1,515,000
Engineering / Administration:	$600,100
Capital Project Implementation Costs	**$3,600,900**

Costs do not account for soil amendment.

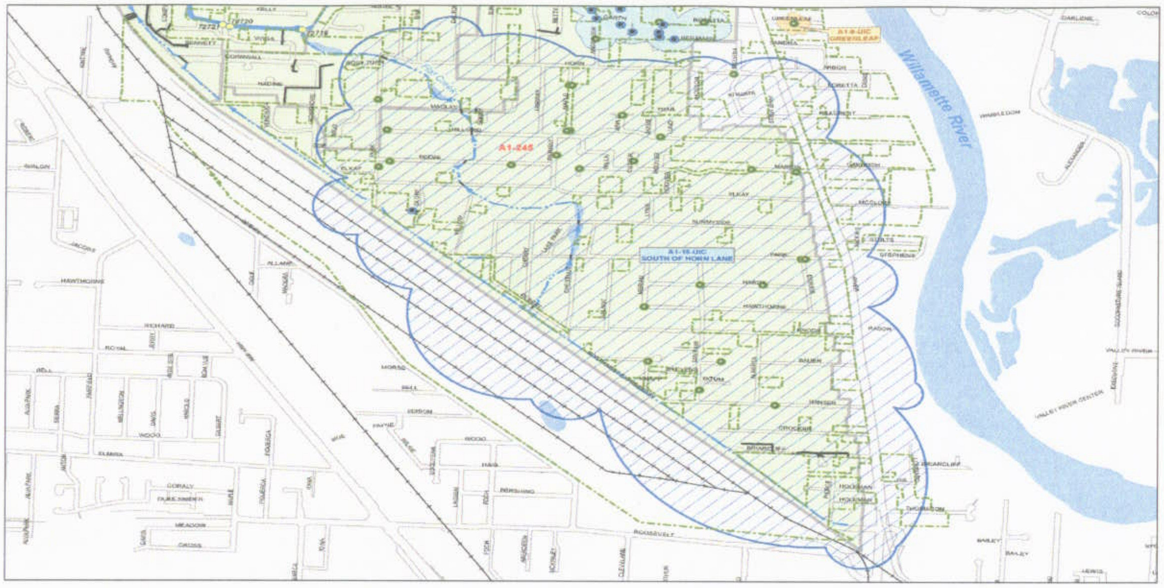
Annual Maintenance Costs	**$241,400**

Design Assumptions

Because drainage areas were not delineated for all UIC clusters (including this one) and the original drainage area deliniation did not account for all UICs, a modified drainage area for each UIC cluster, assuming 2.7 acres area per UIC was used for sizing raingardens. Therefore, preliminary raingarden sizing for this UIC cluster assumes a drainage area of 72.9 acres. A more detailed deliniation of drainage area to the South of Horn Lane UIC cluster would be needed prior to CP design.

Acquisition costs are based on a residential land cost of $337,600/acre and calculated using the raingarden footprint area plus 5% for accessibility. An additional $4,000/project is included for administrative activities associated with land acquisition.

Project #: A1-15-UIC



Project #: FC-1

Project Identifier	**FC-1**
Project Title	**Flat Creek Culvert Replacement at Calla Street**

Project Location

The proposed CP is located in modeled drainage segment RSFC050D. The segment runs east-west, north of Calla Street and west of Hyacinth Street. The CP is proposed to reduce flooding in upstream open channel segments RSFC050E.

Subbasin	**RSFC050**
GIS U/S Node Location	**75654**
GIS D/S Node Location	**78673**
Drainage Area Served by Capital Project	**119.2** Acres
% Impervious (Existing Land Use)	**39.6**
% Impervious (Future Land Use)	**42.4**

Project Description

Replace the three existing 12" CSP culverts with 25' of a 1.5' x 5' box culvert.

Project Elements

25 LF – 1.5' x 5' box culvert

Problems and/or Opportunities Addressed by the Capital Projects

Problems

Modeled flooding problems in upstream open channel segment RSFC050E were predicted for the 10-year existing condition event.

Opportunities

N/A

Project #: FC-1

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
1.5' x 5' box culvert	N/A

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Expected to reduce model-predicted flooding problems identified upstream.

Water Quality

N/A

Natural Resources

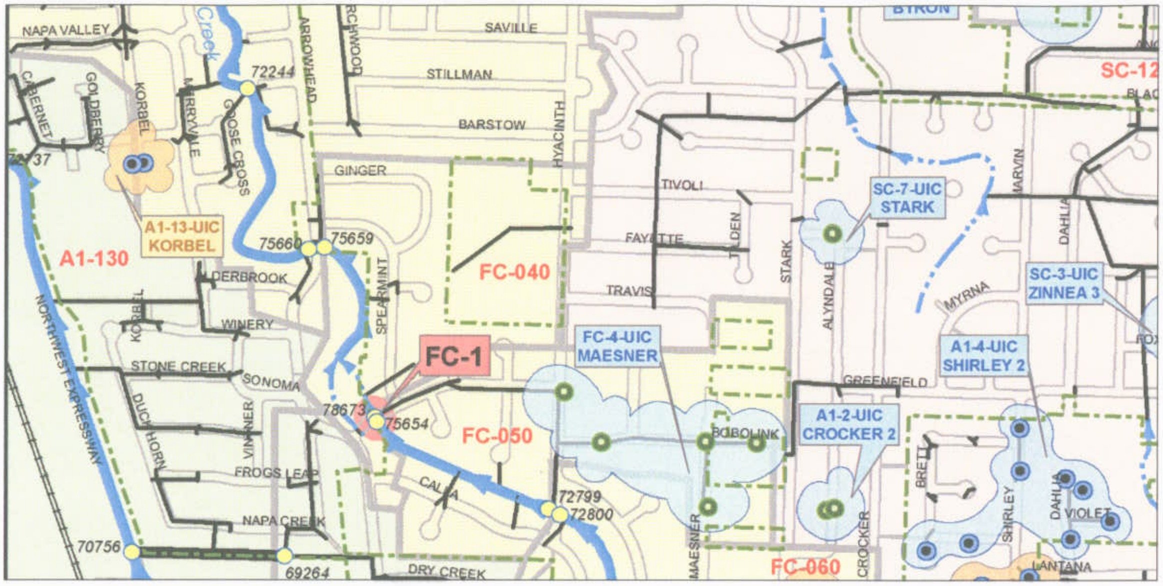
N/A

Costs

Construction Costs:	$11,200
Site Acquisition:	$0
Engineering / Administration:	$2,200
Capital Project Implementation Costs	**$13,400**
Annual Maintenance Costs	**$0**

Design Assumptions

Project #: FC-1



NAPA VALLEY
SAVILLE
STILLMAN
BARSTOW
GINGER
72244
A1-13-UIC KORBEL
A1-130
75660
75659
FC-040
TIVOLI
FAYETTE
TRAVIS
SC-7-UIC STARK
SC-3-UIC ZINNEA 3
SC-12
FC-1
FC-4-UIC MAESNER
A1-4-UIC SHIRLEY 2
A1-2-UIC CROCKER 2
78673
75654
FC-050
72799
72800
70756
69264
DRY CREEK
NAPA CREEK
FROGS LEAP
STONE CREEK
SONOMA
WINERY
NORTHWEST EXPRESSWAY
FC-060
GREENFIELD
MYRNA
VIOLET
LANTANA

Project Identifier	FC-1-UIC
Project Title	Willowbrook 1 UIC Cluster - Raingarden

Project Location

The UICs associated with the Willowbrook UIC cluster are located from Tyson Lane to Swenson Lane, east of Lancaster Drive in the Flat Creek and Spring Creek subbasins. Twelve city UICs are associated with this cluster.

Given design constraints, the UIC cluster was divided into three drainage areas (Willowbrook 1, Willowbrook 2, and Willowbrook 3). This CP includes installation of a raingarden to manage runoff from the three eastern UICs (Willowbrook 1 drainage). Although included in the Spring Creek subbasin, this CP is classified as a Flat Creek CP because drainage from a majority of the Willowbrook cluster is included in the Flat Creek subbasin.

Subbasin	RSSC110	
GIS U/S Node Location	N/A	
GIS D/S Node Location	N/A	
Drainage Area Served by Capital Project	8.1 (estimated)	Acres
% Impervious (Existing Land Use)	N/A	
% Impervious (Future Land Use)	N/A	

Project Description

Construct raingardens throughout the drainage area associated with the Willowbrook 1 UIC cluster. Preliminary estimates indicate that approximately 0.47 acres of raingarden would be required to manage treatment and runoff volumes associated with the 5-year, 24 hour storm event.

Project Elements

20637 SF – Raingarden (native soils)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Raingarden (native soils)	Litter and debris removal, reestablishment of vegetation

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Promotes stormwater treatment through filtration, sedimentation, infiltration, and vegetative uptake within the rain garden.

Natural Resources

N/A

Costs

Construction Costs:	$165,000
Site Acquisition:	$172,000
Engineering / Administration:	$67,400
Capital Project Implementation Costs	**$404,400**

Costs do not account for soil amendment.

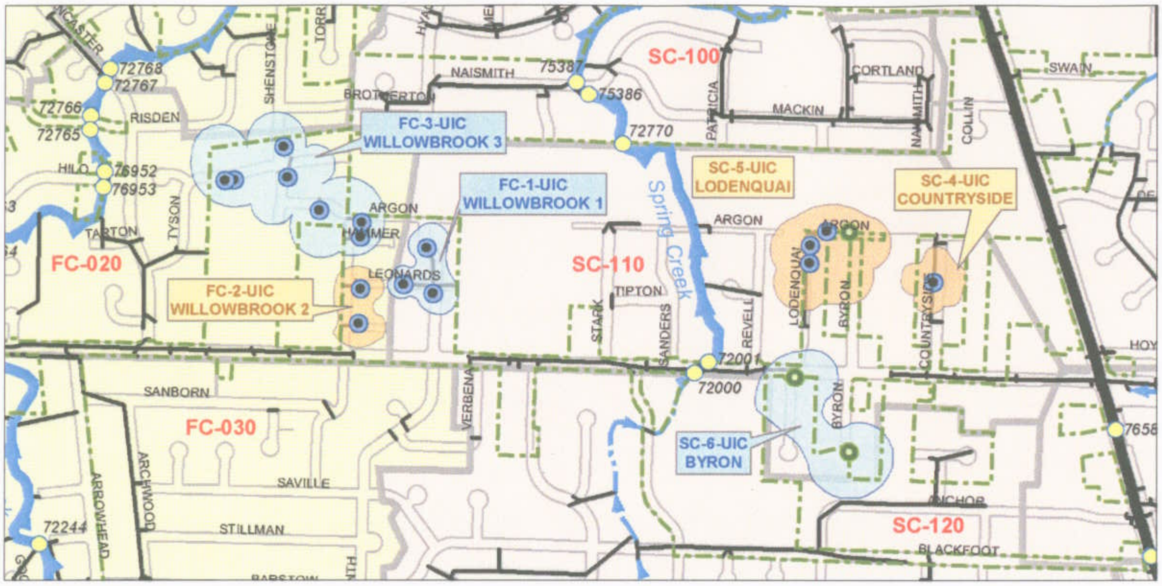
Annual Maintenance Costs	**$26,800**

Design Assumptions

Because drainage areas were not delineated for all UIC clusters and original drainage area deliniation did not account for all UICs, a modified drainage area for each UIC cluster, assuming 2.7 acres area per UIC was used for sizing raingardens. Therefore, preliminary raingarden sizing for this UIC cluster assumes a drainage area of 8.1 acres. A more detailed deliniation of drainage area to the Willowbrook 1 UIC cluster would be needed prior to CP design.

Acquisition costs are based on a residential land cost of $337,600/acre and calculated using the raingarden footprint area plus 5% for accessibility. An additional $4,000/project is included for administrative activities associated with land acquisition.

Project #: FC-1-UIC



Project Identifier	**FC-2-UIC**
Project Title	**Willowbrook 2 UIC Cluster - Pipe and Pre-treat**

Project Location

The UICs associated with the Willowbrook UIC cluster are located from Tyson Lane to Swenson Lane, east of Lancaster Drive in the Flat Creek and Spring Creek subbasins. Twelve city UICs are associated with this cluster.

Given design constraints, the UIC cluster was divided into three drainage areas (Willowbrook 1, Willowbrook 2, and Willowbrook 3). This CP includes a water quality treatment facility and necessary piping to route runoff from the two southwestern UICs (Willowbrook 2 drainage) to node 79031 on Irvington Drive.

Subbasin	**RSFC020**
GIS U/S Node Location	**N/A**
GIS D/S Node Location	**79031**
Drainage Area Served by Capital Project	**3.6** Acres
% Impervious (Existing Land Use)	**N/A**
% Impervious (Future Land Use)	**N/A**

Project Description

Provide water quality treatment in the form of a StormFilter compost filter, and pipe drainage from the Willowbrook 2 UIC cluster to node 79031. The required piping for the Willowbrook 2 UIC cluster was estimated at 440 feet of 18" CSP.

Project Elements

440 Ft – 18" CSP (2-5 ft. cover)
1 Ea – CSF 12x6 (max 11 cartridges)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
18" CSP (2-5 ft. cover)	N/A
CSF 12x6 (max 11 cartridges)	Cartridge replacement by vendor.

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Provides treatment of the water quality design storm using an approved proprietary treatment system.

Natural Resources

N/A

Costs

Construction Costs:	$112,800
Site Acquisition:	$0
Engineering / Administration:	$22,500
Capital Project Implementation Costs	**$135,300**
Annual Maintenance Costs	**$2,100**

Design Assumptions

StormFilter sizing assumes that one facility would be needed to accommodate the number of required cartridges. The facility would be offline and would operate at 7.5 gpm per cartridge. A total of 11 cartridges would be required for treatment of the water quality flow rate.

The drainage area associated with the Willowbrook 2 UIC cluster was deliniated for the XP SWMM CP model. However, the drainage configuration (pipe) was not included in the model because there appears to be a discrepancy in invert elevations between the model and as-builts in this location. Invert elevations would need to be surveyed for final design.

Project #: FC-2-UIC

Project #: FC-3-UIC

Project Identifier	**FC-3-UIC**
Project Title	**Willowbrook 3 UIC Cluster - Raingarden**

Project Location

The UICs associated with the Willowbrook UIC cluster are located from Tyson Lane to Swenson Lane, east of Lancaster Drive in the Flat Creek and Spring Creek subbasins. Twelve city UICs are associated with this cluster.

Given design constraints, the UIC cluster was divided into three drainage areas (Willowbrook 1, Willowbrook 2, and Willowbrook 3). This CP includes installation of a raingarden to manage runoff from the seven northwestern UICs (Willowbrook 3 drainage).

Subbasin	**RSFC020**
GIS U/S Node Location	**N/A**
GIS D/S Node Location	**N/A**
Drainage Area Served by Capital Project	**18.9 (estimated)** Acres
% Impervious (Existing Land Use)	**N/A**
% Impervious (Future Land Use)	**N/A**

Project Description

Construct raingardens throughout the drainage area associated with the Willowbrook 3 UIC cluster. Preliminary estimates indicate that approximately 1.11 acres of raingarden would be required to manage treatment and runoff volumes associated with the 5-year, 24 hour storm event.

Project Elements

48154 SF – Raingarden (native soils)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Raingarden (native soils)	Litter and debris removal, reestablishment of vegetation

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Promotes stormwater treatment through filtration, sedimentation, infiltration, and vegetative uptake within the rain garden.

Natural Resources

N/A

Costs

Construction Costs:	$385,200
Site Acquisition:	$396,000
Engineering / Administration:	$156,200
Capital Project Implementation Costs	**$937,400**

Costs do not account for soil amendment.

Annual Maintenance Costs	**$62,600**

Design Assumptions

Because drainage areas were not delineated for all UIC clusters and original drainage area deliniation did not account for all UICs, a modified drainage area for each UIC cluster, assuming 2.7 acres area per UIC was used for sizing raingardens. Therefore, preliminary raingarden sizing for this UIC cluster assumes a drainage area of 18.9 acres. A more detailed deliniation of drainage area to the Willowbrook 3 UIC cluster would be needed prior to CP design.

Acquisition costs are based on a residential land cost of $337,600/acre and calculated using the raingarden footprint area plus 5% for accessibility. An additional $4,000/project is included for administrative activities associated with land acquisition.

Project #: FC-3-UIC

Project Identifier	FC-4-UIC
Project Title	Maesner UIC Cluster - Raingarden

Project Location

The UICs associated with the Maesner UIC cluster are located surrounding Bobolink Avenue in the Flat Creek subbasin. Five county UICs are associated with this cluster.

The CP involves installation of raingardens.

Subbasin	RSFC050	
GIS U/S Node Location	N/A	
GIS D/S Node Location	N/A	
Drainage Area Served by Capital Project	13.5 (estimated)	Acres
% Impervious (Existing Land Use)	N/A	
% Impervious (Future Land Use)	N/A	

Project Description

Construct raingardens throughout the drainage area associated with the Maesner UIC cluster. Preliminary estimates indicate that approximately 0.79 acres of raingarden would be required to manage treatment and runoff volumes associated with the 5-year, 24 hour storm event.

Project Elements

34396 SF – Raingarden (native soils)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Raingarden (native soils)	Litter and debris removal, reestablishment of vegetation

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Promotes stormwater treatment through filtration, sedimentation, infiltration, and vegetative uptake within the rain garden.

Natural Resources

N/A

Costs

Construction Costs:	$275,100
Site Acquisition:	$284,000
Engineering / Administration:	$111,800
Capital Project Implementation Costs	**$670,900**

Costs do not account for soil amendment.

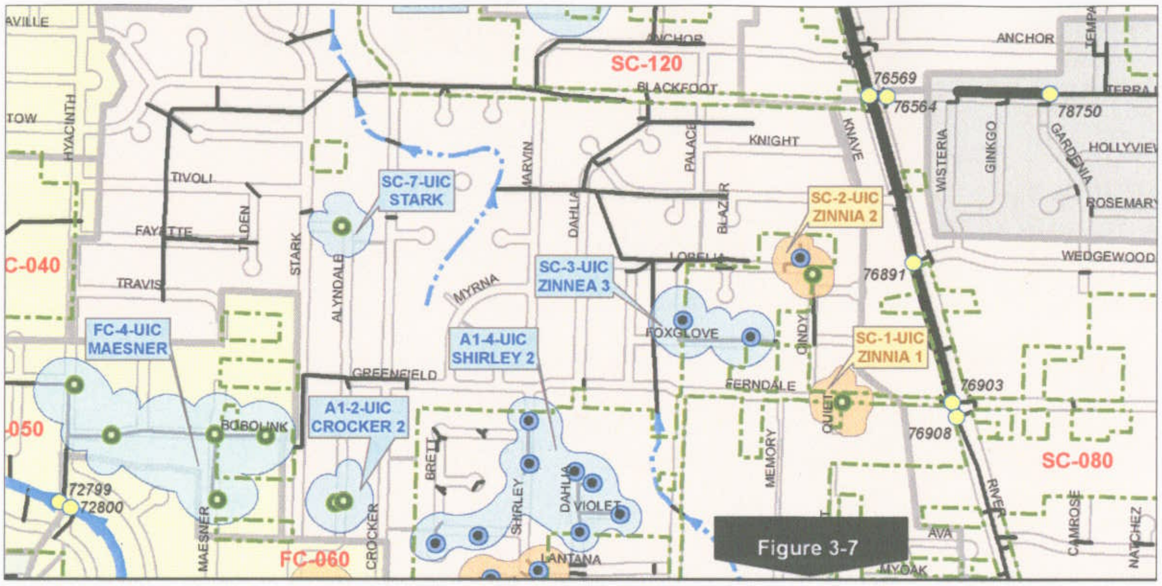
Annual Maintenance Costs	**$44,700**

Design Assumptions

Because drainage areas were not delineated for all UIC clusters and original drainage area deliniation did not account for all UICs, a modified drainage area for each UIC cluster, assuming 2.7 acres area per UIC was used for sizing raingardens. Therefore, preliminary raingarden sizing for this UIC cluster assumes a drainage area of 13.5 acres. A more detailed deliniation of drainage area to the Maesner UIC cluster would be needed prior to CP design.

Acquisition costs are based on a residential land cost of $337,600/acre and calculated using the raingarden footprint area plus 5% for accessibility. An additional $4,000/project is included for administrative activities associated with land acquisition.

Project #: FC-4-UIC



Project #: SC-1

Project Identifier	SC-1
Project Title	Spring Creek Culvert Replacement at Katy Lane

Project Location

The proposed CP is located in modeled drainage segment RSSC040B. The segment runs north-south west of Berry Lane and south of Katy Lane.

Subbasin	RSSC040
GIS U/S Node Location	72006
GIS D/S Node Location	72007
Drainage Area Served by Capital Project	823.8 Acres
% Impervious (Existing Land Use)	39.9
% Impervious (Future Land Use)	44.4

Project Description

Replace the two existing 30" CSP culverts with pedestrian bridge (12' span).

Project Elements

1 EA – Pedestrian Bridge - metal

Problems and/or Opportunities Addressed by the Capital Projects

Problems

Modeled flooding problems in segment RSSC040B are predicted for the 10-year existing condition event.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Pedestrian Bridge - metal	N/A

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Expected to reduce model-predicted flooding problems identified in this segment.

Water Quality

N/A

Natural Resources

N/A

Costs

Construction Costs:	$15,000
Site Acquisition:	$0
Engineering / Administration:	$3,000
Capital Project Implementation Costs	**$18,000**
Annual Maintenance Costs	**$0**

Design Assumptions

Project #: SC-1


SC-1
Modeled segment extends from node 76560 to 72011
SC-9-UIC CALUMET
WO-11-UIC WARRINGTON
SC-040
SC-050
SC-090
WO-005
WO-020
WO-030
East Santa Clara Waterway
72012
72011
72010
72009
72008
72007
72006
72005
72004
72003
76560
72033
72032
72031
72030
79470
72088
99827
99820
LARKSMEAD
REDROCK
BAMPTON
CALUMET
THUNDERBIRD
BRIARS
HERMAN
JILL
MAHONIA
EMILY
WENDOVER
NOTTINGHAM
WATSON
EDWARDS
CLAIRMONT
WARRINGTON
SHAMROCK
BANOVER
KILDARE
CORONA
DOYLE
HAMPSHIRE
SPRING CREEK
SILVER OAK
VAN FOSSEN
VICTORIA
BRADFORD
LYNNBROOK
SCOTTDALE
OROYAN

Project Identifier	**SC-1-UIC**
Project Title	**Zinnia 1 UIC Cluster - Pipe and Pre-treat**

Project Location

The UICs associated with the Zinnia UIC cluster are scattered between Zinnia Street and Cindy Street in the Spring Creek subbasin. Three city UICs and two county UICs are associated with this cluster.

Given design constraints, the UIC cluster was divided into three drainage areas (Zinnia 1, Zinnia 2, and Zinnia 3). This CP includes a water quality treatment facility and necessary piping to route runoff from the one southeastern UIC (Zinnia 1 drainage) to node 76903 on River Road.

Subbasin	**RSSC120**
GIS U/S Node Location	**N/A**
GIS D/S Node Location	**76903**
Drainage Area Served by Capital Project	**4.44** Acres
% Impervious (Existing Land Use)	**N/A**
% Impervious (Future Land Use)	**N/A**

Project Description

Provide water quality treatment in the form of a StormFilter compost filter, and pipe drainage from the Zinnia 1 UIC cluster east to node 76903. The required piping for the Zinnia 1 UIC cluster was estimated at 575 feet of 24" CSP.

Project Elements

575 Ft – 24" CSP (2-5 ft. cover)
1 Ea – CSF 16x8 (max 33 cartridges)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
24" CSP (2-5 ft. cover)	N/A
CSF 16x8 (max 33 cartridges)	Cartridge replacement by vendor.

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Provides treatment of the water quality design storm using an approved proprietary treatment system.

Natural Resources

N/A

Costs

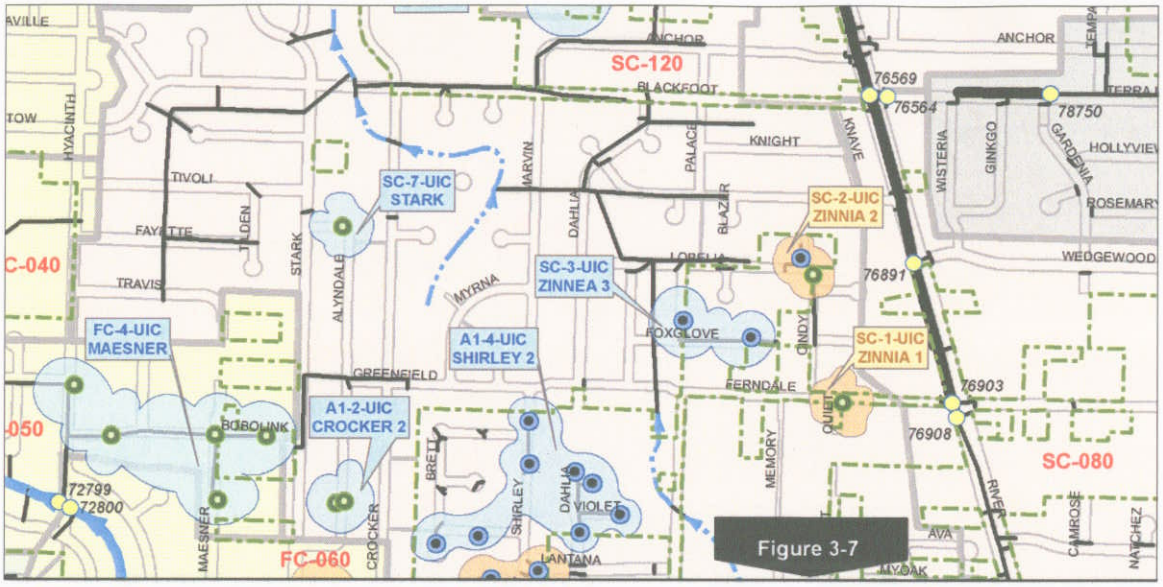
Construction Costs:	$207,500
Site Acquisition:	$0
Engineering / Administration:	$41,500
Capital Project Implementation Costs	**$249,000**
Annual Maintenance Costs	**$6,400**

Design Assumptions

StormFilter sizing assumes that one facility would be needed to accommodate the number of required cartridges. The facility would be offline and would operate at 7.5 gpm per cartridge. A total of 13 cartridges would be required for treatment of the water quality flow rate.

The drainage area was deliniated and the drainage configuration (pipe) associated with the Zinnia 1 UIC cluster was included in the XP SWMM CP model.

Project #: SC-1-UIC



Project Identifier	SC-2-UIC
Project Title	Zinnia 2 UIC Cluster - Pipe and Pre-treat

Project Location

The UICs associated with the Zinnia UIC cluster are scattered between Zinnia Street and Cindy Street in the Spring Creek subbasin. Three city UICs and two county UICs are associated with this cluster.

Given design constraints, the UIC cluster was divided into three drainage areas (Zinnia 1, Zinnia 2, and Zinnia 3). This CP includes a water quality treatment facility and necessary piping to route runoff from the two northeastern UICs (Zinnia 2 drainage) to node 76891 on River Road.

Subbasin	RSSC120
GIS U/S Node Location	N/A
GIS D/S Node Location	76891
Drainage Area Served by Capital Project	7.25 Acres
% Impervious (Existing Land Use)	N/A
% Impervious (Future Land Use)	N/A

Project Description

Provide water quality treatment in the form of a StormFilter compost filter, and pipe drainage from the Zinnia 2 UIC cluster east to node 76891. The required piping for the Zinnia 2 UIC cluster was estimated at 675 feet of 24" CSP.

Project Elements

675 Ft – 24" CSP (2-5 ft. cover)

1 Ea – CSF 16x8 (max 33 cartridges)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
24" CSP (2-5 ft. cover)	N/A
CSF 16x8 (max 33 cartridges)	Cartridge replacement by vendor.

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Provides treatment of the water quality design storm using an approved proprietary treatment system.

Natural Resources

N/A

Costs

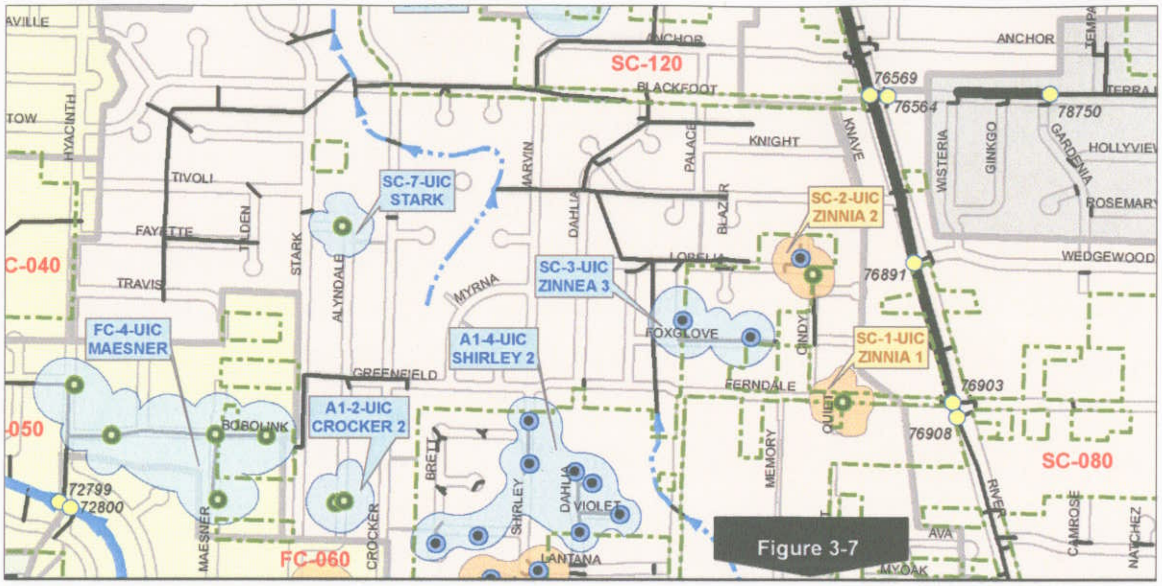
Construction Costs:	$219,500
Site Acquisition:	$0
Engineering / Administration:	$43,900
Capital Project Implementation Costs	**$263,400**
Annual Maintenance Costs	**$6,400**

Design Assumptions

StormFilter sizing assumes that one facility would be needed to accommodate the number of required cartridges. The facility would be offline and would operate at 7.5 gpm per cartridge. A total of 22 cartridges would be required for treatment of the water quality flow rate.

The drainage area was deliniated and the drainage configuration (pipe) associated with the Zinnia 2 UIC cluster was included in the XP SWMM CP model.

Project #: SC-2-UIC



Project #: SC-3-UIC

Project Identifier	SC-3-UIC
Project Title	Zinnia 3 UIC Cluster - Raingarden

Project Location

The UICs associated with the Zinnia UIC cluster are scattered between Zinnia Street and Cindy Street in the Spring Creek subbasin. Three city UICs and two county UICs are associated with this cluster.

Given design constraints, the UIC cluster was divided into three drainage areas (Zinnia 1, Zinnia 2, and Zinnia 3). This CP includes installation of a raingarden to manage runoff from the two western UICs (Zinnia 3 drainage).

Subbasin	RSSC120
GIS U/S Node Location	N/A
GIS D/S Node Location	N/A
Drainage Area Served by Capital Project	5.4 (estimated) Acres
% Impervious (Existing Land Use)	N/A
% Impervious (Future Land Use)	N/A

Project Description

Construct raingardens throughout the drainage area associated with the Zinnia 3 UIC cluster. Preliminary estimates indicate that approximately 0.32 acres of raingarden would be required to manage treatment and runoff volumes associated with the 5-year, 24 hour storm event.

Project Elements

13758 SF – Raingarden (native soils)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Raingarden (native soils)	Litter and debris removal, reestablishment of vegetation

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Promotes stormwater treatment through filtration, sedimentation, infiltration, and vegetative uptake within the rain garden.

Natural Resources

N/A

Costs

Construction Costs:	$110,000
Site Acquisition:	$116,000
Engineering / Administration:	$45,200
Capital Project Implementation Costs	**$271,200**

Costs do not account for soil amendment.

Annual Maintenance Costs	**$17,800**

Design Assumptions

Because drainage areas were not delineated for all UIC clusters and original drainage area deliniation did not account for all UICs, a modified drainage area for each UIC cluster, assuming 2.7 acres area per UIC was used for sizing raingardens. Therefore, preliminary raingarden sizing for this UIC cluster assumes a drainage area of 5.4 acres. A more detailed deliniation of drainage area to the Brentwood UIC cluster would be needed prior to CP design.

Acquisition costs are based on a residential land cost of $337,600/acre and calculated using the raingarden footprint area plus 5% for accessibility. An additional $4,000/project is included for administrative activities associated with land acquisition.

Project #: SC-3-UIC

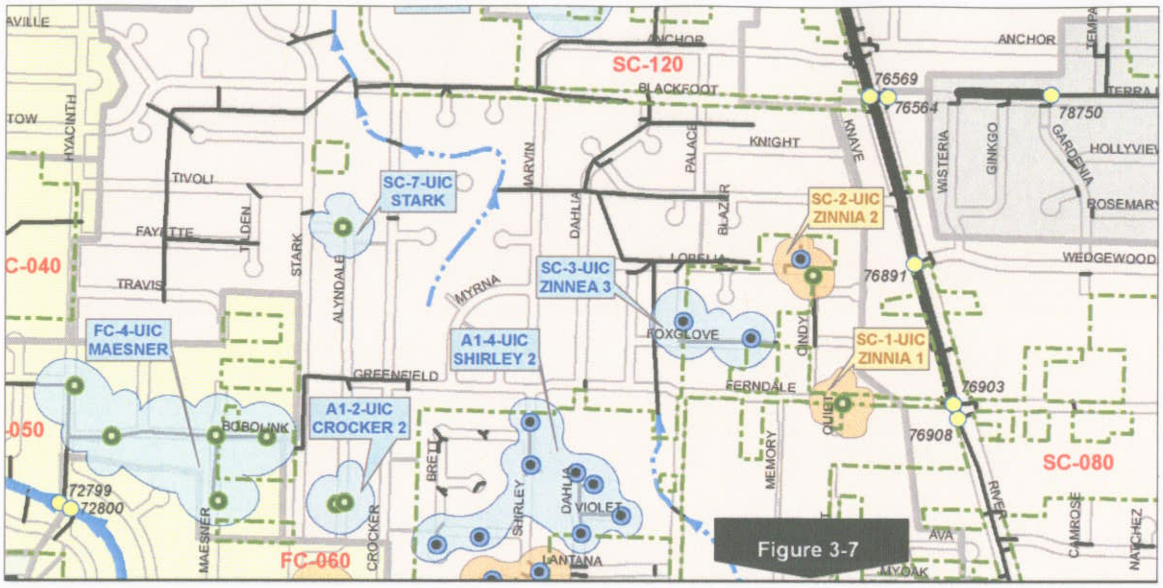


Figure 3-7

Project #: SC-4-UIC

Project Identifier	SC-4-UIC
Project Title	Countryside UIC Cluster - Pipe and Pre-treat

Project Location

The UIC associated with the Countryside UIC cluster is located along Countryside Lane, north of Irvington Drive, in the Spring Creek subbasin. One city UIC is associated with this cluster.

The CP includes a water quality treatment facility and necessary piping to route drainage associated with the cluster to node 76858 on River Road.

Subbasin	RSSC110
GIS U/S Node Location	N/A
GIS D/S Node Location	76858
Drainage Area Served by Capital Project	11.5 Acres
% Impervious (Existing Land Use)	N/A
% Impervious (Future Land Use)	N/A

Project Description

Provide water quality treatment in the form of a StormFilter compost filter, and pipe drainage from the Countryside UIC cluster to node 76858. The required piping for the Countryside UIC cluster was estimated at 860 feet of 2-24" CSP.

Project Elements

1720 Ft – 24" CSP (2-5 ft. cover)

1 Ea – CSF 16x8 (max 39 cartridges)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
24" CSP (2-5 ft. cover)	N/A
CSF 16x8 (max 39 cartridges)	Cartridge replacement by vendor.

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Provides treatment of the water quality design storm using an approved proprietary treatment system.

Natural Resources

N/A

Costs

Construction Costs:	$363,400
Site Acquisition:	$0
Engineering / Administration:	$72,600
Capital Project Implementation Costs	**$436,000**
Annual Maintenance Costs	**$7,600**

Design Assumptions

StormFilter sizing assumes that one facility would be needed to accommodate the number of required cartridges. The facility would be offline and would operate at 7.5 gpm per cartridge. A total of 34 cartridges would be required for treatment of the water quality flow rate.

The drainage area associated with the Counrtyside UIC cluster was deliniated for the XP SWMM CP model. However, the drainage configuration (pipe) was not included in the model because elevations (to determine feasibility) were estimated from two foot contours. A more detailed survey and analysis will be required to confirm feasibility of design.

Project #: SC-4-UIC

Project #: SC-5-UIC

Project Identifier	SC-5-UIC
Project Title	Lodenquai UIC Cluster - Pipe and Pre-treat

Project Location

The UICs associated with the Lodenquai UIC cluster are located along Gibson Street and Argon Avenue in the Spring Creek subbasin. Three city UICs and one county UIC is associated with this cluster.

The CP includes a water quality treatment facility and necessary piping to route drainage associated with the cluster to node 78723 on the A-1 channel.

Subbasin	RSSC110
GIS U/S Node Location	N/A
GIS D/S Node Location	78723
Drainage Area Served by Capital Project	13.2 Acres
% Impervious (Existing Land Use)	N/A
% Impervious (Future Land Use)	N/A

Project Description

Provide water quality treatment in the form of a StormFilter compost filter, and pipe drainage from the Lodenquai UIC cluster to node 78723. The required piping for the Lodenquai UIC cluster was estimated at 815 feet of 2-24" CSP.

Project Elements

1630 Ft – 24" CSP (2-5 ft. cover)

1 Ea – CSF 16x8 (max 39 cartridges)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
24" CSP (2-5 ft. cover)	N/A
CSF 16x8 (max 39 cartridges)	Cartridge replacement by vendor.

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Provides treatment of the water quality design storm using an approved proprietary treatment system.

Natural Resources

N/A

Costs

Construction Costs:	$352,600
Site Acquisition:	$0
Engineering / Administration:	$70,500
Capital Project Implementation Costs	**$423,100**
Annual Maintenance Costs	**$7,600**

Design Assumptions

StormFilter sizing assumes that one facility would be needed to accommodate the number of required cartridges. The facility would be offline and would operate at 7.5 gpm per cartridge. A total of 39 cartridges would be required for treatment of the water quality flow rate.

The drainage area associated with the Lodenquai UIC cluster was deliniated for the XP SWMM CP model. However, the drainage configuration (pipe) was not included in the model because elevation information (to determine feasibility) was interpolated from the model. A more detailed survey would be needed to verify feasibility of this option.

Project #: SC-5-UIC

Project #: SC-6-UIC

Project Identifier	**SC-6-UIC**
Project Title	**Byron UIC Cluster - Raingarden**

Project Location

The UICs associated with the Byron UIC cluster are located at the south end of Byron Street in the Willamette Overflow subbasin. Two county UIC is associated with this cluster.

The CP involves installation of raingardens.

Subbasin	**RSSC110**
GIS U/S Node Location	**N/A**
GIS D/S Node Location	**N/A**
Drainage Area Served by Capital Project	**5.4 (estimated)** Acres
% Impervious (Existing Land Use)	**N/A**
% Impervious (Future Land Use)	**N/A**

Project Description

Construct raingardens throughout the drainage area associated with the Byron UIC cluster. Preliminary estimates indicate that approximately 0.32 acres of raingarden would be required to manage treatment and runoff volumes associated with the 5-year, 24 hour storm event.

Project Elements

13758 SF – Raingarden (native soils)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Raingarden (native soils)	Litter and debris removal, reestablishment of vegetation

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Promotes stormwater treatment through filtration, sedimentation, infiltration, and vegetative uptake within the rain garden.

Natural Resources

N/A

Costs

Construction Costs:	$110,000
Site Acquisition:	$116,000
Engineering / Administration:	$45,200
Capital Project Implementation Costs	**$271,200**

Costs do not account for soil amendment.

Annual Maintenance Costs	**$17,800**

Design Assumptions

Because drainage areas were not delineated for all UIC cluster (including this one) and the original drainage area deliniation did not account for all UICs, a modified drainage area for each UIC cluster, assuming 2.7 acres area per UIC was used for sizing raingardens. Therefore, preliminary raingarden sizing for this UIC cluster assumes a drainage area of 5.4 acres. A more detailed deliniation of drainage area to the Byron UIC cluster would be needed prior to CP design.

Acquisition costs are based on a residential land cost of $337,600/acre and calculated using the raingarden footprint area plus 5% for accessibility. An additional $4,000/project is included for administrative activities associated with land acquisition.

Project #: SC-6-UIC

Project #: SC-7-UIC

Project Identifier	SC-7-UIC
Project Title	Stark UIC Cluster - Raingarden

Project Location

The UIC associated with the Stark UIC cluster is located on Alyndale Lane, east of Stark Street in the Spring Creek subbasin. One county UICs is associated with this cluster.

The CP involves installation of raingardens.

Subbasin	RSSC120
GIS U/S Node Location	N/A
GIS D/S Node Location	N/A
Drainage Area Served by Capital Project	2.7 (estimated) Acres
% Impervious (Existing Land Use)	N/A
% Impervious (Future Land Use)	N/A

Project Description

Construct raingardens throughout the drainage area associated with the Stark UIC cluster. Preliminary estimates indicate that approximately 0.16 acres of raingarden would be required to manage treatment and runoff volumes associated with the 5-year, 24 hour storm event.

Project Elements

6879 SF – Raingarden (native soils)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Raingarden (native soils)	Litter and debris removal, reestablishment of vegetation

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Promotes stormwater treatment through filtration, sedimentation, infiltration, and vegetative uptake within the rain garden.

Natural Resources

N/A

Costs

Construction Costs:	$55,000
Site Acquisition:	$60,000
Engineering / Administration:	$23,000

Capital Project Implementation Costs **$138,000**

Costs do not account for soil amendment.

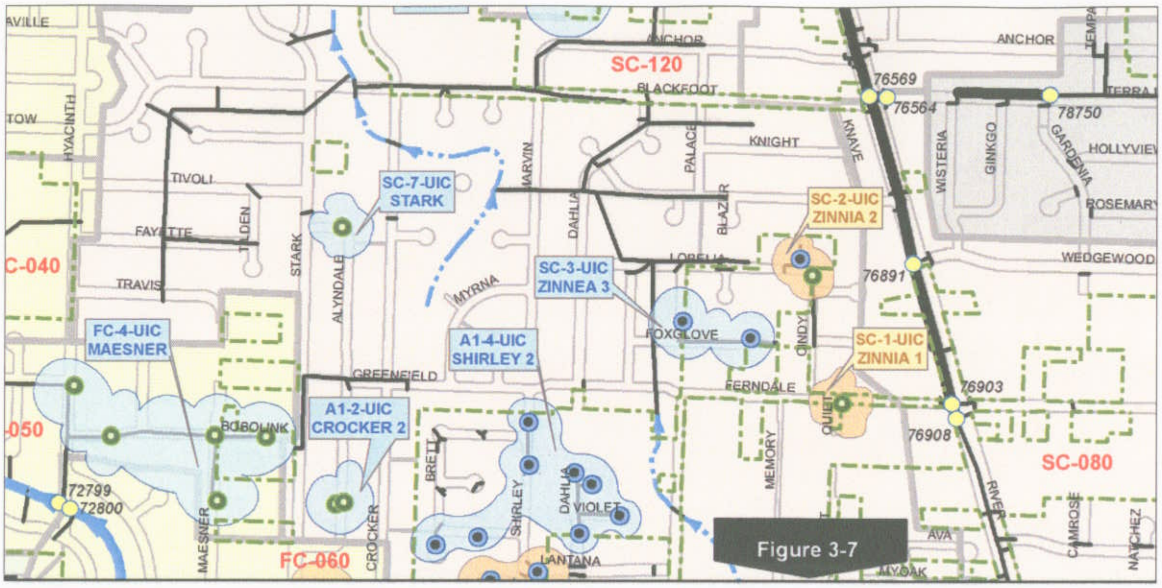
Annual Maintenance Costs **$8,900**

Design Assumptions

Because drainage areas were not delineated for all UIC clusters (including this one) and original drainage area deliniation did not account for all UICs, a modified drainage area for each UIC cluster, assuming 2.7 acres area per UIC was used for sizing raingardens. Therefore, preliminary raingarden sizing for this UIC cluster assumes a drainage area of 2.7 acres. A more detailed deliniation of drainage area to the Stark UIC cluster would be needed prior to CP design.

Acquisition costs are based on a residential land cost of $337,600/acre and calculated using the raingarden footprint area plus 5% for accessibility. An additional $4,000/project is included for administrative activities associated with land acquisition.

Project #: SC-7-UIC



Project #: SC-8-UIC

Project Identifier	SC-8-UIC
Project Title	Castrey UIC Cluster - Raingarden

Project Location

The UICs associated with the Castrey UIC cluster are located on Castrey Street, north of Greenwood Drive in the Spring Creek subbasin. Two county UICs is associated with this cluster.

The CP involves installation of raingardens.

Subbasin	RSSC060
GIS U/S Node Location	N/A
GIS D/S Node Location	N/A
Drainage Area Served by Capital Project	5.4 (estimated) Acres
% Impervious (Existing Land Use)	N/A
% Impervious (Future Land Use)	N/A

Project Description

Construct raingardens throughout the drainage area associated with the Castrey UIC cluster. Preliminary estimates indicate that approximately 0.32 acres of raingarden would be required to manage treatment and runoff volumes associated with the 5-year, 24 hour storm event.

Project Elements

13758 SF – Raingarden (native soils)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Raingarden (native soils)	Litter and debris removal, reestablishment of vegetation

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Promotes stormwater treatment through filtration, sedimentation, infiltration, and vegetative uptake within the rain garden.

Natural Resources

N/A

Costs

Construction Costs:	$110,000
Site Acquisition:	$116,000
Engineering / Administration:	$45,200
Capital Project Implementation Costs	**$271,200**

Costs do not account for soil amendment.

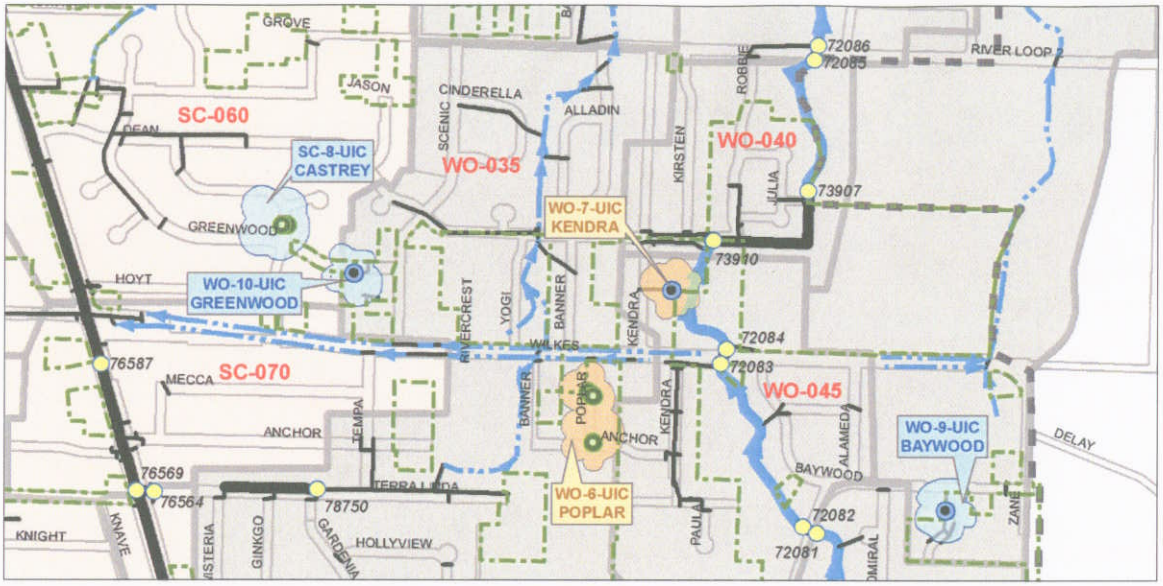
Annual Maintenance Costs	**$17,800**

Design Assumptions

Because drainage areas were not delineated for all UIC clusters and original drainage area deliniation did not account for all UICs, a modified drainage area for each UIC cluster, assuming 2.7 acres area per UIC was used for sizing raingardens. Therefore, preliminary raingarden sizing for this UIC cluster assumes a drainage area of 5.4 acres. A more detailed deliniation of drainage area to the Castrey UIC cluster would be needed prior to CP design.

Acquisition costs are based on a residential land cost of $337,600/acre and calculated using the raingarden footprint area plus 5% for accessibility. An additional $4,000/project is included for administrative activities associated with land acquisition.

Project #: SC-8-UIC



Project #: SC-9-UIC

Project Identifier	SC-9-UIC
Project Title	Calumet UIC Cluster - Raingarden

Project Location

The UICs associated with the Calumet UIC cluster are located on Calumet Way, north of Herman Street in the Spring Creek subbasin. Two city UICs is associated with this cluster.

The CP involves installation of raingardens.

Subbasin	RSSC030
GIS U/S Node Location	N/A
GIS D/S Node Location	N/A
Drainage Area Served by Capital Project	5.4 (estimated) Acres
% Impervious (Existing Land Use)	N/A
% Impervious (Future Land Use)	N/A

Project Description

Construct raingardens throughout the drainage area associated with the Calumet UIC cluster. Preliminary estimates indicate that approximately 0.32 acres of raingarden would be required to manage treatment and runoff volumes associated with the 5-year, 24 hour storm event.

Project Elements

13758 SF – Raingarden (native soils)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Raingarden (native soils)	Litter and debris removal, reestablishment of vegetation

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Promotes stormwater treatment through filtration, sedimentation, infiltration, and vegetative uptake within the rain garden.

Natural Resources

N/A

Costs

Construction Costs:	$110,000
Site Acquisition:	$116,000
Engineering / Administration:	$45,200
Capital Project Implementation Costs	**$271,200**

Costs do not account for soil amendment.

Annual Maintenance Costs	**$17,800**

Design Assumptions

Because drainage areas were not delineated for all UIC clusters and original drainage area deliniation did not account for all UICs, a modified drainage area for each UIC cluster, assuming 2.7 acres area per UIC was used for sizing raingardens. Therefore, preliminary raingarden sizing for this UIC cluster assumes a drainage area of 5.4 acres. A more detailed deliniation of drainage area to the Calumet UIC cluster would be needed prior to CP design.

Acquisition costs are based on a residential land cost of $337,600/acre and calculated using the raingarden footprint area plus 5% for accessibility. An additional $4,000/project is included for administrative activities associated with land acquisition.

Project #: SC-9-UIC

Project Identifier	WO-1
Project Title	Willamette Overflow Culvert Replacement east of Azalea Dr.

Project Location

The proposed CP is located in modeled drainage segment RSWO070D, downstream of segment RSWO070E.
The location is east of Azalea Dr. and north of Yvonne Street.

Subbasin	RSWO070
GIS U/S Node Location	74006
GIS D/S Node Location	74007
Drainage Area Served by Capital Project	352.6 Acres
% Impervious (Existing Land Use)	52.1
% Impervious (Future Land Use)	54.5

Project Description

Replace the existing 18" CMP culvert with 253 ft. of 66" CSP.

Project Elements

253 Ft – 66" CSP (2-5 ft. cover)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

Modeled flooding problems in segment RSWO070D and upstream segment RSWO070E were predicted for the 10-year existing condition storm event.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
66" CSP (2-5 ft. cover)	N/A

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Expected to reduce model-predicted flooding problems identified in this segment and upstream segment.

Water Quality

N/A

Natural Resources

N/A

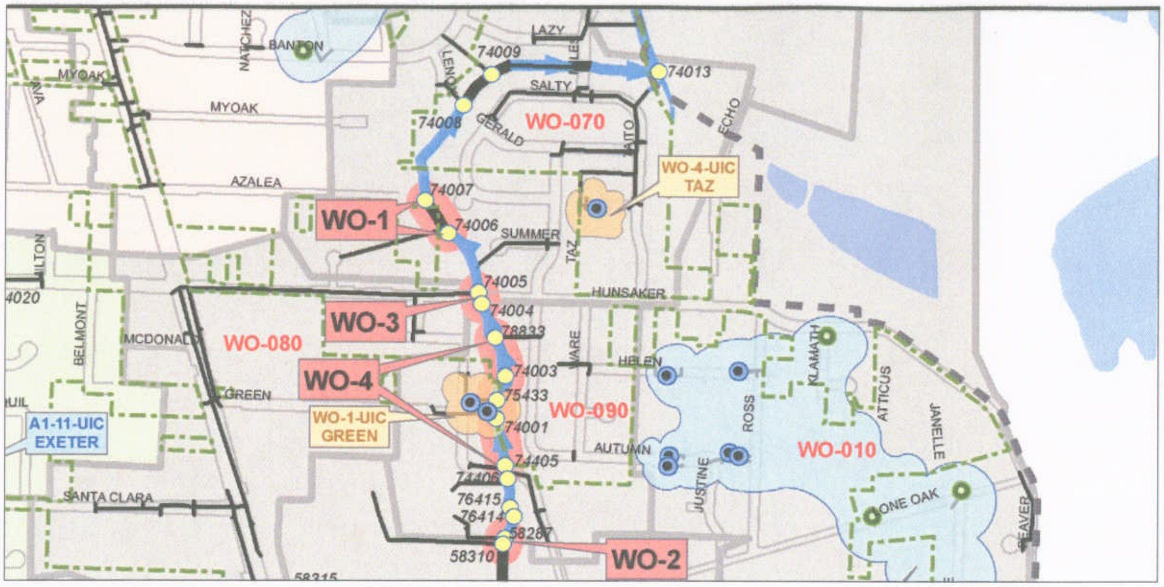
Costs

Construction Costs:	$121,400
Site Acquisition:	$0
Engineering / Administration:	$24,200
Capital Project Implementation Costs	**$145,600**
Annual Maintenance Costs	

Design Assumptions

Flooding in this segment and upstream segment RSWO070E would also be addressed by CP WO-5.

Project #: WO-1


WO-1
WO-2
WO-3
WO-4
WO-070
WO-080
WO-090
WO-010
WO-4-UIC TAZ
WO-1-UIC GREEN
A1-11-UIC EXETER
74009
74013
74008
74007
74006
74005
74004
78833
74003
75433
74001
74405
74406
76415
76414
58287
58310
LAZY
SALTY
MYOAK
AZALEA
SUMMER
HUNSAKER
MCDONALD
GREEN
SANTA CLARA
HELEN
AUTUMN
ROSS
JUSTINE
KLAMATH
ATTICUS
JANELLE
ONE OAK
ECHO
TAZ
BELMONT
NATCHEZ

Project #: WO-2

Project Identifier	**WO-2**
Project Title	**Willamette Overflow Culvert Replacement east of Edgewood Dr.**

Project Location

The proposed CP is located in modeled drainage segment RSWO110A. The location is east of Edgewood Drive and west of Lone Oak Way. The CP is proposed to eliminate flooding in upstream segments RSWO110B and RSWO110C.

Subbasin	**RSWO110**
GIS U/S Node Location	**58310**
GIS D/S Node Location	**58287**
Drainage Area Served by Capital Project	**264.5** Acres
% Impervious (Existing Land Use)	**52.8**
% Impervious (Future Land Use)	**55.3**

Project Description

Replace the existing 36" CSP culvert (segment RSWO110A) with 47 ft. of 60" CSP.

Project Elements

47 Ft – 60" CSP (2-5 ft. cover)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

Modeled flooding problems in upstream segments RSWO110B and RSWO110C were predicted for the 10-year future condition storm event, due to lack of capacity in the existing pipes. No flooding was predicted for segment RSWO110A, but replacement of the existing tip-up in segment RSWO110A alleviates upstream flooding issues.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
60" CSP (2-5 ft. cover)	N/A

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Expected to reduce model-predicted flooding problems identified upstream.

Water Quality

N/A

Natural Resources

N/A

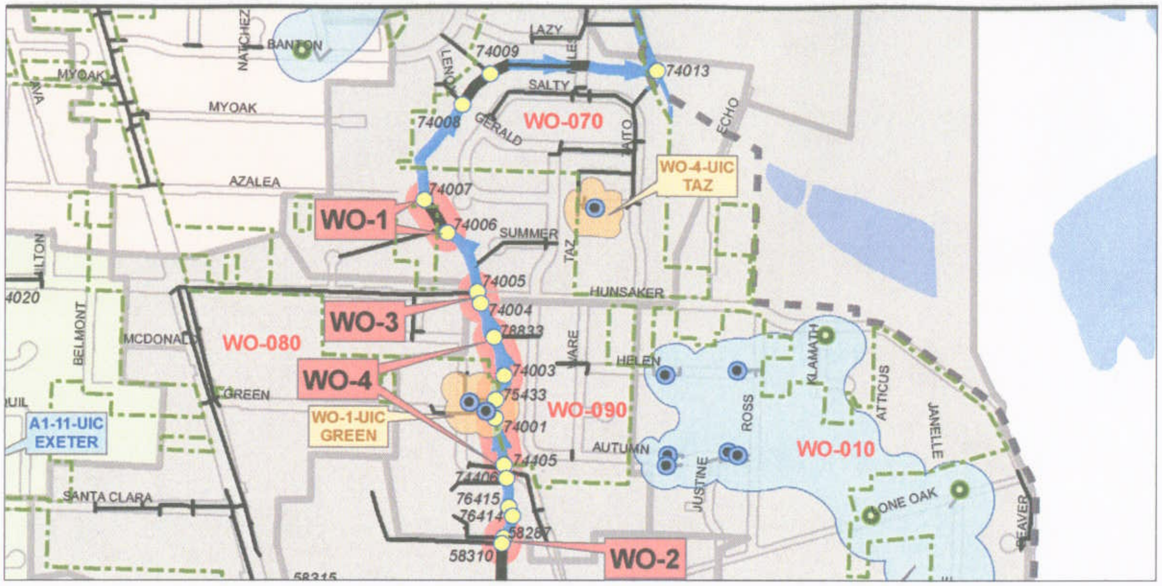
Costs

Construction Costs:	$18,800
Site Acquisition:	$0
Engineering / Administration:	$3,700
Capital Project Implementation Costs	**$22,500**
Annual Maintenance Costs	**$0**

Design Assumptions

Flood reduction in the upstream segments RSWO110B and RSWO110C would also be addressed by CP WO-5.

Project #: WO-2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SANTA CLARA
BELMONT
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KLAMATH
ATTICUS
JANELLE
ONE OAK
BEAVER
NATCHEZ
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Project #: WO-3

Project Identifier	**WO-3**
Project Title	**Willamette Overflow Culvert Replacement east of Yvonne St.**

Project Location

The proposed CP is located in modeled drainage segment RSWO080A. The location is east of Yvonne Street. The CP is proposed to eliminate flooding in upstream open channel segments including RSWO090A, RSWO090Aa, RSWO090B, RSWO090C, RSWO090F, and RSWO090H.

Subbasin	**RSWO080**
GIS U/S Node Location	**74004**
GIS D/S Node Location	**74005**
Drainage Area Served by Capital Project	**352.6** Acres
% Impervious (Existing Land Use)	**52.1**
% Impervious (Future Land Use)	**54.5**

Project Description

Replace the existing 48" CSP culvert (segment RSWO110A) with 43 ft. of 66" CSP.

Project Elements

43 Ft – 66" CSP (5-10 ft. cover)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

Modeled flooding problems in upstream segments RSWO090A, RSWO090Aa, RSWO090B, RSWO090C, RSWO090F, and RSWO090H were predicted for the 10-year existing condition storm event. No flooding was predicted in segment RSWO080A, but replacement of the existing culvert at RSWO080A alleviates upstream flooding issues.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
66" CSP (5-10 ft. cover)	N/A

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Expected to reduce model-predicted flooding problems identified upstream.

Water Quality

N/A

Natural Resources

N/A

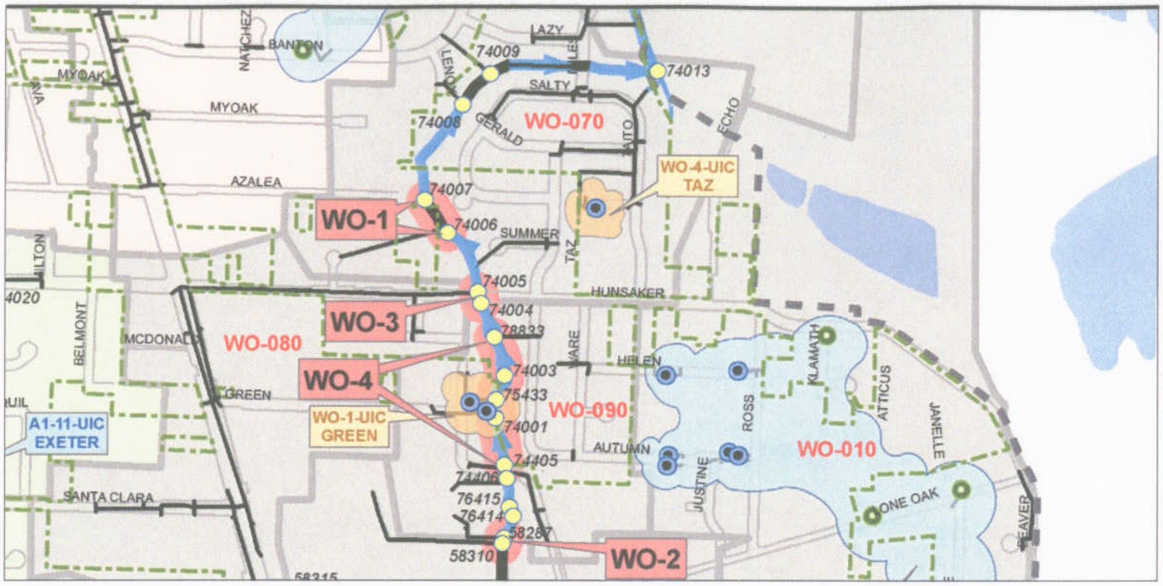
Costs

Construction Costs:	$23,200
Site Acquisition:	$0
Engineering / Administration:	$4,600
Capital Project Implementation Costs	**$27,800**
Annual Maintenance Costs	

Design Assumptions

Flood reduction in the upstream reaches would also be addressed by CP WO-4 and WO-5.

Project #: WO-3



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ATTICUS
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JUSTINE
ONE OAK
SANTA CLARA

Project Identifier	**WO-4**
Project Title	**Willamette Overflow Open Channel Improvement**

Project Location

The proposed CP is located in modeled drainage segments RSWO090A, RSWO090Aa, RSWO090B, RSWO090C, and RSWO090D. The location is west of Summer Lane and east of Edgewood Drive.

Subbasin	**RSWO090**
GIS U/S Node Location	**74405**
GIS D/S Node Location	**78833**
Drainage Area Served by Capital Project	**297.2** Acres
% Impervious (Existing Land Use)	**52.1**
% Impervious (Future Land Use)	**54.5**

Project Description

Regrade the existing Type II open channel segments (RSWO090Aa, RSWO090B, RSWO090C, and RSWO090D).

Project Elements

724 LF – Open Channel Improvements (Type 2)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

Modeled flooding problems in segments RSWO090A, RSWO090Aa, RSWO090B, and RSWO090C were predicted for the 10-year existing condition storm event, due to lack of capacity in the existing open channels. No flooding was predicted for segment RSWO090D, but regrading of the overall channel segment alleviates flooding issues.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Open Channel Improvements (Type 2)	Inspect sediment loading and vegetation, remove sediment and debris.

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Expected to reduce model-predicted flooding problems identified in this area.

Water Quality

N/A

Natural Resources

N/A

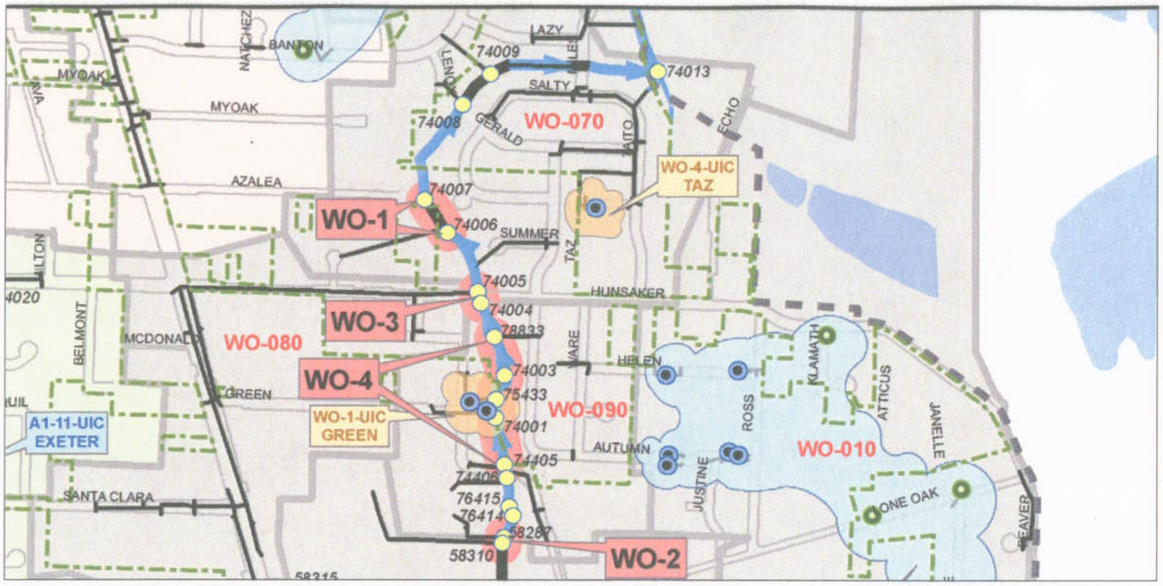
Costs

Construction Costs:	$434,400
Site Acquisition:	$0
Engineering / Administration:	$86,800
Capital Project Implementation Costs	**$521,200**
Annual Maintenance Costs	**$5,500**

Design Assumptions

Flood reduction in these reaches would also be addressed by CP WO-3 and WO-5.

Project #: WO-4



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ATTICUS
JANELLE
JUSTINE
BELMONT
LONE OAK
BEAVER

Capital Project Fact Sheet

Basin Name: Santa Clara Basin

Project #: WO-5

Project Identifier	**WO-5**
Project Title	**Willamette Overflow Flood Control Facility at River Avenue**

Project Location

The proposed storage CP would be located at node 77703. The CP includes 124 ac-ft of storage, located in in tax lots 1700, 1800, 1900, 203, 204, 202, and 302. These tax lots are located east of River Road and north of River Avenue.

Subbasin	**RSWO130**
GIS U/S Node Location	**N/A**
GIS D/S Node Location	**77703**
Drainage Area Served by Capital Project	**198.4** Acres
% Impervious (Existing Land Use)	**35.3**
% Impervious (Future Land Use)	**36.4**

Project Description

Construct 124 ac-ft of storage to minimize flow in downstream open channel system.

Project Elements

124 Ac-Ft – Flood Control Facility

Problems and/or Opportunities Addressed by the Capital Projects

Problems

Modeled flooding problems in segments RSWO090A, RSWO090Aa, RSWO090B, and RSWO090C were predicted for the 10-year existing condition storm event, due to lack of capacity in the existing open channels. Storage proposed to minimize flow in downstream open channel system and reduce magnitude of open channel improvements (see WO-4).

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Flood Control Facility	Inspect and clean inlet and outlet, maintain vegetation, inspect sediment loading, remove sediment, remove debris, inspect and repair separation berm (if applicable).

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Expected to reduce model-predicted flooding problems identified in this area.

Water Quality

N/A

Natural Resources

N/A

Costs

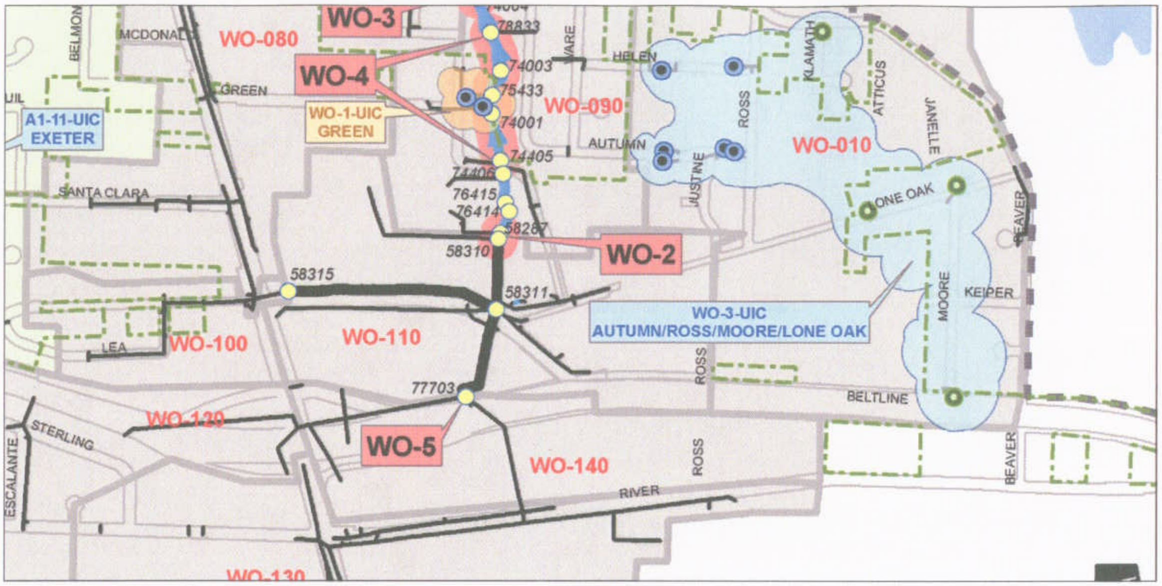
Construction Costs:	$7,402,800
Site Acquisition:	$5,622,380
Engineering / Administration:	$2,605,000
Capital Project Implementation Costs	**$15,630,180**
Annual Maintenance Costs	**$119,200**

Design Assumptions

Flood reduction in the downstream open channels would also be addressed by CP WO-3 and WO-4.

Acquisition costs are based on an industrial land cost of $370,300/acre and calculated using the area of each tax lot required to construct the detention pond plus 5% for accessibility. An additional $4,000/project is included for administrative activities associated with land acquisition.

Project #: WO-5



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Project #: WO-1-UIC

Project Identifier	WO-1-UIC
Project Title	Green UIC Cluster - Pipe and Pre-treat

Project Location

UICs associated with the Green UIC cluster are located east of Edgewood Drive and west of Summer Lane in the Willamette Overflow subbasin. Two city UICs are associated with this cluster.

The CP includes a water quality treatment facility and necessary piping to route drainage associated with the cluster to node 76943 at the East Santa Clara Waterway.

Subbasin	RSWO090
GIS U/S Node Location	N/A
GIS D/S Node Location	76943
Drainage Area Served by Capital Project	2.7 Acres
% Impervious (Existing Land Use)	N/A
% Impervious (Future Land Use)	N/A

Project Description

Provide water quality treatment in the form of a StormFilter compost filter and pipe drainage from the Green UIC cluster east to node 76943 using 215 feet of 18" CSP pipe.

Project Elements

215 Ft – 18" CSP (2-5 ft. cover)

1 Ea – CSF 12x6 (max 11 cartridges)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Project #: WO-1-UIC

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
18" CSP (2-5 ft. cover)	N/A
CSF 12x6 (max 11 cartridges)	Cartridge replacement by vendor.

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Provides treatment of the water quality design storm using an approved proprietary treatment system.

Natural Resources

N/A

Costs

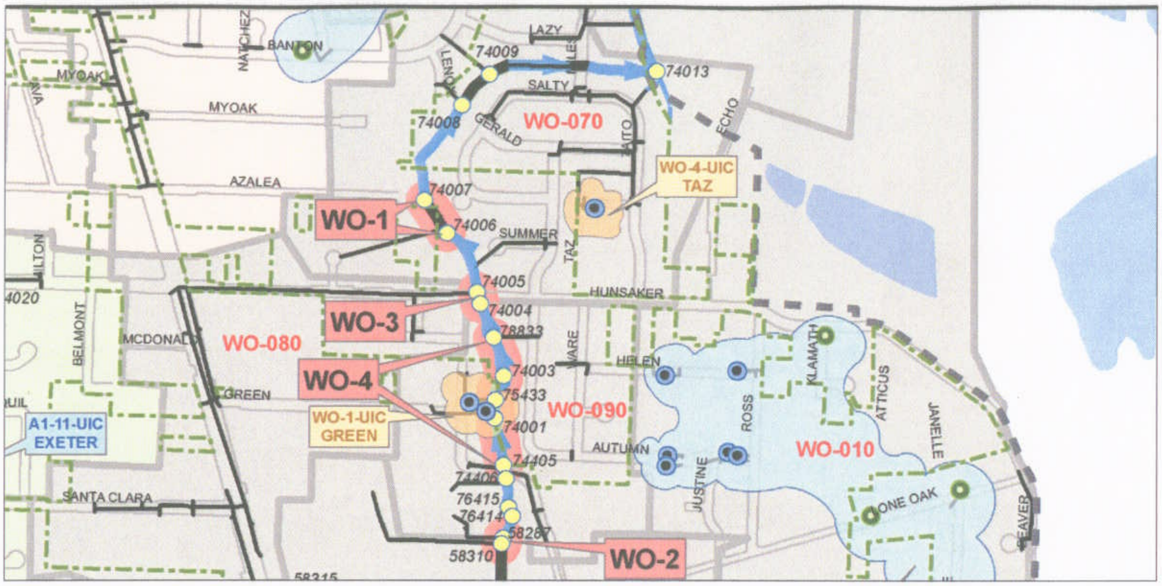
Construction Costs:	$92,500
Site Acquisition:	$0
Engineering / Administration:	$18,500
Capital Project Implementation Costs	**$111,000**
Annual Maintenance Costs	**$2,100**

Design Assumptions

StormFilter sizing assumes that one facility would be needed to accommodate the number of required cartridges. The facility would be offline and would operate at 7.5 gpm per cartridge. Eight cartridges would be required for treatment of the water quality flow rate.

The drainage area associated with the Green UIC cluster was deliniated for the XP SWMM CP model. However, the drainage configuration (pipe) was not included in the model because elevations (to determine feasibility) were estimated from two foot contours. A more detailed survey and analysis will be required to confirm feasibility of design.

Project #: WO-1-UIC



Project #: WO-2-UIC

Project Identifier	WO-2-UIC
Project Title	Corliss/Carolyn/Onyx UIC Cluster - Raingarden

Project Location

UICs associated with the Corliss/ Carolyn UIC cluster are located east of River Road, adjacent to Ono Road and Camelot Avenue in the Willamette Overflow subbasin. Four city UICs are associated with this cluster.

The CP involves installation of raingardens.

Subbasin	RSWO130	
GIS U/S Node Location	N/A	
GIS D/S Node Location	N/A	
Drainage Area Served by Capital Project	10.8 (estimated)	Acres
% Impervious (Existing Land Use)	N/A	
% Impervious (Future Land Use)	N/A	

Project Description

Construct raingardens throughout the drainage area associated with the Corliss/ Carolyn UIC cluster. Preliminary estimates indicate that approximately 0.63 acres of raingarden would be required to manage treatment and runoff volumes associated with the 5-year, 24 hour storm event.

Project Elements

27517 SF – Raingarden (native soils)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and/or disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Raingarden (native soils)	Litter and debris removal, reestablishment of vegetation

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Promotes stormwater treatment through filtration, sedimentation, infiltration, and vegetative uptake within the rain garden.

Natural Resources

N/A

Costs

Construction Costs:	$220,100
Site Acquisition:	$228,000
Engineering / Administration:	$89,600
Capital Project Implementation Costs	**$537,700**

Costs do not account for soil amendment.

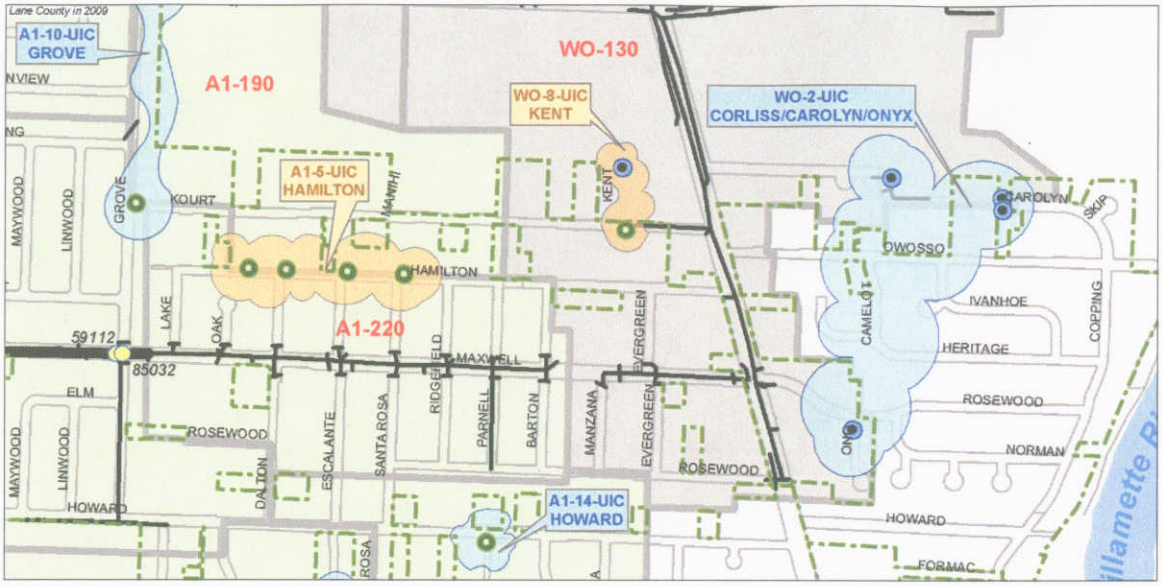
Annual Maintenance Costs	**$35,700**

Design Assumptions

Because drainage areas were not delineated for all UIC cluster and original drainage area deliniation did not account for all UICs, a modified drainage area for each UIC cluster, assuming 2.7 acres area per UIC was used for sizing raingardens. Therefore, preliminary raingarden sizing for this UIC cluster assumes a drainage area of 10.8 acres. A more detailed deliniation of drainage area to Corliss/Carolyn/Onyx UIC cluster would be needed prior to CP design.

Acquisition costs are based on a residential land cost of $337,600/acre and calculated using the raingarden footprint area plus 5% for accessibility. An additional $4,000/project is included for administrative activities associated with land acquisition.

Project #: WO-2-UIC



Project #: WO-3-UIC

Project Identifier	WO-3-UIC
Project Title	Autumn/ Ross/ Moore-Oak UIC Cluster - Raingarden

Project Location

UICs associated with the Autumn/ Ross/ Moore-Oak UIC clusters are located southwest of Beaver Street and east of Warren Land and Ross Lane in the Willamette Overflow subbasin. Four county and six city UICs are associated with these clusters.

The CP involves installation of raingardens.

Subbasin	RSWO150
GIS U/S Node Location	N/A
GIS D/S Node Location	N/A
Drainage Area Served by Capital Project	27.0 (estimated) Acres
% Impervious (Existing Land Use)	N/A
% Impervious (Future Land Use)	N/A

Project Description

Construct raingardens throughout the drainage area associated with the Autumn/ Ross/ Moore-Oak UIC clusters. Preliminary estimates indicate that approximately 1.58 acres of raingarden would be required to manage treatment and runoff volumes associated with the 5-year, 24 hour storm event.

Project Elements

68792 SF – Raingarden (native soils)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and/or disposal of stormwater runoff.

Opportunities

N/A

Project #: WO-3-UIC

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Raingarden (native soils)	Litter and debris removal, reestablishment of vegetation

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Promotes stormwater treatment through filtration, sedimentation, infiltration, and vegetative uptake within the rain garden.

Natural Resources

N/A

Costs

Construction Costs:	$550,300
Site Acquisition:	$564,000
Engineering / Administration:	$222,800
Capital Project Implementation Costs	**$1,337,100**

Costs do not account for soil amendment.

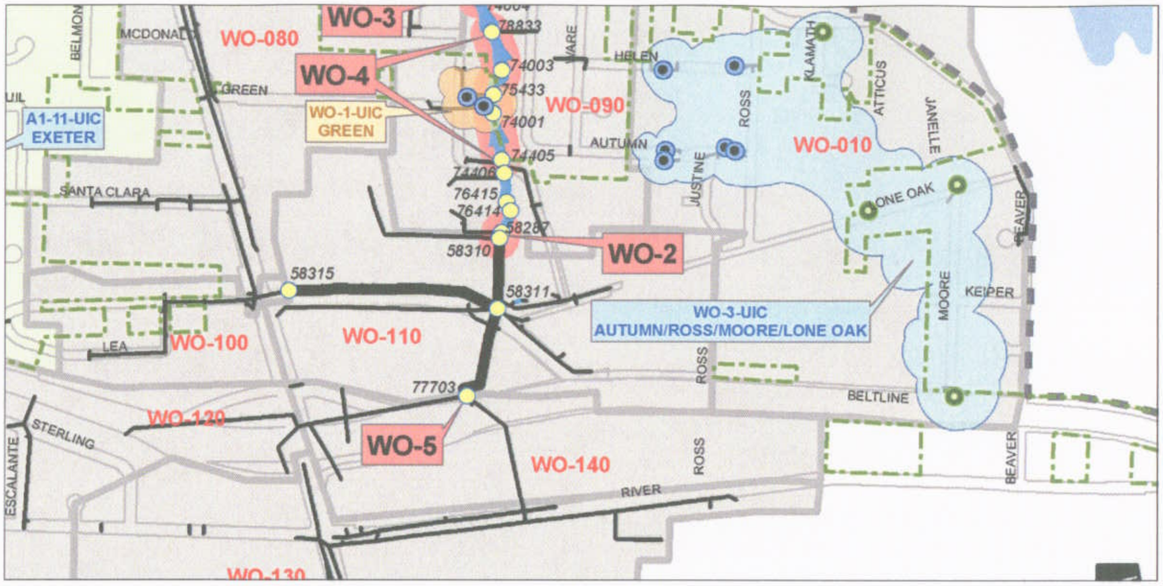
Annual Maintenance Costs	**$89,400**

Design Assumptions

Because drainage areas were not delineated for all UIC cluster and original drainage area deliniation did not account for all UICs, a modified drainage area for each UIC cluster, assuming 2.7 acres area per UIC was used for sizing raingardens. Therefore, preliminary raingarden sizing for this UIC cluster assumes a drainage area of 27 acres. A more detailed deliniation of drainage area to Autumn/ Ross/ Moore-Oak UIC cluster would be needed prior to CP design.

Acquisition costs are based on a residential land cost of $337,600/acre and calculated using the raingarden footprint area plus 5% for accessibility. An additional $4,000/project is included for administrative activities associated with land acquisition.

Project #: WO-3-UIC



Project #: WO-4-UIC

Project Identifier	WO-4-UIC
Project Title	Taz UIC Cluster - Pipe and Pre-treat

Project Location

The UIC associated with the Taz UIC cluster is located east of Summer Lane on Taz Street in the Willamette Overflow subbasin. One city UIC is associated with this cluster.

The CP includes a water quality treatment facility and necessary piping to route drainage associated with the cluster to node 72126 on Hunsaker.

Subbasin	RSWO070
GIS U/S Node Location	N/A
GIS D/S Node Location	72126
Drainage Area Served by Capital Project	3.5 Acres
% Impervious (Existing Land Use)	N/A
% Impervious (Future Land Use)	N/A

Project Description

Provide water quality treatment in the form of a StormFilter compost filter and pipe drainage from the Taz UIC cluster to node 72126 using 340 feet of 18" CSP pipe.

Project Elements

340 Ft – 18" CSP (2-5 ft. cover)

1 Ea – CSF 12x6 (max 11 cartridges)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
18" CSP (2-5 ft. cover)	N/A
CSF 12x6 (max 11 cartridges)	Cartridge replacement by vendor.

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Provides treatment of the water quality design storm using an approved proprietary treatment system.

Natural Resources

N/A

Costs

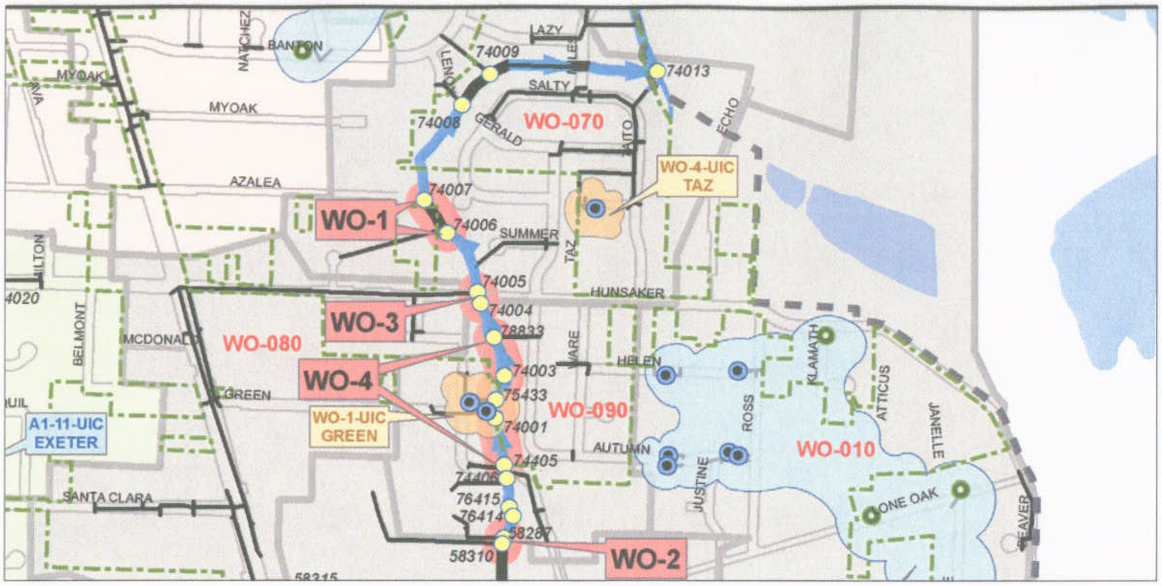
Construction Costs:	$103,800
Site Acquisition:	$0
Engineering / Administration:	$20,700
Capital Project Implementation Costs	**$124,500**
Annual Maintenance Costs	**$2,100**

Design Assumptions

StormFilter sizing assumes that one facility would be needed to accommodate the number of required cartridges. The facility would be offline and would operate at 7.5 gpm per cartridge. Eleven cartridges would be required for treatment of the water quality flow rate.

The drainage area associated with the Taz UIC cluster was deliniated for the XP SWMM CP model. However, the drainage configuration (pipe) was not included in the model because elevations (to determine feasibility) were estimated from two foot contours. A more detailed survey and analysis will be required to confirm feasibility of design.

Project #: WO-4-UIC



Project #: WO-5-UIC

Project Identifier	**WO-5-UIC**
Project Title	**Silver Meadows UIC Cluster - Raingarden**

Project Location

The UIC associated with the Silver Meadows UIC cluster is located on Silver Meadows Drive in the Willamette Overflow subbasin. Three county UICs are associated with this cluster.

The CP involves installation of raingardens.

Subbasin	**RSWO050**
GIS U/S Node Location	**N/A**
GIS D/S Node Location	**N/A**
Drainage Area Served by Capital Project	**8.1 (estimated)** Acres
% Impervious (Existing Land Use)	**N/A**
% Impervious (Future Land Use)	**N/A**

Project Description

Construct raingardens throughout the drainage area associated with the Silver Meadows UIC cluster. Preliminary estimates indicate that approximately 0.47 acres of raingarden would be required to manage treatment and runoff volumes associated with the 5-year, 24 hour storm event.

Project Elements

20637 SF – Raingarden (native soils)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Raingarden (native soils)	Litter and debris removal, reestablishment of vegetation

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Promotes stormwater treatment through filtration, sedimentation, infiltration, and vegetative uptake within the rain garden.

Natural Resources

N/A

Costs

Construction Costs:	$165,000
Site Acquisition:	$172,000
Engineering / Administration:	$67,400
Capital Project Implementation Costs	**$404,400**

Costs do not account for soil amendment.

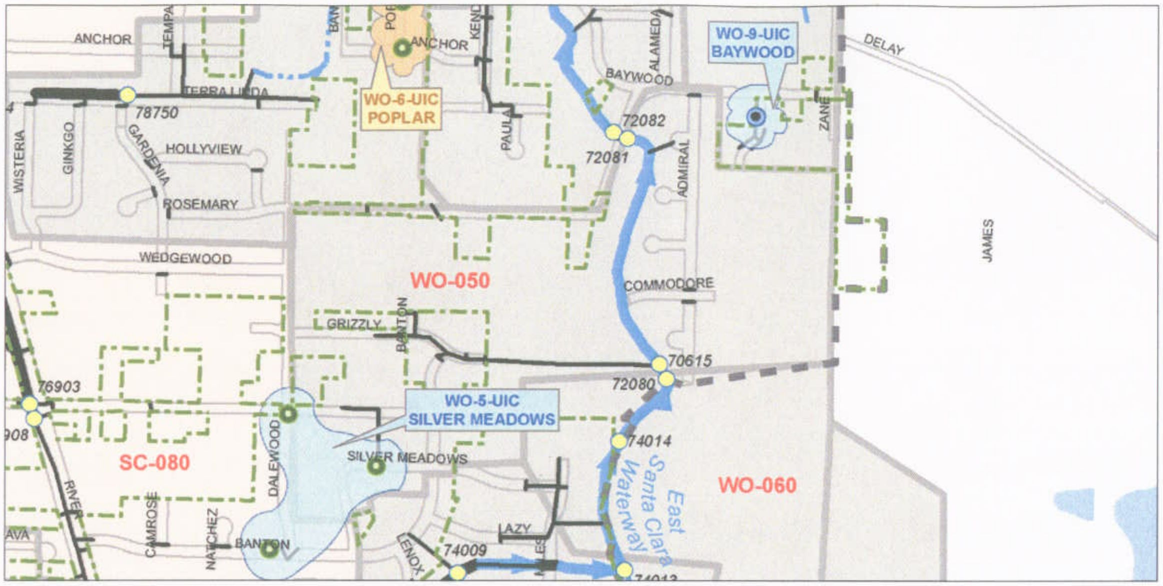
Annual Maintenance Costs	**$26,800**

Design Assumptions

Because drainage areas were not delineated for all UIC cluster and original drainage area deliniation did not account for all UICs, a modified drainage area for each UIC cluster, assuming 2.7 acres area per UIC was used for sizing raingardens. Therefore, preliminary raingarden sizing for this UIC cluster assumes a drainage area of 8.1 acres. A more detailed deliniation of drainage area to the Silver Meadows UIC cluster would be needed prior to CP design.

Acquisition costs are based on a residential land cost of $337,600/acre and calculated using the raingarden footprint area plus 5% for accessibility. An additional $4,000/project is included for administrative activities associated with land acquisition.

Project #: WO-5-UIC



Project #: WO-6-UIC

Project Identifier	WO-6-UIC
Project Title	Poplar UIC Cluster - Pipe and Pre-treat

Project Location

The UICs associated with the Poplar UIC cluster are located along Poplar Street in the Willamette Overflow subbasin. Three county UICs are associated with this cluster.

The CP includes a water quality treatment facility and necessary piping to route drainage associated with the cluster to node 72084 on Wilkes Street.

Subbasin	RSWO035
GIS U/S Node Location	N/A
GIS D/S Node Location	72084
Drainage Area Served by Capital Project	4.2 Acres
% Impervious (Existing Land Use)	N/A
% Impervious (Future Land Use)	N/A

Project Description

Provide water quality treatment in the form of a StormFilter compost filter and pipe drainage from the Poplar UIC cluster to node 72084 using 1100 feet of 30" CSP pipe.

Project Elements

1100 Ft – 30" CSP (2-5 ft. cover)

1 Ea – CSF 16x8 (max 33 cartridges)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
30" CSP (2-5 ft. cover)	N/A
CSF 16x8 (max 33 cartridges)	Cartridge replacement by vendor.

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Provides treatment of the water quality design storm using an approved proprietary treatment system.

Natural Resources

N/A

Costs

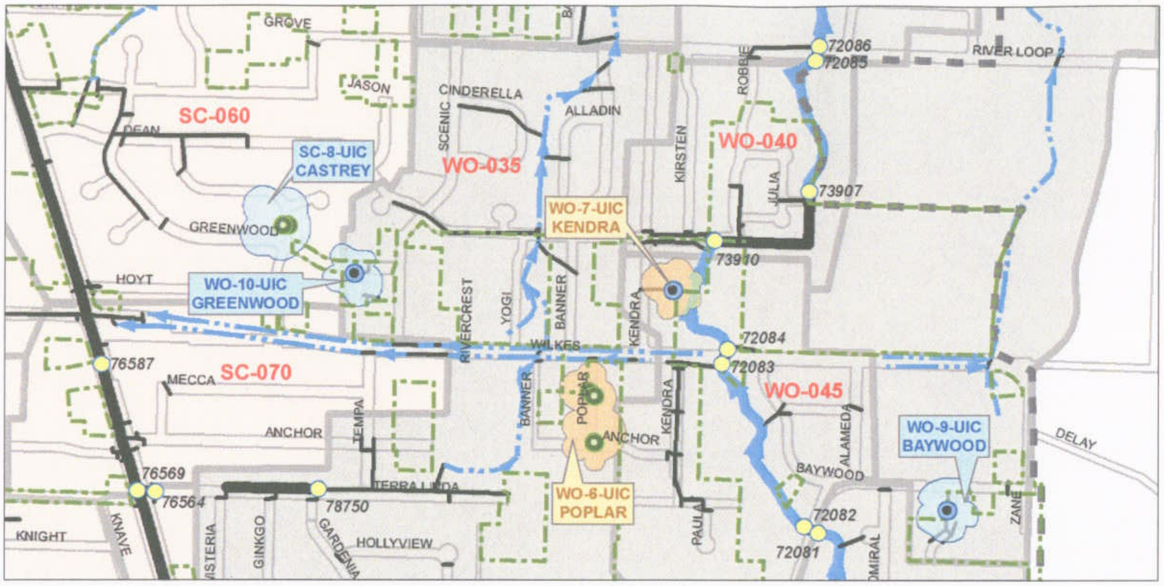
Construction Costs:	$325,500
Site Acquisition:	$0
Engineering / Administration:	$65,100
Capital Project Implementation Costs	**$390,600**
Annual Maintenance Costs	**$0**

Design Assumptions

StormFilter sizing assumes that one facility would be needed to accommodate the number of required cartridges. The facility would be offline and would operate at 7.5 gpm per cartridge. 13 cartridges would be required for treatment of the water quality flow rate.

The drainage area was deliniated and the drainage configuration (pipe) associated with the Poplar UIC cluster was included in the XP SWMM CP model.

Project #: WO-6-UIC



Project Identifier	**WO-7-UIC**
Project Title	**Kendra UIC Cluster - Pipe and Pre-treat**

Project Location

The UIC associated with the Kendra UIC cluster is located east of Kendra Street and south of Dean Avenue in the Willamette Overflow subbasin. One city UIC is associated with this cluster.

The CP includes a water quality treatment facility and necessary piping to route drainage associated with the cluster to node 73028 on the East Santa Clara Waterway.

Subbasin	**RSWO045**
GIS U/S Node Location	**N/A**
GIS D/S Node Location	**73028**
Drainage Area Served by Capital Project	**1.3** Acres
% Impervious (Existing Land Use)	**N/A**
% Impervious (Future Land Use)	**N/A**

Project Description

Provide water quality treatment in the form of a StormFilter compost filter and pipe drainage from the Kendra UIC cluster to node 73028. As node 73028 is located in extremely close proximity to the UIC, required piping was estimated to be a maximum of 50' of 18" CSP.

Project Elements

50 Ft – 18" CSP (2-5 ft. cover)
1 Ea – CSF 8x6 (max 6 cartridges)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
18" CSP (2-5 ft. cover)	N/A
CSF 8x6 (max 6 cartridges)	Cartridge replacement by vendor.

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Provides treatment of the water quality design storm using an approved proprietary treatment system.

Natural Resources

N/A

Costs

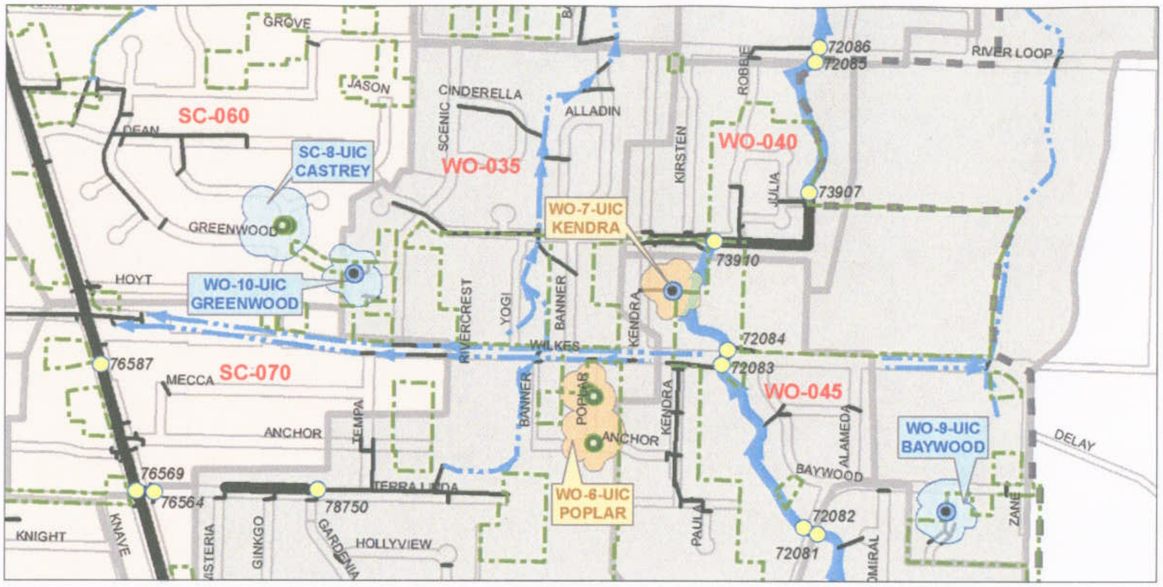
Construction Costs:	$63,000
Site Acquisition:	$0
Engineering / Administration:	$12,600
Capital Project Implementation Costs	**$75,600**
Annual Maintenance Costs	**$1,100**

Design Assumptions

StormFilter sizing assumes that one facility would be needed to accommodate the number of required cartridges. The facility would be offline and would operate at 7.5 gpm per cartridge. Four cartridges would be required for treatment of the water quality flow rate.

The drainage area associated with the Kendra UIC cluster was deliniated for the XP SWMM CP model. However, the drainage configuration (pipe) was not included in the model. The UIC is located almost directly above the storm system, and field verification is needed to confirm the UIC can be properly connected at node 73028.

Project #: WO-7-UIC



Project Identifier	**WO-8-UIC**
Project Title	**Kent UIC Cluster - Pipe and Pre-treat**

Project Location

The UICs associated with the Kent UIC cluster are located on Kent Lane at Kourt Drive in the Willamette Overflow subbasin. One city UIC and one county UIC are associated with this cluster.

The CP includes a water quality treatment facility and necessary piping to route drainage associated with the Kent UICs to Kourt Drive.

Subbasin	**RSWO130**
GIS U/S Node Location	**N/A**
GIS D/S Node Location	**N/A**
Drainage Area Served by Capital Project	**12.8** Acres
% Impervious (Existing Land Use)	**N/A**
% Impervious (Future Land Use)	**N/A**

Project Description

Provide water quality treatment in the form of a StormFilter compost filter, and pipe drainage from the Kent UICs to Kourt Drive. The required piping for Kent UIC #1 was estimated at 430 feet of 24" CSP. As the Kent UIC #2 UIC is located directly above an existing 18" diameter pipe along Kourt Drive, the required piping to plumb that UIC was estimated to be a maximum of 25' of 18" CSP.

Project Elements

25 Ft – 18" CSP (2-5 ft. cover)
430 Ft – 24" CSP (2-5 ft. cover)
2 Ea – CSF 16x8 (max 33 cartridges)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
18" CSP (2-5 ft. cover)	N/A
24" CSP (2-5 ft. cover)	N/A
CSF 16x8 (max 33 cartridges)	Cartridge replacement by vendor.

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Provides treatment of the water quality design storm using an approved proprietary treatment system.

Natural Resources

N/A

Costs

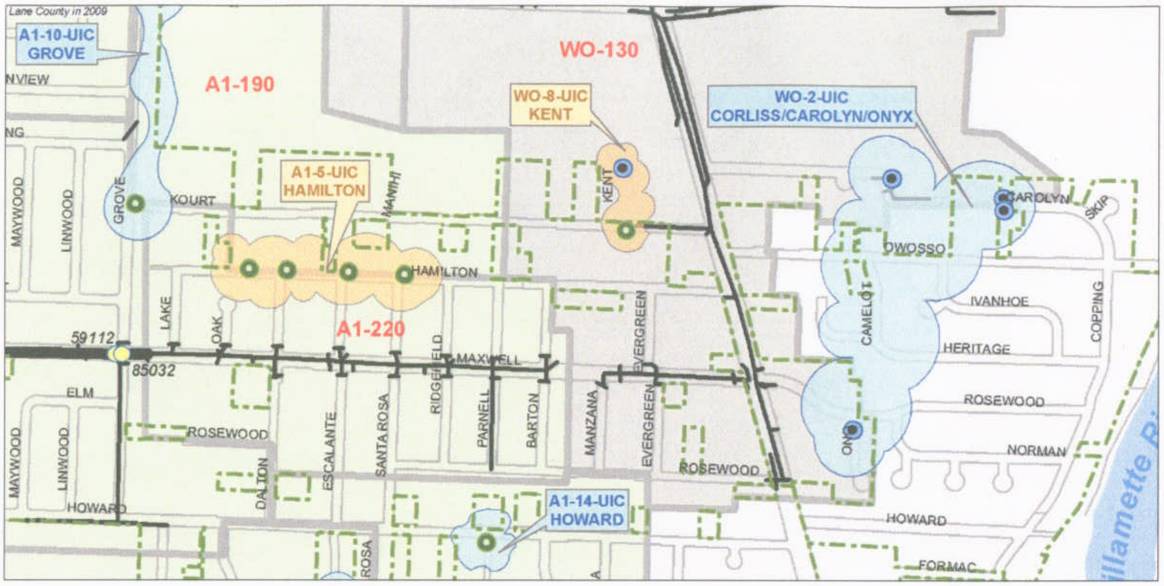
Construction Costs:	$330,900
Site Acquisition:	$0
Engineering / Administration:	$66,100
Capital Project Implementation Costs	**$397,000**
Annual Maintenance Costs	**$12,800**

Design Assumptions

StormFilter sizing assumes that two facilities would be needed, one for each UIC due to the different locations of UICs. Each facility would be offline and would operate at 7.5 gpm per cartridge. Assuming relatively equal drainage areas for each UIC, each facility would require 19 cartridges for treatment of the water quality flow rate.

The drainage area associated with the Kent UIC cluster was deliniated for the XP SWMM CP model. However, the drainage configuration (pipe) was not included in the model because elevations (to determine feasibility) were estimated. A more detailed survey and analysis will be required to confirm feasibility of design.

Project #: WO-8-UIC



Project Identifier	**WO-9-UIC**
Project Title	**Baywood UIC Cluster - Raingarden**

Project Location

The UIC associated with the Baywood UIC cluster is located on Pegrine Street in the Willamette Overflow subbasin. One city UIC is associated with this cluster.

The CP involves installation of raingardens.

Subbasin	**RSWO0000**
GIS U/S Node Location	**N/A**
GIS D/S Node Location	**N/A**
Drainage Area Served by Capital Project	**2.7 (estimated)** Acres
% Impervious (Existing Land Use)	**N/A**
% Impervious (Future Land Use)	**N/A**

Project Description

Construct raingardens throughout the drainage area associated with the Baywood UIC cluster. Preliminary estimates indicate that approximately 0.16 acres of raingarden would be required to manage treatment and runoff volumes associated with the 5-year, 24 hour storm event.

Project Elements

6879 SF – Raingarden (native soils)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Raingarden (native soils)	Litter and debris removal, reestablishment of vegetation

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Promotes stormwater treatment through filtration, sedimentation, infiltration, and vegetative uptake within the rain garden.

Natural Resources

N/A

Costs

Construction Costs:	$55,000
Site Acquisition:	$60,000
Engineering / Administration:	$23,000
Capital Project Implementation Costs	**$138,000**

Costs do not account for soil amendment.

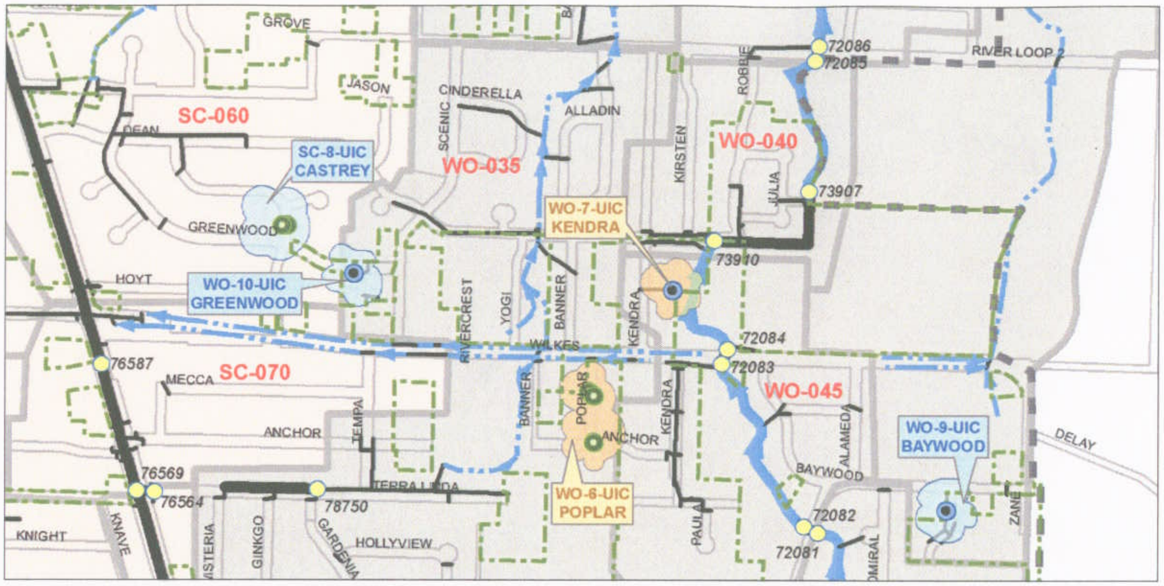
Annual Maintenance Costs	**$8,900**

Design Assumptions

Because drainage areas were not delineated for all UIC cluster and original drainage area deliniation did not account for all UICs, a modified drainage area for each UIC cluster, assuming 2.7 acres area per UIC was used for sizing raingardens. Therefore, preliminary raingarden sizing for this UIC cluster assumes a drainage area of 2.7 acres. A more detailed deliniation of drainage area to the Baywood UIC cluster would be needed prior to CP design.

Acquisition costs are based on a residential land cost of $337,600/acre and calculated using the raingarden footprint area plus 5% for accessibility. An additional $4,000/project is included for administrative activities associated with land acquisition.

Project #: WO-9-UIC



Project #: WO-10-UIC

Project Identifier	WO-10-UIC
Project Title	Greenwood UIC Cluster - Raingarden

Project Location

The UIC associated with the Greenwood UIC cluster is located on Greenwood Street in the Willamette Overflow subbasin. One city UIC is associated with this cluster.

The CP involves installation of raingardens.

Subbasin	RSWO035	
GIS U/S Node Location	N/A	
GIS D/S Node Location	N/A	
Drainage Area Served by Capital Project	2.7 (estimated)	Acres
% Impervious (Existing Land Use)	N/A	
% Impervious (Future Land Use)	N/A	

Project Description

Construct raingardens throughout the drainage area associated with the Greenwood UIC cluster. Preliminary estimates indicate that approximately 0.16 acres of raingarden would be required to manage treatment and runoff volumes associated with the 5-year, 24 hour storm event.

Project Elements

6879 SF – Raingarden (native soils)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Raingarden (native soils)	Litter and debris removal, reestablishment of vegetation

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Promotes stormwater treatment through filtration, sedimentation, infiltration, and vegetative uptake within the rain garden.

Natural Resources

N/A

Costs

Construction Costs:	$55,000
Site Acquisition:	$60,000
Engineering / Administration:	$23,000
Capital Project Implementation Costs	**$138,000**

Costs do not account for land acquisition and soil amendment.

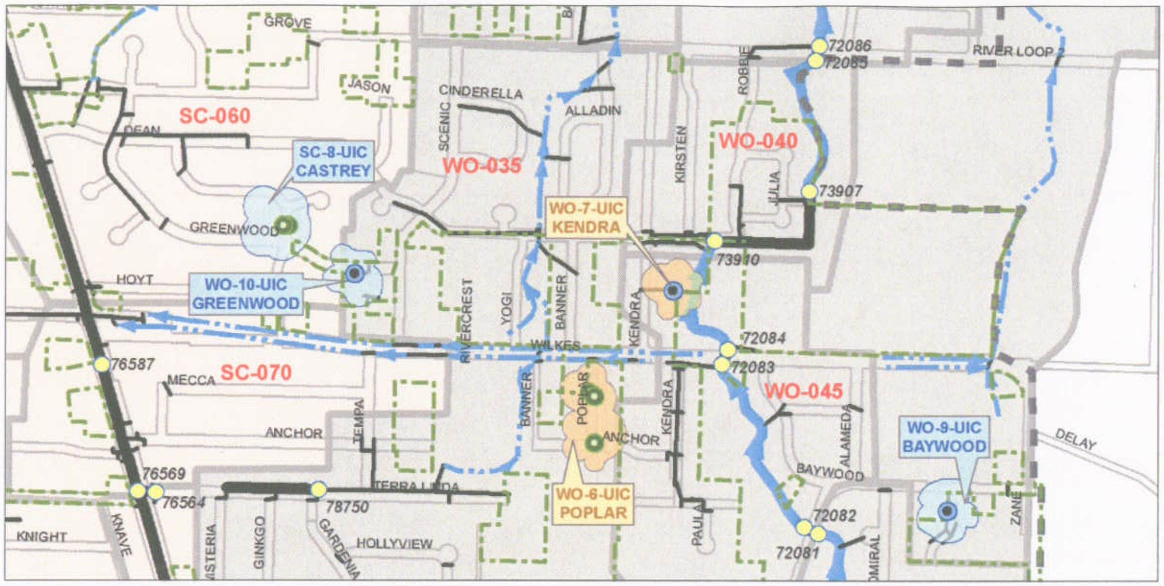
Annual Maintenance Costs	**$8,900**

Design Assumptions

Because drainage areas were not delineated for all UIC cluster and original drainage area deliniation did not account for all UICs, a modified drainage area for each UIC cluster, assuming 2.7 acres area per UIC was used for sizing raingardens. Therefore, preliminary raingarden sizing for this UIC cluster assumes a drainage area of 2.7 acres. A more detailed deliniation of drainage area to the Greenwood UIC cluster would be needed prior to CP design.

Acquisition costs are based on a residential land cost of $337,600/acre and calculated using the raingarden footprint area plus 5% for accessibility. An additional $4,000/project is included for administrative activities associated with land acquisition.

Project #: WO-10-UIC



Project Identifier	**WO-11-UIC**
Project Title	**Warrington UIC Cluster - Raingarden**

Project Location

The UIC associated with the Warrington UIC cluster is located on Scenic Drive in the Willamette Overflow subbasin. One county UIC is associated with this cluster.

The CP involves installation of raingardens.

Subbasin	**RSWO030**
GIS U/S Node Location	**N/A**
GIS D/S Node Location	**N/A**
Drainage Area Served by Capital Project	**2.7 (estimated)** Acres
% Impervious (Existing Land Use)	**N/A**
% Impervious (Future Land Use)	**N/A**

Project Description

Construct raingardens throughout the drainage area associated with the Warrington UIC cluster. Preliminary estimates indicate that approximately 0.16 acres of raingarden would be required to manage treatment and runoff volumes associated with the 5-year, 24 hour storm event.

Project Elements

6879 SF – Raingarden (native soils)

Problems and/or Opportunities Addressed by the Capital Projects

Problems

High groundwater and insufficient pretreatment of runoff prior to disposal in UICs prompted consideration of alternatives to UICs for treatment and disposal of stormwater runoff.

Opportunities

N/A

Maintenance Requirements

Facility Type	Annual Maintenance Activities
Raingarden (native soils)	Litter and debris removal, reestablishment of vegetation

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Disposes of increased runoff that would result from the required decommissioning of public drywells.

Water Quality

Promotes stormwater treatment through filtration, sedimentation, infiltration, and vegetative uptake within the rain garden.

Natural Resources

N/A

Costs

Construction Costs:	$55,000
Site Acquisition:	$60,000
Engineering / Administration:	$23,000
Capital Project Implementation Costs	**$138,000**

Costs do not account for soil amendment.

Annual Maintenance Costs	**$8,900**

Design Assumptions

Because drainage areas were not delineated for all UIC cluster (including this one) and the original drainage area deliniation did not account for all UICs, a modified drainage area for each UIC cluster, assuming 2.7 acres area per UIC was used for sizing raingardens. Therefore, preliminary raingarden sizing for this UIC cluster assumes a drainage area of 2.7 acres. A more detailed deliniation of drainage area to the Warrington UIC cluster would be needed prior to CP design.

Acquisition costs are based on a residential land cost of $337,600/acre and calculated using the raingarden footprint area plus 5% for accessibility. An additional $4,000/project is included for administrative activities associated with land acquisition.

Project #: WO-11-UIC

Project #: RRSC-1

Project Identifier	RRSC-1
Project Title	Annual Budget Line Item for Streambank Stabilization

Project Location

Open waterways throughout the River Road Santa Clara Basin.

Subbasin	N/A
GIS U/S Node Location	N/A
GIS D/S Node Location	N/A
Drainage Area Served by Capital Project	N/A Acres
% Impervious (Existing Land Use)	N/A
% Impervious (Future Land Use)	N/A

Project Description

Maintain an annual budget line item in the CIP for implementation of streambank stabilization projects to help streams adjust to increased runoff volumes while limiting negative impacts associated with downcutting, sedimentation, and erosion. Where appropriate, use bioengineering techniques to stabilize streambanks.

Project Elements

0 SY – Streambank Stabilization

Problems and/or Opportunities Addressed by the Capital Projects

Problems

Downcutting, sedimentation, and erosion problems have been observed in open waterways that are receiving increased runoff volumes associated with urbanization

Opportunities

Streambank stabilization provides the opportunity to improve or restore riparian vegetation and aquatic habitat conditions.

Maintenance Requirements

Facility Type	Annual Maintenance Activities
Streambank Stabilization	Inspect vegetation and banks for erosion.

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

N/A

Water Quality

This CP eliminates localized erosion of streambeds and streambanks.

Natural Resources

This CP can help restore native riparian vegetation and improve aquatic habitat conditions.

Costs

Construction Costs:	$0
Site Acquisition:	$0
Engineering / Administration:	$0
Capital Project Implementation Costs	**$0**

There will be a annual line item in the capital projects budget to address streambank stabilization projects on a city-wide basis.

Annual Maintenance Costs	**$0**

Design Assumptions

Project Identifier	RRSC-2
Project Title	Annual Budget Line Item for Water Quality Facilities for High Source Areas

Project Location

Piped storm drainage systems located throughout the City of Eugene that convey stormwater runoff from mostly developed (i.e., no space for above ground water quality facilities) high pollutant source areas (i.e., commercial and industrial areas).

Subbasin	N/A
GIS U/S Node Location	N/A
GIS D/S Node Location	N/A
Drainage Area Served by Capital Project	N/A Acres
% Impervious (Existing Land Use)	N/A
% Impervious (Future Land Use)	N/A

Project Description

Maintain an annual budget line item in the CIP for construction of offline, underground structural water quality facilities in developed, high pollutant source areas. Types of facilities include sedimentation manholes and proprietary stormwater treatment devices. Depending on flow rate and type of facility installed, costs can widely vary.

Project Elements

0 ea. – Water Quality Facility for High Source Areas

Problems and/or Opportunities Addressed by the Capital Projects

Problems

Based on monitoring data collected within the City of Eugene, stormwater from high pollutant source areas is a significant source of pollutant loads to receiving waters.

Opportunities

Opportunity to reduce pollutant discharges in stormwater runoff from high pollutant sources in developed areas.

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Water Quality Facility for High Source Areas	

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

N/A

Water Quality

This CP provides treatment of stormwater runoff from various high pollutant source drainage areas. Pollutant load reductions will depend on the type of facilities used and the locations of the facilities.

Natural Resources

N/A

Costs

Construction Costs:	
Site Acquisition:	$0
Engineering / Administration:	
Capital Project Implementation Costs	
Annual Maintenance Costs	**$0**

There will be an annual line item in the capital projects budget to address water quality facilities for high source areas on a city-wide basis.

Design Assumptions

Possible high source retrofit locations:
Willamette Overflow Drainage System:
1) Node 68485
2) Nodes 58315, 58314, 58313, and 58312
3) Node 58319
4) Node 67014

Spring Creek Drainage System:
5) 48" pipe east of River Road, north of River Loop 2, south of Swain Lane

Flat Creek Drainage System:
6) Nodes 72206, 72210, 72215, 72218, and 72223
7) Node 72321
8) Node 72326

A1 Channel Drainage System
9) 54" pipe running west between nodes 59020 and 59021 between Bushnell and Park Ave.

Project Identifier	**RRSC-3**
Project Title	**Annual Budget Line Item for Outfall Stabilization**

Project Location

All storm drainage system outfalls in the River Road Santa Clara basin that are causing erosion and bank stabilization problems.

Subbasin	**N/A**
GIS U/S Node Location	**N/A**
GIS D/S Node Location	**N/A**
Drainage Area Served by Capital Project	**N/A** Acres
% Impervious (Existing Land Use)	**N/A**
% Impervious (Future Land Use)	**N/A**

Project Description

Maintain an annual budget line item in the CIP for identification and retrofit of storm drainage system outfalls creating bank stability problems along open waterways in the River Road Santa Clara basin.

Project Elements

0 N/A – Outfall Stabilization

Problems and/or Opportunities Addressed by the Capital Projects

Problems

Erosion and bank stabilization problems, and in some cases maintenance access problems, exist at storm drainage system outfalls draining into open waterways in the River Road Santa Clara basin.

Opportunities

Opportunity to retrofit storm drainage system outfalls to provide maintenance access, energy dissipation, and bank stabilization.

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Outfall Stabilization	

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

N/A

Water Quality

This CP provides bank stabilization that will reduce sedimentation from erosion caused by storm drainage system outfalls draining into open waterways in the River Road Santa Clara basin.

Natural Resources

This CP will reduce impacts on streambank vegetation and aquatic habitat.

Costs

Construction Costs:	
Site Acquisition:	$0
Engineering / Administration:	
Capital Project Implementation Costs	

There will be a annual line item in the capital projects budget to address outfall stabilization projects on a city-wide basis.

Annual Maintenance Costs	**$0**

Design Assumptions

Project Identifier	**RRSC-4**
Project Title	**Annual Budget Line Item for Stream Corridor Acquisition**

Project Location

Stream corridors with relatively high stormwater values and at risk for future development throughout the River Road Santa Clara Basin.

Subbasin	**N/A**
GIS U/S Node Location	**N/A**
GIS D/S Node Location	**N/A**
Drainage Area Served by Capital Project	**N/A** Acres
% Impervious (Existing Land Use)	**N/A**
% Impervious (Future Land Use)	**N/A**

Project Description

Maintain an annual budget line item in the CIP for acquisition of stream corridors in locations with high development potential in order to buffer streams and minimize impacts associated with increased runoff volumes and other negative impacts associated with urbanization.

Project Elements

0 N/A – Stream Corridor Acquisition

Problems and/or Opportunities Addressed by the Capital Projects

Problems

Downcutting, sedimentation, and erosion problems have been observed in open waterways that are receiving increased runoff volumes associated with urbanization.

Opportunities

Stream corridor acquisition provides the opportunity to improve or restore riparian vegetation conditions in locations that otherwise would develop and encroach on the stream corridor.

Project #: RRSC-4

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Stream Corridor Acquisition	

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

Provides additional space allowing for water levels to rise above the top of banks without damaging encroaching structures.

Water Quality

This CP eliminates localized erosion of streambeds and streambanks associated with encroaching development.

Natural Resources

This CP can help restore native riparian vegetation and improve aquatic habitat conditions.

Costs

Construction Costs:	
Site Acquisition:	$0
Engineering / Administration:	
Capital Project Implementation Costs	
Annual Maintenance Costs	**$0**

There will be a annual line item in the capital projects budget to address stream corridor acquisition projects on a city-wide basis.

Design Assumptions

The Willamette Overflow (or East Santa Clara Waterway) has been identified for stream corridor acquisitions.

APPENDIX B

HYDROLOGIC/HYDRAULIC MODEL OUTPUT TABLES

APPENDIX B
TABLE B-1
MAJOR HYDROLOGIC INPUT DATA FOR THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM

Subbasin Name	Inlet Node	Subbasin Area (acres)	Impervious Area (%) Existing Land Use Mapped	Existing Land Use Effective	Future Land Use Mapped	Future Land Use Effective	Average Subbasin Slope (ft/ft)	Subbasin Width (ft)	Overland Flow Roughness Coefficient Impervious	Pervious	Depression Storage (inch) Impervious	Pervious	Green-Ampt Infiltration Parameters Average Capillary Suction (in)	Initial Moisture Deficit (ft/ft)	Saturated Hydraulic Conductivity (inch/hour)
River Road-Santa Clara - A1-Channel															
RSA1-010	72757	34.6	3.7	0.7	35.4	21.1	0.025	2540	0.012	0.20	0.05	0.15	10.70	0.43	0.08
RSA1-020	72757	87.3	13.0	4.7	14.8	5.7	0.014	1446	0.012	0.20	0.05	0.15	10.70	0.43	0.08
RSA1-030	72744	239.8	24.3	12	37.1	22.6	0.016	11160	0.012	0.20	0.05	0.15	10.45	0.41	0.07
RSA1-050	72746	65.4	15.5	6.1	56.3	42.2	0.007	1543	0.012	0.20	0.05	0.15	10.70	0.43	0.08
RSA1-060	72740	152.8	36.8	22.3	49.4	34.7	0.016	20023	0.012	0.20	0.05	0.15	9.99	0.40	0.07
RSA1-070	72742	63.6	29.3	15.9	51.0	36.4	0.015	2570	0.012	0.20	0.05	0.15	10.18	0.41	0.08
RSA1-080	72748	73.1	50.4	35.8	54.0	39.7	0.021	2693	0.012	0.20	0.05	0.15	10.46	0.42	0.08
RSA1-090	72788	50.0	37.9	23.3	54.4	40.1	0.024	3434	0.012	0.20	0.05	0.15	10.35	0.44	0.12
RSA1-100	72784	82.1	49.1	34.4	51.5	37	0.043	3276	0.012	0.20	0.05	0.15	8.43	0.44	0.26
RSA1-110	72103	57.8	54.3	40	55.2	41	0.043	2500	0.012	0.20	0.05	0.15	9.23	0.44	0.21
RSA1-120	72102	91.4	32.8	18.8	54.1	39.8	0.050	4154	0.012	0.20	0.05	0.15	9.43	0.45	0.21
RSA1-130	72737	107.1	36.0	21.6	45.3	30.5	0.023	7687	0.012	0.25	0.05	0.15	10.70	0.43	0.08
RSA1-140	69264	54.3	38.1	23.5	39.3	24.6	0.017	3325	0.012	0.20	0.05	0.15	10.70	0.43	0.08
RSA1-150	72797	73.5	43.9	29.1	49.4	34.7	0.043	2701	0.012	0.20	0.05	0.15	9.45	0.45	0.21
RSA1-160	72733	106.5	40.1	25.4	43.1	28.3	0.022	6146	0.012	0.40	0.05	0.15	9.90	0.44	0.16
RSA1-170	72736	98.9	45.5	30.7	47.7	32.9	0.017	5947	0.012	0.45	0.05	0.15	10.70	0.43	0.08
RSA1-180	72101	78.8	42.7	27.9	43.5	28.7	0.014	2650	0.012	0.45	0.05	0.15	10.60	0.43	0.09
RSA1-190	72100	59.6	43.6	28.8	43.6	28.8	0.011	1623	0.012	0.45	0.05	0.15	10.38	0.43	0.09
RSA1-200	72725	42.2	40.2	25.5	50.1	35.5	0.042	1297	0.012	0.25	0.05	0.15	6.06	0.33	0.23
RSA1-210	59021	99.0	45.6	30.8	46.0	31.2	0.006	4869	0.012	0.45	0.05	0.15	10.56	0.43	0.09
RSA1-220	85032	53.8	45.9	31.1	46.8	32	0.005	1315	0.012	0.45	0.05	0.15	9.63	0.43	0.11
RSA1-230	72723	86.7	34.3	20.1	38.8	24.2	0.030	4686	0.012	0.40	0.05	0.15	7.80	0.38	0.20
RSA1-240	72719	169.1	38.4	23.8	42.2	27.4	0.015	4837	0.012	0.45	0.05	0.15	10.67	0.43	0.08
RSA1-245	72719	566.3	40.1	25.4	42.5	27.7	0.014	9500	0.012	0.45	0.05	0.15	10.59	0.43	0.08
RSA1-270	74040	28.3	46.8	32	47.1	32.3	0.008	4532	0.012	0.45	0.05	0.15	9.01	0.45	0.25
RSA1-280	74030	39.2	45.2	30.4	45.3	30.5	0.004	3610	0.012	0.45	0.05	0.15	10.70	0.43	0.08
RSA1-290	74020	48.4	43.3	28.5	44.3	29.5	0.013	2809	0.012	0.45	0.05	0.15	10.70	0.43	0.08
River Road-Santa Clara - Flat Creek															
RSFC-010	70197	51.3	44.0	29.2	44.1	29.3	0.024	2500	0.012	0.40	0.05	0.15	9.64	0.40	0.11
RSFC-020	72767	84.7	42.8	28	46.8	32	0.015	3743	0.012	0.40	0.05	0.15	10.70	0.43	0.08
RSFC-030	72761	104.2	41.9	27.1	45.1	30.3	0.016	5722	0.012	0.30	0.05	0.15	10.70	0.43	0.08
RSFC-040	75659	35.9	42.1	27.3	43.7	28.9	0.013	1700	0.012	0.45	0.05	0.15	10.70	0.43	0.08
RSFC-050	72799	42.8	36.9	22.4	42.9	28.1	0.013	1680	0.012	0.45	0.05	0.15	10.70	0.43	0.08
RSFC-060	72800	46.2	44.8	30	44.8	30	0.010	2412	0.012	0.45	0.05	0.15	9.90	0.44	0.16
RSFC-070	72794	30.2	35.7	21.3	38.2	23.6	0.016	2903	0.012	0.45	0.05	0.15	10.43	0.43	0.11
River Road-Santa Clara - Spring Creek															
RSSC-010	72013	50.5	38.2	23.6	43.1	28.3	0.024	2938	0.012	0.37	0.05	0.15	10.70	0.43	0.08
RSSC-035	76560	51.9	44.8	30	45.8	31	0.009	1200	0.012	0.30	0.05	0.15	10.70	0.43	0.08
RSSC-040	72008	42.8	38.1	23.5	40.1	25.4	0.027	1869	0.012	0.45	0.05	0.15	9.01	0.43	0.13
RSSC-050	72030	54.4	43.3	28.5	44.9	30.1	0.013	2656	0.012	0.35	0.05	0.15	7.44	0.43	0.18
RSSC-060	79470	114.1	41.4	26.6	47.9	33.1	0.013	4948	0.012	0.45	0.05	0.15	8.96	0.43	0.13
RSSC-070	76587	40.4	47.2	32.4	47.5	32.7	0.009	1941	0.012	0.45	0.05	0.15	10.09	0.43	0.10
RSSC-080	76564	100.3	41.2	26.4	45.9	31.1	0.008	1424	0.012	0.45	0.05	0.15	10.70	0.43	0.08

APPENDIX B
TABLE B-1
MAJOR HYDROLOGIC INPUT DATA FOR THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM

Subbasin Name	Inlet Node	Subbasin Area (acres)	Impervious Area (%)				Average Subbasin Slope (ft/ft)	Subbasin Width (ft)	Overland Flow Roughness Coefficient		Depression Storage (inch)		Green-Ampt Infiltration Parameters		
			Existing Land Use		Future Land Use								Average Capillary Suction (in)	Initial Moisture Deficit (ft/ft)	Saturated Hydraulic Conductivity (inch/hour)
			Mapped	Effective	Mapped	Effective			Impervious	Pervious	Impervious	Pervious			
RSSC-090	72004	82.8	43.3	28.5	43.6	28.8	0.020	3761	0.012	0.30	0.05	0.15	10.70	0.43	0.08
RSSC-100	72002	66.4	40.6	25.9	43.0	28.2	0.013	2722	0.012	0.30	0.05	0.15	10.70	0.43	0.08
RSSC-110	72770	95.9	27.3	14.3	42.5	27.7	0.010	2777	0.012	0.30	0.05	0.15	10.70	0.43	0.08
RSSC-120	72000	323.9	40.8	26.1	43.4	28.6	0.014	4475	0.012	0.45	0.05	0.15	10.54	0.43	0.10
River Road-Santa Clara - Willamette Overflow															
RSWO-010	99820	54.8	11.3	3.8	27.5	14.4	0.034	4578	0.012	0.20	0.05	0.15	7.92	0.43	0.24
RSWO-020	99827	27.5	39.7	25	45.4	30.6	0.015	2261	0.012	0.45	0.05	0.15	3.50	0.43	0.30
RSWO-030	99827	47.8	36.3	21.9	42.8	28	0.018	2282	0.012	0.45	0.05	0.15	3.50	0.43	0.30
RSWO-035	99827	110.8	39.9	25.2	44.5	29.7	0.014	4687	0.012	0.45	0.05	0.15	6.17	0.44	0.31
RSWO-040	73907	25.4	37.1	22.6	38.0	23.4	0.024	5712	0.012	0.20	0.05	0.15	6.50	0.43	0.25
RSWO-045	73910	44.7	36.0	21.6	43.7	28.9	0.027	3000	0.012	0.20	0.05	0.15	6.65	0.42	0.41
RSWO-050	72081	80.0	25.3	12.7	39.0	24.4	0.019	3396	0.012	0.45	0.05	0.15	6.29	0.41	0.52
RSWO-060	72080	37.9	4.0	0.8	12.5	4.4	0.025	1817	0.012	0.20	0.05	0.15	5.33	0.41	0.77
RSWO-070	74013	66.1	31.4	17.6	41.4	26.6	0.022	5273	0.012	0.45	0.05	0.15	9.41	0.43	0.25
RSWO-080	74004	55.4	51.8	37.3	54.6	40.3	0.008	3737	0.012	0.45	0.05	0.15	10.70	0.43	0.08
RSWO-090	74405	34.2	44.9	30.1	45.8	31	0.022	3460	0.012	0.45	0.05	0.15	9.80	0.43	0.20
RSWO-100	58315	15.2	40.3	25.6	40.4	25.7	0.009	3030	0.012	0.45	0.05	0.15	10.70	0.43	0.08
RSWO-110	58311	49.4	57.7	43.8	64.7	52	0.012	2980	0.012	0.45	0.05	0.15	10.65	0.43	0.09
RSWO-120	77703	30.9	56.5	42.5	57.3	43.4	0.044	2010	0.012	0.45	0.05	0.15	10.69	0.43	0.08
RSWO-130	77703	136.9	50.6	36	52.2	37.7	0.010	4533	0.012	0.45	0.05	0.15	9.16	0.43	0.13
RSWO-140	77703	30.6	59.4	45.8	62.2	49.1	0.033	1773	0.012	0.45	0.05	0.15	10.28	0.43	0.13

APPENDIX B
TABLE B-2
HYDROLOGIC MODEL OUTPUT DATA UNDER EXISTING AND FUTURE CONDITIONS
FOR THE RIVER ROAD SANTA CLARA BASIN

Subbasin Name	Inlet Node	Subbasin Area (acres)	Subbasin Peak Flow (cfs) Existing Land Use Conditions					Subbasin Peak Flow (cfs) Future Land Use Conditions				
			10-Year	25-Year-W1	25-Year-S2	50-Year	100-Year	10-Year	25-Year-W1	25-Year-S2	50-Year	100-Year
River Road-Santa Clara - A1-Channel												
RSA1-010	72757	34.6	11	4	8	13	19	15	12	12	25	33
RSA1-020	72757	87.3	12	7	10	16	22	12	8	11	18	24
RSA1-030	72744	239.8	73	44	61	103	139	87	70	76	149	191
RSA1-050	72746	65.4	8	5	7	11	15	24	31	22	47	56
RSA1-060	72740	152.8	76	57	63	140	180	82	77	70	171	212
RSA1-070	72742	63.6	18	13	15	28	37	26	27	23	51	63
RSA1-080	72748	73.1	30	31	26	58	71	32	34	28	63	77
RSA1-090	72788	50.0	17	13	11	29	37	21	22	16	44	54
RSA1-100	72784	82.1	19	31	20	52	61	20	34	21	56	66
RSA1-110	72103	57.8	16	26	16	44	52	16	26	17	45	53
RSA1-120	72102	91.4	12	19	12	34	42	25	40	26	70	82
RSA1-130	72737	107.1	41	29	33	67	88	46	39	38	84	107
RSA1-140	69264	54.3	21	16	17	35	45	21	16	17	36	46
RSA1-150	72797	73.5	14	24	15	41	48	17	28	18	49	57
RSA1-160	72733	106.5	23	30	19	53	64	25	34	21	59	71
RSA1-170	72736	98.9	33	35	28	66	79	34	37	30	69	84
RSA1-180	72101	78.8	20	25	18	43	51	20	25	18	44	52
RSA1-190	72100	59.6	15	19	13	32	38	15	19	13	32	38
RSA1-200	72725	42.2	8	12	8	21	26	11	17	11	29	34
RSA1-210	59021	99.0	27	34	24	58	69	27	35	24	59	69
RSA1-220	85032	53.8	13	19	12	28	33	13	19	12	29	34
RSA1-230	72723	86.7	13	19	12	35	43	15	23	15	42	50
RSA1-240	72719	169.1	126	49	40	86	104	45	55	44	96	115
RSA1-245	72719	566.3	41	168	127	274	326	135	182	136	298	348
RSA1-270	74040	28.3	6	10	6	17	20	6	10	6	17	20
RSA1-280	74030	39.2	12	14	11	25	30	12	14	11	25	30
RSA1-290	74020	48.4	15	16	13	29	35	15	16	13	30	36

APPENDIX B
TABLE B-2
HYDROLOGIC MODEL OUTPUT DATA UNDER EXISTING AND FUTURE CONDITIONS
FOR THE RIVER ROAD SANTA CLARA BASIN

Subbasin Name	Inlet Node	Subbasin Area (acres)	Subbasin Peak Flow (cfs) Existing Land Use Conditions					Subbasin Peak Flow (cfs) Future Land Use Conditions				
			10-Year	25-Year-W1	25-Year-S2	50-Year	100-Year	10-Year	25-Year-W1	25-Year-S2	50-Year	100-Year
River Road-Santa Clara - Flat Creek												
RSFC-010	70197	51.3	16	17	13	32	38	16	17	13	32	38
RSFC-020	72767	84.7	25	27	22	50	60	27	31	24	56	67
RSFC-030	72761	104.2	36	33	30	65	81	38	37	32	71	88
RSFC-040	75659	35.9	10	11	9	20	25	10	12	9	21	26
RSFC-050	72799	42.8	10	11	9	20	24	12	14	10	24	29
RSFC-060	72800	46.2	11	15	10	26	30	11	15	10	26	30
RSFC-070	72794	30.2	8	7	6	15	18	9	8	6	16	20
River Road-Santa Clara - Spring Creek												
RSSC-010	72013	50.5	16	14	14	29	36	18	17	15	33	41
RSSC-035	76560	51.9	14	18	12	29	34	14	18	13	29	35
RSSC-040	72008	42.8	10	11	8	21	25	10	12	8	22	26
RSSC-050	72030	54.4	12	17	11	30	35	13	18	12	32	37
RSSC-060	79470	114.1	26	34	22	60	70	31	42	27	73	84
RSSC-070	76587	40.4	12	15	10	25	30	12	15	10	26	30
RSSC-080	76564	100.3	20	29	19	44	51	24	35	22	50	58
RSSC-090	72004	82.8	28	27	24	53	65	28	28	24	53	66
RSSC-100	72002	66.4	19	20	17	37	45	20	22	18	40	48
RSSC-110	72770	95.9	17	16	14	30	38	26	30	23	52	62
RSSC-120	72000	323.9	65	94	60	145	169	71	103	66	157	182
River Road-Santa Clara - Willamette Overflow												
RSWO-010	99820	54.8	1	2	1	5	10	5	9	6	16	22
RSWO-020	99827	27.5	5	8	5	13	16	6	9	6	16	19
RSWO-030	99827	47.8	7	12	7	20	24	9	15	9	25	30
RSWO-035	99827	110.8	19	31	20	51	59	22	37	23	60	69
RSWO-040	73907	25.4	4	6	4	13	17	4	7	4	13	18
RSWO-045	73910	44.7	7	11	7	18	20	9	14	9	24	27
RSWO-050	72081	80.0	7	11	7	19	21	13	22	14	36	41

APPENDIX B
TABLE B-2
HYDROLOGIC MODEL OUTPUT DATA UNDER EXISTING AND FUTURE CONDITIONS
FOR THE RIVER ROAD SANTA CLARA BASIN

Subbasin Name	Inlet Node	Subbasin Area (acres)	Subbasin Peak Flow (cfs) Existing Land Use Conditions					Subbasin Peak Flow (cfs) Future Land Use Conditions				
			10-Year	25-Year-W1	25-Year-S2	50-Year	100-Year	10-Year	25-Year-W1	25-Year-S2	50-Year	100-Year
RSWO-060	72080	37.9	0	0	0	1	1	1	2	1	3	4
RSWO-070	74013	66.1	8	13	8	22	26	12	20	12	33	38
RSWO-080	74004	55.4	20	23	17	42	50	21	25	18	45	53
RSWO-090	74405	34.2	7	11	7	20	24	7	12	7	21	24
RSWO-100	58315	15.2	6	5	5	11	14	6	5	5	11	14
RSWO-110	58311	49.4	19	24	17	43	50	22	29	20	49	58
RSWO-120	77703	30.9	14	17	13	31	37	14	17	13	31	37
RSWO-130	77703	136.9	38	55	37	91	107	40	58	39	95	111
RSWO-140	77703	30.6	12	16	10	29	34	13	17	11	31	36

Note.
1. W = Winter
2. S = Summer

APPENDIX B
TABLE B-3
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM UNDER EXISTING LAND USE CONDITIONS

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Peak Flow (cfs) Existing Land Use Conditions					Invert Elevation (ft)		Water Surface Elevation under Existing Land Use Conditions (ft)									
													10-Year		25-Year Summer		25-Year Winter		50-Year		100-Year	
	US	DS				10-Year	25-Year-S	25-Year-W	50-Year	100-Year	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS
A-1 Channel																						
RSA1010A	72757	72745	Bridge	42	25	383	283	419	474	587	352.1	352.3	356.3	355.5	356.0	355.1	356.5	355.6	356.6	355.7	357.0	356.0
RSA1010B	72744	72757	Natural	2400	25	369	282	405	458	563	356.2	352.1	359.8	356.3	359.3	356.0	359.9	356.5	360.2	356.6	360.6	357.0
RSA1030A	72743	72744	Natural	4200	25	328	294	358	417	505	362.8	356.2	367.4	359.8	367.4	359.3	367.6	359.9	368.0	360.2	368.4	360.6
RSA1030B.1	72742	72743	Bridge	32	25	326	294	356	413	499	362.9	362.8	367.6	367.4	367.5	367.4	367.8	367.6	368.1	368.0	368.5	368.4
RSA1030BRD	72742	72743	Roadway	32		0	0	0	0	0	372.3	372.3	367.4	367.4	367.4	367.4	367.6	367.6	368.0	368.0	368.4	368.4
RSA1030C	73394	72744	Natural	1633	10	6	2	6	6	10	362.3	356.2	362.7	359.8	362.5	359.3	362.7	359.9	362.7	360.2	362.7	360.6
RSA1030D	75021	73394	Natural	1016	10	7	3	6	7	10	366.1	362.3	366.6	362.7	366.5	362.5	366.5	362.7	366.6	362.7	366.6	362.7
RSA1030Da.	75020	75021	24" x 141" CMP Culvert	96	10	7	3	6	7	10	366.3	366.1	367.3	366.6	367.0	366.5	367.2	366.5	367.3	366.6	367.4	366.6
RSA1030DaR	75020	75021	Roadway	96		0	0	0	0	0	370.7	370.7	366.6	366.6	366.5	366.5	366.5	366.5	366.6	366.6	366.6	366.6
RSA1030Db	73395	75020	Natural	522	10	7	4	6	7	10	366.8	366.3	367.3	367.3	367.2	367.0	367.3	367.2	367.3	367.3	367.5	367.4
RSA1030E	72747	73395	Natural	1633	10	8	4	7	8	13	368.2	366.8	368.8	367.3	368.7	367.2	368.7	367.3	368.8	367.3	368.9	367.5
RSA1030F1	72746	72747	14" CSP Culvert	55	10	4	3	4	5	5	368.8	368.2	369.9	368.8	369.6	368.7	369.8	368.7	370.2	368.8	370.5	368.9
RSA1030F2	72746	72747	24" CSP Culvert	55	10	4	2	3	6	10	369.1	368.8	369.9	369.5	369.6	369.3	369.8	369.4	370.2	369.7	370.5	369.9
RSA1030FRD	72746	72747	Roadway	55		0	0	0	0	0	372.1	372.1	368.8	368.8	368.7	368.7	368.7	368.7	368.8	368.8	368.9	368.9
RSA1060A	71215	72742	Natural	1140	25	313	289	343	396	477	365.0	362.9	368.8	367.6	368.7	367.5	369.0	367.8	369.4	368.1	370.0	368.5
RSA1060B	72741	71215	Natural	560	25	291	273	321	379	456	366.6	365.0	369.9	368.8	369.8	368.7	370.1	369.0	370.4	369.4	370.9	370.0
RSA1060C	72740	72741	Bridge	39	25	291	274	321	379	457	366.7	366.6	370.2	369.9	370.1	369.8	370.3	370.1	370.6	370.4	371.1	370.9
RSA1060D	72739	72740	Natural	1000	25	254	237	280	311	375	367.6	366.7	371.8	370.2	371.7	370.1	372.0	370.3	372.2	370.6	372.6	371.1
RSA1060E	72738	72739	Natural	500	25	234	220	260	290	354	367.8	367.6	372.2	371.8	372.0	371.7	372.4	372.0	372.6	372.2	373.0	372.6
RSA1130A1	72737	72738	72" CSP Culvert	600	25	77	73	86	96	118	370.2	367.9	372.8	372.2	372.7	372.0	373.1	372.4	373.4	372.6	373.9	373.0
RSA1130A2	72737	72738	72" CSP Culvert	600	25	79	75	88	99	120	370.1	367.8	372.8	372.2	372.7	372.0	373.1	372.4	373.4	372.6	373.9	373.0
RSA1130A3	72737	72738	72" CSP Culvert	600	25	77	73	86	96	118	370.2	367.9	372.8	372.2	372.7	372.0	373.1	372.4	373.4	372.6	373.9	373.0
RSA1130ARD	72737	72738	Roadway	600		0	0	0	0	0	381.7	381.7	372.2	372.2	372.0	372.0	372.4	372.4	372.6	372.6	373.0	373.0
RSA1130B	70756	72737	Natural	2145	25	213	208	239	255	307	372.1	370.1	377.4	372.8	377.4	372.7	377.6	373.1	377.7	373.4	378.1	373.9
RSA1140A	72796	70756	Natural	1155	25	203	204	228	240	282	372.8	372.1	378.2	377.4	378.2	377.4	378.4	377.6	378.5	377.7	378.9	378.1
RSA1140B.1	69264	70756	36" CSP Culvert	839	10	21	15	17	27	27	374.1	373.3	379.8	377.4	378.3	377.4	379.3	377.6	382.1	377.7	382.2	378.1
RSA1140BRD	69264	70756	Roadway	839		0	0	0	1	10	382.0	380.0	377.4	377.4	377.4	377.4	377.6	377.6	382.1	380.0	382.2	380.2
RSA1270A.1	74046	72796	60" CSP Culvert	160	10	25	28	25	46	60	372.9	372.8	378.2	378.2	378.2	378.2	378.4	378.4	378.5	378.5	378.9	378.9
RSA1270ARD	74046	72796	Roadway	160		0	0	0	0	0	384.3	386.4	378.2	378.2	378.2	378.2	378.4	378.4	378.5	378.5	378.9	378.9
RSA1270B.1	74044	74046	60" CSP Culvert	463	10	25	29	25	46	60	373.1	372.9	378.2	378.2	378.2	378.2	378.5	378.4	378.6	378.5	379.1	378.9
RSA1270BRD	74044	74046	Roadway	463		0	0	0	0	0	383.0	384.3	378.2	378.2	378.2	378.2	378.5	378.5	378.6	378.6	379.1	379.1
RSA1270C.1	74042	74044	60" CSP Culvert	412	10	25	31	26	47	61	373.3	373.1	378.2	378.2	378.2	378.2	378.5	378.5	378.7	378.6	379.2	379.1
RSA1270CRD	74042	74044	Roadway	412		0	0	0	0	0	382.2	383.0	378.2	378.2	378.2	378.2	378.5	378.5	378.7	378.7	379.2	379.2

APPENDIX B
TABLE B-3
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM UNDER EXISTING LAND USE CONDITIONS

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Peak Flow (cfs) Existing Land Use Conditions					Invert Elevation (ft)		Water Surface Elevation under Existing Land Use Conditions (ft)									
													10-Year		25-Year Summer		25-Year Winter		50-Year		100-Year	
	US	DS				10-Year	25-Year-S	25-Year-W	50-Year	100-Year	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS
RSA1270D.1	74040	74042	60" CSP Culvert	409	10	26	32	26	47	61	373.5	373.3	378.2	378.2	378.2	378.2	378.5	378.5	378.8	378.7	379.5	379.2
RSA1270DRD	74040	74042	Roadway	409		0	0	0	0	0	383.4	382.2	378.2	378.2	378.2	378.2	378.5	378.5	378.7	378.7	379.2	379.2
RSA1280A.1	74034	74040	60" CSP Culvert	216	10	21	23	21	38	50	373.6	373.5	378.3	378.2	378.2	378.2	378.5	378.5	378.9	378.8	379.5	379.5
RSA1280ARD	74034	74040	Roadway	216		0	0	0	0	0	383.3	383.4	378.3	378.3	378.2	378.2	378.5	378.5	378.9	378.9	379.5	379.5
RSA1280B.1	74032	74034	60" CSP Culvert	269	10	21	23	21	38	50	373.8	373.6	378.3	378.3	378.3	378.2	378.5	378.5	378.9	378.9	379.7	379.5
RSA1280BRD	74032	74034	Roadway	269		0	0	0	0	0	382.4	383.3	378.3	378.3	378.3	378.3	378.5	378.5	378.9	378.9	379.7	379.7
RSA1280C.1	74031	74032	60" CSP Culvert	1331	10	22	26	21	39	50	374.4	373.8	378.3	378.3	378.3	378.3	378.6	378.5	379.2	378.9	380.2	379.7
RSA1280CRD	74031	74032	Roadway	1331		0	0	0	0	0	383.0	382.4	378.3	378.3	378.3	378.3	378.5	378.5	378.9	378.9	379.7	379.7
RSA1280D.1	74030	74031	60" CSP Culvert	1012	10	24	28	21	40	51	374.9	374.4	378.4	378.3	378.4	378.3	378.7	378.6	379.5	379.2	380.6	380.2
RSA1280DRD	74030	74031	Roadway	1022		0	0	0	0	0	384.9	383.0	378.3	378.3	378.3	378.3	378.6	378.6	379.2	379.2	380.2	380.2
RSA1290A.1	74026	74030	54" CSP Culvert	496	10	13	15	12	22	29	375.7	375.4	378.4	378.4	378.4	378.4	378.7	378.7	379.5	379.5	380.7	380.6
RSA1290ARD	74026	74030	Roadway	496		0	0	0	0	0	384.0	384.9	378.4	378.4	378.4	378.4	378.7	378.7	379.5	379.5	380.7	380.7
RSA1290B.1	74024	74026	48" CSP Culvert	182	10	14	15	12	23	30	376.3	376.2	378.5	378.4	378.4	378.4	378.7	378.7	379.6	379.5	380.8	380.7
RSA1290BRD	74024	74026	Roadway	182		0	0	0	0	0	384.8	384.0	378.4	378.4	378.4	378.4	378.7	378.7	379.5	379.5	380.7	380.7
RSA1290C.1	74022	74024	48" CSP Culvert	410	10	14	16	12	25	30	376.6	376.3	378.5	378.5	378.5	378.4	378.8	378.7	379.7	379.6	380.9	380.8
RSA1290CRD	74022	74024	Roadway	410		0	0	0	0	0	383.4	384.8	378.5	378.5	378.5	378.5	378.8	378.8	379.7	379.7	380.9	380.9
RSA1290D.1	74020	74022	42" CSP Culvert	880	10	14	16	13	28	32	377.4	376.6	379.2	378.5	379.3	378.5	379.2	378.8	380.3	379.7	381.9	380.9
RSA1290DRD	74020	74022	Roadway	880		0	0	0	0	0	385.7	383.4	378.5	378.5	378.5	378.5	378.8	378.8	379.7	379.7	380.9	380.9
RSA1150A1	72797	72796	72" CSP Culvert	167	25	92	93	103	109	126	374.8	375.0	378.8	378.2	378.8	378.2	379.0	378.4	379.2	378.5	379.6	378.9
RSA1150A2	72797	72796	72" CSP Culvert	155	25	93	94	104	110	128	374.8	375.0	378.8	378.2	378.8	378.2	379.0	378.4	379.2	378.5	379.6	378.9
RSA1150ARD	72797	72796	Roadway	160		0	0	0	0	0	384.4	384.7	378.8	378.8	378.8	378.8	379.0	379.0	379.2	379.2	379.6	379.6
RSA1150B	72734	72797	Natural	3273	25	180	182	199	211	246	377.1	375.1	382.6	378.8	382.6	378.8	382.8	379.0	382.9	379.2	383.3	379.6
RSA1160A.1	72733	72734	Bridge	92	25	144	154	156	171	195	378.7	378.6	382.7	382.6	382.7	382.6	382.9	382.8	383.0	382.9	383.3	383.3
RSA1160ARD	72733	72734	Roadway	92		0	0	0	0	0	387.8	387.8	382.6	382.6	382.6	382.6	382.8	382.8	382.9	382.9	383.3	383.3
RSA1160B	72732	72733	Natural	165	25	136	152	150	162	185	377.1	378.7	382.7	382.7	382.8	382.7	382.9	382.9	383.1	383.0	383.4	383.3
RSA1160C1	72731	72732	60" CSP Culvert	61	25	68	76	75	81	92	377.0	377.1	382.9	382.7	383.0	382.8	383.2	382.9	383.4	383.1	383.8	383.4
RSA1160C2	72731	72732	60" CSP Culvert	61	25	68	76	75	81	92	377.0	377.1	382.9	382.7	383.0	382.8	383.2	382.9	383.4	383.1	383.8	383.4
RSA1160CRD	72731	72732	Roadway	61		0	0	0	0	0	383.9	383.8	382.7	382.7	382.8	382.8	382.9	382.9	383.1	383.1	383.4	383.4
RSA1160D	72730	72731	Natural	769	25	136	150	149	162	184	377.9	377.0	383.2	382.9	383.3	383.0	383.5	383.2	383.8	383.4	384.3	383.8
RSA1160E1	72729	72730	72" CMP Culvert	89	25	68	74	74	81	92	378.4	377.9	383.4	383.2	383.5	383.3	383.7	383.5	384.0	383.8	384.7	384.3

APPENDIX B
TABLE B-3
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM UNDER EXISTING LAND USE CONDITIONS

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Peak Flow (cfs) Existing Land Use Conditions					Invert Elevation (ft)		Water Surface Elevation under Existing Land Use Conditions (ft)									
													10-Year		25-Year Summer		25-Year Winter		50-Year		100-Year	
	US	DS				10-Year	25-Year-S	25-Year-W	50-Year	100-Year	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS
RSA1160E2	72729	72730	72" CMP Culvert	89	25	68	75	74	81	92	378.4	377.9	383.4	383.2	383.5	383.3	383.7	383.5	384.0	383.8	384.7	384.3
RSA1160ERD	72729	72730	Roadway	89		0	0	0	0	0	386.5	386.5	383.2	383.2	383.3	383.3	383.5	383.5	383.8	383.8	384.3	384.3
RSA1160F	71940	72729	Natural	1207	25	136	149	147	163	184	379.1	378.4	383.5	383.4	383.6	383.5	383.8	383.7	384.1	384.0	384.7	384.7
RSA1160G.1	71941	71940	60" x 144" CMP Culvert	61	25	139	155	148	167	185	379.2	379.1	383.8	383.5	384.0	383.6	384.1	383.8	384.5	384.1	385.1	384.7
RSA1160GRD	71941	71940	Roadway	61		0	0	0	0	0	388.2	388.2	383.5	383.5	383.6	383.6	383.8	383.8	384.1	384.1	384.7	384.7
RSA1160H	72726	71941	Natural	650	25	141	159	151	169	188	379.5	379.2	383.9	383.8	384.1	384.0	384.2	384.1	384.6	384.5	385.3	385.1
RSA1170A	72736	72734	Natural	610	10	56	76	53	104	125	379.9	377.1	382.6	382.6	382.7	382.6	382.8	382.8	383.0	382.9	383.3	383.3
RSA1170B.1	72101	72736	60" CSP Culvert	140	25	20	25	17	43	51	380.1	380.0	382.7	382.6	382.7	382.7	382.9	382.8	383.0	383.0	383.3	383.3
RSA1170BRD	72101	72736	Roadway	140		0	0	0	0	0	393.0	393.0	382.6	382.6	382.7	382.7	382.8	382.8	383.0	383.0	383.3	383.3
RSA1170C	72735	72736	Natural	2200	10	14	18	13	23	27	382.7	379.9	383.8	382.6	384.0	382.7	383.8	382.8	384.2	383.0	384.3	383.3
RSA1170D.1	72100	72735	36" CSP Culvert	150	25	15	19	13	32	37	383.5	382.7	384.8	383.8	385.1	384.0	384.7	383.8	385.7	384.2	385.9	384.3
RSA1170DRD	72100	72735	Roadway	150		0	0	0	0	0	393.0	393.0	383.8	383.8	384.0	384.0	383.8	383.8	384.2	384.2	384.3	384.3
RSA1200A1	72725	72726	60" CMP Culvert	200	25	61	69	64	73	79	379.8	379.7	384.4	383.9	384.7	384.1	384.7	384.2	385.3	384.6	386.1	385.3
RSA1200A2	72725	72726	60" CMP Culvert	200	25	59	68	64	73	79	380.0	379.8	384.4	383.9	384.7	384.1	384.7	384.2	385.3	384.6	386.1	385.3
RSA1200ARD	72725	72726	Roadway	200		0	0	0	0	0	393.0	393.0	383.9	383.9	384.1	384.1	384.2	384.2	384.6	384.6	385.3	385.3
RSA1200B	72724	72725	Natural	950	25	124	142	128	152	163	380.6	379.8	384.4	384.4	384.8	384.7	384.8	384.7	385.3	385.3	386.1	386.1
RSA1230A.1	72723	72724	60" CMP Culvert	136	25	134	158	135	170	184	381.9	380.6	386.8	384.4	387.6	384.8	387.0	384.8	388.3	385.3	389.2	386.1
RSA1230ARD	72723	72724	Roadway	136		0	0	0	0	5	389.0	389.0	384.4	384.4	384.8	384.8	384.8	384.8	385.3	385.3	389.2	389.1
RSA1230B	72722	72723	Natural	900	25	129	149	128	164	177	381.6	381.9	386.9	386.8	387.7	387.6	387.1	387.0	388.3	388.3	389.2	389.2
RSA1230C	72721	72722	Natural	1400	25	140	172	134	212	235	382.6	381.6	387.0	386.9	387.8	387.7	387.2	387.1	388.4	388.3	389.3	389.2
RSA1230D1	72720	72721	36" CSP Culvert	68	25	49	62	46	81	90	382.7	382.7	388.0	387.0	389.3	387.8	388.1	387.2	390.5	388.4	391.8	389.3
RSA1230D2	72720	72721	36" CSP Culvert	68	25	49	62	46	81	90	382.6	382.6	388.0	387.0	389.3	387.8	388.1	387.2	390.5	388.4	391.8	389.3
RSA1230D3	72720	72721	36" CSP Culvert	68	25	49	62	46	81	90	382.6	382.6	388.0	387.0	389.3	387.8	388.1	387.2	390.5	388.4	391.8	389.3
RSA1230DRD	72720	72721	Roadway	68		0	0	0	0	0	393.7	393.7	387.0	387.0	387.8	387.8	387.2	387.2	388.4	388.4	389.3	389.3
RSA1230E	72719	72720	Natural	900	25	153	198	141	296	337	384.2	382.6	388.3	388.0	389.4	389.3	388.3	388.1	390.7	390.5	391.9	391.8
RSA1060F.1	85030	71215	48" CMP Culvert	30	10	23	21	27	30	34	366.2	365.7	368.8	368.8	368.7	368.7	369.1	369.0	369.4	369.4	370.0	370.0
RSA1060Fa	71214	85030	Natural	415	10	23	20	26	29	33	368.7	366.2	369.7	368.8	369.6	368.7	369.7	369.1	369.8	369.4	370.0	370.0
RSA1060FRD	85030	71215	Roadway	30		0	0	0	0	0	371.2	371.2	368.8	368.8	368.7	368.7	369.0	369.0	369.4	369.4	370.0	370.0
RSA1060G1	71213	71214	18" CMP Culvert	31	10	12	12	13	14	15	369.1	368.7	371.6	369.7	371.5	369.6	371.8	369.7	372.0	369.8	372.2	370.0
RSA1060G2	71213	71214	24" CMP Culvert	28	10	11	8	13	16	19	370.5	369.4	371.6	370.1	371.5	370.0	371.8	370.1	372.0	370.2	372.2	370.3
RSA1060GRD	71213	71214	Roadway	31		0	0	0	0	0	373.7	373.7	369.7	369.7	369.6	369.6	369.7	369.7	369.8	369.8	370.0	370.0

APPENDIX B
TABLE B-3
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM UNDER EXISTING LAND USE CONDITIONS

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Peak Flow (cfs) Existing Land Use Conditions					Invert Elevation (ft)		Water Surface Elevation under Existing Land Use Conditions (ft)									
													10-Year		25-Year Summer		25-Year Winter		50-Year		100-Year	
	US	DS				10-Year	25-Year-S	25-Year-W	50-Year	100-Year	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS
RSA1060H	71212	71213	Natural	1034	10	23	21	27	30	34	370.3	369.1	371.8	371.6	371.8	371.5	372.0	371.8	372.2	372.0	372.4	372.2
RSA1060I1	71211	71212	18" CMP Culvert	42	10	11	10	13	15	18	370.7	370.5	372.4	371.8	372.3	371.8	372.6	372.0	372.9	372.2	373.2	372.4
RSA1060I2	71211	71212	18" CMP Culvert	42	10	12	11	14	16	18	370.7	370.3	372.4	371.8	372.3	371.8	372.6	372.0	372.9	372.2	373.2	372.4
RSA1060IRD	71211	71212	Roadway	42		0	0	0	0	0	375.7	375.7	371.8	371.8	371.8	371.8	372.0	372.0	372.2	372.2	372.4	372.4
RSA1060J	71210	71211	Natural	712	10	24	21	27	32	37	372.0	370.7	373.5	372.4	373.4	372.3	373.6	372.6	373.7	372.9	373.8	373.2
RSA1060S.1	85031	71210	36" x 72" CMP Culvert	18	10	32	31	30	38	43	371.8	372.1	373.8	373.5	373.8	373.4	373.9	373.6	374.0	373.7	374.2	373.8
RSA1060Sa	71209	85031	Natural	586	10	32	31	30	38	43	371.5	371.8	374.0	373.8	374.0	373.8	374.0	373.9	374.2	374.0	374.3	374.2
RSA1060SRD	85031	71210	Roadway	18		0	0	0	0	0	375.9	375.9	373.5	373.5	373.4	373.4	373.6	373.6	373.7	373.7	373.8	373.8
RSA1060U	72749	71209	Natural	308	10	55	54	53	67	74	371.3	371.5	374.2	374.0	374.2	374.0	374.2	374.0	374.5	374.2	374.6	374.3
RSA1080A.1	72748	72749	48" CMP Culvert	40	10	55	54	53	67	75	371.7	371.3	374.9	374.2	374.9	374.2	374.9	374.2	375.3	374.5	375.6	374.6
RSA1080ARD	72748	72749	Roadway	40		0	0	0	0	0	376.5	376.5	374.2	374.2	374.2	374.2	374.2	374.2	374.5	374.5	374.6	374.6
RSA1080B	72791	72748	Natural	1857	10	29	31	30	32	33	372.4	371.7	375.7	374.9	375.7	374.9	375.7	374.9	376.1	375.3	376.3	375.6
RSA1090A.1	72790	72791	36" CMP Culvert	438	10	29	30	30	31	32	374.4	372.4	378.7	375.7	379.0	375.7	378.9	375.7	379.3	376.1	379.9	376.3
RSA1090ARD	72790	72791	Roadway	438		0	0	0	0	1	379.8	379.7	375.7	375.7	375.7	375.7	375.7	375.7	376.1	376.1	379.9	379.7
RSA1090B	72789	72790	Natural	18	10	29	30	30	31	34	374.3	374.4	378.7	378.7	379.0	379.0	378.9	378.9	379.3	379.3	379.9	379.9
RSA1090C1	72788	72789	27" x 40" CMP Culvert	30	10	14	15	14	15	14	374.4	374.3	378.7	378.7	379.0	379.0	378.9	378.9	379.3	379.3	379.9	379.9
RSA1090C2	72788	72789	27" x 40" CMP Culvert	30	10	14	15	14	15	14	374.5	374.3	378.7	378.7	379.0	379.0	378.9	378.9	379.3	379.3	379.9	379.9
RSA1090CRD	72788	72789	Roadway	30		24	28	27	31	35	378.1	378.1	378.7	378.7	379.0	379.0	378.9	378.9	379.3	379.3	379.9	379.9
RSA1090D	72787	72788	Natural	386	10	23	25	25	25	27	374.7	374.4	378.7	378.7	379.0	379.0	379.0	378.9	379.4	379.3	379.9	379.9
RSA1090E1	72786	72787	24" CMP Culvert	40	10	7	8	7	7	7	375.1	374.7	378.7	378.7	379.0	379.0	379.0	379.0	379.4	379.4	379.9	379.9
RSA1090E2	72786	72787	24" CMP Culvert	40	10	7	8	7	7	7	375.2	374.7	378.7	378.7	379.0	379.0	379.0	379.0	379.4	379.4	379.9	379.9
RSA1090E3	72786	72787	24" CMP Culvert	40	10	7	8	7	7	7	375.0	374.7	378.7	378.7	379.0	379.0	379.0	379.0	379.4	379.4	379.9	379.9
RSA1090ERD	72786	72787	Roadway	40		19	25	23	28	27	377.9	377.9	378.7	378.7	379.0	379.0	379.0	379.0	379.4	379.4	379.9	379.9
RSA1090F	72785	72786	Natural	772	10	26	35	27	43	42	375.1	375.0	378.7	378.7	379.0	379.0	379.0	379.0	379.4	379.4	379.9	379.9
RSA1090G1	72784	72785	36" CMP Culvert	91	10	14	18	14	25	26	375.0	375.1	378.8	378.7	379.1	379.0	379.0	379.0	379.4	379.4	379.9	379.9
RSA1090G2	72784	72785	36" CMP Culvert	91	10	14	18	14	25	26	375.1	375.1	378.8	378.7	379.1	379.0	379.0	379.0	379.4	379.4	379.9	379.9
RSA1090GRD	72784	72785	Roadway	91		0	0	0	0	0	381.0	380.9	378.7	378.7	379.0	379.0	379.0	379.0	379.4	379.4	379.9	379.9
RSA1100A	72783	72784	Natural	19	10	14	16	16	16	17	376.0	375.0	378.8	378.8	379.1	379.1	379.0	379.0	379.4	379.4	379.9	379.9

APPENDIX B
TABLE B-3
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM UNDER EXISTING LAND USE CONDITIONS

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Peak Flow (cfs) Existing Land Use Conditions					Invert Elevation (ft)		Water Surface Elevation under Existing Land Use Conditions (ft)									
													10-Year		25-Year Summer		25-Year Winter		50-Year		100-Year	
	US	DS				10-Year	25-Year-S	25-Year-W	50-Year	100-Year	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS
RSA1100B.1	72782	72783	24" x 42" CMP Culvert	858	10	13	15	15	16	17	376.5	376.0	379.0	378.8	379.3	379.1	379.4	379.0	379.6	379.4	380.1	379.9
RSA1100BRD	72782	72783	Roadway	800		0	0	0	0	1	380.0	380.0	378.8	378.8	379.1	379.1	379.0	379.0	379.4	379.4	380.1	380.0
RSA1100C	72781	72782	Natural	9	10	13	15	15	16	17	376.5	376.5	379.1	379.0	379.4	379.3	379.4	379.4	379.6	379.6	380.1	380.1
RSA1100D.1	72780	72781	30" CSP Culvert	24	10	13	15	15	16	17	376.5	376.5	379.1	379.1	379.4	379.4	379.5	379.4	379.7	379.6	380.2	380.1
RSA1100DRD	72780	72781	Roadway	24		0	0	0	0	0	380.2	380.2	379.1	379.1	379.4	379.4	379.4	379.4	379.6	379.6	380.2	380.2
RSA1100E	72793	72780	Natural	133	10	12	14	14	15	16	376.6	376.5	379.1	379.1	379.4	379.4	379.5	379.5	379.7	379.7	380.2	380.2
RSA1100F.1	72792	72793	30" CSP Culvert	30	10	13	13	14	15	16	376.7	376.6	379.2	379.1	379.6	379.4	379.6	379.5	379.8	379.7	380.2	380.2
RSA1100FRD	72792	72793	Roadway	30		0	0	0	0	11	380.0	380.0	379.1	379.1	379.4	379.4	379.5	379.5	379.7	379.7	380.2	380.2
RSA1100G	72779	72792	Natural	135	10	13	14	14	16	16	376.8	376.7	379.2	379.2	379.6	379.6	379.6	379.6	379.8	379.8	380.2	380.2
RSA1100K	72798	72779	Natural	740	10	6	9	6	19	23	376.9	376.8	379.2	379.2	379.6	379.6	379.6	379.6	379.8	379.8	380.2	380.2
RSA1100L.1	72102	72798	36" CMP Culvert	292	10	12	19	12	34	42	378.2	376.9	379.8	379.2	380.4	379.6	379.9	379.6	382.4	379.8	383.9	380.2
RSA1100LRD	72102	72798	Roadway	292		0	0	0	0	0	413.5	413.5	379.2	379.2	379.6	379.6	379.6	379.6	379.8	379.8	380.2	380.2
RSA1100H	72778	72779	Natural	50	10	13	20	14	20	29	376.7	376.8	379.2	379.2	379.6	379.6	379.6	379.6	379.8	379.8	380.2	380.2
RSA1100I.1	72777	72778	24" CMP Culvert	70	25	15	21	15	22	22	376.9	376.7	380.3	379.2	381.8	379.6	380.7	379.6	382.3	379.8	382.5	380.2
RSA1100IRD	72777	72778	Roadway	70		0	0	0	0	10	382.3	382.3	379.2	379.2	379.6	379.6	379.6	379.6	382.3	382.3	382.5	382.4
RSA1100J	72776	72777	Natural	180	10	15	23	16	32	35	377.2	376.9	380.3	380.3	381.8	381.8	380.7	380.7	382.3	382.3	382.5	382.5
RSA1110A1	72103	72776	30" CSP Culvert	280	25	8	13	8	19	17	377.6	377.2	380.5	380.3	382.1	381.8	380.8	380.7	382.3	382.3	382.5	382.5
RSA1110A2	72103	72776	30" CSP Culvert	280	25	8	13	8	19	17	377.6	377.2	380.5	380.3	382.1	381.8	380.8	380.7	382.3	382.3	382.5	382.5
RSA1110ARD	72103	72776	Roadway	280		0	0	0	12	28	382.0	382.0	380.3	380.3	382.1	382.0	380.7	380.7	382.3	382.3	382.5	382.5
RSA1060K	71208	72740	Natural	800	10	25	27	28	29	26	371.6	366.7	372.3	370.2	372.3	370.1	372.3	370.3	372.3	370.6	372.3	371.1
RSA1060L	71207	71208	24" CMP Culvert	40	10	8	9	8	8	8	371.6	371.6	373.5	372.3	373.4	372.3	373.6	372.3	373.7	372.3	373.8	372.3
RSA1060M	71210	71207	Natural	550	10	10	11	9	9	8	370.8	371.6	373.5	373.5	373.4	373.4	373.6	373.6	373.7	373.7	373.8	373.8
RSA1060N.1	72754	72739	36" CMP Culvert	25	10	20	21	22	25	27	368.9	368.4	372.0	371.8	371.9	371.7	372.2	372.0	372.5	372.2	373.0	372.6
RSA1060NRD	72754	72739	Roadway	25		0	0	0	0	0	373.1	373.0	371.8	371.8	371.7	371.7	372.0	372.0	372.2	372.2	372.6	372.6
RSA1060O	72753	72754	Natural	320	10	21	21	22	24	26	371.4	368.9	372.7	372.0	372.7	371.9	372.7	372.2	372.8	372.5	373.0	373.0
RSA1060P.1	72752	72753	26" x 42" CMP Culvert	40	10	21	21	22	24	26	371.6	371.4	373.4	372.7	373.3	372.7	373.4	372.7	373.5	372.8	373.6	373.0
RSA1060PRD	72752	72753	Roadway	40		0	0	0	0	0	374.9	374.9	372.7	372.7	372.7	372.7	372.7	372.7	372.8	372.8	373.0	373.0
RSA1060Q	72751	72752	Natural	330	10	21	21	22	25	27	371.2	371.6	373.5	373.4	373.4	373.3	373.5	373.4	373.6	373.5	373.7	373.6
RSA1060R.1	72750	72751	36" CMP Culvert	40	10	22	22	22	26	29	371.5	371.2	373.9	373.5	373.9	373.4	373.9	373.5	374.1	373.6	374.3	373.7
RSA1060RRD	72750	72751	Roadway	40		0	0	0	0	0	375.4	375.4	373.5	373.5	373.4	373.4	373.5	373.5	373.6	373.6	373.7	373.7
RSA1060T	71209	72750	Natural	270	10	22	22	22	26	29	371.5	371.5	374.0	373.9	374.0	373.9	374.0	373.9	374.2	374.1	374.3	374.3

APPENDIX B
TABLE B-3
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM UNDER EXISTING LAND USE CONDITIONS

Segment ID	Node ID		Segment Size/Type	Segment Length	Design Storm	Peak Flow (cfs) Existing Land Use Conditions					Invert Elevation (ft)		Water Surface Elevation under Existing Land Use Conditions (ft)									
													10-Year		25-Year Summer		25-Year Winter		50-Year		100-Year	
	US	DS		(ft)		10-Year	25-Year-S	25-Year-W	50-Year	100-Year	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS
RSA1160I.1	59020	72726	60" CMP Culvert	1081	10	37	52	33	78	92	380.8	379.5	384.3	383.9	384.8	384.1	384.6	384.2	386.9	384.6	388.2	385.3
RSA1160IRD	59020	72726	Roadway	1081		0	0	0	0	0	388.8	393.0	384.3	384.3	384.8	384.8	384.6	384.6	386.9	386.9	388.2	388.2
RSA1210A.1	59021	59020	54" CSP Culvert	560	10	38	52	34	84	92	381.2	380.8	384.6	384.3	385.2	384.8	384.8	384.6	387.9	386.9	389.7	388.2
RSA1210ARD	59021	59020	Roadway	560		0	0	0	0	0	390.6	388.8	384.3	384.3	384.8	384.8	384.6	384.6	386.9	386.9	388.2	388.2
RSA1210B.1	59112	59021	48" CSP Culvert	1506	10	12	18	11	28	36	382.3	381.2	384.7	384.6	385.5	385.2	384.9	384.8	388.5	387.9	390.0	389.7
RSA1210BRD	59112	59021	Roadway	1506		0	0	0	0	0	390.0	390.6	384.7	384.7	385.5	385.5	384.9	384.9	388.5	388.5	390.0	390.0
RSA1210C.1	85032	59112	36" CSP Culvert	33	10	13	19	12	28	40	382.8	382.8	384.8	384.7	385.6	385.5	384.9	384.9	388.5	388.5	390.1	390.0
RSA1210CRD	85032	59112	Roadway	33		0	0	0	0	4	390.0	390.0	384.7	384.7	385.5	385.5	384.9	384.9	388.5	388.5	390.1	390.1
Flat Creek																						
RSFC010A	99329	70197	Natural	850	10	57	46	57	66	81	364.6	364.3	368.0	367.8	368.0	367.8	368.0	367.8	368.1	367.8	368.2	367.8
RSFC010B1	99330	99329	41' x 60" CMP Culvert	92	10	28	23	28	32	40	365.0	364.7	368.2	368.0	368.1	368.0	368.2	368.0	368.4	368.1	368.6	368.2
RSFC010B2	99330	99329	41' x 60" CMP Culvert	92	10	29	23	29	34	40	365.4	364.6	368.2	368.0	368.1	368.0	368.2	368.0	368.4	368.1	368.6	368.2
RSFC010BRD	99330	99329	Roadway	92		0	0	0	0	0	371.5	371.5	368.0	368.0	368.0	368.0	368.0	368.0	368.1	368.1	368.2	368.2
RSFC020A	72768	99330	Natural	750	10	57	46	57	66	81	365.3	364.7	368.4	368.2	368.2	368.1	368.4	368.2	368.5	368.4	368.8	368.6
RSFC020B1	72767	72768	36" CSP Culvert	72	10	28	23	28	33	41	366.1	365.3	368.7	368.4	368.4	368.2	368.7	368.4	369.0	368.5	369.5	368.8
RSFC020B2	72767	72768	36" CSP Culvert	72	10	29	23	29	33	41	366.3	365.3	368.7	368.4	368.4	368.2	368.7	368.4	369.0	368.5	369.5	368.8
RSFC020BRD	72767	72768	Roadway	72		0	0	0	0	0	372.0	372.0	368.4	368.4	368.2	368.2	368.4	368.4	368.5	368.5	368.8	368.8
RSFC020C	72766	72767	Natural	200	10	41	32	42	48	58	366.5	366.1	369.0	368.7	368.7	368.4	369.0	368.7	369.2	369.0	369.7	369.5
RSFC020D1	72765	72766	36" CSP Culvert	68	10	18	14	18	22	28	367.2	367.0	369.2	369.0	368.9	368.7	369.2	369.0	369.5	369.2	370.0	369.7
RSFC020D2	72765	72766	36" CSP Culvert	68	10	23	18	23	26	30	366.7	366.5	369.2	369.0	368.9	368.7	369.2	369.0	369.5	369.2	370.0	369.7
RSFC020Da	76952	72765	Natural	233	10	41	32	41	48	58	366.7	366.7	369.3	369.2	368.9	368.9	369.3	369.2	369.6	369.5	370.1	370.0
RSFC020Db.	76953	76952	50" x 76" CMP Culvert	63	10	41	32	41	48	58	366.8	366.7	369.5	369.3	369.1	368.9	369.5	369.3	369.8	369.6	370.3	370.1
RSFC020DbR	76953	76952	Roadway	63		0	0	0	0	0	373.9	374.0	369.5	369.5	369.1	369.1	369.5	369.5	369.8	369.8	370.3	370.3
RSFC020DRD	72765	72766	Roadway	68		0	0	0	0	0	372.2	372.2	369.0	369.0	368.7	368.7	369.0	369.0	369.2	369.2	369.7	369.7
RSFC020E	72764	76953	Natural	809	10	41	32	41	47	58	367.7	366.8	369.7	369.5	369.4	369.1	369.7	369.5	370.0	369.8	370.4	370.3
RSFC020F1	72763	72764	36" x 48" CMP Culvert	65	10	14	12	14	16	19	367.2	367.7	369.9	369.7	369.5	369.4	369.9	369.7	370.2	370.0	370.7	370.4
RSFC020F2	72763	72764	36" x 48" CMP Culvert	65	10	12	9	12	15	20	367.2	368.2	369.9	369.7	369.5	369.4	369.9	369.7	370.2	370.0	370.7	370.4

APPENDIX B
TABLE B-3
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM UNDER EXISTING LAND USE CONDITIONS

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Peak Flow (cfs) Existing Land Use Conditions					Invert Elevation (ft)		Water Surface Elevation under Existing Land Use Conditions (ft)									
													10-Year		25-Year Summer		25-Year Winter		50-Year		100-Year	
	US	DS				10-Year	25-Year-S	25-Year-W	50-Year	100-Year	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS
RSFC020F3	72763	72764	36" x 48" CMP Culvert	65	10	14	11	14	16	19	367.2	367.9	369.9	369.7	369.5	369.4	369.9	369.7	370.2	370.0	370.7	370.4
RSFC020FRD	72763	72764	Roadway	65		0	0	0	0	0	373.1	373.1	369.7	369.7	369.4	369.4	369.7	369.7	370.0	370.0	370.4	370.4
RSFC020G	72762	72763	Natural	800	10	42	33	41	52	64	368.2	367.2	370.1	369.9	369.8	369.5	370.1	369.9	370.3	370.2	370.9	370.7
RSFC030A1	72761	72762	82" x 84" CSP Culvert	55	10	22	17	21	29	36	368.5	368.2	370.2	370.1	369.9	369.8	370.2	370.1	370.4	370.3	370.9	370.9
RSFC030A2	72761	72762	82" x 84" CSP Culvert	55	10	22	17	21	29	36	368.5	368.2	370.2	370.1	369.9	369.8	370.2	370.1	370.4	370.3	370.9	370.9
RSFC030ARD	72761	72762	Roadway	55		0	0	0	0	0	374.7	374.7	370.1	370.1	369.8	369.8	370.1	370.1	370.3	370.3	370.9	370.9
RSFC030B	72244	72761	Natural	1456	10	18	16	20	22	26	370.4	368.5	371.0	370.2	371.2	369.9	371.3	370.2	371.3	370.4	371.4	370.9
RSFC050A	75660	72244	Natural	1294	10	19	17	20	24	28	372.2	370.4	373.3	371.0	373.1	371.2	373.1	371.3	373.2	371.3	373.3	371.4
RSFC050B1	75659	75660	24" CSP Culvert	61	10	6	6	7	8	10	372.5	372.2	373.6	373.3	373.5	373.1	373.7	373.1	373.8	373.3	374.0	373.3
RSFC050B2	75659	75660	24" CSP Culvert	61	10	7	6	7	9	10	372.5	372.2	373.6	373.3	373.5	373.1	373.7	373.1	373.8	373.2	374.0	373.3
RSFC050B3	75659	75660	24" CSP Culvert	61	10	6	6	6	8	10	372.5	372.3	373.6	373.3	373.5	373.1	373.7	373.2	373.8	373.3	374.0	373.4
RSFC050BRD	75659	75660	Roadway	61		0	0	0	0	0	376.9	377.0	373.6	373.6	373.5	373.5	373.7	373.7	373.8	373.8	374.0	374.0
RSFC050C	78673	75659	Natural	1056	10	13	11	13	14	17	375.9	372.5	376.6	373.6	376.6	373.5	376.7	373.7	376.7	373.8	376.7	374.0
RSFC050D1	75654	78673	12" CSP Culvert	25	10	6	5	6	6	7	376.1	375.9	378.4	376.6	378.2	376.6	378.5	376.7	378.6	376.7	379.0	376.7
RSFC050D2	75654	78673	12" CSP Culvert	25	10	3	3	4	4	5	377.2	377.0	378.4	377.8	378.2	377.7	378.5	377.9	378.6	377.9	379.0	377.9
RSFC050D3	75654	78673	12" CSP Culvert	25	10	3	3	4	4	5	377.2	377.0	378.4	377.8	378.2	377.7	378.5	377.8	378.6	377.9	379.0	377.9
RSFC050DRD	75654	78673	Roadway	25		0	0	0	0	0	379.2	379.2	376.6	376.6	376.6	376.6	376.7	376.7	376.7	376.7	376.7	376.7
RSFC050E	72799	75654	Natural	1016	10	15	15	15	21	24	374.9	376.1	378.4	378.4	378.2	378.2	378.5	378.5	378.6	378.6	379.0	379.0
RSFC060A.1	72800	72799	30" CSP Culvert	56	10	12	16	10	15	17	375.6	374.9	378.5	378.4	378.3	378.2	378.6	378.5	378.7	378.6	379.1	379.0
RSFC060ARD	72800	72799	Roadway	56		0	0	0	0	0	379.8	379.8	378.4	378.4	378.2	378.2	378.5	378.5	378.6	378.6	379.0	379.0
RSFC060B	72795	72800	Natural	850	10	6	6	4	6	8	376.7	375.6	378.5	378.5	378.3	378.3	378.6	378.6	378.7	378.7	379.1	379.1
RSFC070A.1	72794	72795	30" CSP Culvert	45	5	8	7	6	15	18	377.2	376.7	378.5	378.5	378.3	378.3	378.6	378.6	378.8	378.7	379.1	379.1
RSFC070ARD	72794	72795	Roadway	45		0	0	0	0	0	381.0	381.0	378.5	378.5	378.3	378.3	378.6	378.6	378.7	378.7	379.1	379.1
Spring Creek																						
OFALL#1	72014	76427	Natural	200	25	149	151	158	191	225	358.4	356.5	362.8	362.8	362.8	362.8	362.8	362.8	362.8	362.8	362.8	362.8
RSSC010A1	72013	72014	48" x 72" CMP Culvert	51	25	75	75	79	96	112	358.7	358.4	363.5	362.8	363.5	362.8	363.5	362.8	363.9	362.8	364.3	362.8
RSSC010A2	72013	72014	48" x 72" CMP Culvert	51	25	75	75	79	96	112	358.8	358.5	363.5	362.8	363.5	362.8	363.5	362.8	363.9	362.8	364.3	362.8

APPENDIX B
TABLE B-3
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM UNDER EXISTING LAND USE CONDITIONS

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Peak Flow (cfs) Existing Land Use Conditions					Invert Elevation (ft)		Water Surface Elevation under Existing Land Use Conditions (ft)									
													10-Year		25-Year Summer		25-Year Winter		50-Year		100-Year	
	US	DS				10-Year	25-Year-S	25-Year-W	50-Year	100-Year	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS
RSSC010ARD	72013	72014	Roadway	51		0	0	0	0	0	365.0	365.0	362.8	362.8	362.8	362.8	362.8	362.8	362.8	362.8	362.8	362.8
RSSC010B	85033	72013	Natural	150	25	139	147	148	179	210	358.9	358.7	363.5	363.5	363.5	363.5	363.6	363.5	363.9	363.9	364.3	364.3
RSSC010D	79483	85033	Natural	392	25	139	146	148	179	210	358.9	358.9	363.6	363.6	363.6	363.6	363.7	363.7	364.1	364.0	364.5	364.4
RSSC010Da1	79482	79483	68" x 144" Box Culvert	38	25	69	72	74	89	104	359.0	359.0	363.6	363.6	363.7	363.6	363.7	363.7	364.1	364.1	364.5	364.5
RSSC010Da2	79482	79483	68" x 144" Box Culvert	38	25	70	73	75	90	105	358.9	358.9	363.6	363.6	363.7	363.6	363.7	363.7	364.1	364.1	364.5	364.5
RSSC010DaR	79482	79483	Roadway	38		0	0	0	0	0	367.1	367.1	363.6	363.6	363.6	363.6	363.7	363.7	364.1	364.1	364.5	364.5
RSSC010Db	72012	79482	Natural	1620	25	139	145	150	186	214	360.8	358.9	364.1	363.6	364.2	363.7	364.2	363.7	364.6	364.1	365.0	364.5
RSSC010E.1	72011	72012	Natural	13	25	141	148	153	193	224	360.5	360.8	364.1	364.1	364.2	364.2	364.2	364.2	364.6	364.6	365.0	365.0
RSSC010ERD	72011	72012	Roadway	13		0	0	0	0	0	368.3	368.3	364.1	364.1	364.2	364.2	364.2	364.2	364.6	364.6	365.0	365.0
RSSC035A	76560	72011	42" CSP Culvert	127	10	14	18	12	29	34	360.9	360.5	364.2	364.1	364.2	364.2	364.3	364.2	364.7	364.6	365.1	365.0
RSSC035ARD	76560	72011	Roadway	127		0	0	0	0	0	370.0	370.0	364.1	364.1	364.2	364.2	364.2	364.2	364.6	364.6	365.0	365.0
RSSC010F	72010	72011	Natural	100	25	132	138	144	182	210	361.1	360.6	364.1	364.1	364.2	364.2	364.2	364.2	364.6	364.6	365.0	365.0
RSSC010G.1	72009	72010	Natural	12	25	132	138	144	183	211	361.1	361.1	364.3	364.1	364.4	364.2	364.4	364.2	364.8	364.6	365.2	365.0
RSSC010GRD	72009	72010	Roadway	12		0	0	0			368.0	368.0										
RSSC010H	72008	72009	Natural	300	25	133	138	144	185	213	361.7	361.1	364.6	364.3	364.7	364.4	364.7	364.4	365.1	364.8	365.4	365.2
RSSC040D	72033	72008	Natural	800	10	12	17	11	23	26	364.2	361.7	365.1	364.6	365.3	364.7	365.1	364.7	365.5	365.1	365.6	365.4
RSSC040E.1	72032	72033	40" x 54" CMP Culvert	90	10	12	17	11	24	28	365.1	364.2	366.3	365.1	366.6	365.3	366.3	365.1	367.0	365.5	367.2	365.6
RSSC040ERD	72032	72033	Roadway	33		0	0	0	0	0	370.2	370.2	365.1	365.1	365.3	365.3	365.1	365.1	365.5	365.5	365.6	365.6
RSSC040F	72031	72032	Natural	530	10	12	17	11	27	32	365.9	365.1	367.1	366.3	367.3	366.6	367.0	366.3	367.6	367.0	367.8	367.2
RSSC050A1	72030	72031	48" CMP Culvert	50	10	6	9	6	15	18	363.4	363.9	367.1	367.1	367.3	367.3	367.0	367.0	367.7	367.6	367.8	367.8
RSSC050A2	72030	72031	48" CMP Culvert	50	10	6	9	5	15	17	363.6	364.0	367.1	367.1	367.3	367.3	367.0	367.0	367.7	367.6	367.8	367.8
RSSC050ARD	72030	72031	Roadway	33		0	0	0	0	0	373.5	373.5	367.1	367.1	367.3	367.3	367.0	367.0	367.6	367.6	367.8	367.8
RSSC040A	72007	72008	Natural	120	25	119	123	130	163	188	362.4	361.7	365.0	364.6	365.0	364.7	365.1	364.7	365.4	365.1	365.7	365.4
RSSC040B1	72006	72007	30" CSP Culvert	12	25	55	55	55	55	55	362.6	362.5	367.0	365.0	367.0	365.0	367.0	365.1	367.2	365.4	367.4	365.7
RSSC040B2	72006	72007	30" CSP Culvert	12	25	55	55	55	56	56	362.4	362.4	367.0	365.0	367.0	365.0	367.0	365.1	367.2	365.4	367.4	365.7
RSSC040BRD	72006	72007	Roadway	12		9	13	20	56	86	366.8	366.8	367.0	366.9	367.0	366.9	367.0	367.0	367.2	367.2	367.4	367.3
RSSC040C	72005	72006	Natural	800	25	119	123	130	164	188	363.5	362.4	367.3	367.0	367.4	367.0	367.4	367.0	367.7	367.2	367.9	367.4
RSSC060A.1	79470	72005	42" CSP Culvert	383	10	53	72	49	86	86	365.1	363.5	368.6	367.3	369.4	367.4	368.6	367.4	371.1	367.7	371.2	367.9
RSSC060ARD	79470	72005	Roadway	383		0	0	0	0	4	371.1	370.4	367.3	367.3	367.4	367.4	367.4	367.4	371.1	370.4	371.2	370.4
RSSC060B.1	76587	79470	54" CSP Culvert	2906	10	31	41	29	47	44	368.2	365.1	370.5	368.6	371.3	369.4	370.4	368.6	373.1	371.1	372.8	371.2
RSSC060BRD	76587	79470	Roadway	2906		0	0	0	0	0	374.4	371.1	368.6	368.6	369.4	369.4	368.6	368.6	372.0	371.1	372.1	371.2

APPENDIX B
TABLE B-3
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM UNDER EXISTING LAND USE CONDITIONS

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Peak Flow (cfs) Existing Land Use Conditions					Invert Elevation (ft)		Water Surface Elevation under Existing Land Use Conditions (ft)									
													10-Year		25-Year Summer		25-Year Winter		50-Year		100-Year	
	US	DS				10-Year	25-Year-S	25-Year-W	50-Year	100-Year	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS
RSSC070A.1	76569	76587	48" CMP Culvert	919	10	20	29	19	41	51	369.2	368.4	371.3	370.5	372.0	371.3	371.3	370.4	373.6	373.1	373.5	372.8
RSSC070ARD	76569	76587	Roadway	919		0	0	0	0	0	375.2	374.4	370.5	370.5	371.3	371.3	370.4	370.4	373.1	373.1	372.8	372.8
RSSC080A.1	76564	76569	36" CSP Culvert	69	10	20	29	19	44	51	369.3	369.2	371.6	371.3	372.3	372.0	371.5	371.3	374.0	373.6	374.3	373.5
RSSC080ARD	76564	76569	Roadway	69		0	0	0	0	0	375.3	375.2	371.3	371.3	372.0	372.0	371.3	371.3	373.6	373.6	373.5	373.5
RSSC090A1	72004	72005	48" x 84" Box Culvert	92	10	40	40	43	52	62	364.4	364.1	367.4	367.3	367.4	367.4	367.5	367.4	367.8	367.7	368.0	367.9
RSSC090A2	72004	72005	48" x 84" Box Culvert	92	10	40	40	43	52	62	364.4	364.1	367.4	367.3	367.4	367.4	367.5	367.4	367.8	367.7	368.0	367.9
RSSC090ARD	72004	72005	Roadway	92		0	0	0	0	0	370.4	370.4	367.3	367.3	367.4	367.4	367.4	367.4	367.7	367.7	367.9	367.9
RSSC090B	72003	72004	Natural	2880	10	61	62	65	78	93	367.1	364.1	370.2	367.4	370.3	367.4	370.4	367.5	370.8	367.8	371.1	368.0
RSSC100A1	72002	72003	48" CMP Culvert	85	10	32	32	35	45	52	367.0	367.1	370.5	370.2	370.6	370.3	370.7	370.4	371.2	370.8	371.6	371.1
RSSC100A2	72002	72003	48" CMP Culvert	85	10	32	32	35	45	52	367.0	367.1	370.5	370.2	370.6	370.3	370.7	370.4	371.2	370.8	371.6	371.1
RSSC100ARD	72002	72003	Roadway	85		0	0	0	0	0	372.4	372.4	370.2	370.2	370.3	370.3	370.4	370.4	370.8	370.8	371.1	371.1
RSSC100B	75387	72002	Natural	1238	10	54	59	58	80	90	366.9	367.0	370.6	370.5	370.6	370.6	370.7	370.7	371.2	371.2	371.7	371.6
RSSC100C.1	75386	75387	48" x 96" Box Culvert	92	10	59	71	61	97	112	366.9	366.9	370.6	370.6	370.7	370.6	370.8	370.7	371.3	371.2	371.8	371.7
RSSC100CRD	75386	75387	Roadway	92		0	0	0	0	0	373.7	373.7	370.6	370.6	370.7	370.7	370.8	370.8	371.3	371.3	371.8	371.8
RSSC100D	72770	75386	Natural	371	10	61	75	62	102	118	367.5	366.9	370.6	370.6	370.7	370.7	370.8	370.8	371.3	371.3	371.8	371.8
RSSC110A	72001	72770	Natural	1700	10	56	84	54	114	131	367.9	367.5	370.7	370.6	370.8	370.7	370.9	370.8	371.3	371.3	371.8	371.8
RSSC110B.1	72000	72001	72" CMP Culvert	61	10	65	94	60	145	169	368.2	367.9	371.3	370.7	371.9	370.8	371.4	370.9	372.9	371.3	373.4	371.8
RSSC110BRD	72000	72001	Roadway	61		0	0	0	0	0	378.2	378.2	370.7	370.7	370.8	370.8	370.9	370.9	371.3	371.3	371.8	371.8
Willamette Overflow																						
RSWO010A	99820	72088	Natural	1050	25	97	76	109	110	153	362.6	362.4	370.7	370.7	370.7	370.7	370.7	370.7	370.7	370.7	370.7	370.7
RSWO020A.1	99827	99820	36" CSP Culvert	675	5	31	46	32	47	48	367.7	365.8	372.7	370.7	375.1	370.7	372.8	370.7	375.4	370.7	375.5	370.7
RSWO020ARD	99827	99820	Roadway	675		0	1	0	11	21	375.0	375.0	372.7	372.7	375.1	375.0	372.8	372.8	375.4	375.1	375.5	375.2
RSWO010B	72086	99820	Natural	1950	10	85	56	91	94	105	364.9	362.6	370.8	370.7	370.7	370.7	370.8	370.7	370.8	370.7	370.8	370.7
RSWO040A1	72085	72086	72" CMP Culvert	61	10	7	3	8	9	11	370.6	369.3	371.1	370.8	370.9	370.7	371.2	370.8	371.2	370.8	371.3	370.8
RSWO040A2	72085	72086	72" CMP Culvert	61	10	5	2	7	7	9	370.6	369.5	371.1	370.8	370.9	370.7	371.2	370.8	371.2	370.8	371.3	370.8
RSWO040A3	72085	72086	60" CMP Culvert	61	10	73	52	76	78	84	366.6	364.9	371.1	370.8	370.9	370.7	371.2	370.8	371.2	370.8	371.3	370.8
RSWO040ARD	72085	72086	Roadway	61		0	0	0	0	0	380.1	380.1	370.8	370.8	370.7	370.7	370.8	370.8	370.8	370.8	370.8	370.8
RSWO040B	73907	72085	Natural	570	10	85	56	91	94	105	368.1	366.6	371.2	371.1	371.0	370.9	371.3	371.2	371.3	371.2	371.4	371.3
RSWO040C.1	73910	73907	60" CMP Culvert	760	10	83	56	88	92	103	370.8	368.1	375.1	371.2	373.9	371.0	375.5	371.3	376.0	371.3	376.8	371.4

APPENDIX B
TABLE B-3
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM UNDER EXISTING LAND USE CONDITIONS

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Peak Flow (cfs) Existing Land Use Conditions					Invert Elevation (ft)		Water Surface Elevation under Existing Land Use Conditions (ft)									
													10-Year		25-Year Summer		25-Year Winter		50-Year		100-Year	
	US	DS				10-Year	25-Year-S	25-Year-W	50-Year	100-Year	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS
RSWO040CRD	73910	73907	Roadway	760		0	0	0	0	0	382.0	382.0	371.2	371.2	371.0	371.0	371.3	371.3	371.3	371.3	371.4	371.4
RSWO045A	72084	73910	Natural	570	10	81	56	85	90	100	371.5	370.8	375.2	375.1	374.1	373.9	375.5	375.5	376.0	376.0	376.9	376.8
RSWO045B1	72083	72084	72" CMP Culvert	68	10	42	30	43	47	51	371.5	371.5	375.3	375.2	374.3	374.1	375.6	375.5	376.1	376.0	376.9	376.9
RSWO045B2	72083	72084	72" CMP Culvert	68	10	40	27	42	45	51	371.8	371.6	375.3	375.2	374.3	374.1	375.6	375.5	376.1	376.0	376.9	376.9
RSWO045BRD	72083	72084	Roadway	68		0	0	0	0	0	380.5	380.5	375.2	375.2	374.1	374.1	375.5	375.5	376.0	376.0	376.9	376.9
RSWO045C	72082	72083	Natural	850	10	83	59	87	95	105	372.2	371.5	375.7	375.3	374.9	374.3	375.9	375.6	376.3	376.1	377.1	376.9
RSWO050A1	72081	72082	72" CSP Culvert	46	10	41	29	43	48	53	372.2	372.4	375.8	375.7	375.0	374.9	376.0	375.9	376.4	376.3	377.1	377.1
RSWO050A2	72081	72082	72" CSP Culvert	46	10	43	31	45	50	55	372.4	372.2	375.8	375.7	375.0	374.9	376.0	375.9	376.4	376.3	377.1	377.1
RSWO050ARD	72081	72082	Roadway	46		0	0	0	0	0	384.7	384.7	375.7	375.7	374.9	374.9	375.9	375.9	376.3	376.3	377.1	377.1
RSWO050B	70615	72081	Natural	1353	10	83	62	86	98	109	375.2	372.2	377.4	375.8	377.1	375.0	377.4	376.0	377.6	376.4	377.7	377.1
RSWO050C	72080	70615	Natural	141	10	83	63	86	98	109	375.5	375.2	378.2	377.4	377.9	377.1	378.2	377.4	378.4	377.6	378.5	377.7
RSWO060A	74014	72080	Natural	693	10	83	65	86	98	109	370.5	375.5	378.2	378.2	377.9	377.9	378.3	378.2	378.4	378.4	378.5	378.5
RSWO060B	74013	74014	Natural	420	10	85	75	88	100	111	369.2	370.5	378.2	378.2	377.9	377.9	378.3	378.3	378.4	378.4	378.5	378.5
RSWO070A	74009	74013	Natural	288	10	83	79	83	98	107	377.0	371.4	378.5	378.2	378.5	377.9	378.5	378.3	378.7	378.4	378.8	378.5
RSWO070B1	74008	74009	48" CSP Culvert	501	10	29	28	29	34	37	378.3	376.8	380.2	378.5	380.1	378.5	380.2	378.5	380.4	378.7	380.5	378.8
RSWO070B2	74008	74009	48" CSP Culvert	501	10	27	25	27	32	35	378.2	377.0	380.2	378.5	380.1	378.5	380.2	378.5	380.4	378.7	380.5	378.8
RSWO070B3	74008	74009	48" CSP Culvert	501	10	28	26	28	33	35	378.1	377.0	380.2	378.6	380.1	378.5	380.2	378.6	380.4	378.7	380.5	378.8
RSWO070BRD	74008	74009	Roadway	501		0	0	0	0	0	384.1	384.1	378.5	378.5	378.5	378.5	378.5	378.5	378.7	378.7	378.8	378.8
RSWO070C	74007	74008	Natural	826	10	83	80	83	98	107	378.9	378.1	381.1	380.2	381.1	380.1	381.1	380.2	381.3	380.4	381.4	380.5
RSWO070D.1	74006	74007	18" CMP Culvert	253	10	9	9	9	9	9	378.5	378.9	386.7	381.1	386.7	381.1	386.7	381.1	386.8	381.3	386.8	381.4
RSWO070DRD	74006	74007	Roadway	250		75	72	75	90	99	386.0	386.0	386.7	386.4	386.7	386.4	386.7	386.4	386.8	386.4	386.8	386.4
RSWO070E	74005	74006	Natural	296	10	83	80	83	98	107	378.3	378.5	386.7	386.7	386.7	386.7	386.7	386.7	386.8	386.8	386.8	386.8
RSWO080A.1	74004	74005	48" CSP Culvert	43	10	83	80	83	99	107	378.5	378.3	387.5	386.7	387.4	386.7	387.5	386.7	387.9	386.8	388.1	386.8
RSWO080ARD	74004	74005	Roadway	43		0	0	0	0	0	388.2	388.2	386.7	386.7	386.7	386.7	386.7	386.7	386.8	386.8	386.8	386.8
RSWO090A	78833	74004	Natural	197	10	69	71	69	83	88	377.2	378.5	387.5	387.5	387.4	387.4	387.5	387.5	387.9	387.9	388.1	388.1
RSWO090Aa	74003	78833	Natural	208	10	68	69	68	82	88	380.1	377.2	387.5	387.5	387.5	387.4	387.5	387.5	387.9	387.9	388.2	388.1
RSWO090B	75433	74003	Natural	153	10	68	83	68	82	87	380.6	380.1	387.6	387.5	387.5	387.5	387.6	387.5	388.0	387.9	388.3	388.2
RSWO090C	74001	75433	Natural	112	10	68	88	68	82	87	377.5	380.6	387.6	387.6	387.5	387.5	387.6	387.6	388.0	388.0	388.3	388.3
RSWO090D	74405	74001	Natural	251	10	67	99	67	82	87	379.3	377.5	387.6	387.6	387.5	387.5	387.6	387.6	388.0	388.0	388.3	388.3
RSWO090E.1	74406	74405	84" x 120" CMP Culvert	71	10	63	94	62	77	81	379.8	379.3	387.6	387.6	387.5	387.5	387.6	387.6	388.0	388.0	388.3	388.3
RSWO090ERD	74406	74405	Roadway	71		0	0	0	0	0	389.4	389.4	387.6	387.6	387.5	387.5	387.6	387.6	388.0	388.0	388.3	388.3
RSWO090F	76415	74406	Natural	146	10	63	95	62	76	80	380.0	379.8	387.6	387.6	387.5	387.5	387.6	387.6	388.0	388.0	388.3	388.3

APPENDIX B
TABLE B-3
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM UNDER EXISTING LAND USE CONDITIONS

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Peak Flow (cfs) Existing Land Use Conditions					Invert Elevation (ft)		Water Surface Elevation under Existing Land Use Conditions (ft)									
													10-Year		25-Year Summer		25-Year Winter		50-Year		100-Year	
	US	DS				10-Year	25-Year-S	25-Year-W	50-Year	100-Year	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS
RSWO090G.1	76414	76415	84" x 120" CMP Culvert	57	10	63	97	64	76	80	379.9	380.0	387.6	387.6	387.6	387.5	387.6	387.6	388.1	388.0	388.3	388.3
RSWO090GRD	76414	76415	Roadway	57		0	0	0	0	0	390.1	390.0	387.6	387.6	387.5	387.5	387.6	387.6	388.0	388.0	388.3	388.3
RSWO090H	58287	76414	Natural	116	10	62	98	66	76	80	380.5	379.9	387.6	387.6	387.6	387.6	387.6	387.6	388.1	388.1	388.3	388.3
RSWO110A.1	58310	58287	36" CSP Culvert	47	10	62	99	68	76	80	381.0	380.5	389.2	387.6	389.1	387.6	389.1	387.6	390.4	388.1	390.8	388.3
RSWO110ARD	58310	58287	Roadway	26		0	0	0	0	0	392.0	389.0	387.6	387.6	387.6	387.6	387.6	387.6	388.1	388.1	388.3	388.3
RSWO110B.1	58311	58310	54" CSP Culvert	387	10	62	99	68	64	63	376.5	374.8	389.7	389.2	389.8	389.1	389.7	389.1	390.4	390.4	390.9	390.8
RSWO110BRD	58311	58310	Roadway	388		0	0	0	59	76	389.8	389.8	389.2	389.2	389.1	389.1	389.1	389.1	390.4	390.4	390.9	390.8
RSWO110C.1	58315	58311	27" CSP Culvert	1155	10	5	7	6	7	7	379.9	376.5	389.6	389.7	389.6	389.8	389.6	389.7	390.4	390.4	390.9	390.9
RSWO110CRD	58315	58311	Roadway	1154		0	0	0	-49	-69	389.8	389.1	389.6	389.7	389.6	389.8	389.6	389.7	390.4	390.4	390.9	390.9
RSWO140	77703	58311	54" CSP Culvert	544	10	64	85	56	139	162	379.7	376.5	390.3	389.7	390.8	389.8	390.2	389.7	393.1	390.4	394.4	390.9

APPENDIX B
TABLE B-4
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM UNDER FUTURE LAND USE CONDITIONS WITH CIPs

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Invert Elevation (ft)		Peak Flow (cfs) Future Land Use Conditions					Water Surface Elevation under Future Land Use Conditions (ft)									
													10-Year		25-Year Summer		25-Year Winter		50-Year		100-Year	
	US	DS				US	DS	10-Year	25-Year-S	25-Year-W	50-Year	100-Year	US	DS	US	DS	US	DS	US	DS	US	DS
Spring Creek																						
OFALL#1	72014	76427	Natural	200	25	358.4	356.5	175	180	182	211	243	362.8	362.8	362.8	362.8	362.8	362.8	362.8	362.8	362.8	362.8
RSSC010A1	72013	72014	48" x 72" CMP Culvert	51	25	358.7	358.4	87	90	91	105	121	363.7	362.8	363.8	362.8	363.8	362.8	364.1	362.8	364.5	362.8
RSSC010A2	72013	72014	48" x 72" CMP Culvert	51	25	358.8	358.5	87	90	91	105	121	363.7	362.8	363.8	362.8	363.8	362.8	364.1	362.8	364.5	362.8
RSSC010ARD	72013	72014	Roadway	51		365.0	365.0	0	0	0	0	0	362.8	362.8	362.8	362.8	362.8	362.8	362.8	362.8	362.8	362.8
RSSC010B	85033	72013	Natural	150	25	358.9	358.7	163	175	172	199	229	363.7	363.7	363.8	363.8	363.8	363.8	364.1	364.1	364.5	364.5
RSSC010D	79483	85033	Natural	392	25	358.9	358.9	163	174	172	199	229	363.9	363.8	364.0	363.9	364.0	363.9	364.3	364.3	364.7	364.7
RSSC010Da1	79482	79483	68" x 144" Box Culvert	38	25	359.0	359.0	81	86	85	99	114	363.9	363.9	364.0	364.0	364.0	364.0	364.3	364.3	364.8	364.7
RSSC010Da2	79482	79483	68" x 144" Box Culvert	38	25	358.9	358.9	82	87	87	100	115	363.9	363.9	364.0	364.0	364.0	364.0	364.3	364.3	364.8	364.7
RSSC010DaR	79482	79483	Roadway	38		367.1	367.1	0	0	0	0	0	363.9	363.9	364.0	364.0	364.0	364.0	364.3	364.3	364.7	364.7
RSSC010Db	72012	79482	Natural	1620	25	360.8	358.9	166	173	174	202	231	364.4	363.9	364.5	364.0	364.5	364.0	364.8	364.3	365.2	364.8
RSSC010E.1	72011	72012	Natural	13	25	360.5	360.8	170	175	176	211	237	364.4	364.4	364.5	364.5	364.5	364.5	364.8	364.8	365.2	365.2
RSSC010ERD	72011	72012	Roadway	13		368.3	368.3	0	0	0	0	0	364.4	364.4	364.5	364.5	364.5	364.5	364.8	364.8	365.2	365.2
RSSC035A	76560	72011	42" CSP Culvert	127	10	360.9	360.5	14	18	13	29	35	364.5	364.4	364.6	364.5	364.6	364.5	364.9	364.8	365.3	365.2
RSSC035ARD	76560	72011	Roadway	127		370.0	370.0	0	0	0	0	0	364.4	364.4	364.5	364.5	364.5	364.5	364.8	364.8	365.2	365.2
RSSC010F	72010	72011	Natural	100	25	361.1	360.6	161	165	166	199	221	364.4	364.4	364.5	364.5	364.5	364.5	364.8	364.8	365.2	365.2
RSSC010G.1	72009	72010	Natural	12	25	361.1	361.1	162	166	167	200	222	364.6	364.4	364.7	364.5	364.7	364.5	365.0	364.8	365.4	365.2
RSSC010GRD	72009	72010	Roadway	12		368.0	368.0	0	0	0	0	0										
RSSC010H	72008	72009	Natural	300	25	361.7	361.1	163	167	167	201	224	364.9	364.6	365.0	364.7	365.0	364.7	365.3	365.0	365.6	365.4
RSSC040D	72033	72008	Natural	800	10	364.2	361.7	12	18	11	24	27	365.2	364.9	365.3	365.0	365.1	365.0	365.5	365.3	365.6	365.6
RSSC040E.1	72032	72033	40" x 54" CMP Culvert	90	10	365.1	364.2	13	18	12	25	29	366.4	365.2	366.7	365.3	366.3	365.1	367.1	365.5	367.3	365.6
RSSC040ERD	72032	72033	Roadway	33		370.2	370.2	0	0	0	0	0	365.2	365.2	365.3	365.3	365.1	365.1	365.5	365.5	365.6	365.6
RSSC040F	72031	72032	Natural	530	10	365.9	365.1	13	18	12	29	33	367.1	366.4	367.3	366.7	367.0	366.3	367.7	367.1	367.8	367.3
RSSC050A1	72030	72031	48" CMP Culvert	50	10	363.4	363.9	7	9	6	16	18	367.1	367.1	367.3	367.3	367.0	367.0	367.7	367.7	367.9	367.8
RSSC050A2	72030	72031	48" CMP Culvert	50	10	363.6	364.0	6	9	6	16	18	367.1	367.1	367.3	367.3	367.0	367.0	367.7	367.7	367.9	367.8
RSSC050ARD	72030	72031	Roadway	33		373.5	373.5	0	0	0	0	0	367.1	367.1	367.3	367.3	367.0	367.0	367.7	367.7	367.8	367.8
RSSC040A	72007	72008	Natural	120	25	362.4	361.7	147	149	151	179	202	365.3	364.9	365.3	365.0	365.3	365.0	365.6	365.3	365.9	365.6
RSSC040B1	72006	72007	Pedestrian Bridge	12	25	362.4	362.4	147	149	151	179	191	365.9	365.3	366.0	365.3	366.0	365.3	366.6	365.6	367.0	365.9
RSSC040BRD	72006	72007	Roadway	12		366.8	366.8	0	0	0	0	13	365.3	365.3	365.3	365.3	365.3	365.3	365.6	365.6	367.0	366.9
RSSC040C	72005	72006	Natural	800	25	363.5	362.4	148	150	152	180	203	367.1	365.9	367.1	366.0	367.1	366.0	367.5	366.6	367.8	367.0
RSSC060A.1	79470	72005	42" CSP Culvert	383	10	365.1	363.5	68	88	64	88	88	369.5	367.1	371.1	367.1	369.2	367.1	371.2	367.5	371.4	367.8

APPENDIX B
TABLE B-4
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM UNDER FUTURE LAND USE CONDITIONS WITH CIPs

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Invert Elevation (ft)		Peak Flow (cfs) Future Land Use Conditions					Water Surface Elevation under Future Land Use Conditions (ft)									
													10-Year		25-Year Summer		25-Year Winter		50-Year		100-Year	
	US	DS				US	DS	10-Year	25-Year-S	25-Year-W	50-Year	100-Year	US	DS	US	DS	US	DS	US	DS	US	DS
RSSC060ARD	79470	72005	Roadway	383		371.1	370.4	0	0	0	4	12	367.1	367.1	371.1	370.4	367.1	367.1	371.2	370.5	371.4	370.5
RSSC060B.1	76587	79470	54" CSP Culvert	2906	10	368.2	365.1	41	50	38	49	47	371.3	369.5	373.2	371.1	371.0	369.2	373.0	371.2	373.1	371.4
RSSC060BRD	76587	79470	Roadway	2906		374.4	371.1	0	0	0	0	0	369.5	369.5	373.1	371.1	369.2	369.2	372.1	371.2	372.3	371.4
RSSC070A.1	76569	76587	48" CMP Culvert	919	10	369.2	368.4	29	33	27	46	51	372.0	371.3	373.8	373.2	371.8	371.0	373.6	373.0	373.7	373.1
RSSC070ARD	76569	76587	Roadway	919		375.2	374.4	0	0	0	0	0	371.3	371.3	373.2	373.2	371.0	371.0	373.0	373.0	373.1	373.1
RSSC080A.1	76564	76569	36" CSP Culvert	69	10	369.3	369.2	2	2	2	4	4	372.0	372.0	373.8	373.8	371.8	371.8	373.6	373.6	373.7	373.7
RSSC080ARD	76564	76569	Roadway	69		375.3	375.2	0	0	0	0	0	372.0	372.0	373.8	373.8	371.8	371.8	373.6	373.6	373.7	373.7
RSSC090A1	72004	72005	48" x 84" Box Culvert	92	10	364.4	364.1	43	43	47	55	65	367.2	367.1	367.2	367.1	367.2	367.1	367.6	367.5	367.9	367.8
RSSC090A2	72004	72005	48" x 84" Box Culvert	92	10	364.4	364.1	43	43	47	55	65	367.2	367.1	367.2	367.1	367.2	367.1	367.6	367.5	367.9	367.8
RSSC090ARD	72004	72005	Roadway	92		370.4	370.4	0	0	0	0	0	367.1	367.1	367.1	367.1	367.1	367.1	367.5	367.5	367.8	367.8
RSSC090B	72003	72004	Natural	2880	10	367.1	364.1	66	69	72	86	102	370.5	367.2	370.5	367.2	370.6	367.2	371.0	367.6	371.3	367.9
RSSC100A1	72002	72003	48" CMP Culvert	85	10	367.0	367.1	35	36	38	50	57	370.8	370.5	370.9	370.5	371.0	370.6	371.5	371.0	372.0	371.3
RSSC100A2	72002	72003	48" CMP Culvert	85	10	367.0	367.1	35	36	38	50	57	370.8	370.5	370.9	370.5	371.0	370.6	371.5	371.0	372.0	371.3
RSSC100ARD	72002	72003	Roadway	85		372.4	372.4	0	0	0	0	0	370.5	370.5	370.5	370.5	370.6	370.6	371.0	371.0	371.3	371.3
RSSC100B	75387	72002	Natural	1238	10	366.9	367.0	60	67	64	90	101	370.8	370.8	370.9	370.9	371.0	371.0	371.5	371.5	372.0	372.0
RSSC100C.1	75386	75387	48" x 96" Box Culvert	92	10	366.9	366.9	66	81	68	110	123	370.8	370.8	371.0	370.9	371.1	371.0	371.6	371.5	372.1	372.0
RSSC100CRD	75386	75387	Roadway	92		373.7	373.7	0	0	0	0	0	370.8	370.8	371.0	371.0	371.1	371.1	371.6	371.6	372.1	372.1
RSSC100D	72770	75386	Natural	371	10	367.5	366.9	68	86	69	116	131	370.9	370.8	371.0	371.0	371.1	371.1	371.6	371.6	372.1	372.1
RSSC110A	72001	72770	Natural	1700	10	367.9	367.5	58	86	57	117	135	370.9	370.9	371.1	371.0	371.2	371.1	371.7	371.6	372.2	372.1
RSSC110B.1	72000	72001	72" CMP Culvert	61	10	368.2	367.9	69	99	63	152	177	371.5	370.9	372.0	371.1	371.6	371.2	373.1	371.7	373.6	372.2
RSSC110BRD	72000	72001	Roadway	61		378.2	378.2	0	0	0	0	0	370.9	370.9	371.1	371.1	371.2	371.2	371.7	371.7	372.2	372.2
Pipe Segments associated with some UIC CP Pipe and Pretreat Projects																						
Cindy	Zinnia-2	76891	24" CSP Culvert	675	10	375.5	373.1	2	2	2	4	5	376.0	374.9	377.0	377.0	376.0	374.6	377.4	377.5	378.1	377.8
Ferndale	Zinnia-1	76903	24" CSP Culvert	575	10	375.5	374.5	2	6	2	8	-8	378.4	378.4	380.9	380.9	377.9	377.9	381.3	381.8	381.6	381.8
River R	76908	76903	24" CSP Culvert	79.91	10	374.6	374.5	15	20	13	25	25	378.8	378.4	381.6	380.9	378.3	377.9	382.4	381.8	382.8	381.8
River R-1	76903	76891	24" CSP Culvert	758.5	10	374.5	373.1	16	19	14	19	19	378.4	374.9	380.9	377.0	377.9	374.6	381.8	377.5	381.8	377.8
River R-2	76891	76569	27" CSP Culvert	905.75	10	373.1	369.2	18	20	16	21	21	374.9	372.0	377.0	373.8	374.6	371.8	377.5	373.6	377.8	373.7

APPENDIX B
TABLE B-4
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM UNDER FUTURE LAND USE CONDITIONS WITH CIPs

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Invert Elevation (ft)		Peak Flow (cfs) Future Land Use Conditions					Water Surface Elevation under Future Land Use Conditions (ft)									
													10-Year		25-Year Summer		25-Year Winter		50-Year		100-Year	
	US	DS				US	DS	10-Year	25-Year-S	25-Year-W	50-Year	100-Year	US	DS	US	DS	US	DS	US	DS	US	DS
Willamette Overflow																						
RSWO010A	99820	72088	Natural	1050	25	362.6	362.4	96	106	99	137	171	370.7	370.7	370.7	370.7	370.7	370.7	370.7	370.7	370.7	370.7
RSWO020A.1	99827	99820	36" CSP Culvert	675	5	367.7	365.8	36	47	38	48	49	373.4	370.7	375.3	370.7	373.6	370.7	375.5	370.7	375.6	370.7
RSWO020ARD	99827	99820	Roadway	675		375.0	375.0	0	10	0	25	41	373.4	373.4	375.3	375.1	373.6	373.6	375.5	375.2	375.6	375.2
RSWO010B	72086	99820	Natural	1950	10	364.9	362.6	58	41	65	53	63	370.7	370.7	370.7	370.7	370.7	370.7	370.7	370.7	370.8	370.7
RSWO040A1	72085	72086	72" CMP Culvert	61	10	370.6	369.3	3	1	3	2	3	370.9	370.7	370.8	370.7	371.0	370.7	370.9	370.7	371.0	370.8
RSWO040A2	72085	72086	72" CMP Culvert	61	10	370.6	369.5	2	1	3	1	2	370.9	370.7	370.8	370.7	371.0	370.7	370.9	370.7	371.0	370.8
RSWO040A3	72085	72086	60" CMP Culvert	61	10	366.6	364.9	53	38	59	44	55	370.9	370.7	370.8	370.7	371.0	370.7	370.9	370.7	371.0	370.8
RSWO040ARD	72085	72086	Roadway	61		380.1	380.1	0	0	0	0	0	370.7	370.7	370.7	370.7	370.7	370.7	370.7	370.7	370.8	370.8
RSWO040B	73907	72085	Natural	570	10	368.1	366.6	58	40	65	47	61	371.0	370.9	370.9	370.8	371.1	371.0	370.9	370.9	371.0	371.0
RSWO040C.1	73910	73907	60" CMP Culvert	760	10	370.8	368.1	56	34	62	45	59	373.9	371.0	373.0	370.9	374.2	371.1	373.4	370.9	374.0	371.0
RSWO040CRD	73910	73907	Roadway	760		382.0	382.0	0	0	0	0	0	371.0	371.0	370.9	370.9	371.1	371.1	370.9	370.9	371.0	371.0
RSWO045A	72084	73910	Natural	570	10	371.5	370.8	53	22	58	42	54	374.1	373.9	373.1	373.0	374.3	374.2	373.7	373.4	374.2	374.0
RSWO045B1	72083	72084	72" CMP Culvert	68	10	371.5	371.5	27	11	30	22	28	374.2	374.1	373.2	373.1	374.5	374.3	373.8	373.7	374.3	374.2
RSWO045B2	72083	72084	72" CMP Culvert	68	10	371.8	371.6	25	9	28	20	26	374.2	374.1	373.2	373.1	374.5	374.3	373.8	373.7	374.3	374.2
RSWO045BRD	72083	72084	Roadway	68		380.5	380.5	0	0	0	0	0	374.1	374.1	373.1	373.1	374.3	374.3	373.7	373.7	374.2	374.2
RSWO045C	72082	72083	Natural	850	10	372.2	371.5	53	21	58	41	54	374.8	374.2	373.8	373.2	375.0	374.5	374.5	373.8	374.9	374.3
RSWO050A1	72081	72082	72" CSP Culvert	46	10	372.2	372.4	26	10	28	20	26	374.9	374.8	373.9	373.8	375.1	375.0	374.6	374.5	375.0	374.9
RSWO050A2	72081	72082	72" CSP Culvert	46	10	372.4	372.2	28	11	30	22	28	374.9	374.8	373.9	373.8	375.1	375.0	374.6	374.5	375.0	374.9
RSWO050ARD	72081	72082	Roadway	46		384.7	384.7	0	0	0	0	0	374.8	374.8	373.8	373.8	375.0	375.0	374.5	374.5	374.9	374.9
RSWO050B	70615	72081	Natural	1353	10	375.2	372.2	48	11	51	36	48	376.9	374.9	376.1	373.9	376.9	375.1	376.7	374.6	376.9	375.0
RSWO050C	72080	70615	Natural	141	10	375.5	375.2	48	11	51	36	48	377.7	376.9	376.8	376.1	377.7	376.9	377.5	376.7	377.7	376.9
RSWO060A	74014	72080	Natural	693	10	370.5	375.5	47	12	50	35	48	377.7	377.7	376.8	376.8	377.7	377.7	377.5	377.5	377.7	377.7
RSWO060B	74013	74014	Natural	420	10	369.2	370.5	49	30	51	41	54	377.7	377.7	376.8	376.8	377.7	377.7	377.5	377.5	377.7	377.7
RSWO070A	74009	74013	Natural	288	10	377.0	371.4	43	29	45	41	52	378.1	377.7	377.9	376.8	378.1	377.7	378.1	377.5	378.2	377.7
RSWO070B1	74008	74009	48" CSP Culvert	501	10	378.3	376.8	15	10	16	15	18	379.6	378.1	379.3	377.9	379.6	378.1	379.5	378.1	379.7	378.2
RSWO070B2	74008	74009	48" CSP Culvert	501	10	378.2	377.0	14	9	14	13	16	379.6	378.1	379.3	377.9	379.6	378.1	379.5	378.1	379.7	378.2
RSWO070B3	74008	74009	48" CSP Culvert	501	10	378.1	377.0	14	10	15	14	17	379.6	378.1	379.3	377.9	379.6	378.1	379.5	378.1	379.7	378.2
RSWO070BRD	74008	74009	Roadway	501		384.1	384.1	0	0	0	0	0	378.1	378.1	377.9	377.9	378.1	378.1	378.1	378.1	378.2	378.2
RSWO070C	74007	74008	Natural	826	10	378.9	378.1	43	29	45	42	53	380.6	379.6	380.3	379.3	380.6	379.6	380.6	379.5	380.7	379.7
RSWO070D.1	74006	74007	66" CSP Culvert	253	10	378.5	378.9	43	30	45	43	54	381.7	380.6	381.2	380.3	381.7	380.6	381.7	380.6	382.0	380.7

APPENDIX B
TABLE B-4
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM UNDER FUTURE LAND USE CONDITIONS WITH CIPs

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Invert Elevation (ft)		Peak Flow (cfs) Future Land Use Conditions					Water Surface Elevation under Future Land Use Conditions (ft)									
													10-Year		25-Year Summer		25-Year Winter		50-Year		100-Year	
	US	DS				US	DS	10-Year	25-Year-S	25-Year-W	50-Year	100-Year	US	DS	US	DS	US	DS	US	DS	US	DS
RSWO070DRD	74006	74007	Roadway	250		386.0	386.0	0	0	0	0	0	380.6	380.6	380.3	380.3	380.6	380.6	380.6	380.6	380.7	380.7
RSWO070E	74005	74006	Natural	296	10	378.3	378.5	44	30	45	43	54	381.7	381.7	381.2	381.2	381.8	381.7	381.7	381.7	382.1	382.0
RSWO080A.1	74004	74005	66" CSP Culvert	43	10	378.5	378.3	44	30	46	45	56	381.9	381.7	381.3	381.2	381.9	381.8	381.8	381.7	382.2	382.1
RSWO080ARD	74004	74005	Roadway	43		388.2	388.2	0	0	0	0	0	381.7	381.7	381.2	381.2	381.8	381.8	381.7	381.7	382.1	382.1
RSWO090A	78833	74004	Natural	197	10	377.2	378.5	33	14	35	24	33	381.9	381.9	381.3	381.3	381.9	381.9	381.8	381.8	382.2	382.2
RSWO090Aa	74003	78833	Natural	208	10	377.3	377.2	32	11	34	24	32	381.9	381.9	381.3	381.3	382.0	381.9	381.9	381.8	382.2	382.2
RSWO090B	75433	74003	Natural	153	10	377.4	377.3	32	11	34	24	32	381.9	381.9	381.3	381.3	382.0	382.0	381.9	381.9	382.2	382.2
RSWO090C	74001	75433	Natural	112	10	377.5	377.4	31	12	33	25	32	381.9	381.9	381.3	381.3	382.0	382.0	381.9	381.9	382.2	382.2
RSWO090D	74405	74001	Natural	251	10	379.3	377.5	31	14	34	33	42	381.9	381.9	381.3	381.3	382.0	382.0	381.9	381.9	382.2	382.2
RSWO090E.1	74406	74405	84" x 120" CMP Culvert	71	10	379.8	379.3	29	4	30	22	30	381.9	381.9	381.3	381.3	382.0	382.0	381.9	381.9	382.2	382.2
RSWO090ERD	74406	74405	Roadway	71		389.4	389.4	0	0	0	0	0	381.9	381.9	381.3	381.3	382.0	382.0	381.9	381.9	382.2	382.2
RSWO090F	76415	74406	Natural	146	10	380.0	379.8	29	4	30	22	30	382.1	381.9	381.3	381.3	382.2	382.0	381.9	381.9	382.3	382.2
RSWO090G.1	76414	76415	84" x 120" CMP Culvert	57	10	379.9	380.0	29	5	30	22	30	382.1	382.1	381.3	381.3	382.2	382.2	381.9	381.9	382.3	382.3
RSWO090GRD	76414	76415	Roadway	57		390.1	390.0	0	0	0	0	0	382.1	382.1	381.3	381.3	382.2	382.2	381.9	381.9	382.3	382.3
RSWO090H	58287	76414	Natural	116	10	380.5	379.9	29	5	30	22	30	382.2	382.1	381.3	381.3	382.3	382.2	381.9	381.9	382.3	382.3
RSWO110A.1	58310	58287	60" CSP Culvert	47	10	381.0	380.5	29	5	30	22	30	382.6	382.2	381.5	381.3	382.7	382.3	382.4	381.9	382.7	382.3
RSWO110ARD	58310	58287	Roadway	26		392.0	389.0	0	0	0	0	0	382.2	382.2	381.3	381.3	382.3	382.3	381.9	381.9	382.3	382.3
RSWO110B.1	58311	58310	54" CSP Culvert	387	10	376.5	374.8	29	5	30	22	30	382.8	382.6	381.5	381.5	382.8	382.7	382.5	382.4	382.8	382.7
RSWO110BRD	58311	58310	Roadway	388		389.8	389.8	0	0	0	0	0	382.6	382.6	381.5	381.5	382.7	382.7	382.4	382.4	382.7	382.7
RSWO110C.1	58315	58311	27" CSP Culvert	1155	10	379.9	376.5	6	5	5	10	13	383.0	382.8	381.8	381.5	383.0	382.8	384.1	382.5	385.4	382.8
RSWO110CRD	58315	58311	Roadway	1154		389.8	389.1	0	0	0	0	0	382.8	382.8	381.5	381.5	382.8	382.8	382.5	382.5	382.8	382.8
RSWO140	77703	58311	54" CSP Culvert	544	10	379.7	376.5	23	-30	25	-37	-42	382.8	382.8	381.3	381.5	382.9	382.8	382.5	382.5	382.8	382.8
Pipe Segments associated with some UIC CP Pipe and Pretreat Projects																						
Wilkes	Poplar	72084	30" CSP Culvert	1100	10	376.0	371.5	1	2	1	2	3	376.3	374.1	376.5	373.1	376.3	374.3	376.5	373.7	376.5	374.2

APPENDIX B
TABLE B-4
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM UNDER FUTURE LAND USE CONDITIONS WITH CIPs

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Invert Elevation (ft)		Peak Flow (cfs) Future Land Use Conditions					Water Surface Elevation under Future Land Use Conditions (ft)									
													10-Year		25-Year Summer		25-Year Winter		50-Year		100-Year	
	US	DS				US	DS	10-Year	25-Year-S	25-Year-W	50-Year	100-Year	US	DS	US	DS	US	DS	US	DS	US	DS
Flat Creek																						
RSFC010A	99329	70197	Natural	850	10	364.6	364.3	66	58	68	76	90	368.1	367.8	368.0	367.8	368.1	367.8	368.2	367.8	368.3	367.8
RSFC010B1	99330	99329	41' x 60" CMP Culvert	92	10	365.0	364.7	32	28	34	38	45	368.4	368.1	368.3	368.0	368.4	368.1	368.6	368.2	368.8	368.3
RSFC010B2	99330	99329	41' x 60" CMP Culvert	92	10	365.4	364.6	34	30	35	38	45	368.4	368.1	368.3	368.0	368.4	368.1	368.6	368.2	368.8	368.3
RSFC010BRD	99330	99329	Roadway	92		371.5	371.5	0	0	0	0	0	368.1	368.1	368.0	368.0	368.1	368.1	368.2	368.2	368.3	368.3
RSFC020A	72768	99330	Natural	750	10	365.3	364.7	66	59	68	77	90	368.5	368.4	368.4	368.3	368.6	368.4	368.7	368.6	369.0	368.8
RSFC020B1	72767	72768	36" CSP Culvert	72	10	366.1	365.3	33	30	34	38	45	369.0	368.5	368.8	368.4	369.1	368.6	369.4	368.7	369.9	369.0
RSFC020B2	72767	72768	36" CSP Culvert	72	10	366.3	365.3	33	30	35	38	45	369.0	368.5	368.8	368.4	369.1	368.6	369.4	368.7	369.9	369.0
RSFC020BRD	72767	72768	Roadway	72		372.0	372.0	0	0	0	0	0	368.5	368.5	368.4	368.4	368.6	368.6	368.7	368.7	369.0	369.0
RSFC020C	72766	72767	Natural	200	10	366.5	366.1	50	47	51	59	69	369.2	369.0	369.0	368.8	369.3	369.1	369.5	369.4	370.1	369.9
RSFC020D1	72765	72766	36" CSP Culvert	68	10	367.2	367.0	23	21	24	29	34	369.6	369.2	369.3	369.0	369.6	369.3	370.0	369.5	370.6	370.1
RSFC020D2	72765	72766	36" CSP Culvert	68	10	366.7	366.5	27	26	27	30	35	369.6	369.2	369.3	369.0	369.6	369.3	370.0	369.5	370.6	370.1
RSFC020DRD	72765	72766	Roadway	68		372.2	372.2	0	0	0	0	0	369.2	369.2	369.0	369.0	369.3	369.3	369.5	369.5	370.1	370.1
RSFC020Da	76952	72765	Natural	233	10	366.7	366.7	50	47	51	59	69	369.6	369.6	369.4	369.3	369.7	369.6	370.0	370.0	370.6	370.6
RSFC020Db.	76953	76952	50" x 76" CMP Culvert	63	10	366.8	366.7	50	46	51	59	69	369.8	369.6	369.6	369.4	369.9	369.7	370.2	370.0	370.9	370.6
RSFC020DbR	76953	76952	Roadway	63		373.9	374.0	0	0	0	0	0	369.8	369.8	369.6	369.6	369.9	369.9	370.2	370.2	370.9	370.9
RSFC020E	72764	76953	Natural	809	10	367.7	366.8	50	47	51	59	69	370.0	369.8	369.9	369.6	370.1	369.9	370.4	370.2	371.0	370.9
RSFC020F1	72763	72764	36" x 48" CMP Culvert	65	10	367.2	367.7	17	17	17	20	23	370.3	370.0	370.1	369.9	370.3	370.1	370.7	370.4	371.4	371.0
RSFC020F2	72763	72764	36" x 48" CMP Culvert	65	10	367.2	368.2	16	15	17	20	23	370.3	370.0	370.1	369.9	370.3	370.1	370.7	370.4	371.4	371.0
RSFC020F3	72763	72764	36" x 48" CMP Culvert	65	10	367.2	367.9	17	16	18	20	23	370.3	370.0	370.1	369.9	370.3	370.1	370.7	370.4	371.4	371.0
RSFC020FRD	72763	72764	Roadway	65		373.1	373.1	0	0	0	0	0	370.0	370.0	369.9	369.9	370.1	370.1	370.4	370.4	371.0	371.0
RSFC020G	72762	72763	Natural	800	10	368.2	367.2	52	50	53	61	71	370.4	370.3	370.3	370.1	370.5	370.3	370.8	370.7	371.5	371.4
RSFC030A1	72761	72762	82" x 84" CSP Culvert	55	10	368.5	368.2	26	26	27	34	41	370.5	370.4	370.3	370.3	370.5	370.5	370.9	370.8	371.5	371.5
RSFC030A2	72761	72762	82" x 84" CSP Culvert	55	10	368.5	368.2	26	26	27	34	41	370.5	370.4	370.3	370.3	370.5	370.5	370.9	370.8	371.5	371.5
RSFC030ARD	72761	72762	Roadway	55		374.7	374.7	0	0	0	0	0	370.4	370.4	370.3	370.3	370.5	370.5	370.8	370.8	371.5	371.5

APPENDIX B
TABLE B-4
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM UNDER FUTURE LAND USE CONDITIONS WITH CIPs

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Invert Elevation (ft)		Peak Flow (cfs) Future Land Use Conditions					Water Surface Elevation under Future Land Use Conditions (ft)									
													10-Year		25-Year Summer		25-Year Winter		50-Year		100-Year	
	US	DS				US	DS	10-Year	25-Year-S	25-Year-W	50-Year	100-Year	US	DS	US	DS	US	DS	US	DS	US	DS
RSFC030B	72244	72761	Natural	1456	10	370.4	368.5	30	32	30	37	43	371.3	370.5	371.5	370.3	371.5	370.5	371.6	370.9	371.8	371.5
RSFC050A	75660	72244	Natural	1294	10	372.2	370.4	31	35	31	39	46	373.5	371.3	373.5	371.5	373.4	371.5	373.5	371.6	373.6	371.8
RSFC050B1	75659	75660	24" CSP Culvert	61	10	372.5	372.2	10	11	10	13	15	374.0	373.5	374.1	373.5	374.0	373.4	374.2	373.5	374.5	373.6
RSFC050B2	75659	75660	24" CSP Culvert	61	10	372.5	372.2	10	11	11	13	15	374.0	373.5	374.1	373.5	374.0	373.4	374.2	373.5	374.5	373.6
RSFC050B3	75659	75660	24" CSP Culvert	61	10	372.5	372.3	10	11	10	12	15	374.0	373.5	374.1	373.5	374.0	373.4	374.2	373.5	374.5	373.6
RSFC050BRD	75659	75660	Roadway	61		376.9	377.0	0	0	0	0	0	374.0	374.0	374.1	374.1	374.0	374.0	374.2	374.2	374.5	374.5
RSFC050C	78673	75659	Natural	1056	10	375.9	372.5	23	26	23	30	34	376.9	374.0	376.9	374.1	376.9	374.0	377.0	374.2	377.1	374.5
RSFC050D1	75654	78673	1.5x5' Box Culvert	25	10	376.1	375.9	23	26	23	30	34	377.2	376.9	377.3	376.9	377.2	376.9	377.5	377.0	377.6	377.1
RSFC050DRD	75654	78673	Roadway	25		379.2	379.2	0	0	0	0	0	376.9	376.9	376.9	376.9	376.9	376.9	377.0	377.0	377.1	377.1
RSFC050E	72799	75654	Natural	1016	10	374.9	376.1	24	27	24	32	37	377.6	377.2	377.6	377.3	377.5	377.2	377.8	377.5	377.9	377.6
RSFC060A.1	72800	72799	30" CSP Culvert	56	10	375.6	374.9	16	18	14	21	23	377.8	377.6	377.9	377.6	377.7	377.5	378.1	377.8	378.4	377.9
RSFC060ARD	72800	72799	Roadway	56		379.8	379.8	0	0	0	0	0	377.6	377.6	377.6	377.6	377.5	377.5	377.8	377.8	377.9	377.9
RSFC060B	72795	72800	Natural	850	10	376.7	375.6	7	7	6	11	13	377.8	377.8	377.9	377.9	377.7	377.7	378.2	378.1	378.4	378.4
RSFC070A.1	72794	72795	30" CSP Culvert	45	5	377.2	376.7	9	8	6	16	20	378.2	377.8	378.2	377.9	378.0	377.7	378.7	378.2	379.0	378.4
RSFC070ARD	72794	72795	Roadway	45		381.0	381.0	0	0	0	0	0	377.8	377.8	377.9	377.9	377.7	377.7	378.2	378.2	378.4	378.4

APPENDIX B
TABLE B-4
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM UNDER FUTURE LAND USE CONDITIONS WITH CIPs

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Invert Elevation (ft)		Peak Flow (cfs) Future Land Use Conditions					Water Surface Elevation under Future Land Use Conditions (ft)									
													10-Year		25-Year Summer		25-Year Winter		50-Year		100-Year	
	US	DS				US	DS	10-Year	25-Year-S	25-Year-W	50-Year	100-Year	US	DS	US	DS	US	DS	US	DS	US	DS
A-1 Channel																						
RSA1010A	72757	72745	Bridge	42	25	352.1	352.3	396	305	407	440	548	356.4	355.5	356.1	355.2	356.4	355.5	356.5	355.6	356.9	355.9
RSA1010B	72744	72757	Natural	2400	25	356.2	352.1	378	302	392	421	521	359.8	356.4	359.4	356.1	359.9	356.4	360.0	356.5	360.4	356.9
RSA1030A	72743	72744	Natural	4200	25	362.8	356.2	323	286	335	368	447	367.4	359.8	367.3	359.4	367.5	359.9	367.7	360.0	368.1	360.4
RSA1030B.1	72742	72743	Bridge	32	25	362.9	362.8	321	284	335	364	441	367.6	367.4	367.4	367.3	367.6	367.5	367.8	367.7	368.2	368.1
RSA1030BRD	72742	72743	Roadway	32		372.3	372.3	0	0	0	0	0	367.4	367.4	367.3	367.3	367.5	367.5	367.7	367.7	368.1	368.1
RSA1030C	73394	72744	Natural	1633	10	362.3	356.2	14	14	15	17	20	362.8	359.8	362.8	359.4	362.8	359.9	362.8	360.0	362.9	360.4
RSA1030D	75021	73394	Natural	1016	10	366.1	362.3	14	17	15	18	20	366.7	362.8	366.8	362.8	366.7	362.8	366.7	362.8	366.7	362.9
RSA1030Da.	75020	75021	24" x 141" CMP Culvert	96	10	366.3	366.1	14	16	15	17	20	367.7	366.7	367.7	366.8	367.7	366.7	367.8	366.7	368.0	366.7
RSA1030DaR	75020	75021	Roadway	96		370.7	370.7	0	0	0	0	0	366.7	366.7	366.8	366.8	366.7	366.7	366.7	366.7	366.7	366.7
RSA1030Db	73395	75020	Natural	522	10	366.8	366.3	15	20	16	20	22	367.7	367.7	367.7	367.7	367.8	367.7	367.8	367.8	368.0	368.0
RSA1030E	72747	73395	Natural	1633	10	368.2	366.8	24	31	21	36	43	369.0	367.7	369.2	367.7	369.0	367.8	369.2	367.8	369.2	368.0
RSA1030F1	72746	72747	14" CSP Culvert	55	10	368.8	368.2	7	9	7	9	9	371.2	369.0	371.9	369.2	371.0	369.0	372.3	369.2	372.3	369.2
RSA1030F2	72746	72747	24" CSP Culvert	55	10	369.1	368.8	16	22	15	25	25	371.2	370.3	371.9	370.5	371.0	370.2	372.3	370.6	372.3	370.6
RSA1030FRD	72746	72747	Roadway	55		372.1	372.1	0	0	0	12	21	369.0	369.0	369.2	369.2	369.0	369.0	372.3	372.2	372.3	372.2
RSA1060A	71215	72742	Natural	1140	25	365.0	362.9	303	266	316	341	411	368.8	367.6	368.5	367.4	368.9	367.6	369.1	367.8	369.5	368.2
RSA1060B	72741	71215	Natural	560	25	366.6	365.0	293	254	306	332	401	369.9	368.8	369.6	368.5	370.0	368.9	370.1	369.1	370.5	369.5
RSA1060C	72740	72741	Bridge	39	25	366.7	366.6	293	254	306	332	402	370.2	369.9	370.0	369.6	370.2	370.0	370.4	370.1	370.8	370.5
RSA1060D	72739	72740	Natural	1000	25	367.6	366.7	215	176	232	230	284	371.5	370.2	371.2	370.0	371.6	370.2	371.7	370.4	372.1	370.8
RSA1060E	72738	72739	Natural	500	25	367.8	367.6	192	153	213	208	261	371.8	371.5	371.5	371.2	372.0	371.6	372.0	371.7	372.4	372.1
RSA1130A1	72737	72738	72" CSP Culvert	600	25	370.2	367.9	63	50	70	69	86	372.5	371.8	372.1	371.5	372.7	372.0	372.6	372.0	373.1	372.4
RSA1130A2	72737	72738	72" CSP Culvert	600	25	370.1	367.8	66	52	73	71	89	372.5	371.8	372.1	371.5	372.7	372.0	372.6	372.0	373.1	372.4
RSA1130A3	72737	72738	72" CSP Culvert	600	25	370.2	367.9	63	50	70	69	86	372.5	371.8	372.1	371.5	372.7	372.0	372.6	372.0	373.1	372.4
RSA1130ARD	72737	72738	Roadway	600		381.7	381.7	0	0	0	0	0	371.8	371.8	371.5	371.5	372.0	372.0	372.0	372.0	372.4	372.4
RSA1130B	70756	72737	Natural	2145	25	372.1	370.1	164	124	191	166	208	377.0	372.5	376.5	372.1	377.2	372.7	377.0	372.6	377.4	373.1
RSA1140A	72796	70756	Natural	1155	25	372.8	372.1	154	116	182	153	196	377.6	377.0	377.1	376.5	377.9	377.2	377.6	377.0	378.1	377.4
RSA1140B.1	69264	70756	36" CSP Culvert	839	10	374.1	373.3	21	16	17	31	30	379.6	377.0	377.6	376.5	379.0	377.2	382.1	377.0	382.2	377.4
RSA1140BRD	69264	70756	Roadway	839		382.0	380.0	0	0	0	1	8	377.0	377.0	376.5	376.5	377.2	377.2	382.1	380.0	382.2	380.1
RSA1270A.1	74046	72796	60" CSP Culvert	160	10	372.9	372.8	35	41	34	55	67	377.6	377.6	377.1	377.1	378.0	377.9	377.6	377.6	378.1	378.1
RSA1270ARD	74046	72796	Roadway	160		384.3	386.4	0	0	0	0	0	377.6	377.6	377.1	377.1	378.0	378.0	377.6	377.6	378.1	378.1
RSA1270B.1	74044	74046	60" CSP Culvert	463	10	373.1	372.9	35	41	34	55	67	377.7	377.6	377.2	377.1	378.0	378.0	377.8	377.6	378.4	378.1
RSA1270BRD	74044	74046	Roadway	463		383.0	384.3	0	0	0	0	0	377.7	377.7	377.2	377.2	378.0	378.0	377.8	377.8	378.4	378.4
RSA1270C.1	74042	74044	60" CSP Culvert	412	10	373.3	373.1	35	42	34	56	68	377.7	377.7	377.4	377.2	378.1	378.0	378.0	377.8	378.7	378.4
RSA1270CRD	74042	74044	Roadway	412		382.2	383.0	0	0	0	0	0	377.7	377.7	377.4	377.4	378.1	378.1	378.0	378.0	378.7	378.7

APPENDIX B
TABLE B-4
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM UNDER FUTURE LAND USE CONDITIONS WITH CIPs

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Invert Elevation (ft)		Peak Flow (cfs) Future Land Use Conditions					Water Surface Elevation under Future Land Use Conditions (ft)									
													10-Year		25-Year Summer		25-Year Winter		50-Year		100-Year	
	US	DS				US	DS	10-Year	25-Year-S	25-Year-W	50-Year	100-Year	US	DS	US	DS	US	DS	US	DS	US	DS
RSA1270D.1	74040	74042	60" CSP Culvert	409	10	373.5	373.3	36	42	34	56	68	377.8	377.7	377.5	377.4	378.1	378.1	378.1	378.0	379.0	378.7
RSA1270DRD	74040	74042	Roadway	409		383.4	382.2	0	0	0	0	0	377.7	377.7	377.4	377.4	378.1	378.1	378.0	378.0	378.7	378.7
RSA1280A.1	74034	74040	60" CSP Culvert	216	10	373.6	373.5	31	34	29	48	58	377.8	377.8	377.5	377.5	378.1	378.1	378.2	378.1	379.1	379.0
RSA1280ARD	74034	74040	Roadway	216		383.3	383.4	0	0	0	0	0	377.8	377.8	377.5	377.5	378.1	378.1	378.2	378.2	379.1	379.1
RSA1280B.1	74032	74034	60" CSP Culvert	269	10	373.8	373.6	31	34	29	48	58	377.9	377.8	377.6	377.5	378.2	378.1	378.3	378.2	379.2	379.1
RSA1280BRD	74032	74034	Roadway	269		382.4	383.3	0	0	0	0	0	377.9	377.9	377.6	377.6	378.2	378.2	378.3	378.3	379.2	379.2
RSA1280C.1	76483	74032	60" CSP Culvert	1331	10	374.3	373.8	32	35	29	49	59	378.1	377.9	377.9	377.6	378.3	378.2	378.7	378.3	379.9	379.2
RSA1280CRD	76483	74032	Roadway	1331		382.9	382.4	0	0	0	0	0	377.9	377.9	377.6	377.6	378.2	378.2	378.3	378.3	379.2	379.2
RSA1280Ca.	74031	76483				374.4	374.3	29	32	27	47	54	378.1	378.1	377.9	377.9	378.3	378.3	378.8	378.7	380.0	379.9
RSA1280CaR	74031	76483				383.0	382.9	0	0	0	0	0	378.1	378.1	377.9	377.9	378.3	378.3	378.7	378.7	379.9	379.9
RSA1280D.1	74030	74031	60" CSP Culvert	1012	10	374.9	374.4	30	33	27	49	60	378.4	378.1	378.2	377.9	378.5	378.3	379.1	378.8	380.5	380.0
RSA1280DRD	74030	74031	Roadway	1022		384.9	383.0	0	0	0	0	0	378.1	378.1	377.9	377.9	378.3	378.3	378.8	378.8	380.0	380.0
RSA1290A.1	74026	74030	54" CSP Culvert	496	10	375.7	375.4	14	15	12	23	25	378.4	378.4	378.3	378.2	378.5	378.5	379.2	379.1	380.6	380.5
RSA1290ARD	74026	74030	Roadway	496		384.0	384.9	0	0	0	0	0	378.4	378.4	378.3	378.3	378.5	378.5	379.2	379.2	380.6	380.6
RSA1290B.1	74024	74026	48" CSP Culvert	182	10	376.3	376.2	14	16	12	25	26	378.5	378.4	378.4	378.3	378.5	378.5	379.2	379.2	380.6	380.6
RSA1290BRD	74024	74026	Roadway	182		384.8	384.0	0	0	0	0	0	378.4	378.4	378.3	378.3	378.5	378.5	379.2	379.2	380.6	380.6
RSA1290C.1	74022	74024	48" CSP Culvert	410	10	376.6	376.3	14	16	12	26	30	378.6	378.5	378.6	378.4	378.7	378.5	379.4	379.2	380.8	380.6
RSA1290CRD	74022	74024	Roadway	410		383.4	384.8	0	0	0	0	0	378.6	378.6	378.6	378.6	378.7	378.7	379.4	379.4	380.8	380.8
RSA1290D.1	74020	74022	42" CSP Culvert	880	10	377.4	376.6	15	16	13	29	34	379.3	378.6	379.4	378.6	379.2	378.7	380.3	379.4	381.3	380.8
RSA1290DRD	74020	74022	Roadway	880		385.7	383.4	0	0	0	0	0	378.6	378.6	378.6	378.6	378.7	378.7	379.4	379.4	380.8	380.8
RSA1150A1	72797	72796	72" CSP Culvert	167	25	374.8	375.0	65	40	77	67	85	378.1	377.6	377.5	377.1	378.5	377.9	378.1	377.6	378.6	378.1
RSA1150A2	72797	72796	72" CSP Culvert	155	25	374.8	375.0	66	41	78	68	86	378.1	377.6	377.5	377.1	378.5	377.9	378.1	377.6	378.6	378.1
RSA1150ARD	72797	72796	Roadway	160		384.4	384.7	0	0	0	0	0	378.1	378.1	377.5	377.5	378.5	378.5	378.1	378.1	378.6	378.6
RSA1150B	72734	72797	Natural	3273	25	377.1	375.1	126	65	147	129	165	381.9	378.1	380.8	377.5	382.2	378.5	382.0	378.1	382.4	378.6
RSA1160A.1	72733	72734	Bridge	92	25	378.7	378.6	97	28	112	102	128	382.0	381.9	380.8	380.8	382.2	382.2	382.0	382.0	382.5	382.4
RSA1160ARD	72733	72734	Roadway	92		387.8	387.8	0	0	0	0	0	381.9	381.9	380.8	380.8	382.2	382.2	382.0	382.0	382.4	382.4
RSA1160B	72732	72733	Natural	165	25	377.1	378.7	94	-36	107	94	121	382.0	382.0	380.8	380.8	382.3	382.2	382.1	382.0	382.5	382.5
RSA1160C1	72731	72732	60" CSP Culvert	61	25	377.0	377.1	47	-17	53	47	60	382.1	382.0	380.8	380.8	382.4	382.3	382.2	382.1	382.7	382.5
RSA1160C2	72731	72732	60" CSP Culvert	61	25	377.0	377.1	47	-17	53	47	60	382.1	382.0	380.8	380.8	382.4	382.3	382.2	382.1	382.7	382.5
RSA1160CRD	72731	72732	Roadway	61		383.9	383.8	0	0	0	0	0	382.0	382.0	380.8	380.8	382.3	382.3	382.1	382.1	382.5	382.5
RSA1160D	72730	72731	Natural	769	25	377.9	377.0	93	-30	106	94	120	382.2	382.1	380.8	380.8	382.5	382.4	382.3	382.2	382.9	382.7

APPENDIX B
TABLE B-4
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM UNDER FUTURE LAND USE CONDITIONS WITH CIPs

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Invert Elevation (ft)		Peak Flow (cfs) Future Land Use Conditions					Water Surface Elevation under Future Land Use Conditions (ft)									
													10-Year		25-Year Summer		25-Year Winter		50-Year		100-Year	
	US	DS				US	DS	10-Year	25-Year-S	25-Year-W	50-Year	100-Year	US	DS	US	DS	US	DS	US	DS	US	DS
RSA1160E1	72729	72730	72" CMP Culvert	89	25	378.4	377.9	46	14	52	47	60	382.4	382.2	380.8	380.8	382.7	382.5	382.5	382.3	383.1	382.9
RSA1160E2	72729	72730	72" CMP Culvert	89	25	378.4	377.9	46	14	53	47	60	382.4	382.2	380.8	380.8	382.7	382.5	382.5	382.3	383.1	382.9
RSA1160ERD	72729	72730	Roadway	89		386.5	386.5	0	0	0	0	0	382.2	382.2	380.8	380.8	382.5	382.5	382.3	382.3	382.9	382.9
RSA1160F	71940	72729	Natural	1207	25	379.1	378.4	91	28	104	94	120	382.5	382.4	380.8	380.8	382.7	382.7	382.5	382.5	383.2	383.1
RSA1160G.1	71941	71940	60" x 144" CMP Culvert	61	25	379.2	379.1	91	29	103	95	120	382.7	382.5	380.8	380.8	383.0	382.7	382.8	382.5	383.5	383.2
RSA1160GRD	71941	71940	Roadway	61		388.2	388.2	0	0	0	0	0	382.5	382.5	380.8	380.8	382.7	382.7	382.5	382.5	383.2	383.2
RSA1160H	72726	71941	Natural	650	25	379.5	379.2	91	29	103	96	121	382.8	382.7	381.4	380.8	383.1	383.0	382.9	382.8	383.5	383.5
RSA1170A	72736	72734	Natural	610	10	379.9	377.1	64	76	54	111	134	382.0	381.9	382.0	380.8	382.2	382.2	382.4	382.0	382.6	382.4
RSA1170B.1	72101	72736	60" CSP Culvert	140	25	380.1	380.0	20	25	18	44	52	382.1	382.0	382.3	382.0	382.3	382.2	382.9	382.4	383.1	382.6
RSA1170BRD	72101	72736	Roadway	140		393.0	393.0	0	0	0	0	0	382.0	382.0	382.0	382.0	382.2	382.2	382.4	382.4	382.6	382.6
RSA1170C	72735	72736	Natural	2200	10	382.7	379.9	12	15	11	19	23	383.8	382.0	383.9	382.0	383.7	382.2	384.0	382.4	384.2	382.6
RSA1170D.1	72100	72735	36" CSP Culvert	150	25	383.5	382.7	13	16	11	27	32	384.7	383.8	384.9	383.9	384.6	383.7	385.5	384.0	385.7	384.2
RSA1170DRD	72100	72735	Roadway	150		393.0	393.0	0	0	0	0	0	383.8	383.8	383.9	383.9	383.7	383.7	384.0	384.0	384.2	384.2
RSA1200A1	72725	72726	60" CMP Culvert	200	25	379.8	379.7	54	17	61	57	72	383.5	382.8	381.8	381.4	383.8	383.1	383.6	382.9	384.3	383.5
RSA1200A2	72725	72726	60" CMP Culvert	200	25	380.0	379.8	51	15	59	54	70	383.5	382.8	381.8	381.4	383.8	383.1	383.6	382.9	384.3	383.5
RSA1200ARD	72725	72726	Roadway	200		393.0	393.0	0	0	0	0	0	382.8	382.8	381.4	381.4	383.1	383.1	382.9	382.9	383.5	383.5
RSA1200B	72724	72725	Natural	950	25	380.6	379.8	138	155	145	171	225	383.6	383.5	383.2	381.8	383.9	383.8	383.7	383.6	384.4	384.3
RSA1230A.1	72723	72724	60" CMP Culvert	136	25	381.9	380.6	142	159	150	171	187	387.2	383.6	388.2	383.2	387.4	383.9	388.8	383.7	389.5	384.4
RSA1230ARD	72723	72724	Roadway	136		389.0	389.0	0	0	0	0	40	383.6	383.6	383.2	383.2	383.9	383.9	383.7	383.7	389.5	389.3
RSA1230B	72722	72723	Natural	900	25	381.6	381.9	135	150	140	164	209	387.3	387.2	388.3	388.2	387.5	387.4	388.9	388.8	389.6	389.5
RSA1230C	72721	72722	Natural	1400	25	382.6	381.6	148	184	146	224	245	387.4	387.3	388.3	388.3	387.6	387.5	388.9	388.9	389.6	389.6
RSA1230D1	72720	72721	36" CSP Culvert	68	25	382.7	382.7	53	68	50	86	95	388.5	387.4	390.0	388.3	388.7	387.6	391.3	388.9	392.6	389.6
RSA1230D2	72720	72721	36" CSP Culvert	68	25	382.6	382.6	53	68	50	86	95	388.5	387.4	390.0	388.3	388.7	387.6	391.3	388.9	392.6	389.6
RSA1230D3	72720	72721	36" CSP Culvert	68	25	382.6	382.6	53	68	50	86	95	388.5	387.4	390.0	388.3	388.7	387.6	391.3	388.9	392.6	389.6
RSA1230DRD	72720	72721	Roadway	68		393.7	393.7	0	0	0	0	0	387.4	387.4	388.3	388.3	387.6	387.6	388.9	388.9	389.6	389.6
RSA1230E	72719	72720	Natural	900	25	384.2	382.6	165	217	153	316	361	388.7	388.5	390.1	390.0	388.8	388.7	391.3	391.3	392.7	392.6
RSA1060F.1	85030	71215	48" CMP Culvert	30	10	366.2	365.7	13	14	11	15	19	368.8	368.8	368.5	368.5	368.9	368.9	369.1	369.1	369.5	369.5
RSA1060Fa	71214	85030	Natural	415	10	368.7	366.2	12	12	11	15	18	369.4	368.8	369.4	368.5	369.4	368.9	369.5	369.1	369.6	369.5
RSA1060FRD	85030	71215	Roadway	30		371.2	371.2	0	0	0	0	0	368.8	368.8	368.5	368.5	368.9	368.9	369.1	369.1	369.5	369.5
RSA1060G1	71213	71214	2x4.5' Box Culvert	31	10	369.1	368.7	12	12	11	15	18	369.8	369.4	369.8	369.4	369.8	369.4	369.9	369.5	370.1	369.6
RSA1060GRD	71213	71214	Roadway	31		373.7	373.7	0	0	0	0	0	369.4	369.4	369.4	369.4	369.4	369.4	369.5	369.5	369.6	369.6

APPENDIX B
TABLE B-4
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM UNDER FUTURE LAND USE CONDITIONS WITH CIPs

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Invert Elevation (ft)		Peak Flow (cfs) Future Land Use Conditions					Water Surface Elevation under Future Land Use Conditions (ft)									
													10-Year		25-Year Summer		25-Year Winter		50-Year		100-Year	
	US	DS				US	DS	10-Year	25-Year-S	25-Year-W	50-Year	100-Year	US	DS	US	DS	US	DS	US	DS	US	DS
RSA1060H	71212	71213	Natural	1034	10	370.3	369.1	12	12	11	15	18	371.7	369.8	371.7	369.8	371.7	369.8	371.8	369.9	371.9	370.1
RSA1060I1	71211	71212	18" CMP Culvert	42	10	370.7	370.5	6	6	5	7	9	372.0	371.7	371.9	371.7	371.9	371.7	372.1	371.8	372.2	371.9
RSA1060I2	71211	71212	18" CMP Culvert	42	10	370.7	370.3	7	7	6	8	10	372.0	371.7	371.9	371.7	371.9	371.7	372.1	371.8	372.2	371.9
RSA1060IRD	71211	71212	Roadway	42		375.7	375.7	0	0	0	0	0	371.7	371.7	371.7	371.7	371.7	371.7	371.8	371.8	371.9	371.9
RSA1060J	71210	71211	Natural	712	10	372.0	370.7	13	13	11	15	18	373.1	372.0	373.1	371.9	373.1	371.9	373.2	372.1	373.3	372.2
RSA1060S.1	85031	71210	36" x 72" CMP Culvert	18	10	371.8	372.1	37	37	34	43	50	374.0	373.5	374.0	373.5	373.9	373.4	374.2	373.6	374.4	373.8
RSA1060Sa	71209	85031	Natural	586	10	371.5	371.8	37	37	34	43	50	374.2	374.0	374.2	374.0	374.1	373.9	374.4	374.2	374.5	374.4
RSA1060SRD	85031	71210	Roadway	18		375.9	375.9	0	0	0	0	0	373.1	373.1	373.1	373.1	373.1	373.1	373.2	373.2	373.3	373.3
RSA1060U	72749	71209	Natural	308	10	371.3	371.5	63	64	58	74	83	374.4	374.2	374.4	374.2	374.3	374.1	374.6	374.4	374.8	374.5
RSA1080A.1	72748	72749	48" CMP Culvert	40	10	371.7	371.3	63	64	58	74	84	375.2	374.4	375.2	374.4	375.0	374.3	375.6	374.6	375.9	374.8
RSA1080ARD	72748	72749	Roadway	40		376.5	376.5	0	0	0	0	0	374.4	374.4	374.4	374.4	374.3	374.3	374.6	374.6	374.8	374.8
RSA1080B	72791	72748	Natural	1857	10	372.4	371.7	37	37	33	38	41	376.6	375.2	376.6	375.2	376.1	375.0	377.0	375.6	377.5	375.9
RSA1090A.1	72790	72791	42" CSP Culvert	438	10	374.3	372.4	41	42	34	48	53	377.5	376.6	377.5	376.6	376.8	376.1	378.0	377.0	378.7	377.5
RSA1090ARD	72790	72791	Roadway	438		379.8	379.7	0	0	0	0	0	376.6	376.6	376.6	376.6	376.1	376.1	377.0	377.0	377.5	377.5
RSA1090B	72789	72790	Natural	18	10	374.3	374.3	41	43	34	49	56	377.5	377.5	377.5	377.5	376.9	376.8	378.0	378.0	378.7	378.7
RSA1090C1	72788	72789	27" x 40" CMP Culvert	30	10	374.4	374.3	21	21	17	25	25	377.8	377.5	377.8	377.5	377.1	376.9	378.3	378.0	378.7	378.7
RSA1090C2	72788	72789	27" x 40" CMP Culvert	30	10	374.5	374.3	21	21	17	25	25	377.8	377.5	377.8	377.5	377.1	376.9	378.3	378.0	378.7	378.7
RSA1090CRD	72788	72789	Roadway	30		378.1	378.1	0	0	0	9	42	377.5	377.5	377.5	377.5	376.9	376.9	378.3	378.2	378.7	378.7
RSA1090D	72787	72788	Natural	386	10	374.7	374.4	23	23	20	22	24	377.9	377.8	377.9	377.8	377.3	377.1	378.3	378.3	378.7	378.7
RSA1090E1	72786	72787	2x8' box Culvert	40	10	375.0	374.7	24	24	19	24	22	377.9	377.9	377.9	377.9	377.3	377.3	378.3	378.3	378.7	378.7
RSA1090ERD	72786	72787	Roadway	40		377.9	377.9	0	1	0	18	25	377.9	377.9	377.9	377.9	377.3	377.3	378.3	378.3	378.7	378.7
RSA1090F	72785	72786	Natural	772	10	375.1	375.0	25	26	20	38	42	378.0	377.9	378.0	377.9	377.4	377.3	378.3	378.3	378.7	378.7
RSA1090G1	72784	72785	36" CMP Culvert	91	10	375.0	375.1	13	14	10	22	24	378.0	378.0	378.1	378.0	377.5	377.4	378.4	378.3	378.8	378.7
RSA1090G2	72784	72785	36" CMP Culvert	91	10	375.1	375.1	13	14	10	22	25	378.0	378.0	378.1	378.0	377.5	377.4	378.4	378.3	378.8	378.7
RSA1090GRD	72784	72785	Roadway	91		381.0	380.9	0	0	0	0	0	378.0	378.0	378.0	378.0	377.4	377.4	378.3	378.3	378.7	378.7
RSA1100A	72783	72784	Natural	19	10	376.0	375.0	11	-7	10	-12	-15	378.0	378.0	378.1	378.1	377.5	377.5	378.4	378.4	378.8	378.8
RSA1100B.1	72782	72783	24" x 42" CMP Culvert	858	10	376.5	376.0	11	-7	10	12	14	378.5	378.0	377.7	378.1	378.4	377.5	378.6	378.4	378.8	378.8
RSA1100BRD	72782	72783	Roadway	800		380.0	380.0	0	0	0	0	0	378.0	378.0	378.1	378.1	377.5	377.5	378.4	378.4	378.8	378.8
RSA1100C	72781	72782	Natural	9	10	376.5	376.5	16	16	17	18	21	378.5	378.5	378.2	377.7	378.4	378.4	378.6	378.6	378.8	378.8

APPENDIX B
TABLE B-4
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM UNDER FUTURE LAND USE CONDITIONS WITH CIPs

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Invert Elevation (ft)		Peak Flow (cfs) Future Land Use Conditions					Water Surface Elevation under Future Land Use Conditions (ft)									
													10-Year		25-Year Summer		25-Year Winter		50-Year		100-Year	
	US	DS				US	DS	10-Year	25-Year-S	25-Year-W	50-Year	100-Year	US	DS	US	DS	US	DS	US	DS	US	DS
RSA1100D.1	72780	72781	30" CSP Culvert	24	10	376.5	376.5	16	16	17	18	21	378.7	378.5	378.5	378.2	378.6	378.4	378.7	378.6	378.9	378.8
RSA1100DRD	72780	72781	Roadway	24		380.2	380.2	0	0	0	0	0	378.5	378.5	378.2	378.2	378.4	378.4	378.6	378.6	378.8	378.8
RSA1100E	72793	72780	Natural	133	10	376.6	376.5	16	16	17	18	21	378.7	378.7	378.6	378.5	378.7	378.6	378.8	378.7	379.0	378.9
RSA1100F.1	72792	72793	30" CSP Culvert	30	10	376.7	376.6	16	16	17	18	21	378.9	378.7	378.8	378.6	379.0	378.7	379.1	378.8	379.3	379.0
RSA1100FRD	72792	72793	Roadway	30		380.0	380.0	0	0	0	0	0	378.7	378.7	378.6	378.6	378.7	378.7	378.8	378.8	379.0	379.0
RSA1100G	72779	72792	Natural	135	10	376.8	376.7	16	16	17	18	21	379.0	378.9	378.9	378.8	379.1	379.0	379.1	379.1	379.3	379.3
RSA1100K	72798	72779	Natural	740	10	376.9	376.8	10	-10	11	10	12	379.0	379.0	378.9	378.9	379.1	379.1	379.1	379.1	379.3	379.3
RSA1100L.1	72102	72798	36" CMP Culvert	292	10	378.2	376.9	9	6	9	10	11	379.5	379.0	379.2	378.9	379.6	379.1	379.6	379.1	379.8	379.3
RSA1100LRD	72102	72798	Roadway	292		413.5	413.5	0	0	0	0	0	379.0	379.0	378.9	378.9	379.1	379.1	379.1	379.1	379.3	379.3
RSA1100H	72778	72779	Natural	50	10	376.7	376.8	15	26	16	39	46	379.0	379.0	378.9	378.9	379.1	379.1	379.1	379.1	379.3	379.3
RSA1100I.1	72777	72778	36" CSP Culvert	70	25	376.9	376.7	16	26	16	41	48	379.1	379.0	379.3	378.9	379.1	379.1	379.9	379.1	380.2	379.3
RSA1100IRD	72777	72778	Roadway	70		382.3	382.3	0	0	0	0	0	379.0	379.0	378.9	378.9	379.1	379.1	379.1	379.1	379.3	379.3
RSA1100J	72776	72777	Natural	180	10	377.2	376.9	16	26	16	43	50	379.2	379.1	379.3	379.3	379.1	379.1	380.0	379.9	380.3	380.2
RSA1110A1	72103	72776	30" CSP Culvert	280	25	377.6	377.2	8	13	8	23	26	379.3	379.2	379.8	379.3	379.3	379.1	381.2	380.0	381.9	380.3
RSA1110A2	72103	72776	30" CSP Culvert	280	25	377.6	377.2	8	13	8	23	26	379.3	379.2	379.8	379.3	379.3	379.1	381.2	380.0	381.9	380.3
RSA1110ARD	72103	72776	Roadway	280		382.0	382.0	0	0	0	0	0	379.2	379.2	379.3	379.3	379.1	379.1	380.0	380.0	380.3	380.3
RSA1060K	71208	72740	Natural	800	10	371.6	366.7	34	38	36	34	31	372.5	370.2	372.5	370.0	372.6	370.2	372.5	370.4	372.5	370.8
RSA1060L	71207	71208	2x4' Box Culvert	40	10	371.6	371.6	24	24	22	27	29	373.0	372.5	373.0	372.5	373.0	372.6	373.1	372.5	373.3	372.5
RSA1060M	71210	71207	Natural	550	10	370.8	371.6	24	24	22	27	30	373.1	373.0	373.1	373.0	373.1	373.0	373.2	373.1	373.3	373.3
RSA1060N.1	72754	72739	36" CMP Culvert	25	10	368.9	368.4	24	26	23	28	30	371.8	371.5	371.5	371.2	371.9	371.6	372.0	371.7	372.5	372.1
RSA1060NRD	72754	72739	Roadway	25		373.1	373.0	0	0	0	0	0	371.5	371.5	371.2	371.2	371.6	371.6	371.7	371.7	372.1	372.1
RSA1060O	72753	72754	Natural	320	10	371.4	368.9	24	24	23	27	29	372.8	371.8	372.8	371.5	372.7	371.9	372.8	372.0	372.9	372.5
RSA1060P.1	72752	72753	26" x 42" CMP Culvert	40	10	371.6	371.4	24	24	23	27	29	373.5	372.8	373.5	372.8	373.4	372.7	373.6	372.8	373.7	372.9
RSA1060PRD	72752	72753	Roadway	40		374.9	374.9	0	0	0	0	0	372.8	372.8	372.8	372.8	372.7	372.7	372.8	372.8	372.9	372.9
RSA1060Q	72751	72752	Natural	330	10	371.2	371.6	25	24	23	27	30	373.6	373.5	373.6	373.5	373.5	373.4	373.7	373.6	373.8	373.7
RSA1060R.1	72750	72751	36" CMP Culvert	40	10	371.5	371.2	25	25	23	29	32	374.1	373.6	374.1	373.6	374.0	373.5	374.3	373.7	374.5	373.8
RSA1060RRD	72750	72751	Roadway	40		375.4	375.4	0	0	0	0	0	373.6	373.6	373.6	373.6	373.5	373.5	373.7	373.7	373.8	373.8
RSA1060T	71209	72750	Natural	270	10	371.5	371.5	25	26	23	29	32	374.2	374.1	374.2	374.1	374.1	374.0	374.4	374.3	374.5	374.5
RSA1160I.1	59020	72726	60" CMP Culvert	1081	10	380.8	379.5	-13	-2	-17	-14	-22	381.8	382.8	381.2	381.4	381.9	383.1	381.9	382.9	382.1	383.5
RSA1160IRD	59020	72726	Roadway	1081		388.8	393.0	0	0	0	0	0	381.2	381.2	377.2	377.2	381.3	381.3	380.7	380.7	382.1	382.1
RSA1210A.1	59021	59020	54" CSP Culvert	560	10	381.2	380.8	42	57	38	79	92	383.9	382.7	384.4	383.0	383.8	382.6	385.2	383.4	385.8	383.6
RSA1210ARD	59021	59020	Roadway	560		390.6	388.8	0	0	0	0	0	381.2	381.2	377.2	377.2	381.3	381.3	380.7	380.7	382.1	382.1

APPENDIX B
TABLE B-4
HYDRAULIC PERFORMANCE OF THE RIVER ROAD SANTA CLARA STORM DRAINAGE SYSTEM UNDER FUTURE LAND USE CONDITIONS WITH CIPs

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Invert Elevation (ft)		Peak Flow (cfs) Future Land Use Conditions					Water Surface Elevation under Future Land Use Conditions (ft)									
													10-Year		25-Year Summer		25-Year Winter		50-Year		100-Year	
	US	DS				US	DS	10-Year	25-Year-S	25-Year-W	50-Year	100-Year	US	DS	US	DS	US	DS	US	DS	US	DS
RSA1210B.1	59112	59021	48" CSP Culvert	1506	10	382.3	381.2	16	22	14	32	35	384.4	383.9	385.0	384.4	384.3	383.8	386.0	385.2	386.8	385.8
RSA1210BRD	59112	59021	Roadway	1506		390.0	390.6	0	0	0	0	0	384.4	384.4	385.0	385.0	384.3	384.3	386.0	386.0	386.8	386.8
RSA1210C.1	85032	59112	36" CSP Culvert	33	10	382.8	382.8	16	22	14	30	34	384.5	384.4	385.1	385.0	384.4	384.3	386.1	386.0	386.9	386.8
RSA1210CRD	85032	59112	Roadway	33		390.0	390.0	0	0	0	0	0	384.4	384.4	385.0	385.0	384.3	384.3	386.0	386.0	386.8	386.8
RSA1210D	76744	59059				384.3	382.8	16	22	14	31	34	385.7	384.5	386.0	385.1	385.6	384.4	386.9	386.1	388.0	386.9
Pipe Segments associated with some UIC CP Pipe and Pretreat Projects																						
Shirley-1	Shirley	74030	30" CSP Culvert	1090	10	377.1	374.9	3	3	3	5	7	378.4	378.4	378.3	378.2	378.5	378.5	379.2	379.1	380.7	380.5
Shirley-2	Shirley	74030	30" CSP Culvert	1090	10	377.1	374.9	3	3	3	5	7	378.4	378.4	378.3	378.2	378.5	378.5	379.2	379.1	380.7	380.5
Stark	Crocker	76483	36" CSP Culvert	1060	10	376.5	374.4	3	5	3	6	7	378.1	378.1	377.9	377.9	378.3	378.3	378.8	378.7	379.9	379.9
BushnelST	Bushnell	72730	18" CSP Culvert	1015	10	379.9	377.9	1	1	0	1	1	382.2	382.2	380.8	380.8	382.5	382.5	382.3	382.3	382.9	382.9
Dalton	Hamilton	76744	36" CSP Culvert	1100	10	386.5	384.3	4	5	3	8	9	387.2	385.7	387.3	386.0	387.2	385.6	387.6	386.9	388.2	388.0

APPENDIX C

METHODOLOGY FOR ESTIMATING THE EFFECTIVE IMPERVIOUS AREA OF URBAN WATERSHEDS

Technical Note 58

Methodology for Estimating the Effective Impervious Area of Urban Watersheds

By: Roger C. Sutherland, P.E.

One of the most difficult and important param eters that must be estimated for accurate hydrologic analyses is the effective impervious area (EIA) of a watershed or basin of interest. Effective impervious area (EIA) is the portion of the mapped impervious area (MIA) within a basin that is directly connected to the drainage collection system. EIA includes street surfaces, paved driveways connecting to the street, sidewalks adjacent to curbed streets, rooftops which are hydraulically connected to the curb or storm sewer system, and parking lots.

EIA is usually reported as a percentage of total basin or subbasin area. In traditional urban runoff modeling or hydrologic analysis, the EIA for a given basin is usually less than the MIA. However, in highly urbanized basins, EIA values can approach and equal MIA values.

Effective impervious area is the portion of total impervious cover that is directly connected to the storm drain network.

The EIA of a basin is an important parameter in the rainfall to runoff process because it directly affects the volume of runoff. Many hydrological models assume all the precipitation that falls on impervious areas becomes direct runoff. In actuality, the precipitation falling on impervious areas which are not hydraulically connected to the drainage collection system will not always result in direct runoff. Impervious area that does not contribute directly to runoff should be subtracted from the mapped impervious area to obtain the *effective* impervious area, in order to get a more accurate estimate of runoff volumes.

Determination of Effective Impervious Area

The methodology for determining EIA has been refined through three levels:

1. Direct measurement in the field

The direct measurement of EIA is a tedious exercise which is rarely undertaken since most consultants cannot afford its excessive labor cost. To actually measure the EIA of a basin, it is necessary to catalog and evaluate the effectiveness of the hydraulic connection between *each* of the impervious areas and the major collector systems. This extremely time consuming exercise is impractical for most drainage planning and design related activities.

2. Derivation from models run on gauging data

If a basin is gaged, the effective impervious area can be estimated by employing a rainfall-to-runoff model like HEC-1 or SWMM to calibrate the EIA parameter. This calibration is performed by fixing reasonable estimates of the precipitation loss components for the pervious portions of the basin and impervious areas, then adjusting the value of EIA to correlate computed and observed runoff volumes. The calibration process should be undertaken for several observed rainfall events, with the final estimate of EIA representing the weighted average of those values calibrated for each individual storm.

3. Empirical equations derived from whole-basin or subbasin parameters

Empirical equations can be developed to compute realistic values of EIA based on physical basin parameters that are easy to estimate. For example, the U.S.G.S. developed estimates of EIA for over forty watersheds throughout the metropolitan areas of Portland and Salem, Oregon (Laenen, 1980 and 1983). Working with this database, the U.S.G.S. also developed an empirical equation to estimate EIA as a function of MIA.

It should be noted that the modeling technique used by the U.S.G.S. lumped all of the precipitation excess into a single optimized percentage of the basin area that was assumed to be contributing runoff. This optimized value was defined as the effective impervious area. Working with these optimized values (in %) of EIA and their corresponding MIA values, the U.S.G.S. (Laenen, 1983) developed the following equation:

$$\mathrm{EIA} = 3.6 + 0.43\,(\mathrm{MIA}) \qquad (1)$$

Equation (1) has been found to work well for MIA values greater than 10% and less than 50% but provides unrealistic EIA values for MIA values outside of this range, i.e., the more urbanized areas. In surface water management master planning, one commonly deals with *small subbasins* (i.e. 20 to 70 acres) in which the ultimate mapped impervious area can routinely exceed 50%, and may be as high as 90%.

Therefore, there is a need to develop a better relationship between MIA and EIA and several alternative equations have been recently developed, based upon the U.S.G.S. data, to satisfy this need, known as the Sutherland Equations.

The general form of the equation to describe the relationship between MIA and EIA is as follows:

$$EIA = A\ (MIA)^{B} \quad (2)$$

In Equation (2), A and B are a unique combination of numbers such that the following criteria are satisfied:

1. If MIA = 1 then EIA = 0%
2. If MIA = 100 then EIA = 100%

Based on the U.S.G.S. calibrated values of EIA for all basins with MIA $\geq$ 4%, several empirical equations were developed to apply to various generalized conditions of subbasins which may be encountered in the drainage master planning process. The first equation presented below (i.e. Equation 3) provided the best fit for all of the MIA versus EIA data used in the analysis. The remaining equations were based primarily on engineering judgement and experience as it relates to the various subbasin conditions which affect EIA.

The **Sutherland EIA Equations** are as follows:

1. *Average basins* where the local drainage collector systems for the urban areas within the basin are predominantly storm sewered with curb and gutters, no dry wells or other drainage infiltration areas are known to exist, and the rooftops in the single family residential areas are not connected to the storm sewer or piped directly to the street curb.

$$EIA = 0.1\ (MIA)^{1.5},\ MIA \geq 1 \quad (3)$$

2. *Highly connected basins* where everything in Condition 1 applies except the residential rooftops are predominantly connected to the streets or storm sewer system.

$$EIA = 0.4\ (MIA)^{1.2},\ MIA \geq 1 \quad (4)$$

3. Totally connected basins where 100% of the urban area within the basin is storm-sewered, with all impervious surfaces appearing to be directly connected to the system.

$$EIA = MIA \quad (5)$$

4. Somewhat disconnected basins where at least 50% of the urban areas within the basin are not storm sewered, but are served by grassy swales or roadside ditches, and the residential rooftops are not directly connected. Alternatively, Condition 1 may apply, but the basin is known to have a few dry wells or other infiltration areas.

$$EIA = 0.04\ (MIA)^{1.7},\ MIA \geq 1 \quad (6)$$

5. Extremely disconnected basins where only a small percentage of the urban area within the basin is storm sewered, or a large portion of the basin area (i.e. 70 percent or more) drains to dry wells or other infiltration areas.

$$EIA = 0.01\ (MIA)^{2.0},\ MIA \geq 1 \quad (7)$$

Figure 1 compares the Sutherland EIA Equations along with the original U.S.G.S. Equation for the range of impervious data collected in Oregon. The variation in the 42 actual subbasin data presented in Figure 58.1 demonstrates the difficulty in accurately estimating the EIA of a drainage basin. It is imperative that the drainage planner or engineer performs some degree of on-site investigation of the basin to determine which EIA equation may apply to the given circumstance. The greatest strength of the Sutherland EIA Equations is their consistency in providing reasonable estimates of EIA over the entire range of MIA. Therefore, they can be used in the surface water management planning process to estimate the change in EIA which will occur as a basin becomes urbanized.

References

Laenen, A. 1980. Storm Runoff as Related to Urbanization in the Portland, Oregon - Vancouver, Washington Area, U.S.G.S. Water Resource Investigations Open File Report 80-689.

Laenen, A. 1983. Storm Runoff as Related to Urbanization Based on Data Collected in Salem and Portland and Generalized for the Willamette Valley, Oregon, U.S.G.S. Water Resources Investigations Open File Report 83-4143.

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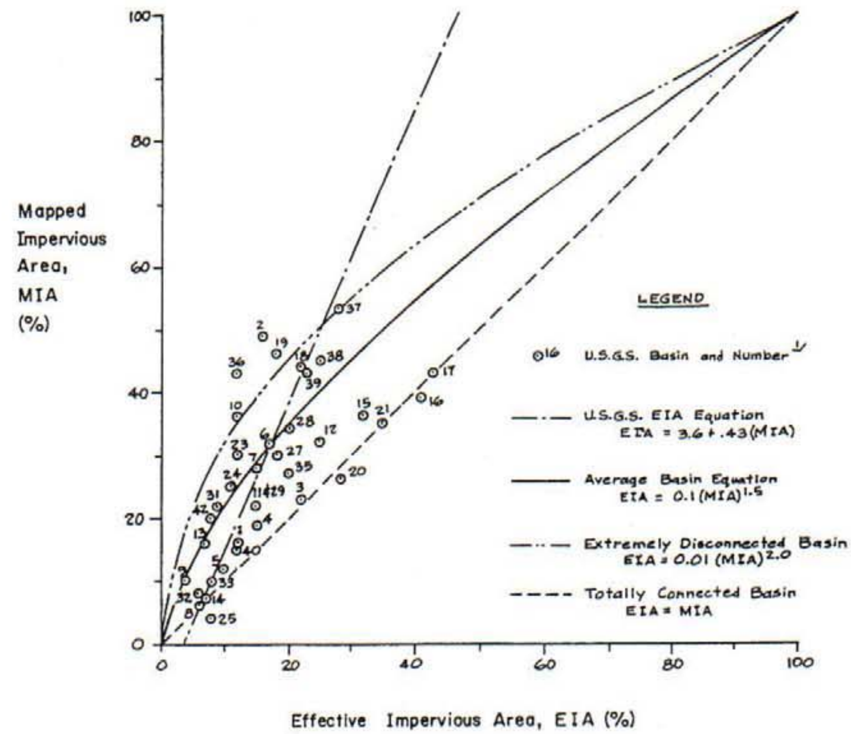
Figure 58.1: Plot of Sutherland equations and USGS equation



1/ EIA values were based on a U.S.G.S. rainfall to runoff model study. Only points with MIA ≥ 4 were plotted (Laenen, 1980 and 1983).

APPENDIX D

CAPITAL PROJECT UNIT COST TABLES

APPENDIX D
Eugene Basin Planning
Unit Cost Tables for Estimating Capital Project (CP) Costs
August 2009

INTRODUCTION

The following tables provide the unit costs and back-up documentation associated with material and construction costs for various drainage system components.

The purpose of these tables is to provide general guidance with respect to CP costs and to allow for cost comparisons between CPs. These unit costs are based on original and refined unit costs used for the Eugene Master Plan in 1999 with a 15% increase to all original unit costs to reflect current conditions (2007). These increased costs are only applicable to the scale of projects in the City's preliminary storm system CP list. They are not applicable to projects that are of a much smaller or larger scale than those preliminary CPs.

Tables 1 through 4 – Tables 1 through 4 provide estimated capital/construction costs for each CP type (e.g., pipe installation, open channel improvements, and detention and water quality facilities). Table 1 provides cost estimates for all of the CP types except for pipes and structural water quality treatment systems (i.e., CONTECH Storm Filter). Table 2 provides cost estimates for drainage pipe, based on pipe size and depth of cover. Table 3 provides detailed back-up information regarding estimated construction costs for drainage pipe installation. Table 4 provides cost estimates for five different sized structural water quality facilities (i.e., CONTECH Storm Filter). For many of the CPs in Table 1 and the pipe costs in Table 2, the unit cost must be multiplied by a quantity such as acre-feet, square yards, or lineal feet to estimate the total capital cost for that CP.

Tables 5 through 7 – Tables 5 through 7 provide the back-up information that was used to estimate the unit costs for CP types listed in Table 1. Table 5 provides unit costs for the various elements that comprise each CP (e.g., labor, excavation, etc.). Table 6 provides the quantities of each element that comprise the CPs (e.g., 1 hour of labor, 6 cubic yards of excavation, etc.). Table 7 provides the detailed back-up capital/construction cost information for each CP type based on Tables 5 and 6.

(Note: a revision was made to the Natural Resource Enhancement and Open Waterway Improvement Construction unit costs November 2001. See the addendum following this summary, prior to the tables.)

Table 8 – Table 8 provides the estimated maintenance costs for each CP type. For many of the CPs, the maintenance cost must be multiplied by a unit such as acre-feet or square yards in order to come up with the total estimated maintenance cost.

Estimated maintenance costs have been calculated and reported for flood control CPs. A maintenance cost is not provided for capital projects to increase the pipe sizes based on the assumption that maintenance of piped systems typically includes catch basin/manhole cleaning and that this cleaning is already being conducted for the existing piped system. A general maintenance cost is provided for water quality CPs (CONTECH StormFilter and raingardens), based on personal communication (emails and phone calls).

Table 9 – Table 9 provides the detailed back-up information for estimating the maintenance costs for each CP type except for increased pipe sizes and raingardens.

Tables 1, 2, 4, and 8 were used to estimate capital and maintenance costs that are provided in the draft CP fact sheets. Tables 3, 5, 6, 7 and 9 are only provided to show back-up for information presented in Tables 1, 2, 4, and 8.

November 1, 2001

Addendum to Natural Resource Enhancement and Open Waterway Improvement Construction Unit Costs

As requested by the City, URS has reviewed and recommended revisions to the construction activity/material unit costs developed for the Storm Drainage Master Planning project for open channel improvements (Types 1 and 2), natural resource enhancement, and natural resource revegetation. The distinction between these project types for basin planning was as follows:

- Open channel improvements (Type 1) – Modify existing channels. Construction activities and materials included traffic control, excavation (0 to 10 foot bottom width, 4 to 6 foot depth, 3:1 side slopes), hydroseed, and erosion protection at inlets and outlets.
- Open channel improvements (Type 2) – Modify existing channels. Construction activities and materials included the same elements as for Type 1 except channel excavation was increased to a 10 to 20 foot bottom width and 6 to 10 foot depth.
- Natural resource enhancement – Plant additional vegetation.
- Natural resource revegetation – Remove invasive vegetation, grade and revegetate.

For each of these project types, overall unit costs were developed based on unit costs for construction activities and materials including: traffic control, general excavation, hydroseeding, trees and shrubs, riprap, and erosion control. In this letter, we revised our unit costs for the project construction activities and materials based on a review of bid tabulations from two recently completed enhancement projects in Eugene (i.e., the 1135 and ACE projects), the Longfellow Creek Habitat Improvement Project in Seattle, Washington, the Oregon Department of Transportation Historical Bid Price Listings, and the RS Means 2000 Heavy Construction Cost Data book. This letter report includes a description of how the specific construction activities/materials unit costs were revised, a discussion of how recommended unit costs were identified, a recommended new unit cost for natural resource enhancement, and a recommendation for computing construction costs for open waterway improvements.

Unit Costs Compiled from Other Projects/Sources

Table 1 presents the unit costs from the above mentioned projects and sources for each of the appropriate construction activities/materials. Clearing and grubbing, and grading were added to the list of construction activities and materials because it is likely that with most natural resource enhancement projects some clearing and grubbing of invasive vegetation or dead trees will be necessary and that regrading of the top soil will also be necessary. The range of unit costs, which can be compared with the existing basin planning unit costs, is provided in Table 1. From this range, we developed new recommended unit costs to be used for the construction activities/materials elements of the project types. For those elements that had unit costs from more than two projects/sources (i.e., general excavation, hydroseeding, trees, shrubs, and riprap) the average of the unit costs was recommended. For elements that had only two sources (i.e., clearing and grubbing, grading, and erosion control), the numbers were compared with the existing basin planning costs and an average was taken of all three. The recommended unit costs (rounded up to the nearest dollar) are presented in Table 1.

Natural Resource Enhancement

The natural resource enhancement and natural resource revegetation project types were combined into one type of improvement “natural resource enhancement”. For earlier basin planning, natural resource enhancement included planting of trees/shrubs only, while natural resource revegetation included general excavation, hydroseeding, planting trees/shrubs, and erosion control. During this review it was determined that it would be unlikely that a capital project would include only tree/shrub planting, and that if the natural resources of an area were designated to be enhanced, that enhancement would likely include some clearing and grubbing, grading, hydroseeding, planting trees/shrubs and erosion control. Clearing and grubbing, and grading were added because it is likely that with most natural resource enhancement projects some clearing and grubbing of invasive vegetation or dead trees would be necessary and that regrading of the top soil would also be necessary. For a strictly natural resource enhancement project (i.e., no channel modifications) it is unlikely that much excavation would be necessary, therefore excavation was removed from the cost estimate. The construction activities/materials that comprise natural resource enhancement now include clearing and grubbing, grading, hydroseeding, planting trees/shrubs, and erosion control.

The original basin planning costs for natural resource enhancement and natural resource revegetation were $10/square yard (SY) and $49/SY respectively. After combining the two types of projects into one type, natural resource enhancement, the new recommended unit cost is $13/SY, as presented in the table below.

Natural Resource Enhancement Unit Cost

Construction Activity/Material	Units	Unit Costs	Units	Unit Costs	Comments
Clearing and Grubbing	AC	$4,300	SY	$0.90	
Grading	CY	$5	SY	$5	Assume a maximum depth of 1 foot to be regraded.
Hydroseed	AC	$3,200	SY	$0.66	
Trees/Shrubs	EA	$120/$36	SY	$6	Assume trees planted at 20-foot spacing on-center (O.C.) and shrubs planted at 10 feet O.C.
Erosion Control	AC	$3,800	SY	$0.62	
Total for Natural Resource Enhancement			**SY**	**$13**	

Although the construction activity and material unit costs for clearing and grubbing, hydroseed and erosion control increased, they are being applied on a square yard basis. Therefore, these increases did not have much impact on the unit cost for natural resource enhancement. The greatest factor that led to the decrease in the unit cost for natural resource enhancement is the modification to the quantity of trees/shrubs per square yard. In the calculations for the basin planning costs, the quantity of trees/shrubs was 0.5 each per SY, which corresponds to a tree/shrub planted approximately every 4 feet O.C. During this review, it was determined that a more appropriate spacing for shrubs would be every 8 feet O.C. and every 20 feet O.C. for trees. For example, on a 100 foot long, 25 foot wide buffer the revised spacing would allow for planting of either 12 trees at a unit cost of $120/tree or 52 shrubs at a unit cost of $36/shrub, while the original basin planning allowed approximately 139 trees/shrubs to be planted. On a square yard basis, the basin planning costs for trees/shrubs as part of natural resource enhancement were approximately $25/SY, while the recommended unit costs would be approximately $6/SY for either trees or shrubs. Another significant factor in the decrease of the natural resource enhancement unit cost was the quantity of erosion control per SY in the basin planning quantity tables. The basin planning quantity tables indicated that 0.008 acres (38.7 SY) of erosion control would be applied every SY. It appears that this quantity was an error and that the correct quantity for erosion control per SY would be 0.0002 AC (1 SY) per SY.

Open Waterway Improvements

Before this review, open channel improvements were divided into two different types (i.e., Type 1 and Type 2). Both the Type 1 and Type 2 improvements included traffic control, excavation, hydroseeding, trees and shrubs, riprap, and erosion control. The estimated construction costs per unit were based on lineal feet. During this review, it was determined that there was a need to determine quantities for each open waterway improvement project specifically, rather than rely on general quantities for the various construction activities/materials. The quantities that are input into the cost tables have a significant impact on the overall cost of open waterway improvements. The quantity of excavation, the area to be hydroseeded and the area disturbed for which erosion control would be needed vary greatly between projects. Therefore, we are not recommending a general construction unit cost for open waterway improvements. We are recommending that each project be evaluated individually and that costs are developed based on the recommended unit costs for construction activities and materials provided in Table 1. In addition, if each open waterway improvement project is evaluated individually there is no longer a need for two different types of improvements. Therefore, we recommend that these improvements be combined into one category.

TABLE 1
STORMWATER FACILITIES
ESTIMATED CONSTRUCTION COSTS PER UNIT

Stormwater Facility Type	Unit	$/Unit[Notes 1+2]	Description of Stormwater Facility Construction Activities
Trash Rack Inlet (Type 1)	EA	$5,940	Cone shaped rebar cage bolted to an inlet structure (manhole or vault), inlet protection (riprap, geotextile fabric), clearing of invasive vegetation, grading and revegetation .
Trash Rack Inlet (Type 2)	EA	$9,970	Steel trash rack approximately 15 ft wide and 4 ft high placed in the channel with concrete foundation walls on both banks. Also includes inlet protection, clearing of invasive vegetation, grading and revegetation.
Garbage and Debris Removal	CY	$120	Hand collected debris not requiring mechanical means to lift, hauled in 10 CY truck to disposal.
Sediment Removal	CY	$250	Removal of sediment from channels and culverts with heavy equipment. Includes hydroseeding for revegetation.
Streambank Stabilization	SY	$90	Grading, geotextile, toe reinforcement, revegetation and erosion control.
Open Channel Improvements (Type 1)	LF	$350	Traffic control, excavation (0 to10 ft bottom width, 4 to 6 ft depth, 3:1 side slopes), hydroseed, erosion protection at inlet and outlet. Modification of existing channel.
Open Channel Improvements (Type 2)[Note 4]	LF	$730	Same as above except 10 to 20 ft bottom width, 6 to 10 ft depth.
Dry Extended Pond	Ac-Ft	$59,700	Gravel access road (25 ft long x 12 ft width), clearing & grubbing, excavation (3 ft depth), grading, erosion protection at inlet & outlet, hydroseed, trees & shrubs, safety fence, erosion control.
Wet Extended Pond	Ac-Ft	$59,700	Gravel access road (25 ft long x 12 ft width), clearing & grubbing, excavation (3-6 ft depth), grading, erosion protection at inlet & outlet, hydroseed, trees & shrubs, safety fence, erosion control. No lining has been included.
Stormwater Marsh/Wetland	AC	$88,300	Gravel access road (25 ft long x 12 ft width), grading (1-2 ft depth, no removal from site), erosion protection at inlet & outlet, hydroseed, vegetation and erosion control.
Flood Control Facility	Ac-Ft	$59,700	Gravel access road (25 ft long x 12 ft width), clearing & grubbing, excavation (3 ft depth), grading, erosion protection at inlet & outlet, hydroseed, trees & shrubs, safety fence, erosion control.
Outfall Protection	EA	$7,670	Precast concrete outlet structure, erosion protection, geotextile fabric, clearing of vegetation around structure, grading and revegetation.
Vegetated Swale	LF	$17	Traffic control, clearing & grubbing, excavation (4ft bottom width, 2 ft depth, 4:1 side slopes), hydroseed, erosion protection at inlet and outlet.
Infiltration Trench	LF	$50	Clearing & grubbing, excavation (2ft bottom width, 4 ft depth), geotextile fabric, 4"-8" perforated pipe, drain rock, and hydroseed.
Natural Resource Enhancement[Note 3]	SY	$10	Add additional vegetation
Natural Resource Revegetation[Note 3]	SY	$56	Remove invasive vegetation, grade and revegetate.
Recreational Trail	SF	$5	Clearing & grubbing, grading (up to 1 ft depth), erosion control, cedar shavings. Does not include storm drainage, signage, benches or other recreational amenities.
Raingarden - Native Soils [Note 5]	SF	$8	Includes installation of plants. Does not include grading, curb work, and sod installation outside of garden area.
Raingarden - Engineered Soils [Note 6]	SF	$29	Includes installation of plants, bed amendment (with engineered soils), and underdrain piping. Does not include grading, curb work, and sod installation outside of garden area.

Note 1: The costs in this table reflect an update of the original Table 1 prepared in 1999. It is based on a 2007 update that included an accross the board increase of 15% to all unit costs in Table 7. It also includes the inclusion of geotextile fabric for both types of open channel improvements (see update to Table 7).

Note 2: Construction costs presented in this table are planning level estimates. They are reflective of average facilities constructed under typical conditions. Each facility will vary depending on site conditions, the size and number of facilities constructed, and depending on the local construction market at the time of bidding. Contingencies should be reflected for budgeting purposes based on the variety of possible conditions.

Note 3: For purposes of calculating costs, these 2 categories have been combined and called Natural Resource Enhancement (use $13/sy) see attached addendum dated 11/01. This $13/sy should be updated to $15/sq based on the 15% increase being applied for a 2007 update.

Note 4: The cost presented here for TYPE II channel improvements of $730 reflects a 2007 accross the board update of +15% to the costs in the 1999 tables. However, due to several years experience with this type of project and an expectation of economies of scale (e.g., wider bottom width, deeper excavation, but same start up/mobilization/erosion control costs, etc.), an amount of **$600/LF** is now used as the unit cost here.

Note 5: Native soil raingarden cost estimates are assumed for 2007 and were provided by David Dods at URS (Overland Park, Kansas) , email dated 9-21-2007 and approved by Eugene and Lane County staff. See attached email.

Note 6: Engineered soil raingarden cost estimates are estimated for 2007, based on information provided by David Dods at URS (Overland Park, Kansas) , email dated 9-21-2007, and information provided by the City of Portland (phone call with City 8-10-09). The two costs provided ($24/sf from Kansas City and $34/sf from Portland) were averaged to take into account the fact that the Kansas City estimate was assumed to be on the low side when compared to typical costs in Eugene, and the City of Portland's estimate was on the high side given that it reflected 2009 costs as opposed to 2007. To be consistent with the other unit costs in these tables, unit costs should reflect 2007 estimates.

Reference:
Table 1 summarizes data in Table 7.
Table 5 (Unit Cost) x Table 6 (Quantities) = Table 7 (Unit Cost per CIP Type)

TABLE 2
STORMWATER FACILITIES
ESTIMATED CONSTRUCTION COSTS
FOR STORM DRAIN INSTALLATION IN IMPROVED AREAS

Storm Drain Pipe Construction Cost per Linear Foot												
	Diameter (inches)											
Cover Depth (feet)	**18**	24	30	36	42	48	54	60	66	72	84	96
2-5	$90	$120	$170	$220	$250	$300	$350	$400	$480	$520	$680	$830
5-10	$110	$150	$200	$250	$290	$340	$400	$450	$540	$580	$760	$920
10-15	$120	$170	$230	$280	$330	$380	$440	$500	$600	$650	$830	$1000
15-20	$140	$190	$250	$310	$360	$420	$490	$560	$660	$710	$910	$1090

Note 1: The costs in this table reflect an update of the original table prepared in 1999. The 2007 update includes a 15% increase to all unit costs.

Note 2: Construction costs presented in this table are planning level estimates. These estimated costs include shoring, excavation, backfill/air tamped compaction, piping, pavement restoration, minor stream management, and traffic control costs associated with typical projects, and average utility relocation in improved areas. Trench excavation is assumed to be by excavator or backhoe (mechanical means or blasting not included). Utility easement or other land acquisition costs are excluded. Information presented in this table is a summary of Table 3.

Reference: Cost = volume * ($excavation + $backfill) + $shoring + $piping + 5 + $pavement + $traffic control + $stream management

TABLE 3
STORMWATER FACILITIES
ESTIMATED CONSTRUCTION COSTS
FOR STORM DRAIN INSTALLATION IN IMPROVED AREAS
BACK UP INFORMATION

	Storm Drain Pipe Construction Cost per Linear Foot											
	Diameter (inch)											
Depth of Cover (ft)	18	24	30	36	42	48	54	60	66	72	84	96
Sub Task												
Pipe + Bed (ft)	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7.5	8.5
Width (ft)	3	4	5	6	7	8	9	10	11	12	14	16
Bedding (ft)	0.1	0.1	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.6
Shoring (lf)	$ 10.34	$12.42	$14.90	$17.88	$21.46	$25.75	$30.90	$30.90	$37.09	$44.51	$53.41	$64.09
Excavation (CY)	$ 11.50	$11.50	$11.50	$11.50	$11.50	$11.50	$11.50	$11.50	$11.50	$11.50	$11.50	$11.50
Backfill and Air Tamped Compaction (CY)	$ 17.25	$17.25	$17.25	$17.25	$17.25	$17.25	$17.25	$17.25	$17.25	$17.25	$17.25	$17.25
Piping (lf)	$ 15.00	$29.33	$59.80	$79.35	$90.85	$108.10	$131.10	$154.10	$204.70	$203.55	$304.75	$379.50
Pavement Restoration	$ 6.40	$8.54	$10.67	$12.81	$14.94	$17.08	$19.21	$21.35	$23.48	$25.62	$29.89	$34.16
Traffic Control	$ 20.91	$23.00	$25.30	$27.83	$30.61	$33.67	$37.04	$40.75	$44.82	$49.30	$54.23	$59.66
Stream Management	$ 12.54	$14.38	$16.53	$19.01	$21.86	$25.14	$28.91	$33.25	$38.24	$43.97	$50.57	$58.15
Cover (CY)												
2-5	0.7	1.1	1.5	1.9	2.3	2.8	3.3	3.9	4.5	5.1	6.5	8.0
5-10	1.4	1.9	2.4	3.0	3.6	4.3	5.0	5.7	6.5	7.3	9.1	11.0
10-15	1.9	2.6	3.3	4.1	4.9	5.8	6.7	7.6	8.6	9.6	11.7	13.9
15-20	2.3	3.3	4.3	5.2	6.2	7.3	8.3	9.4	10.6	11.8	14.3	16.9
2-5	$90.32	$124.60	$174.80	$216.19	$251.81	$295.67	$348.00	$397.15	$482.17	$518.89	$684.19	$830.56
5-10	$110.44	$145.90	$201.42	$248.13	$289.08	$338.26	$395.92	$450.39	$540.73	$582.78	$758.72	$915.74
10-15	$124.82	$167.20	$228.04	$280.08	$326.35	$380.85	$443.83	$503.63	$599.30	$646.67	$833.26	$1,000.93
15-20	$136.32	$188.49	$254.66	$312.02	$363.62	$423.45	$491.75	$556.87	$657.86	$710.56	$907.80	$1,086.11

Note 1: The costs in this table reflect an update of the original table prepared in 1999. The 2007 update includes a 15% increase to all unit costs.

Note 2: Construction costs presented in this table are planning level estimates. These estimated costs include minor stream management, traffic control costs associated with typical in-stream culvert projects, average utility relocation and pavement restoration costs in improved areas. Utility easement or other land acquisition costs are excluded. Information presented in this table is summarized in Table 2 (costs in Table 2 are rounded to the nearest $10).

TABLE 4
STORMWATER FACILITIES
ESTIMATED CONSTRUCTION COSTS
FOR WATER QUALITY STRUCTURES

Device/Model	Total Installed Cost	Number of Cartridges
Compost Storm Filter (CSF) Function: Primarily metals uptake and oil & grease removal. Commonly used with sediment manhole.		
CSF 8x6	$58,500	6
CSF 8x6	$70,000	11
CSF 12x6	$73,280	11
CSF 16x8	$138,560	33
CSF 16x8	$157,000	39

Note 1: StormFilter costs were provided by Contech Stormwater Solutions (email to URS dated 10-24-2007, email attached). If other proprietary treatment systems are proposed, costs for other facilities will be updated.

Note 2: Construction costs presented in this table are planning level estimates. Costs represent installation of average facilities under typical conditions. Estimates reflect vaults installed in public right of way, in an existing residential paved street, with average utility conflicts and restoration costs.

TABLE 5
STORMWATER FACILITIES
CONSTRUCTION COST ESTIMATE
BACK-UP INFORMATION

Construction Activity/Materials	**Units**	**$/Unit**
Manual Labor	Labor-Hr	$35
Traffic Control	Labor-Hr	$32
Gravel Access Road	SF	$4.37
Clearing & Grubbing	AC	$2,300
General Excavation	CY	$17
Grading	CY	$6
Inlet Cone & Structure	EA	$4,025
Trash Rack Structure	EA	$8,050
Pond Outlet	EA	$5,750
Curb & Gutter	LF	$14
Hydroseed	AC	$2,300
Trees & Shrubs	EA	$58
Geotextile Fabric	SY	$2.01
Rip Rap	TN	$69
Chain Link Fence	LF	$20
Erosion Control	AC	$2,300
Drain Rock	CY	$30
Crushed Rock	CY	$25
Truck Haul (Disposal)	CY	$21
Perforated Drain Pipe	LF	$30
Cedar Savings	CY	$25

Note 1: The above costs (originally prepared in 1999) were updated in 2007 with an across the board increase of 15%.

Note 2: The above are representative unit costs based on information collected from bid tabulation sheets from two years (1997-1999) in the Eugene, Lebanon and Portland areas. These costs are representative of average conditions and assume that the CP projects are competitively bid. Unit costs include materials and installation. Actual construction cost will vary with site conditions and local factors at time of bidding.

Unit cost for trees assumes bare root stock with temporary water for 2-3 years.

Note 3: With respect to Natural Resource Enhancement and Open Waterway Improvement Construction Costs (not included in this table), unit costs were revised (Nov. 2001) for clearing & grubbing, hydroseeding, trees & shrubs, and erosion control. See attached addendum.

Reference:
Table 5 (Unit Cost) x Table 6 (Quantities) = Table 7 (Unit Cost per CIP Type)

TABLE 6
STORMWATER FACILITIES
CONSTRUCTION EFFORT/QUANTITIES ESTIMATE
BACK-UP INFORMATION

Construction Activity/ Materials	Unit	Trash Rack Inlet (Type 1)	Trash Rack Inlet (Type 2)	Garbage and Debris Removal	Sediment Removal	Streambank Stabilization	Open Channel Improvements (Type 1)	Open Channel Improvements (Type 2)	Dry Extended Pond	Wet Extended Pond	Stormwater Marsh/Wetland	Flood Control Facility	Outfall Protection	Vegetated Swale	Infiltration Trench	Natural Resource Revegetation*	Natural Resource Enhancement*	Recreational Trail
		EA	EA	CY	CY	SY	LF	LF	Ac-Ft	Ac-Ft	AC	Ac-Ft	EA	LF	LF	SY	SY	SF
Manual Labor	**Lb-Hr**			3														
Traffic Control	**Lb-Hr**						0.6	1.2						0.16				
Gravel Access Road	**SF**								350	350	350	350						
Clearing & Grubbing	**AC**	0.1	0.1		0.0002				0.33	0.33		0.33	0.1	0.0002	0.0002			0.00002
General Excavation	**CY**				8		2	6	1600	1600	500	1600		0.3	0.3	0.5		
Grading	**CY**	8	8			0.6			100	100	1000	100	8					0.4
Inlet Cone & Structure	**EA**	1							1	1	1	1						
Trash Rack Structure	**EA**		1															
Pond Outlet Structure	**EA**								1	1	1	1	1					
Curb & Gutter	**LF**								20	20	20	20						
Hydroseed	**AC**	0.1	0.1		0.0002	0.0002	0.008	0.02	0.33	0.33	1	0.33	0.1	0.0002	0.0002	0.0002		
Trees & Shrubs	**EA**	5	5		2	1	4	8	100	100	1000	100	5	0.1		0.5	0.21	
Geotextile Fabric	**SY**	45	45			1	3	3					45		1.1			
Rip Rap	**CY**	15	15			0.33	0.28	0.5	3	3	3	3	15					
Chain Link Fence	**LF**								600	600		600						
Erosion Control	**AC**				0.0002	0.0002	0.008	0.016	0.33	0.33	1	0.33		0.0002		0.008		0.00002
Drain Rock	**CY**														0.3			
Crushed Rock	**CY**																	
Truck Haul	**CY**			1														
Perforated Drain Pipe	**LF**														1			
Cedar Shavings	**CY**																	0.11

Note 1: An update to this table was made in 2007 to add 3SY of geotextile fabric for each lineal foot of open channel improvement for both TYPE I and TYPE II improvements.

Note 2: The above are representative quantities based on average construction conditions. Actual construction quantities will vary with site conditions. The quantities above represent the volume and effort to construct/perform each unit of water quality facility (i.e. 1 CY of Sediment Removal). Volumes of excavation are assumed to include hauling offsite (approximately 10 mile round trip) and disposal.

*To calculate costs, the Natural Resource Revegetation and Natural Resource Enhancement activities (and associated costs) were combined into one activity, called Natural Resources Enhancements, and cost estimate. See attached memo dated 11/2001.

Reference:
Table 5 (Unit Cost) x Table 6 (Quantities) = Table 7 (Cost per CIP)

TABLE 7
STORMWATER FACILITIES
CONSTRUCTION COST ESTIMATE
BACK-UP INFORMATION

Construction Activity/ Materials	Unit	Trash Rack Inlet (Type 1) EA	Trash Rack Inlet (Type 2) EA	Garbage and Debris Removal CY	Sediment Removal CY	Streambank Stabilization SY	Open Channel Improvements (Type 1) LF	Open Channel Improvements (Type 2) LF	Dry Extended Pond Ac-Ft	Wet Extended Pond Ac-Ft	Stormwater Marsh/Wetland AC	Flood Control Facility Ac-Ft	Outfall Protection EA	Vegetated Swale LF	Infiltration Trench LF	Natural Resource Revegetation* SY	Natural Resource Enhancement* SY	Recreational Trail SF
Manual Labor	**Lb-Hr**	$ -	$ -	$ 103.50	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Traffic Control	**Lb-Hr**	$ -	$ -	$ -	$ -	$ -	$ 19.32	$ 38.64	$ -	$ -	$ -	$ -	$ -	$ 5.15	$ -	$ -	$ -	$ -
Gravel Access Road	**SF**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,529.50	$ 1,529.50	$ 1,529.50	$ 1,529.50	$ -	$ -	$ -	$ -	$ -	$ -
Clearing & Grubbing	**AC**	$ 230.00	$ 230.00	$ -	$ 0.46	$ -	$ -	$ -	$ 759.00	$ 759.00	$ -	$ 759.00	$ 230.00	$ 0.46	$ 0.46	$ -	$ -	$ 0.05
General Excavation	**CY**	$ -	$ -	$ -	$ 138.00	$ -	$ 34.50	$ 103.50	$ 27,600.00	$ 27,600.00	$ 8,625.00	$ 27,600.00	$ -	$ 5.18	$ 5.18	$ 8.63	$ -	$ -
Grading	**CY**	$ 46.00	$ 46.00	$ -	$ -	$ 3.45	$ -	$ -	$ 575.00	$ 575.00	$ 5,750.00	$ 575.00	$ 46.00	$ -	$ -	$ -	$ -	$ 2.30
Inlet Cone & Structure	**EA**	$ 4,025.00	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,025.00	$ 4,025.00	$ 4,025.00	$ 4,025.00	$ -	$ -	$ -	$ -	$ -	$ -
Trash Rack Structure	**EA**	$ -	$ 8,050.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pond Outlet Structure	**EA**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,750.00	$ 5,750.00	$ 5,750.00	$ 5,750.00	$ 5,750.00	$ -	$ -	$ -	$ -	$ -
Curb & Gutter	**LF**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 276.00	$ 276.00	$ 276.00	$ 276.00	$ -	$ -	$ -	$ -	$ -	$ -
Hydroseed	**AC**	$ 230.00	$ 230.00	$ -	$ 0.46	$ 0.46	$ 18.40	$ 46.00	$ 759.00	$ 759.00	$ 2,300.00	$ 759.00	$ 230.00	$ 0.46	$ 0.46	$ 0.46	$ -	$ -
Trees & Shrubs	**EA**	$ 287.50	$ 287.50	$ -	$ 115.00	$ 57.50	$ 230.00	$ 460.00	$ 5,750.00	$ 5,750.00	$ 57,500.00	$ 5,750.00	$ 287.50	$ 5.75	$ -	$ 28.75	$ 12.08	$ -
Geotextile Fabric	**SY**	$ 90.56	$ 90.56	$ -	$ -	$ 2.01	$ 6.04	$ 6.04	$ -	$ -	$ -	$ -	$ 90.56	$ -	$ 2.21	$ -	$ -	$ -
Rip Rap	**CY**	$ 1,035.00	$ 1,035.00	$ -	$ -	$ 22.77	$ 19.32	$ 34.50	$ 207.00	$ 207.00	$ 207.00	$ 207.00	$ 1,035.00	$ -	$ -	$ -	$ -	$ -
Chain Link Fence	**LF**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 11,730.00	$ 11,730.00	$ -	$ 11,730.00	$ -	$ -	$ -	$ -	$ -	$ -
Erosion Control	**AC**	$ -	$ -	$ -	$ 0.46	$ 0.46	$ 18.40	$ 36.80	$ 759.00	$ 759.00	$ 2,300.00	$ 759.00	$ -	$ 0.46	$ -	$ 18.40	$ -	$ 0.05
Drain Rock	**CY**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8.97	$ -	$ -	$ -
Crushed Rock	**CY**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Truck Haul	**CY**	$ -	$ -	$ 20.70	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Perforated Drain Pipe	**LF**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 29.90	$ -	$ -	$ -
Cedar Shavings	**CY**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2.78
Total $/Unit CIP		$ 5,944.06	$ 9,969.06	$ 124.20	$ 254.38	$ 86.65	$ 345.98	$ 725.48	$ 59,719.50	$ 59,719.50	$ 88,262.50	$ 59,719.50	$ 7,669.06	$ 17.46	$ 47.18	$ 56.24	$ 12.08	$ 5.18

Note 1: These costs that were originally estimated in 1999 now reflect 2007 updates. The updates in this table are based on a 15% increase to costs provided in Table 5.

*To calculate costs, the Natural Resource Revegetation and Natural Resource Enhancement activities (and associated costs) were combined into one activity, called Natural Resources Enhancements, and cost estimate. See attached memo dated 11/2001.

Reference:
Table 5 (Unit Cost) x Table 6 (Quantities) = Table 7 (Unit Cost per CIP Type)
Table 7 Total Cost per Unit of CIP is Summarized in Table 1

TABLE 8
STORMWATER FACILITIES
ESTIMATED ANNUAL MAINTENANCE COSTS

Stormwater Facility Type	Unit	Annual $/Unit	Description of Stormwater Facility Maintenance Activities
Trash Rack Inlet (Type 1 & 2)	1 EA	$3,080	Inspect and clean inlet, inspect vegetation and slope protection, remove debris.
Open Channel (Type 1 & 2)	500 LF	$3,800	Inspect sediment loading and vegetation, remove sediment and debris.
Dry Extended Pond	5 AC-FT	$6,490	Inspect and clean inlet and outlet, maintain vegetation, inspect sediment loading, remove sediment, remove debris, inspect separation berm.
Wet Extended Pond	5 AC-FT	$6,030	Inspect and clean inlet and outlet, maintain vegetation, inspect sediment loading, remove sediment, remove debris, inspect and repair separation berm.
Flood Control Facility	5 AC-FT	$4,810	Inspect and clean inlet and outlet, maintain vegetation, inspect sediment loading, remove sediment, remove debris, inspect and repair separation berm.
Stormwater Marsh/Wetland	5 AC	$3,310	Inspect and clean inlet and outlet, inspect & maintain vegetation, remove debris.
Vegetated Swale	500 LF	$4,090	Inspect and clean inlet and outlet, remove debris, remove sediment, maintain vegetation.
Infiltration Trench	500 LF	$2,700	Inspect and clean inlet, remove debris, remove sediment.
Water Quality Structures	1 EA	$1,170	Inspect and remove debris and sediment from structures.
Natural Resource Enhancement	5 AC	$644	Inspect vegetation, remove debris.
Natural Resource Revegetation	5 AC	$1,012	Inspect vegetation, remove debris.
Recreational Trail	1,000 LF	$2,300	Inspect trail, remove debris and maintain vegetation.

Note: Maintenance costs presented in this table are planning level estimates and are based on information provided by the Unified Sewerage Agency (now clean Water Services) of Washington County. They ar representative of average facilities maintained under typical conditions. Each facility will vary depending on site conditions and the size of the facility.

StormFilter maintenance costs are not presented but estimated to be **$195** per cartridge annually (representative of 2009 cost, per phone call with vendor dated 6-18-2009). This cost assumes that maintenance would be provided by the vendor. If the City/County were to perform maintenance, the unit cost per cartridge would be approximately $90 (2009 estimate).

Raingarden maintenance costs are not presented but estimated to be $1.30/ square foot of raingarden (representative of 2009 cost, per email communication with Steve Fancher at the City of Gresham - email attached). This average cost is calculated assuming $1.00/ square foot of raingarden for typical annual maintenance and $3.00/ square foot of raingarden every 10-years for larger-scale maintenance.

Reference:
Table 8 is a summary of data presented in Table 9.

TABLE 9
STORMWATER FACILITIES
ESTIMATED ANNUAL MAINTENANCE COSTS

	Frequency Times/Year	Effort/Time Lb-Hr	$ @ $46/hr	Hours	Equip./Time $/hr Rate	$ Total	Comments
Trash Rack Inlet (Type 1 & 2)							
Emergency Response	10	1	$ 460.00	0	$ -	$ -	
Inspect & Clean Inlet/Outlet	4	4	$ 736.00	2	$ 172.50	$ 1,380.00	Vactor Truck & Operator
Routine Repair			$ -		$ -	$ -	
Maintain Vegetation	4	2	$ 368.00	2	$ 11.50	$ 92.00	Mower, Weedeater, Etc.
Disposal Costs	4		$ 46.00		$ -	$ -	
Subtotals			*$ 1,610.00*			*$ 1,472.00*	
Total Estimate Annual Maintenance				***$ 3,082.00***			
Open Channel (Type 1 & 2)							
Inspect Vegetation & Sediment Loading	2	1	$ 92.00	0	$ -	$ -	
Maintain Vegetation			$ -		$ -	$ -	
Remove Debris/Garbage	4	2	$ 368.00	0	$ -	$ -	
Remove Sediment	1	8	$ 368.00	4	$ 345.00	$ 1,380.00	Tractor Shovel, 10 CY Dump & Operators
Disposal Costs	1		$ 920.00		$ -	$ -	Assumes 10 CY/Year
Inspect Slopes	2	1	$ 92.00	0	$ -	$ -	
Repair Slopes (On Going Activity)			$ 575.00	0	$ -	$ -	Annual Misc. Cost
Subtotals			*$ 2,415.00*			*$ 1,380.00*	
Total Estimate Annual Maintenance				***$ 3,795.00***			
Dry Extended Pond							
Inspect & Clean Inlet/Outlet	4	4	$ 736.00	2	$ 172.50	$ 1,380.00	Vactor Truck & Operator
Inspect Vegetation	2	1	$ 92.00	0	$ -	$ -	
Remove Debris/Garbage	4	2	$ 368.00	0	$ -	$ -	
Maintain Vegetation	4	4	$ 736.00	4	$ 11.50	$ 184.00	Mower, Weedeater, Etc.
Inspect Sediment Loading	2	1	$ 92.00	0	$ -	$ -	
Remove Sediment	0.5	12	$ 276.00	6	$ 345.00	$ 1,035.00	Tractor Shovel, 10 CY Dump & Operators
Disposal Costs	0.5		$ 920.00		$ -	$ -	Assumes 10 CY Every Two Years
Inspect slopes	2	1	$ 92.00	0	$ -	$ -	
Repair Slopes (On Going Activity)			$ 575.00		$ -	$ -	Annual Misc. Cost
Subtotals			*$ 3,887.00*			*$ 2,599.00*	
Total Estimate Annual Maintenance				***$ 6,486.00***			
Wet Extended Pond							
Inspect & Clean Inlet/Outlet	4	4	$ 736.00	2	$ 172.50	$ 1,380.00	Vactor Truck & Operator
Inspect Vegetation	2	1	$ 92.00	0	$ -	$ -	
Remove Debris/Garbage	4	2	$ 368.00	0	$ -	$ -	
Maintain Vegetation	4	4	$ 736.00	4	$ 11.50	$ 184.00	Mower, Weedeater, Etc.
Inspect Sediment Loading	2	1	$ 92.00	0	$ -	$ -	
Remove Sediment	0.5	12	$ 276.00	6	$ 345.00	$ 1,035.00	Tractor Shovel, 10 CY Dump & Operators
Disposal Costs	0.5		$ 460.00		$ -	$ -	Assumes 10 CY Every TwoYears
Inspect slopes	2	1	$ 92.00	0	$ -	$ -	
Repair Slopes			$ 575.00		$ -	$ -	Annual Misc. Cost
Subtotals			*$ 3,427.00*			*$ 2,599.00*	
Total Estimate Annual Maintenance				***$ 6,026.00***			
Flood Control Facility							
Inspect & Clean Inlet/Outlet	4	2	$ 368.00	2	$ 172.50	$ 1,380.00	Vactor Truck & Operator
Inspect Vegetation	2	1	$ 92.00	0	$ -	$ -	
Remove Debris/Garbage	4	1	$ 184.00	0	$ -	$ -	
Maintain Vegetation	4	4	$ 736.00	4	$ 11.50	$ 184.00	Mower, Weedeater, Etc.
Inspect Sediment Loading	2	1	$ 92.00	0	$ -	$ -	
Remove Sediment	0.5	8	$ 184.00	4	$ 345.00	$ 690.00	Tractor Shovel, 10 CY Dump & Operators
Disposal Costs	0.5		$ 230.00			$ -	Assumes 5 CY Every two Years
Inspect slopes	2	1	$ 92.00	0	$ -	$ -	
Slope Repair (On Going Activity)			$ 575.00		$ -	$ -	Annual Misc. Cost
Subtotals			*$ 2,553.00*			*$ 2,254.00*	
Total Estimate Annual Maintenance				***$ 4,807.00***			
Stormwater Marsh/Wetland							
Inspect & Clean Inlet/Outlet	4	4	$ 736.00	2	$ 172.50	$ 1,380.00	Vactor Truck & Operator
Inspect Vegetation	2	1	$ 92.00	0	$ -	$ -	
Remove Debris/Garbage	2	2	$ 184.00	0	$ -	$ -	
Maintain Vegetation	4	4	$ 736.00	4	$ 11.50	$ 184.00	Mower, Weedeater, Etc.
Subtotals			*$ 1,748.00*			*$ 1,564.00*	
Total Estimate Annual Maintenance				***$ 3,312.00***			
Vegetated Swale							
Inspect & Clean Inlet/Outlet	4	2	$ 368.00	1	$ 172.50	$ 690.00	Vactor Truck & Operator
Remove Debris/Garbage	2	2	$ 184.00	0	$ -	$ -	
Maintain Vegetation	4	4	$ 736.00	4	$ 11.50	$ 184.00	Mower, Weedeater, Etc.
Inspect Sediment Loading	2	1	$ 92.00	0	$ -	$ -	
Remove Sediment/Regrade	1	8	$ 368.00	4	$ 345.00	$ 1,380.00	Tractor Shovel, 10 CY Dump & Operators
Disposal Costs	1		$ 92.00		$ -	$ -	Assumes 2 CY Per Year
Subtotals			*$ 1,840.00*			*$ 2,254.00*	
Total Estimate Annual Maintenance				***$ 4,094.00***			

	Frequency Times/Year	Effort/Time Lb-Hr	$ @ $40/hr	Hours	Equip./Time $/hr Rate	$ Total	Comments
Infiltration Trench							
Inspect & Clean Inlet/Outlet	4	4	$ 736.00	2	$ 172.50	$ 1,380.00	Vactor Truck & Operator
Remove Debris/Garbage	2	2	$ 184.00	0	$ -	$ -	
Inspect Sediment Loading	2	2	$ 184.00	0	$ -	$ -	
Remove Sediment	0.3	8	$ 110.40	4	$ 86.25	$ 103.50	Water Truck (Flush lines) & Operator
Disposal Costs	0.3		$ 28.75		$ -	$ -	Assumes 2 CY Every Three Years
Subtotals			*$ 1,214.40*			*$ 1,483.50*	
Total Estimate Annual Maintenance				***$ 2,697.90***			
Water Quality Structures							
Remove Debris/Garbage	2	2	$ 184.00	0	$ -	$ -	
Inspect Sediment Loading	2	2	$ 184.00	0	$ -	$ -	
Remove Sediment	0.3	8	$ 110.40	4	$ 172.50	$ 690.00	Vactor Truck & Operator
Disposal Costs	4		$ 276.00		$ -	$ -	Assumes 3 CY a Year
Subtotals			*$ 478.40*			*$ 690.00*	
Total Estimate Annual Maintenance				***$ 1,168.40***			

Natural Resource Enhancement							
Inspect Vegetation	1	1	$ 46.00	0	$ -	$ -	
Routine Repair			$ 230.00		$ -	$ -	Annual Misc. Cost
Remove Debris/Garbage	2	4	$ 368.00	0	$ -	$ -	
Subtotals			*$ 644.00*			*$ -*	
Total Estimate Annual Maintenance				***$ 644.00***			
Natural Resource Revegetation							
Inspect Vegetation	2	2	$ 184.00	0	$ -	$ -	
Routine Repair			$ 460.00		$ -	$ -	Annual Misc. Cost
Remove Debris/Garbage	2	4	$ 368.00	0	$ -	$ -	
Subtotals			*$ 1,012.00*			*$ -*	
Total Estimate Annual Maintenance				***$ 1,012.00***			
Recreational Trail							
Inspect Vegetation	2	2	$ 184.00	0	$ -	$ -	
Remove Debris/Garbage	4	4	$ 736.00	0	$ -	$ -	
Maintain Vegetation	2	12	$ 1,104.00	12	$ 11.50	$ 276.00	Mower, Weedeater, Etc.
Subtotals			*$ 2,024.00*			*$ 276.00*	
Total Estimate Annual Maintenance				***$ 2,300.00***			

Note: Labor rate of $40/hr from the original table produced in 1999 was updated with an increase of 15% to $46/hr in 2007. The original information was based on information provided by the Unified Sewerage Agency of Washington County (now Clean Water Services). Labor for maintenance activities was assumed to be City maintenance staff averaged for maintenance and supervisor effort. Effort shown includes travel time and office documentation time. This table also reflects a 2007 update of of +15% to the unit costs for equipment, disposal, and slope repair.

Reference:
Table 9 information is summarized in Table 8.

"Simescu, Andreea"
<SimescuA@contech-cpi.com>
10/24/2007 01:59 PM

To <Angela_Brown@URSCorp.com>
cc
bcc
Subject RE: Cost estimates for various size Stormfilter units

History: This message has been replied to and forwarded.

Angela,

Here are the designs available soon:

- 8X6 w/ 11 cartridges $35,000
- 8X16 w/ 39 cartridges $78,500

Let me know if you need anything else.

Andreea Simescu, E.I.
Stormwater Designer
CONTECH Stormwater Solutions Inc.
11835 NE Glenn Widing Dr., Portland, OR 97220
Tel: 503.258.3138 Toll free: 800.548.4667 x138 Fax: 800.561.1271
simescua@contech-cpi.com
contechstormwater.com

From: Angela_Brown@URSCorp.com [mailto:Angela_Brown@URSCorp.com]
Sent: Tuesday, October 23, 2007 4:15 PM
To: Simescu, Andreea
Cc: Krista_Reininga@URSCorp.com
Subject: RE: Cost estimates for various size Stormfilter units

Hi Andrea - Thanks for the cost information. If you guys are proposing additional designs of the vaults to hold more cartridges, please send me those costs and sizes as well. We are in the process of writing up the costs now and the entire update to the plan should be done in Dec/ Jan so the more information we can pull together now, the better.

Thanks!
Angela

Angela Brown, PE
URS Corporation
111 SW Columbia Suite 1500
Portland, OR 97201

Phone: (503) 478-2762
Email: angela_brown@urscorp.com

"Simescu, Andreea"
<SimescuA@contech-cpi.com>
10/23/2007 04:07 PM

To <Angela_Brown@URSCorp.com>
cc
bcc
Subject RE: Cost estimates for various size Stormfilter units

History: This message has been replied to.

Hi Angela,

Sorry I am just getting back to you on this. Here is the updated pricing:

- 6X8 w/6 cartridges $29,250
- 6X12 w/11 cartridges $36,640
- 8X16 w/33 cartridges $69,280

The 8X18 design can hold 33 cartridges (same as the 8X16). We are coming up with some new designs in November that will have integrated inlet and outlet sumps and you will be able to fit more cartridges in each size. I can give you that information as well but the vaults are not available yet. Please let me know if you need to have that now or later.
Thank you.

Andreea Simescu, E.I.
Stormwater Designer
CONTECH Stormwater Solutions Inc.
11835 NE Glenn Widing Dr., Portland, OR 97220
Tel: 503.258.3138 Toll free: 800.548.4667 x138 Fax: 800.561.1271
simescua@contech-cpi.com
contechstormwater.com

From: Angela_Brown@URSCorp.com [mailto:Angela_Brown@URSCorp.com]
Sent: Monday, October 22, 2007 4:16 PM
To: Simescu, Andreea
Cc: Krista_Reininga@URSCorp.com
Subject: Cost estimates for various size Stormfilter units

Hi Andrea - Im working on updating the unit cost tables for a Master Plan that we (URS) previously completed in 1999 for the City of Eugene. The compost StormFilters were referenced and I am hoping you would be able to help me with some updated costs for some various standard sizes (I realize that you have the manhole and cast in place units, but I think we will stick with just the vault systems for right now). In the original cost estimate, we assumed full number of cartridges (operating at 15 gpm) per size facility. The depth is assumed to be 8'.

The standard sizes previously referenced are:
6x8, 6x12, 8x12, 8x14, 8x16, 8x18

I know that some of these sizes no longer exist, so we will only reference those sizes that are currently used. Hopefully you will be able to help. Thanks in advance and let me know if you need any more information

Thanks
Angela

Angela Brown, PE

URS

David Dods/OverlandPark/URSCorp
09/21/2007 12:34 PM

To Krista Reininga/Portland/URSCorp@URSCORP
cc Angela Brown/Portland/URSCorp@URSCORP
bcc
Subject Re: rain garden costs

History: This message has been forwarded.

Rusty in Minnesota says he builds streetside raingardens with replaced soils and an underdrain for $7 - $8/square foot. The qualifiers:

- Most of the plants that go in them are plugs
- the edging is the black plastic stuff
- No walls around the gardens
- The underdrain is a pipe wrapped in a filter fabric sock. He does not use a gravel layer

For KC, I estimated that same price ($7/SF) for gardens that use native soils and no underdrains. A garden with replaced soils and underdrains might run $15 - 25/square foot. I don't have a high degree of confidence in the latter number because we just have not built that many here yet.

My calculations are attached. If you need to put together a pretty good cost estimate for your project, I could help you come up with the line items to be included. But the unit costs would have to come from your area.

Raingarden construction cost est, 09-21-07.xls

Best wishes,

David

Krista Reininga/Portland/URSCorp

Krista Reininga/Portland/URSCorp
09/20/2007 03:36 PM

To David Dods/OverlandPark/URSCorp@URSCORP
cc Angela Brown/Portland/URSCorp@URSCorp
Subject rain garden costs

Hi David,
For our Eugene project, we are developing capital improvement program costs. Do you have any kind of table or anything already prepared that would show the range in rain garden costs in terms of construction and then also maintenance?
Thanks,
Krista

"Fancher, Steve"
<Steve.Fancher@greshamoregon.gov>
08/03/2009 01:58 PM

To "'Angela_Brown@URSCorp.com'" <Angela_Brown@URSCorp.com>
cc
bcc
Subject RE: Raingarden Maintenance Costs

History: This message has been replied to and forwarded.

Hi Angela,

My slide from the ACWA conference is a little (or a lot) confusing. The anticipated $500/year maintenance cost for NE Holladay Street is wholly contributed to the rain gardens, as we're not planning on sweeping the porous pavement portion any more than the 10-times/year we already sweep standard streets in Gresham. The 3 rain gardens total about 500 square-feet in size, so you can say we anticipate the annual maintenance cost to be around $1/square-foot. On top of the annual maintenance cost, we anticipate needing to spend $1,500 or $3/sf every 10 years for a larger-scale rehab.

As a disclaimer, the costs I've presented are still very rough guesses, as we don't have very many public rain gardens or porous pavements and the ones we do have are relatively new. So far, we have not spent any time or money maintaining the public street rain gardens at NE Holladay (2.5 years old). They continue to look very nice and are performing well, and it's unclear about how much maintenance the adjacent property owners are taking on if any. We also are not spending any more maintaining our porous pavement streets than we do on standard ones. The City of Gresham already sweeps streets 10 times per year on average, which has been sufficient to prevent clogging of the porous systems. At some point in time maybe 5-10 years out, I do anticipate having to do some type of maintenance to the streetside rain gardens, such as removal of some accumulated sediment, replanting and remulching.

A better source of rain garden maintenance data is Henry Stevens with the City of Portland BES. The policy in place while I was there relied on the adjacent property owner for routine maintenance, but I believe they have since changed to perform more functions as a city. Hope this helps.

Steve Fancher
Watershed Division Manager
City of Gresham, DES
503-618-2583
steve.fancher@greshamoregon.gov

From: Angela_Brown@URSCorp.com [mailto:Angela_Brown@URSCorp.com]
Sent: Monday, August 03, 2009 10:37 AM
To: Fancher, Steve
Subject: Raingarden Maintenance Costs

Hi Steve -

Im working with Krista Reininga on a Stormwater Basin Plan for Eugene where we are proposing raingardens to manage runoff generated after UICs are decommissioned. I was wondering if you have any maintenance cost

APPENDIX E

EVALUATION OF UICS WITH RESPECT TO HIGH GROUNDWATER

EVALUATION OF DEQ RULE AUTHORIZATION CRITERION G FOR SANTA CLARA STORMWATER BASIN DRY WELLS

INTRODUCTION

In 1974, the U.S. Environmental Protection Agency (EPA) enacted the Underground Injection Control (UIC) program under the Safe Drinking Water Act. The Oregon Department of Environmental Quality (DEQ) was delegated primacy in Oregon by the EPA in 1984, and re-authorized in 1991. DEQ regulates the program under Oregon Administrative Rules (OAR) Chapter 340, Division 44. The intent of the UIC program is to protect groundwater quality by regulating the injection of fluids into the ground. Dry wells are a type of injection system installed and used by the City of Eugene and Lane County to manage stormwater runoff from roads, parking lots, roofs, and other impervious surfaces by injecting the stormwater into the ground. Dry wells are regulated by the DEQ UIC program.

DEQ developed a set of criteria, known as "rule authorization criteria" to assess whether use of an injection system is authorizable by DEQ. The criteria define certain conditions that must be met in order for the injection system to be authorizable. Criterion G specifies the condition that a dry well shall not discharge directly into groundwater or below the highest seasonal groundwater level. This technical memorandum presents the methods, results, and conclusions for assessing whether dry wells within the Santa Clara Stormwater Basin (SCSB) have a reasonable likelihood of discharging to groundwater.

PROJECT LOCATION AND DRY WELL DESCRIPTION

The SCSB is located in the northern portion of the City of Eugene, primarily with Sections 1 through 16, 23, and 24 in Township 17 South, Range 4 West, in Lane County, Oregon. Dry wells are typically constructed as approximately 4-foot-diameter perforated concrete pipes installed vertically within the ground. Installation steps typically include excavation of a pit, placement of the dry well pipe into the pit, and backfilling of the pit with drain rock. The depths of the dry wells are typically in the range of 10 to 15 feet. Stormwater catch basins collect stormwater runoff from curbs and gutters, and convey the stormwater to the dry wells via drainpipes. Less commonly the dry well may contain a perforated lid through which stormwater may directly discharge to the dry well.

METHODS

The Oregon Water Resources Department (OWRD) maintains a database of water wells installed within the state of Oregon. The database consists of copies of "well logs", which are forms completed by well installers (drillers) to record pertinent data regarding well location, method of well construction, and hydrogeologic observations such as the water level. To assess the depth to groundwater in the SCSB, the well log database was searched to identify well logs within the township, range, and sections described above that contained useful water level information.

RESULTS

A search of the OWRD well log database resulted in 1,447 well log records, of which 1,187 records contained water level information. The water levels for these 1,187 records ranged from 0.7 to 230 feet below ground surface (bgs), and spanned the time from 1914 to 2006. Of these, only seven records contained water levels that were below 50 feet bgs. The mean water level for all 1,187 records was 11.6 feet bgs. Figure 1 is a time-sorted plot of the 1,187 water level records.

To further assess the water levels, the water level for each record was plotted as a function of well completion depth. Of the 1,187 records with useful water level information, only 1,027 records also contained completion depth information. Figure 2 presents a plot of the water level as a function of well completion depth. Well completion depths ranged from seven to 390 feet bgs. The plot shows a slight downward trend, indicating that deeper water levels are more commonly associated with deeper wells.

The comparison of water level to well depth is important because the dry wells within the SCSB are typically installed at shallow depths (about 10 to 15 feet). To accurately estimate the water level at these shallow depths, it is best to use water level information for water wells that are installed at similar depths. Wells that are installed at greater depths may have corresponding water levels that are not representative of shallow conditions (i.e., depths at which dry wells are installed). Therefore, a subset of the 1,187 records was created by selecting records for wells with completion depths of 20 feet or less. This resulted in 286 records. The mean water level for the 286 records was 9.4 feet bgs. Figure 3 is a time-sorted plot of the 286 water level records.

Finally, water levels are also a function of climate and are known to fluctuate throughout the year as a function of seasonal rainfall. In the Eugene area, the highest water levels typically occur during the February through May time period. To estimate the highest seasonal groundwater level within the SCSB, a subset of the 286 shallow well records was created by selecting records for the months of February through May. This resulted in 105 records. The mean water level for the 105 records is 8.1 feet. Of these 105 records, 19 of them (or approximately 18%) had water levels that were 5 feet or shallower.

CONCLUSIONS

The OWRD well log database was searched to obtain historic water level information for water wells within the SCSB. The information was used to assess whether dry wells within the SCSB have a reasonable likelihood of discharging directly into groundwater or below the highest seasonal groundwater level. The following conclusions are based on the evaluation of the well log database:

1. The mean water level for 1,187 wells with completion depths of seven to 390 feet bgs is 11.6 feet bgs.
2. The mean water level for 286 wells with completion depths of 20 feet or less is 9.4 feet bgs.
3. The mean water level during the wettest part of the year for wells with completion depths of 20 feet or less is 8.1 feet and 18% of these water depths were five feet or less.
4. Dry wells within the SCSB have a reasonable likelihood of discharging directly to groundwater or below the highest seasonal groundwater level.

FIGURE 1
Depth to Groundwater for 1,187 Records
1914 to Present

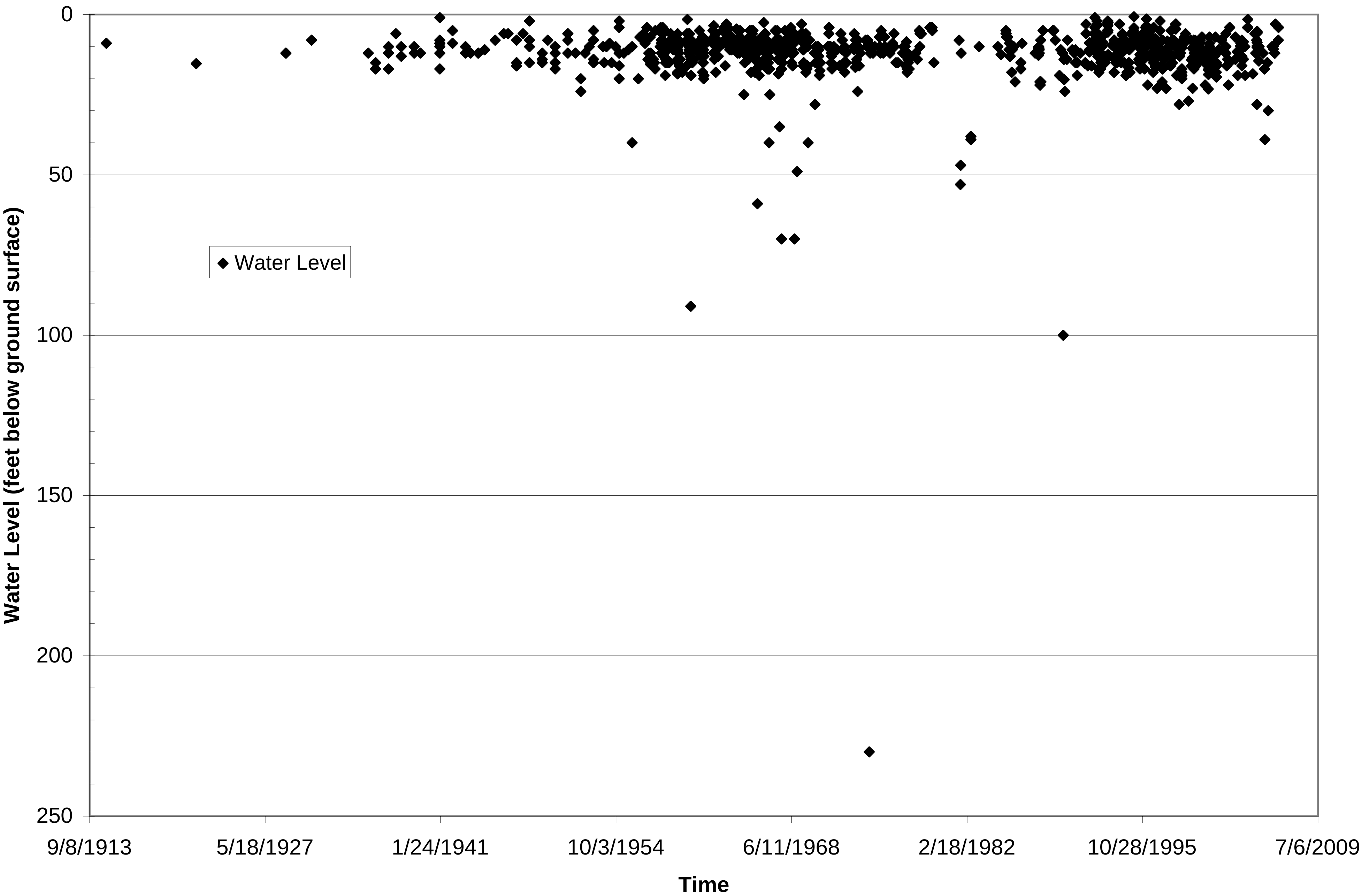


FIGURE 2
Water Level Plotted as a Function of Well Completion Depth

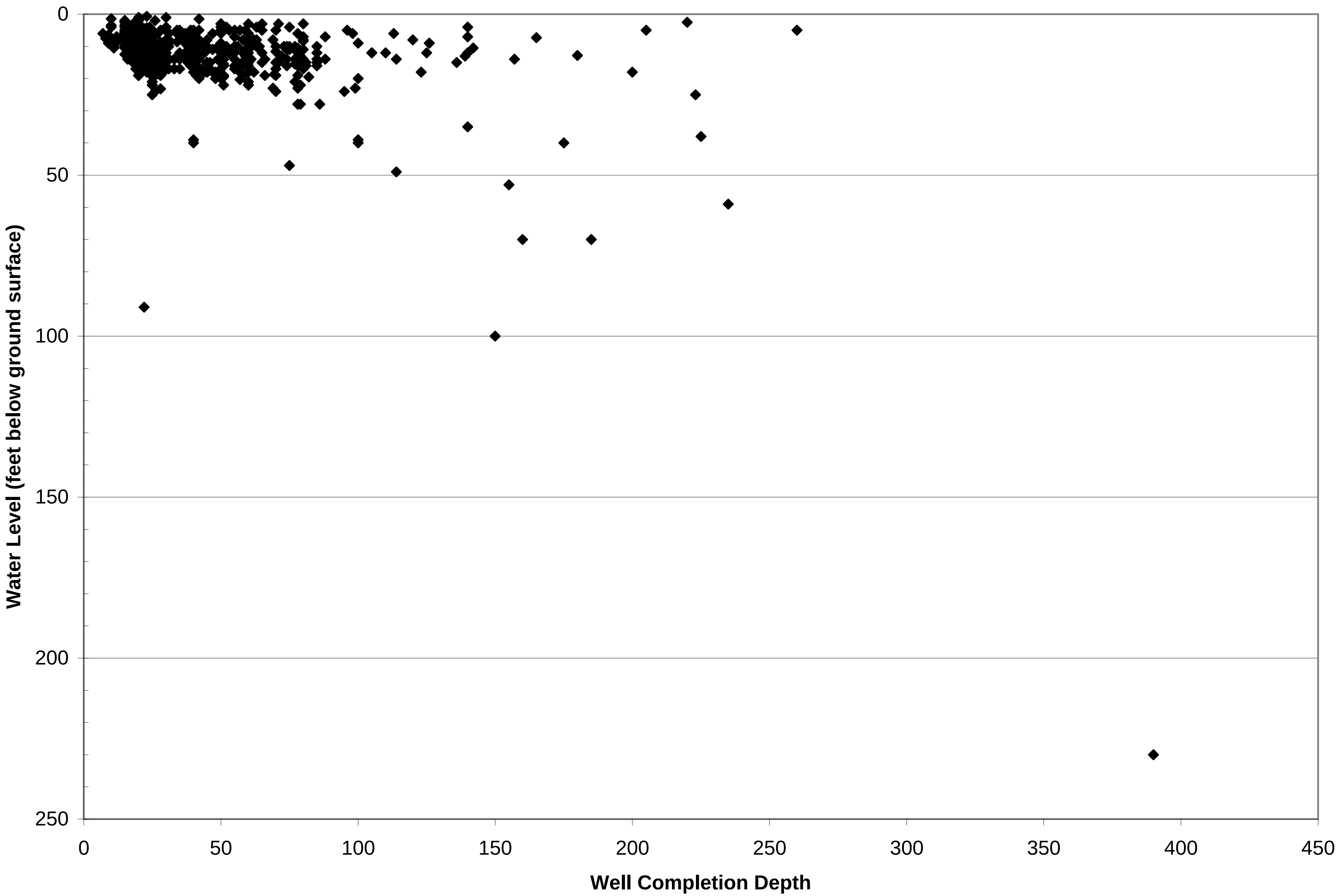
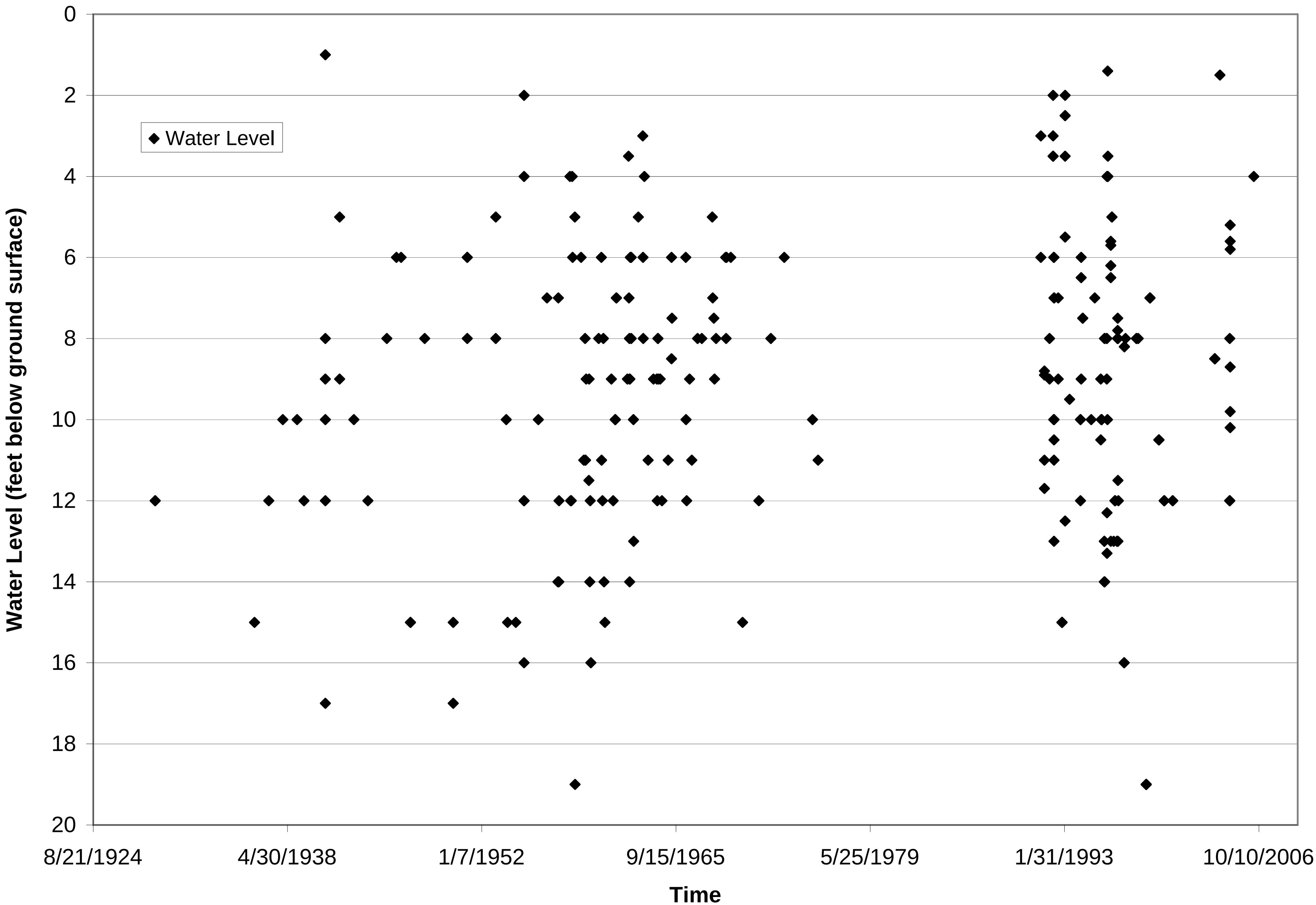


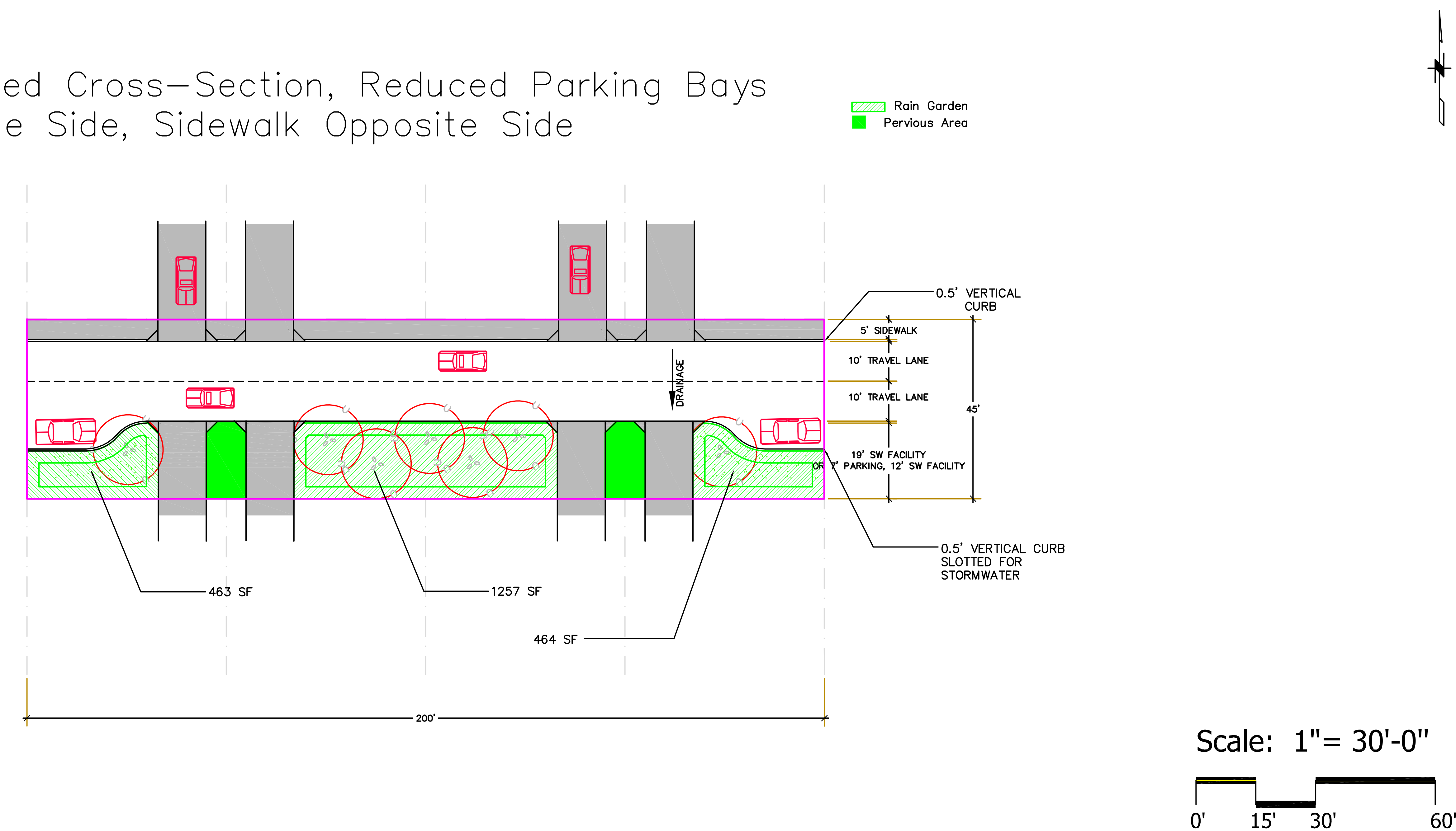
FIGURE 3
Depth to Groundwater for Shallow Wells (20 feet deep or less)



APPENDIX F

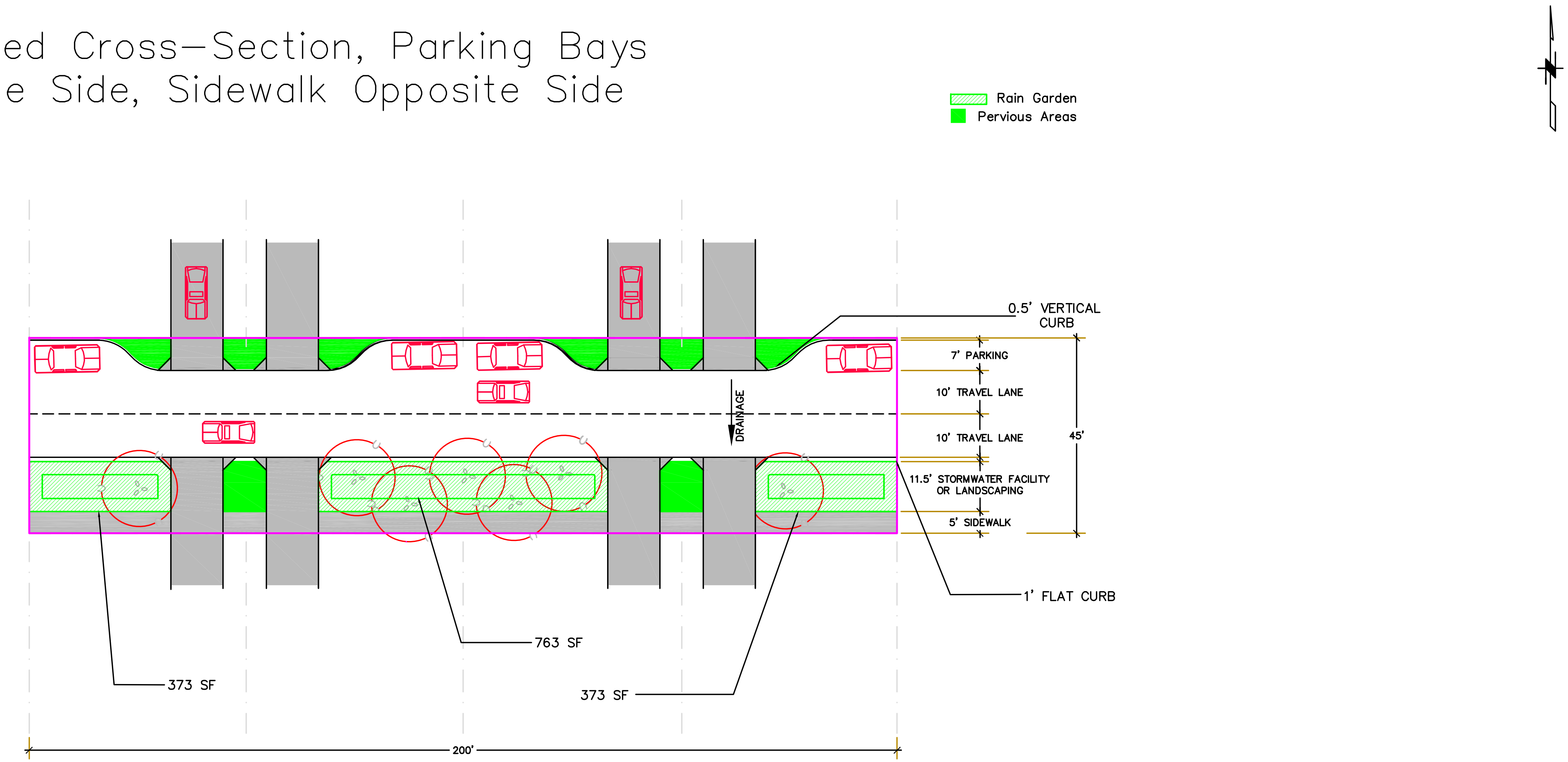
RAIN GARDEN SIZING CALCULATIONS AND PLAN VIEWS FOR SIX ROW OPTIONS

Shed Cross-Section, Reduced Parking Bays One Side, Sidewalk Opposite Side



GREEN STREET CONCEPT #1 - SHED CROSS-SECTION

Shed Cross-Section, Parking Bays One Side, Sidewalk Opposite Side

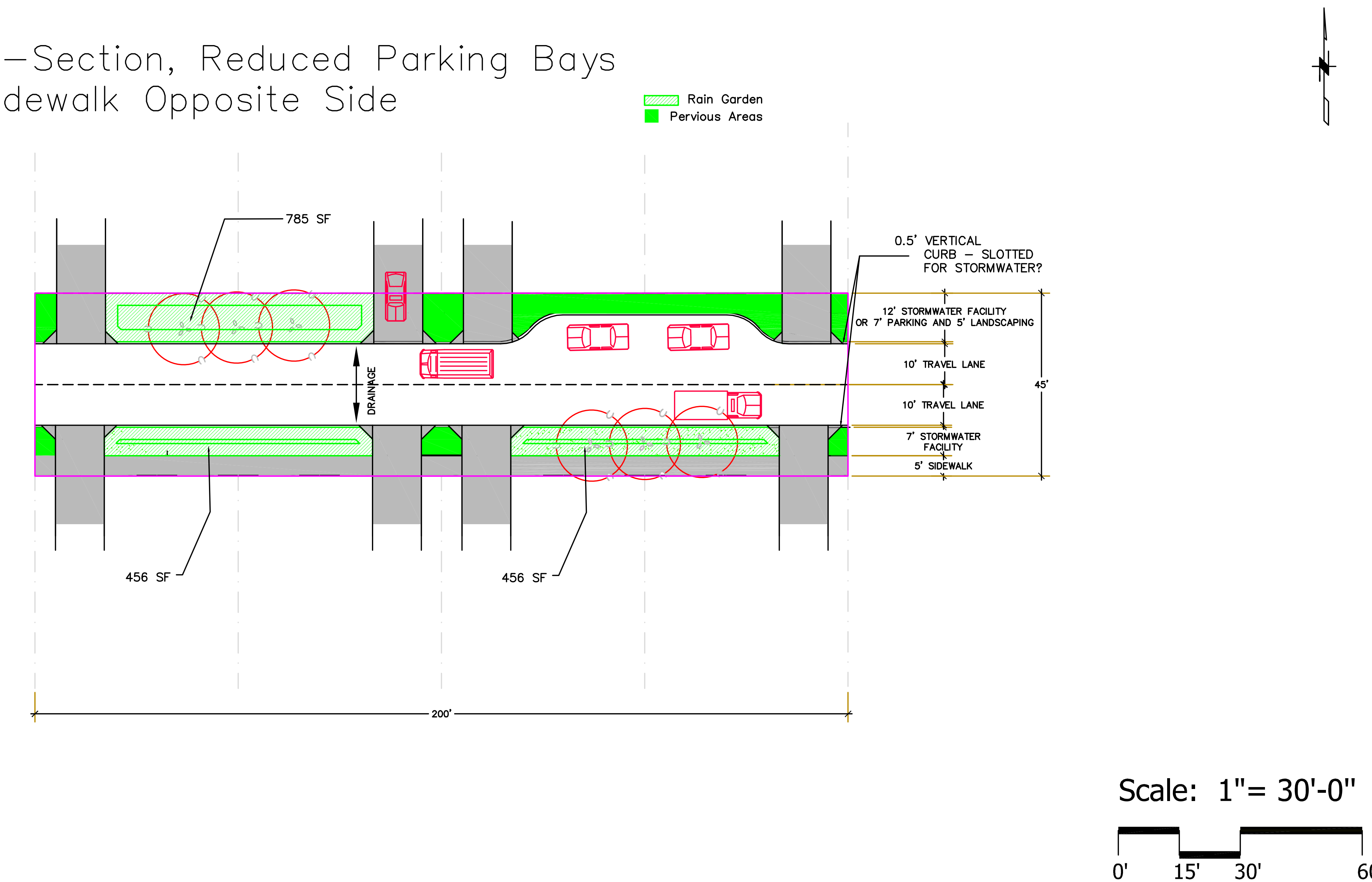


Scale: 1"= 30'-0"

0' 15' 30' 60'

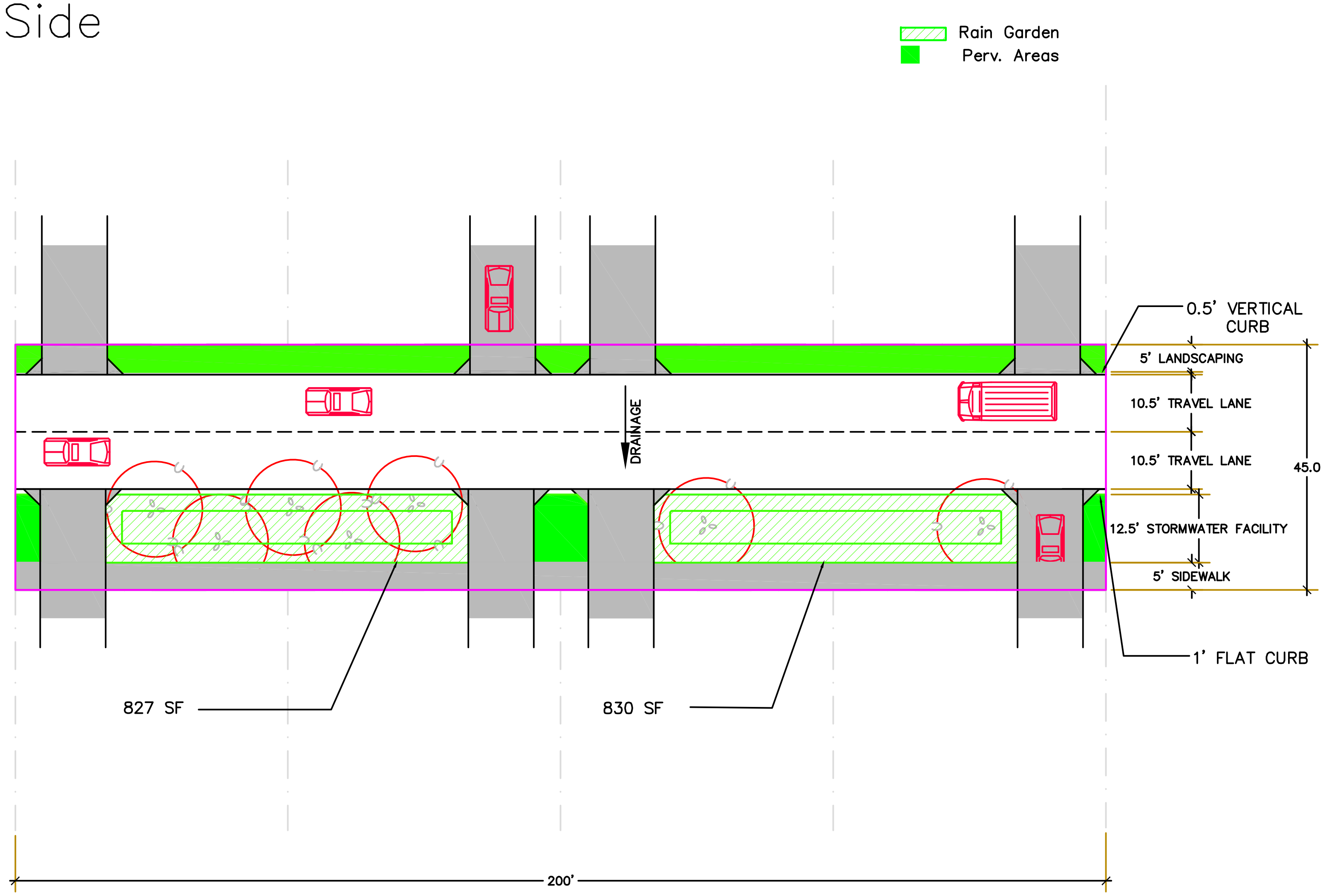
GREEN STREET CONCEPT #2 - SHED CROSS-SECTION

Crown Cross–Section, Reduced Parking Bays One Side, Sidewalk Opposite Side



GREEN STREET CONCEPT #3 - CROWNED CROSS-SECTION

Shed Cross-Section, On-Street Parking, Sidewalk One Side

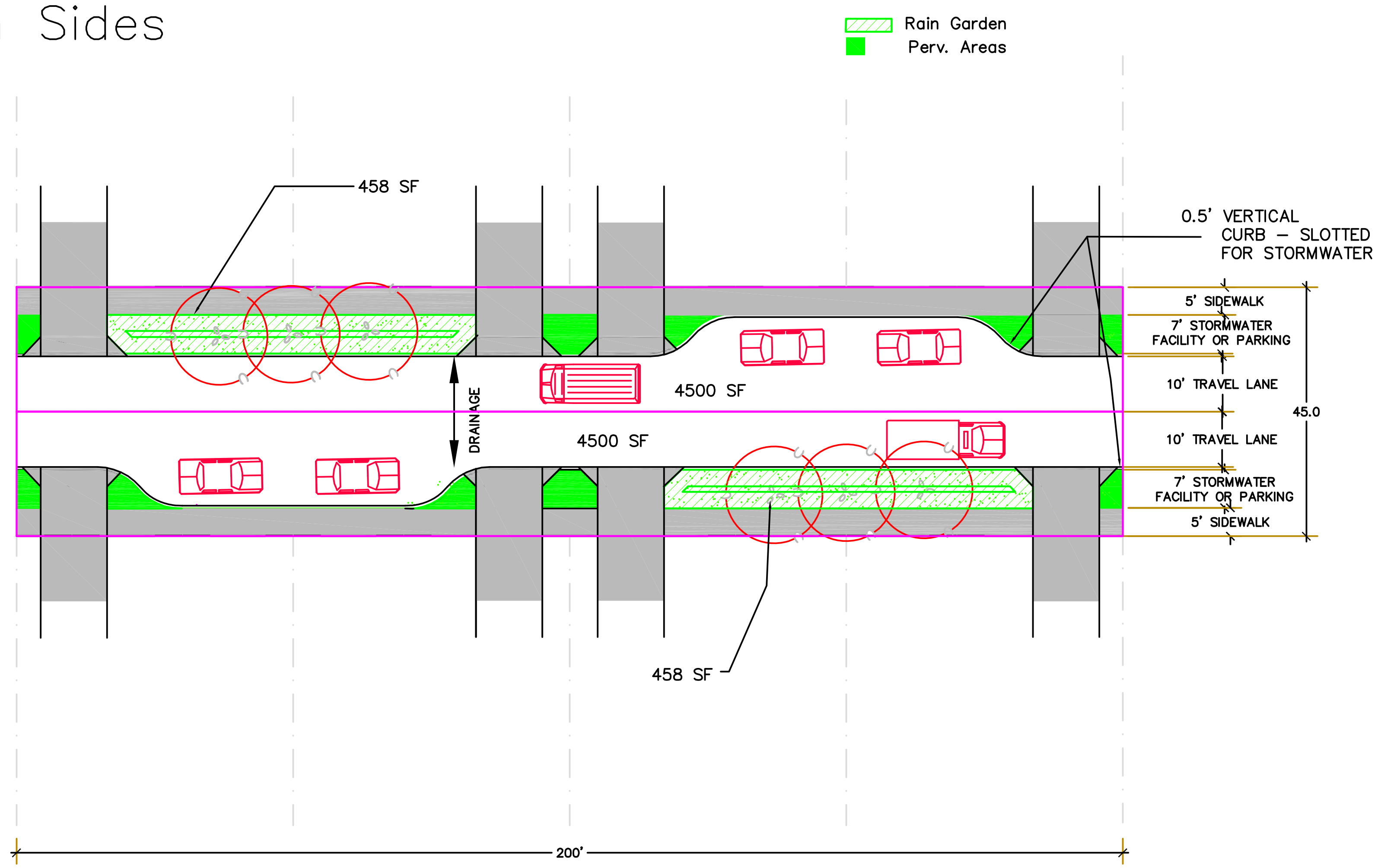


Scale: 1"= 30'-0"

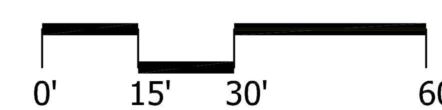
0' 15' 30' 60'

GREEN STREET CONCEPT #4 - SHED CROSS-SECTION

Crown Cross–Section, On–Street Parking, Sidewalk Both Sides

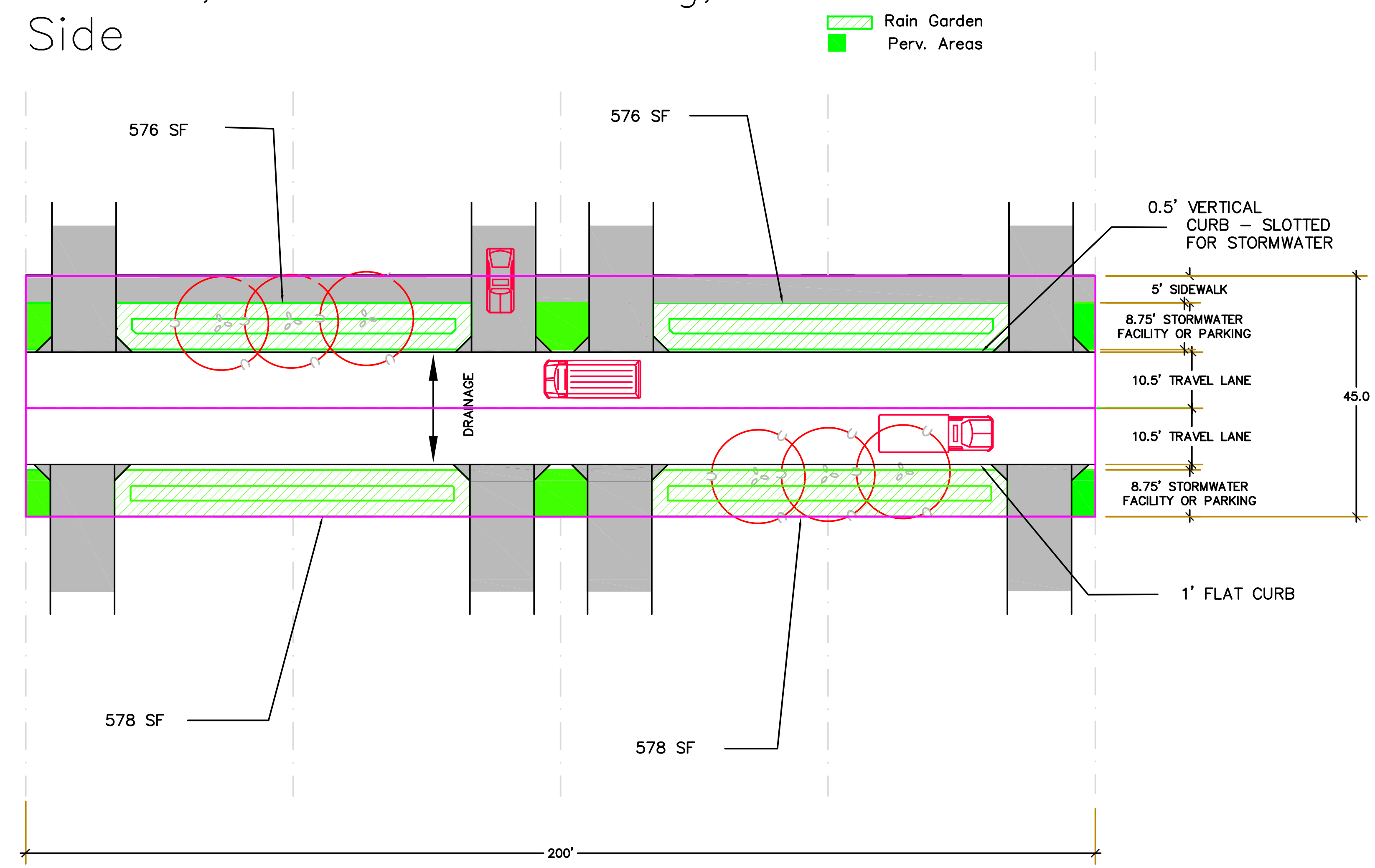


Scale: 1"= 30'-0"



GREEN STREET CONCEPT #5 - CROWNED CROSS-SECTION

Crown Cross-Section, On-Street Parking, Sidewalk One Side



Scale: 1"= 30'-0"

0' 15' 30' 60'

GREEN STREET CONCEPT #6 - CROWN CROSS-SECTION

APPENDIX G

SUMMARY OF MODEL REFINEMENTS SINCE THE INITIAL 2002 STUDY

To: Therese Walch

From: Hernan Rodriguez, PE and Krista Reininga, PE.

Date: April 10, 2007

Subject: River Road Santa Clara Model Changes

As requested by the City, URS has updated the XP-SWMM models developed for the River Road Santa Clara Stormwater Master Plan project (August 2002). Models were updated using survey data collected by Lane County between October and December 2005. Areas surveyed for updating the models were identified in Section 3.0 of the current draft basin plan (August 2002) and during a June 21, 2005 meeting and in a memo to the City from URS dated August 25, 2005. Once the survey was completed, the original subbasin delineations were refined to account for new information. In addition, drainage basins for UIC areas were delineated. The model was then run to simulate conditions both with and without UICs in place. This was done to get an initial idea of whether decommissioning of all UICs would result in additional flooding issues. The purpose of this memo is to summarize the following:

- changes to the original model based on new survey information;
- changes to the model based on updated subbasin delineations;
- methods for modeling UICs; and
- results from modeling conditions both with and without UICs.

HYDRAULIC CHANGES

The following changes were made, based on the new survey data collected between October and December 2005, when updating each subbasin model:

Flat Creek Subbasin

- Model segment RSFC020E from node 72765 to 72764 was divided into 3 segments to incorporate the culvert under Hilo Dr. (node 75697 to 75698) that was not included in the original model. The new segment names are RSFC020Da, RSFC020Db, and RSFC020E.

- Model segment RSFC050A from node 72244 to 72799 was divided into 5 segments to incorporate 2 culverts that were not included in the original model. The new segment names are RSFC050A, RSFC050B, RSFC050C, RSFC050D, and RSFC050E.

Spring Creek Subbasin

- Model segment RSSC010D from node 85033a to 72012 was divided into 3 segments to incorporate a culvert not included in the original model. The new segment names are RSSC010D, RSSC010Da, and RSSC010Db.

- Segment RSSC040B from node 72006 to 72007 was updated with a new length, invert, and rim elevations obtained from the new survey data.

- Model segment RSSC100B from node 72002 to 72770 was divided into 3 segments to incorporate a culvert not included in the original model. The new segment names are RSSC100B, RSSC100C, and RSSC100D.

Willamette Overflow Subbasin

- A new segment RSWO140 from node 77703 to 58311 was added to the model to extend the model farther upstream to incorporate a 54-inch pipe segment upstream of node 58311 that was not included in the original model.

- Node 58289 was renamed to 58310 to match the node number from the survey data and the GIS layer.

- Data for segments RSWO110A, RSWO110B, RSWO110C, RSWO040C, RSWO090B, RSWO090C, RSWO090D, RSWO090E, RSWO090F, RSWO090G, RSWO090H, RSWO080A, were updated according to survey information related to lengths and elevations.

- Segment RSWO090A was divided into 2 segments, segment RSWO090A and RSWO090Aa, since new survey data was collected for these segments individually.

- Segments RSWO070E, RSWO070F, RSWO070G, and RSWO070H were renamed to RSWO070B, RSWO070C, RSWO070D, and RSWO070E respectively because old segment names RSWO070A, RSWO070B, RSWO070C, and RSWO070D were combined into one segment (RSWO070A) in the new survey data. These segments were updated with new invert elevation and cross-section information obtained from new survey data.

- Segments RSWO060B, RSWO060A, RSWO050C, RSWO050B, RSWO050A, and RSWO040C were updated based on new survey information for lengths and elevations.

A-1 Channel Subbasin

- Segments RSA1100L, RSA1100K, RSA1100G, RSA1100F, RSA1100E, RSA1100D, RSA1100C, RSA1100B, RSA1100A, RSA1090G, RSA1090F, RSA1090E, RSA1090D, RSA1090C, RSA1090B, RSA1090A, RSA1080B, RSA1080A, RSA1060U, RSA1060J, RSA1060I, RSA1060H, RSA1060G, RSA1060C, RSA1010A, RSA1030B, RSA1230A, RSA1160F, RSA1160E, RSA1160D, RSA1160C, RSA1160B, RSA1160A, RSA1150B were updated based on survey information for lengths and elevations.

- Segment RSA1060S from node 71209 to 71210 was divided into 2 segments to incorporate a 36x72-inch CMP culvert that was included in the new survey but not included in the original model. The new segment names are RSA1060S and RSA1060Sa.

- Segment RSA1060F from node 71214 to 71215 was divided into 2 segments to incorporate a 48-inch CMP culvert that was included in the survey but not included in the original model. The new segment names are RSA1060F and RSA1060Fa.

- Segment RSA1030D from node 73395 to 73394 was divided into 3 segments to incorporate the culvert under Auction Ct. that was not included in the original model. The new segment names are RSA1030D, RSA1030Da and RSA1030Db.

- Node numbers for segment RSA1160H were changed from 72727-72728 to 71941-71940 to match node numbers from the GIS layer.

HYDROLOGY CHANGES

The following changes were made with respect to updating subbasin delineations, as a result of the new survey data:

Flat Creek Subbasin

- A runoff node was moved from node 72244 to 75659 according to the new basin delineation.

A-1 Channel Subbasin

- Subbasin RSA1-020 was added at node 72757 according to the new basin delineation.
- Subbasin RSA1-070 was moved from node 72740 to 72742 according to the new basin delineation.

MODELING METHODOLOGY TO ACCOUNT FOR UICs

A separate XP-SWMM model was developed for each of the four subbasins in the River Road Santa Clara major basin. The following four models were developed for each of the four subbasins:

- Existing conditions model without UICs;
- Existing conditions model with UICs;
- Future conditions model without UICs; and
- Future conditions model with UICs

Existing Conditions Model without UICs

This model was developed to represent existing conditions of the stormwater system without modeling the effects of UICs. All runoff from subbasins with UICs was assumed to drain into the piped and surface stormwater drainage system without infiltrating into the existing UICs.

Existing Conditions with UICs

This model was developed to represent existing conditions of the stormwater system while modeling the effects of the UICs. UICs were assumed to infiltrate runoff from up to the 5-year storm event (3.6 inches). UICs were modeled as storage nodes that store runoff up to the 5-year storm event. When the capacity of the storage node is reached (5-year event) the subbasins with UICs begin contributing all additional runoff flows to the piped and surface stormwater drainage system. The storage nodes were sized using an iterative trial and error process until the 5-year event filled the storage volume but did not contribute runoff flows to the piped and surface stormwater drainage system.

Future Conditions Model without UICs

This model was developed to represent future development conditions of the stormwater system without modeling the effects of the UICs. All runoff from subbasins with UICs was assumed to drain into the piped and surface stormwater drainage system without infiltrating into the existing UICs.

Future Conditions with UICs

This model was developed to represent future development conditions of the stormwater system while modeling the effects of the UICs. UICs were assumed to infiltrate runoff from up to the 5-year storm event (3.6 inches). UICs were modeled as storage nodes that store runoff up to the 5-year storm event. When the capacity of the storage node is reached (5-year event) the subbasins with UICs begin contributing all additional runoff flows to the piped and surface stormwater drainage system. The storage nodes were sized using an iterative trial and error process until the 5-year event filled the storage volume but did not contribute additional runoff flows to the piped and surface stormwater drainage system.

Results of Modeling Conditions Both With and Without UICs

While it was anticipated that existing UICs might relieve some flooding issues, the comparison of model results between the models with and without UICs for the design storms required by the City (10-year and 25-year storm event) did not show significant differences with respect to flooding problems. It is assumed that this was the case for the following reasons:

1. The UICs were only assumed to infiltrate runoff up to the 5-year storm event and the design events modeled were the 10 and 25-year events. Hence, the accommodation of the 5-year storm was overwhelmed by the larger storms; and

2. Only 20% of the total drainage area was assumed to be area draining to UICs. Hence the majority of the drainage area is accommodated via the pipe and surface drainage system only.

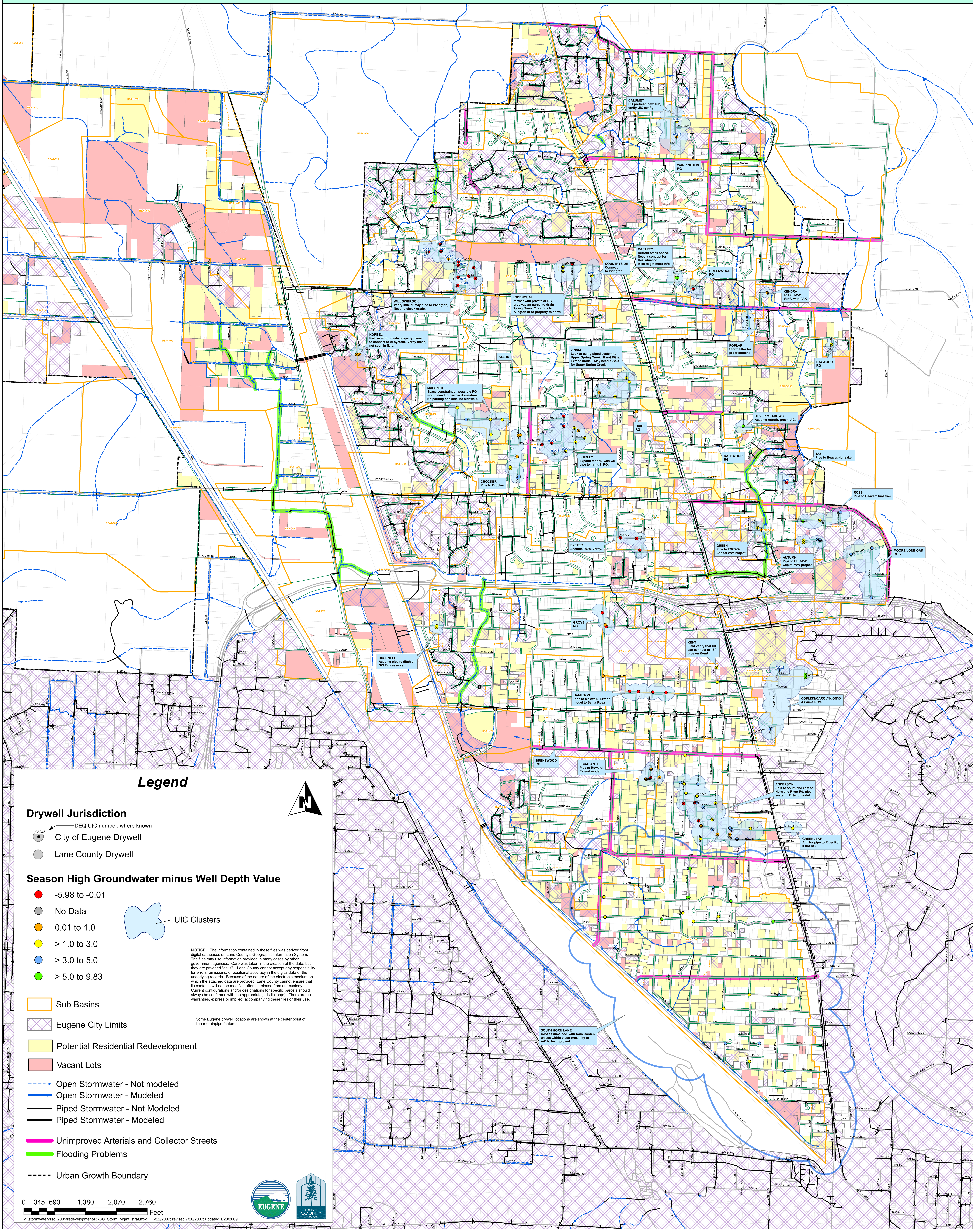
Following the development of the XP-SWMM models for each subbasin (with and without UICs) it was discovered that the GIS maps only included the 86 Lane County dry wells and not the 72 Eugene dry wells. A decision was made not to update the basin delineations to include the Eugene UICs, as resources were limited to conduct an additional analysis. In addition, it was decided that the model without the UICs would be used to design conceptual flood control CIPs, in order to be conservative and to account for the fact that UICs may need to be decommissioned in the future to address UIC regulatory requirements under the Safe Drinking Water Act. Therefore, results of an updated analysis to include the Eugene dry wells in addition to the Lane County dry wells already included in the model would not provide significant additional value.

APPENDIX H

RIVER ROAD SANTA CLARA
STORMWATER MANAGEMENT STRATEGY
DEVELOPMENT MAP

River Road - Santa Clara Stormwater Management Strategy Development

Preliminary Concepts



APPENDIX I

PUBLIC COMMENTS AND RESPONSES

Comments on the River Road / Santa Clara Stormwater Basin Master Plan from the Santa Clara Community Organization.

Therese Walch
Eugene Public Works
99 E. Broadway, Suite 400
Eugene, OR 97401

October 23, 2009

This basin master plan for River Rd/Santa Clara is an opportunity to use all the "tools" in the toolbox to best protect the open waterways, maximize storm water conveyance through these channels, and accommodate future densification without sacrificing what makes the RR/SC neighborhoods unique. While this plan touts some new ideas in the use of rain-gardens both along streets and in neighborhoods, it misses the mark in recognizing the existing natural infrastructure and prioritizing its protection and enhancement. The cost of manufactured infrastructure that degrades over time versus the protection of existing natural infrastructure that improves over time is not something we can afford, and is not the wisest use of what we have. This plan falls short of its aspirations to "provide a management strategy for storm water that reflects the uniqueness of the RR/SC basin". Our hydrology is not what makes us unique. The forms and patterns created by heritage trees, waterways, prime soils, agricultural operations, significant populations of both urban and rural and county and city residents and all they bring to their neighborhood is what makes us unique. Without taking into account these factors, this plan has no chance to meet its goal of planning reflecting that uniqueness.

The major difference between this basin and others throughout the city is our lack of storm water infrastructure and our extensive network of open waterways. These waterways, both large and small, are the infrastructure that makes development possible. They are also our primary defense from flooding. To date, many of the "lesser" waterways in our area have not been mapped and merit no level of protection from filling by development. These swales and watercourses, not wet much of the time, are what protect the existing older development from high water events. As larger lots on these swales are divided and infill development happens, the swales are not identified as part of a complete stormwater system and are instead deemed "depressions" in otherwise developable land and filled. There is no recourse for the existing residents along what was a continuous watercourse that now ends at their property line. The neighbor's fill has increased their risk of inundation. There is a need for these watercourses to be mapped and protected from filling. Developers in our area view them as impediments to the "clean slate" they like to use when mapping their subdivision. We see them as an opportunity for the developer to design around their own use of them to accommodate the increase in stormwater their development will ultimately bring while maintaining the natural infrastructure that protects all of Santa Clara and River Rd. In this way, there is a direct benefit for the developer to use them and save on manufactured infrastructure costs.

To date our basin has a total impervious surface area of approximately 37.5%, and is projected in this plan to reach 51% at buildout. This will be the highest projected percentage of impervious surface of any of the city's basin areas. This plan highlights how impervious surface area affects both water quality and flood control profoundly.

> Water quality: Research shows that "water quality degradation occurs at relatively low levels of imperviousness (10-20%), so the implications of development on water quality are significant" (p.2-23).
>
> Flood control: The computer model used to predict water levels did not match actual observed levels. Model parameters were adjusted to try and make the model more closely resemble actual conditions. Then several "additional model runs were conducted to evaluate the model's sensitivity to changes in input parameters. The results of these sensitivity analyses indicated that the impervious percentage area was the most sensitive model input parameter."(p. 3-6)

So, with impervious surface percentage being the most influential variable, this basin projected to have the greatest impervious area, and our necessary reliance on infiltration and open waterways for stormwater conveyance, alternative development standards to require on-site storage and infiltration of stormwater makes sense. The unique set of circumstances in the RR/SC basin (lack of piped infrastructure, reliance on infiltration and open waterways, highly permeable soils) requires a solution that protects and enhances our natural drainage.

Section 2: study area characteristics
Both the city and the county have differing development standards for floodplain development and floodway development, however, "more detailed floodplain studies necessary to map floodway boundaries have not been conducted for this basin" (p.2-17). Without these delineations, development is allowed to encroach on waterways in detrimental ways. We need development standards that will allow our natural infrastructure to meet our needs.

Section 3: flood control evaluation
Data collected for the computer modeling in this section was collected over an eight day period and validated for only three of those days in only one location. The effects of the resulting modeling did not match observed conditions and the data was subsequently "adjusted" to try and match real events. This is not a comprehensive data set upon which to draw conclusions for an entire basin, design major capital projects and form a course of action.

In looking at table 3-2, which details the hydraulic performance of RR/SC under present conditions and notes capacity issues for 10, 25, 50 and 100 year storms, there is no data listed for WO-005 from node 72088 continuing downstream to the end of the basin boundary. This section of the WO experienced significant flooding in the Feb. 1996 event. Stormwater rose from the storm drains to inundate the street over the curbs. In relating this to public works multiple times over the last few years in relation to ongoing development on this section of the WO, we were told that in high water events the sheer quantity of water in the Willamette River causes the WO to back up and not be able to drain into the Willamette. This anomaly is not reflected in the planning along the WO, or in the computer model which projects waterway capacity in high water events. The 1996 high water was deemed a "25 year" storm event, yet this section of the WO rose to the 374-375 foot level, close to the"100 year flood" level. I am concerned that this computer modeling will not reflect actual conditions.

Drywells in our area were designed to accommodate a five year event. Current code requires stormwater systems to accommodate a ten year event. When rainfall exceeds the five year event, drywells become ineffective and the water is instead infiltrated where it falls, in roadside swales, in "remnant" waterways and identified open waterways. The data presented here shows that there are very few flooding problems associated with existing development in both the 10 and 25 year storms, yet the plan, in section 3.5.1 proposes 16 major capital projects associated with existing and future modeled capacity problems. Section 3.5.2 proposes an additional thirty-some projects associated with drywell decommissioning and rain gardens along all streets south of Horn Lane in River Rd. The modeling for future problems was done with the assumption that the drywells would be decommissioned. If that is so, how are these two lists not redundant and creating capacity for the same stormwater twice? The data presented (few capacity issues, disparity between modeled and observed conditions, ineffectiveness of drywells in carrying capacity) is not complete or compelling in light of the proposed capital projects.

Plans for the other basins, completed in 2002, did not incorporate development standard alternatives. "The reason for this decision was that most of the identified flooding problems were anticipated to occur as a result of existing developed conditions. While future development would exacerbate some of the problems, a capital project to address flows from future development was more cost effective than requiring developers to address the issue through on-site storage requirements. For this basin, the conclusions from this previous analysis were assumed to apply" (p. 3-15). The RR/SC basin plan was delayed for the last seven years in part because this basin is <u>significantly</u> different than the other basins. The challenges we face and the opportunities we have require us to problem solve differently than we did in the other basins. The last quote, however, clearly states that there was no analysis of the value of development standard alternatives in light of our circumstances and whether or not they are an appropriate tool for RR/SC. The data provided shows that there are few capacity issues related to existing development but that capacity will need to be expanded to accommodate expected buildout scenarios. This possibility cries out for the use of development standards to avoid costly capital projects and to meet the goals of the neighborhoods for livable communities. The required use of low impact development standards (LIDS), pervious pavement in all roads, parking lots and driveways, and on-site storage and infiltration of all storm water would go a long way toward meeting the goals for water quality and flood control for new development without staggeringly expensive capital projects.

Section 4: water quality evaluation

The water quality evaluation for the RR/SC basin is based on incomplete data. All water quality collection sites were located in other basins and pollution estimates were extrapolated from measured levels of total suspended solids (TSS) even though "TSS has not been shown to directly relate to all other pollutants".

The estimated percentage increase in TSS loads (as a measure of pollution) for our basin, according to fig. 4-2, is approximately 20% due to decommissioning of drywells, but 55% due to future development. These figures suggest that future development will be far more deleterious to our water quality than the effects of decommissioning drywells. However, this plan proposes no development standards for future development to address this situation. Conventional wisdom is that storm water directly injected to the water table via drywells pollutes the groundwater and that runoff directly piped to open waterways pollutes the surface water. We agree with those premises, but do not come to the same action plan for the basin based on the collected information. Instead of trying to collect and treat storm water on a municipal scale without adequate mechanical infrastructure and piping, a dispersed system of infiltration based on development standards that prioritize non-mechanical infiltration of storm water, on site infiltration, and post development flows not exceeding pre-development conditions would accomplish both capacity and quality issues. Greater dividends will be reaped through addressing future development impacts before they are manifest than creating oversized capital projects for decommissioning drywells that will also hopefully meet the needs for future capacity.

Pollutant load estimates in this plan are built on an assumption that "new development would occur without the inclusion of water quality BMPs". However, new stormwater standards require the pretreatment of storm water using BMPs in PUDs and subdivisions and the stormwater code updates should require the same of all new development.

The idea that "decommissioning of all drywells would result in those discharges being transferred, untreated, to surface waters" presupposes that the water otherwise captured by drywells will be sent to open waterways. The water presently collected in drywells could surface infiltrate, as happens informally everywhere throughout our basin presently. If this were the case, it would not be transported to surface waters untreated, but treat itself in our native soils through infiltration.

The proposed rain garden street designs and the accompanying assumption that streets in our area will be widened at the time of "improvement" have not been publicly discussed. Adopting a menu of options that change a 25 foot road bed to a 50 foot roadway without public process or input will create undue amounts of tension and dissent within our neighborhoods. Experiences with context sensitive street designs and the ongoing discussions around costs to the adjacent property owners for these "improvements" need to be rolled out to our community with adequate opportunity for participation, questioning, and processing by the residents. Ironically, all of the proposed street options create more impervious surface than presently exists. Are we not then creating the problem so that we can engineer a solution instead of valuing our narrower roadbeds which do an admirable job of transporting us and reducing runoff? Many communities around the world are adopting the use of narrower streets, shared streets and other more innovative solutions that encourage the use of alternative modes of transport while reducing the paving footprint, preserving urban canopy and vegetation, and improving neighborhood livability.

Section 5: stormwater related natural resources

As mentioned in the beginning, the top-tier priority for stormwater related natural resources in our basin would be the mapping, protection, and enhancement of all our "lesser" waterways that are not accounted for through Goal 5, WR, WP and WQ overlays. The progress of changes to and implementation of LID standards in the code is unclear to us, but the required use of them within our basin makes functional, fiscal, and environmental sense. Doing all we can to minimize the need for large scale centralized infrastructure will allow us to grow and develop at a rate that the neighborhood can support.

In closing, this plan outlines a wide array of costly capital projects designed to meet capacity and quality issues that have been identified based on incomplete data. Instead of forging ahead with a hope that this will be good enough, we would like to see us really look at all the possible tools to meet our needs. New development can and should retain and infiltrate all its stormwater on site. This is done in other communities with both new development and redevelopment and with retrofits for existing development. Responsibility for the effects of our own impacts should rest with each of us. In this way we can begin to build neighborhoods that meet the needs of their residents and minimize the need for costly capital projects that invariably need maintenance and replacement over time.

Thank you for your consideration,
Jerry Finigan, Chair SCCO
Kate Perle, executive board SCCO
Kelly Burke, executive board SCCO
Rod Graves, executive board SCCO
Timothy Foelker, executive board SCCO
Cathy Lesiak, member SCCO
Karen Lawrence, member SCCO

Comments on the River Road / Santa Clara Stormwater Basin Master Plan
from the River Road Community Organization.

October 23, 2009

Dear Therese,

These comments are submitted on behalf three members of the RRCO Executive Board. There has not been time to share the information in the Basin Plan with RRCO's full board or membership or the broader neighborhood during this comment period, nor have we been able to solicit feedback or take any kind of vote on its content.

Overall, we are very disappointed that the proposed Basin Plan does not assess or recommend low impact development (LID) standards for our neighborhood--standards to reduce the percentage of impervious surface and development footprints, protect well-draining native soils and "country-style" drainage systems, and protect large trees. It also does not discuss downspout disconnects or rainwater catchment systems, topics raised by RRCO members at past meetings about the Basin Plan. LID standards are desirable not only for stormwater management, but also to protect neighborhood character and broader environmental values. RRCO and residents of our area have been asking for such standards for many years--during the Transition Project meetings and other processes and venues. As noted in the Executive Summary, each drainage basin offers unique conditions and opportunities for implementing development standards. Yet this plan ignores previous public input, and does not use this opportunity to propose unique or specific low impact development standards for this basin.

We are also disappointed that neither this Plan nor existing City-wide stormwater standards (whether for private development or public capital projects) require on-site infiltration to the maximum extent feasible, as is required in Portland, nor require non-structural best management practices first, before use of engineered facilities.

We are also very concerned that the proposed local street designs--with sidewalks, wider lanes or parking bays, and on-street rain gardens--are much wider and pave much more land than our existing local streets. Such streets would dramatically alter the character of our neighborhood, lead to loss of large trees and landscaping, and likely involve costly assessments to adjacent property owners. We believe that they would also encourage faster driving and greatly reduce the effective pedestrian zone relative to our existing "shared space" streets. There must be less expensive and intrusive ways to manage stormwater runoff from our streets. More options need to be evaluated (shared space and skinny streets, pervious/porous surfacing), and the public needs much more opportunity for involvement in designs for our local streets.

Section 3: Flood Control Evaluation

3.2-3.4 Model validation, results, and flooding problems

This plan compares model results with actual conditions at just one point during one 3-day rainy period. This does not seem like enough data to validate a model over the entire basin. Also, the model results at this one point do not correlate well with actual observed conditions, even after "adjustments"--actual drainage is considerably better than predicted by the model. It seems that more work is needed to truly validate the model, or it may lead to over-predicting flooding problems and over-sizing of stormwater facilities.

Also, simulations were done that showed that drywells do not provide significant drainage benefits in larger storms, even if they are carrying the full flow they are sized to handle (from a five-year storm). And even without the drywells being included, the overall model shows very few flooding problems even during the larger (10- and 25-year) storms. This aspect of the modelling does seem to match some of our observations about what happens to roadway runoff during a rainstorm. Water infiltrates quickly into roadside drainage swales, and some of it also pools at low points in the street or areas where the drainage areas along the right of way have been compacted or paved. Eventually this water just evaporates. Certainly areas right near the drywells do drain into those for a short time during and after rainstorms, but it seems that even without the drywells, water flows have many places to drain away naturally into roadside swales, and soils are permeable enough to drain quickly. More could be done to educate property owners and residents about the function of the roadside swales, and to intervene to correct minor drainage problems in areas where water pooling does occur.

3.5.1 Capital projects

Capacity deficiencies (e.g, areas of potential flooding) in the system are identified through modelling, and 16 specific capital projects are recommended to add more capacity to provide varying levels of flood protection for various sizes of rainstorms. However, as above, it seems that these projects might be over-sized, given that the model seems to overestimate flooding problems. It seems important to refine the model until its results more closely match observed reality before designing capital projects, some of which are extremely expensive.

3.5.2 Drywell decommissioning projects

Supposedly the capital projects above will handle all modelled and observed flooding problems throughout the system. Also, the modelling results and on-street observations suggest that existing drywells may not be contributing much to the overall drainage of our area. Given this, is it really necessary to add additional capacity to replace the lost capacity of drywells? Isn't this just redundant capacity that will be largely superfluous to controlling flooding, just as the drywells are now? Certainly the capacity in existing roadside swales needs to be preserved, but it seems that capacity arguably is sufficient as long as pavement width of roadways is not widened (since there is very little flooding now).

The assumption that local streets will be widened at the time of "improvement," with added paving width for driving, parking and sidewalks, is something that has not had a proper public airing. These assumptions also do not seem to be the best choices in terms of stormwater management.

In our opinion, the local street designs summarized in Table 4-1 are unnecessarily wide, with too much new paving and too much deference to facilitating cars. Many neighbors have expressed interest in narrower, pedestrian-oriented "shared street" or "woonerf" street models (and currently our local streets function in much this way), yet none of the proposed designs reflects such a model. The models that are proposed all include a separate new sidewalk, which arguably is not necessary or desirable for local streets in most of our neighborhood. The models also propose either widening existing travel lanes for cars, or adding separate parking bays. Adding all this pavement is detrimental to stormwater goals, as well as to neighborhood livability and other environmental goals. And it seems to be contributing to the need for extra-wide engineered rain gardens to infiltrate the induced new runoff. In any case, the wide "footprints" of the new roadways (2.5 - 3 times wider than current paving widths) would have a huge impact on neighborhood character (front yards, landscaping and existing large trees). The design of residential streets, together with the amount and speed of traffic they carry, contributes significantly to a sense of community, neighborhood feeling, and perceptions of safety and comfort. At the least, affected residents need much more say before any street designs are adopted as guidelines. Residents also need to be fully informed at the outset about their responsibility for costs of road improvements, and the relative costs of various design options. The potential costs and impacts on neighborhood character are significant.

Residents should have the opportunity to evaluate and compare some "shared street" options without sidewalks, and some narrower driving lane and on-street parking options. Some communities and guidelines are now suggesting and installing roadways as narrow as 14 feet wide for two-way traffic (18 feet of "drive-able" surface counting edge treatments). Also, permeable pavement options need to be considered. The use of permeable paving could reduce roadway runoff and help filter out pollutants, reducing or eliminating the need for additional stormwater facilities. Residents are also interested in "context sensitive" designs that preserve existing large trees, something that also has value for stormwater management.

3.5.3 Development standards

This section states that flood control development standards were not selected for implementation in other Basin plans completed in 2002, for various reasons. The text also notes that detailed cost comparisons were done in conjunction with the other Basin Plans, showing that it was more cost effective to use public capital improvements, not a combination of public improvements and requirements on developers to address on-site storage.

It is not explained why the same conclusions from other Basin Plans, or the rather dated cost analyses, are assumed to apply to our RR-SC Basin today. It is also not clear how total costs of public capital projects can (or should) be compared with costs to private developers. At the least, more explanation is needed to justify why these earlier data and conclusions are relevant to the RR-SC Basin and this Basin Plan.

The text notes that many flooding problems in other basins are caused by "existing developed conditions", and concludes that these problems need to be addressed by new (public) capital projects (instead of new development standards). It seems that other conclusions are equally reasonable. If existing (private) development causes flooding, then doesn't this suggest that development standards DO need to change to prevent similar flooding problems in the future? Also, shouldn't private property owners be required to address existing problems on their property, rather than new public projects having to be sized to handle their runoff? Portland's Stormwater code encourages, and in some cases, requires stormwater retrofit projects for private property. Eugene's could do the same.

In any case, at least parts of the RR-SC Basin are significantly different than other Basins. Many areas in our neighborhood rely more on on-site stormwater infiltration and (non-structural) natural infiltration. We also have a relatively high groundwater table, and many people have and use irrigation wells. Current City-wide stormwater standards allow, but do not encourage or prioritize dispersed, on-site stormwater management. City stormwater codes also do not require protection of natural hydrology, nor offer enough non-structural choices for accomplishing on-site infiltration. We do not believe that existing City-wide stormwater standards or programs to encourage LID practices are sufficient to protect natural drainage, groundwater recharge, or surface water flows needed to maintain stream ecology in our area. Surface water flows (Flat Creek, Spring Creek) have already been altered by existing development.

Also, if projected total impervious surface in the Basin could be reduced via new development standards, it seems that would reduce the few modelled and observed flooding problems throughout the system and allow some of the proposed public (flood control) capital projects to be smaller in size.

Here are some of the low impact development standards or methods that we think need to be required or promoted in our Basin, and that need to be evaluated in this Basin Plan:
* prioritization of on-site infiltration (as in Portland)
* prioritization of non-structural Best Management Practices, including

* Cluster development,
* Minimize soil compaction,
* Minimize total disturbed area,
* Protect natural flow pathways,
* Protect riparian buffers,
* Protect and enhance sensitive areas and native vegetation,
* Reduce impervious surfaces,
* Disconnect impervious surfaces/downspouts,
* Rainwater catchment/harvesting.

* Split flow infiltration methods that preserve predevelopment stormwater flows in terms of rate, quality, frequency, duration, and volume, and thus more closely mimic natural systems. This is important for groundwater recharge, and preservation of surface water flow and natural channels and landscapes.

Section 4: Water Quality Evaluation

4.2 Evaluation of existing and expected future water quality conditions

The pollutant load estimates seem based on very shaky assumptions. First, no actual data was collected from our Basin about pollution levels, but data from other areas of Eugene was used to estimate it. Second, pollutant loads for Total Suspended Solids (TSS) were used as a general indicator of other pollutants, though "TSS has not been shown to directly relate to all other pollutants". Third, when computing pollutant loads, decommissioning of drywells is assumed to result in 100% of those discharges being transferred, untreated, to surface waters. This seems like a very high estimate given the discontinuous nature of our drainage system, and the relatively high permeability of soils.

In any case, it is unclear how these questionable pollution estimates are even used--they don't seem to be driving particular actions or sizing of treatment facilities.

On pg. 4-5, the Plan does conclude that "pollutant loads in the RR-SC basin could potentially increase by up to 85% as a result of future development and drywell decommissioning, if treatment and/or other forms of infiltration are not provided for flows associated with drywell decommissioning." But in fact, Figures 4-1 through 4-3 show that the treatment of flows associated with drywell decommissioning would handle only a small part of the additional pollution that is projected--and this is the case even with the seemingly very exaggerated assumption about pollution that will be re-directed from drywells. In fact, the data presented show that most of the projected future pollution will be from new development.

Thus, "treatment and infiltration of the flows associated with drywell decommissioning" appears to be NOT very helpful at reducing the potential 85% increase in pollution that is mainly from other sources. Instead, it seems that development standards to address pollution from private development would be more effective, and the logical top priority for this Plan. The sentence would be less misleading if it said "pollutant loads in the RR-SC basin could potentially increase by up to 85% as a result of future development, if treatment and/or other forms of infiltration are not provided for flows associated with future development."

4.3.1 Capital projects alternatives

We understand that the existing drywells in our area are considered potential sources of pollution to groundwater, and that they need to be decommissioned to meet federal and state laws. However, not much else is very clear or convincing in this section about how (surface water) pollution will be addressed in our Basin, or what pollutants are of concern, or how the Basin Plan contributes to solving identified problems. In particular, it is not clear why rain gardens in conjunction with drywell decommissioning ought to be such a major focus. As above, the data is not convincing that decommissioning drywells will lead to significant additional surface water pollution that needs to be addressed near the sites of those drywells.

As in our comments on Section 3, we have many concerns about the proposed local street designs with sidewalks and rain gardens. In terms of water quality, narrower "shared space" designs that do not include a separate sidewalk, and that use pervious pavement to reduce effective impervious area of the roadway, would be better choices for protecting water quality.

4.3.2. Development standards to address water quality

Water quality development standards in the City stormwater manual may be sufficient to address water quality issues for new development in our Basin, unless significant types or amounts of new development (smaller and single-family units?) are exempted from the standards. Also, we are not aware of what particular changes are being proposed for the update underway, nor what particular ways to encourage LID might be proposed under separate LID initiatives. However, there are many other low impact development standards that protect water quality that the City could consider, including those we listed above in our comments on section 3.5.3. Some of these may be lower in cost, more effective, and serve other beneficial functions besides just protecting water quality. We think additional low impact development standards should be encouraged or required for the RR-SC basin, to protect water quality and other values.

As for preventing stream bank erosion, the Eugene Water Quality Protected Waterways ordinance and WQ overlay zone requirements are a good first step for protecting waterway segments that run through certain identified properties that are within City jurisdiction. However, Lane County needs to adopt similar protections that apply to waterway segments running through unannexed properties within the UGB. These waterways--including segments of Upper Flat Creek and tributaries of the A1 channel--need protection whether or not the properties annex to the City.

Section 5: Stormwater Related Natural Resources

5.2.2 Development Standards Alternatives

As above, Lane County needs to adopt protections similar to those in the City's Water Quality Waterways ordinance, to protect waterway segments that pass through properties that are in Lane County jurisdiction now, and whether or not they are ever annexed to the City. Also, more protections are needed to prevent fill of waterways, even small ones, and whether or not such fill is done in the context of "development".
And low impact development standards, as listed in our comments on section 3.5.3, are needed to help ensure groundwater recharge and
to help retain more natural stream flow in waterways such as Flat Creek and Spring Creek.

Perhaps it is not feasible to consider more stream corridor acquisition for segments of Flat Creek or other waterways in our neighborhood, but it does seem that more could be done to educate property owners and the community about the natural values of even small waterways, and to encourage their protection and restoration.

Section 6: Summary

Overall, it seems that the data in this document show that the rain garden projects proposed as part of the drywell decommissioning are not needed for flood control. Also, the data is not convincing that they are needed for pollution control. If they were constructed, of course, they'd perform some of these functions. But they will replace swales that already perform these same functions, seemingly well. Does decommissioning the drywells really need to be linked to proposals for new sidewalks and wider streets and replacing our existing drainage swales? If necessary, the swales probably could be "spot renovated" with much less cost and disruption to our neighborhood character and landscape.

Section 6.3 says that the proposed capital projects will be funded primarily through stormwater user fees and systems development charges. But does this include the costs of all the local street "improvements" that are proposed in conjunction with the drywell decommissioning? If not, and if the full street improvements are going to occur at the same time as the decommissionings (and assessments charged to local property owners), then this needs to be explained.

Sincerely,

Becky Riley
Jolene Siemsen (co-chair)
Marilyn Mohr
(RRCO board members)

Date: February 23, 2010

To: Jerry Finigan (Chair), Santa Clara Community Organization
Becky Riley & Jolene Siemsen (Co-Chair), River Road Community Organization

From: Therese Walch, City of Eugene Public Works
Dan Hurley, Lane County Public Works

Thank you for the offering your comments and input on the draft River Road-Santa Clara (RR-SC) Stormwater Basin Plan. We sincerely appreciate the time and attention you have given to reviewing this document and the proposed stormwater management strategies. We have considered your comments carefully, consulted with other staff and managers in our respective organizations, and offer the following responses. We reiterate first the purpose of the stormwater basin planning, and what we understand to be the main themes of your comments. Following that, responses are provided by topic area, and include references to the community organization's comments (Attachments A[1] and B[2]). We are looking forward to meeting with you to discuss these responses in more detail. Please see the last page of this letter for contact information if you need to reach us in the meantime.

PURPOSE OF STORMWATER BASIN PLANNING

The purpose of the basin planning is to develop a stormwater management strategy that takes into consideration the unique stormwater-related characteristics of each basin, carries out established local policies, complies with federal and state regulations, and reflects input from stakeholders including residents of the basin. As with the City's six other basin plans, the RR-SC Plan describes a "multiple-objective" approach (i.e. incorporating water quality, stormwater-related natural resources and flood control) to stormwater management that reflects the problems and opportunities within the RR-SC basin. It is to be used by City and County staff for background/contextual information, for development of the City's (and County's, in this case) capital improvement programming, for contextual support for development standards, and for evaluating technical information about the stormwater system. It is intended to be complementary with the other activities conducted within the City and County's stormwater programs. The Basin Plans are not used by the City or County in a manner that regulates the conduct or activities of the public.

[1] Attachment A: Santa Clara Community Organization comments (Letter to Therese Walch from Kate Perle, on behalf of Jerry Finnigan (Chair), Kate Perle, Kelly Burke, Rod Graves, Timothy Foelker, Cathy Lesiak, and Karen Lawrence, October 23, 2009), annotated to include comment numbers: "SC-XX."

[2] Attachment B: River Road Community Organization comments (E-mail to Therese Walch from Becky Riley, on behalf of Becky Riley, Jolene Siemsen (Co-Chair), Marilyn Mohr, and Carleen Reilly (Co-Chair), October 26, 2009), annotated to including comment numbers: "RR-XX."

OVERARCHING THEME OF PUBLIC COMMENT

An overarching theme of the comments from the River Road Community Organization (RRCO) and Santa Clara Community Organization (SCCO) is that the basin plan strategies do not address the uniqueness of the basin, reflected in its "heritage trees, waterways, prime soils, agricultural operations, significant populations of both urban and rural and county and city residents" and that the plan misses the mark in prioritizing the protection and enhancement of the basin's existing natural infrastructure [SC-1][3].

While the RR-SC Plan does not go as far, prescriptively, as the community organizations desire, the unique stormwater-related characteristics of the basin were significant factors in the development of strategies for River Road – Santa Clara. The strategies reflected in the basin plan, complimented by city-wide efforts including new initiatives implemented since the 2002 adoption of the other six stormwater basin plans, go a long way towards achieving the desired outcomes we heard expressed by the community groups, and reflect significant accomplishments in moving away from single-focused flood control stormwater management to multiple-objective stormwater management as conveyed in the City's stormwater policies. The mechanisms for achieving the outcomes with respect to development standards are not as prescriptive as the community organization's comments indicate they would like to see, but reflect the City's policy decisions aimed at balancing prescriptive-ness, incentives, and choice. Some factors such as the preservation of heritage trees and the protection of agricultural uses for example simply reside outside of the purview of the basin planning process. We offer the following as examples of stormwater management strategies that address the RR-SC basin's unique characteristics:

- New <u>local green street design concepts</u> were developed that utilize rain gardens, surface infiltration, and on-site stormwater management for adjoining properties as opposed to a traditional curb/gutter/piped street improvement. These green street design concepts were developed specifically to address the problems and opportunities related to stormwater management in RR-SC including the lack of a consistent stormwater system, very flat topography, well-draining soils, mixed jurisdictional areas, significant extent of vacant and "underdeveloped" properties, large number of unimproved streets, and federal regulatory limitations on the use of drywells for stormwater destination. Once incorporated into the City's Local Street Plan, these green street design concepts may be used city-wide as appropriate.

- <u>Public underground injection controls (UICs), or drywells</u> in RR-SC that do not meet Safe Drinking Water Act regulations, primarily due to the shallow groundwater conditions in the basin, will be replaced, many with vegetated surface infiltration facilities (i.e. rain gardens).

[3] SC = Santa Clara Community Organization comment, on annotated Attachment A.

- Water quality retrofit projects were identified for specific locations in RR-SC to address high pollutant land uses in built-out areas developed prior to the enactment of Stormwater Development Standards.

- Capital projects were identified to address flooding problems on the major stormwater system that were identified by the RR-SC system model under existing and future development conditions. Capital projects will be incorporated into the City's larger list of capital projects, and prioritized in accordance with capital improvement program (CIP) project prioritization criteria.

- Support for implementation of Stormwater Development Standards to address the quality of runoff from new development and re-development (Note: Stormwater Development Standards were instituted in 2006 for development inside city limits). The standards include incentives for impervious surface area reduction techniques, and a range of green infrastructure options for meeting the stormwater requirements including rain gardens, filter strips, vegetated swales, and green roofs.

- Support for increased implementation of green infrastructure and low impact development (LID) practices through potential administrative adjustments, integration of LID practices with other initiatives, land use code amendments and other program enhancements. (Note: City Council direction on implementing LID was provided at a January 17, 2007 worksession on "Green Infrastructure and Low Impact Development" and a September 17, 2008 follow up work session).

- Support for protecting certain waterways with a strong relationship to those considered water quality impaired by the State of Oregon, and not otherwise protected, including segments of waterways in RR-SC: Flat Creek, Spring Creek, and the East Santa Clara Waterway (Note: The City's /WQ Water Quality Overlay Zone was enacted in 2009 and applies to certain properties within the Eugene city limits including in RR-SC. It also applies to certain properties outside city limits and inside the urban growth boundary, (UGB) but only upon annexation). The /WQ Overlay Zone compliments other waterway protections previously adopted by the City and County (namely, Goal 5) to protect wetlands and wildlife habitat.

The City of Eugene and Lane County have worked closely together on the basin planning and will continue to collaborate to implement the RR-SC Plan, within the respective agency's funding constraints.

COMMENTS AND RESPONSES BY TOPIC AREA

Topic: Protection of Natural Functions of Waterways

- ***Map all waterways, and protect them from filling. County should adopt /WQ inside UGB, outside city limits. [SC-2], [SC-14], [RR-14] [RR-15][4]***

Waterways are very important components of the RR-SC stormwater system, as is the case in each of Eugene's six other stormwater basins. Evidence of the importance of waterways to the City's stormwater system is Policy 1.1 of the Comprehensive Stormwater Management Plan (CSWMP, adopted by City Council in 1993) which states: *Incorporate the beneficial functions (flood control, stormwater conveyance, water quality treatment) of natural resources into the City's storm drainage system.*

In total, the City and County have applied land use/zoning regulations to a system of local waterways inside the urban growth boundary (approximately 100 miles in length) which meet federal and state requirements and local policies related to water quality and natural resources. The City recently applied waterway protections to 13.5 miles of waterways in the form of the /WQ Water Quality Overlay Zone, adopted by City Council in March 2009. Prior to that, in 2005 and 2006, the City Council and the Board of County Commissioners each adopted a /WR Water Resources Overlay Zone that protects waterways within the Eugene UGB for their significant habitat value. Prior to that, in 1995, the City Council adopted waterside setback ordinances (/WB Wetland Buffer Overlay Zone, /WP Waterside Protection Overlay Zone) in the west Eugene wetlands area to protect wetlands and waterways in west Eugene. A fact sheet describing local waterway protections through land use and zoning overlays is included in this response to comments. Additional waterway protections through land use and zoning regulations are not under consideration by the City at this time or in the foreseeable future. Lane County is constrained by resources to enforce greater protections of minor waterways. However it is presently establishing a working group in conjunction with watershed councils and other interested parties to analyze and make recommended changes to the County's riparian protection ordinance applicable outside of the urban growth boundary.

While significant waterway protection has been achieved over the last decade through local land use regulation, the protections do not apply to all waterways. Smaller waterways may be categorized as wetlands and may therefore be protected to some degree by federal and state wetland fill regulations.

[4] RR = River Road Community Organization comment, on annotated Attachment B.

- ***Educate property owners and residents about the function of roadside swales and small waterways. [RR-5]***

Lane County and the City of Eugene currently partner on stormwater education activities inside the Urban Growth Boundary (UGB) as part of the City/County Stormwater Intergovernmental Agreement related to the City of Eugene's National Pollutant Discharge Elimination System (NPDES) Phase I permit and Lane County's NPDES Phase II Permit. Under the agreement, a *Stormwater Connections* newsletter is mailed directly to all city and county residents inside the urban growth boundary. Articles have been included in the *Stormwater Connections* newsletter (Spring 2005, Spring 2007 issues) related to the importance of ditches and swales and the adverse impacts to them of dumping debris and filling. An article is being drafted for inclusion in the Spring 2010 issue related to this topic, and additional articles will be considered for future additions. The City and County are always open to input about newsletter topics and public outreach strategies in general, and encourage residents to contact Kathy Eva, Eugene's Stormwater Information Specialist at: 541-682-2739.

Citizens in both jurisdictions are encouraged to contact the City of Eugene Maintenance Division (#541-682-4800) or County Road Maintenance Department (#541-682-6901) to identify areas where water pooling occurs and to assist in identifying possibilities for correcting minor drainage problems.

- ***City and County have different floodplain development standards. More detailed delineations are needed to prevent encroachment on waterways. [SC-5]***

The City and County participate in the National Flood Insurance Program (NFIP) program. The Federal Emergency Management Agency (FEMA) is tasked with creating floodplain maps for the entire country; the City has adopted the most recent flood maps provided by FEMA. For financial and practical reasons FEMA has devoted more attention to urban areas that are at risk of flooding, and to larger streams and rivers. Detailed studies have been conducted for two waterways in the Eugene area: the Willamette River and Amazon Creek. As with rural areas and smaller tributaries across the country, the smaller waterways in Eugene have had floodplain boundaries determined using approximate methods; these areas are known as 'approximate A Zones.' Santa Clara has many small approximate A Zones. It is not anticipated that FEMA will perform a detailed hydrological analysis for Eugene's approximate A Zones in the foreseeable future.

The City and Lane County have adopted floodplain development regulations that apply in their respective jurisdictional areas. The Lane County and City of Eugene floodplain regulations are similar as both are intended to meet Code of Federal Regulation standards for participation with the NFIP, and state mandates. Under a 1987 Intergovernmental Agreement, authority for land use and building permit review within the urban growth boundary including areas outside Eugene city limits is conveyed to the City (with some exceptions, e.g. for the Airport and the

Lane County Fairgrounds). Development in approximate A Zones is required to meet the same City and County development standards as those in areas where detailed studies have been conducted, with just a few differences. Where detailed studies have been conducted, the hundred year water surface elevation is determined by FEMA (the expected water surface elevation corresponding to a statistical flooding event that has a one percent chance of occurring in any given year), and a floodway is designated. For approximate A Zones, the best available data from an authoritative source is used where possible to determine the 100-year water surface elevation, and when good data is not available the applicant is responsible for determining the 100-year elevation using a FEMA approved method, which is then evaluated by City staff. Larger developments, such as subdivisions over five acres or fifty lots are required to provide detailed hydrological analyses. Floodplain development regulations are the same in either case (detailed study areas vs. approximate A Zone areas) except that approximate A Zone areas do not have designated floodways. Floodways are intended to remain unobstructed to convey floodwaters out of our community, are typically associated with high velocity flows, and have significant encroachment provisions.

The City and County floodplain development standards would not significantly change as a result of a detailed floodplain analysis in areas now designated as approximate A Zones, with the exception of floodway development prohibitions. However, for the City of Eugene, regulations regarding watercourse alterations at Eugene Code Section 9.6707 protect the flood carrying capacity of some rivers and streams that have no designated floodway. Other regulations often apply to development within the floodplain such as federal and state wetland regulations, and local natural resource and water quality waterway protections.

Topic: Development Standards / Low Impact Development

- ***No development standards proposed in the Basin Plan for future development. Instead of collecting and treating stormwater on a municipal scale, maximize on-site infiltration, and require that post-development flows equal pre-development flows for new development. Require prioritization of non-structural BMPs over engineered facilities. Basin plan does not assess or recommend LID standards. Require low impact development standards [RR-1], [RR-2], [SC-10], [SC-14]***

The RR-SC Plan supports the implementation of city-wide Stormwater Development Standards, for much the same reasons they were proposed by the other 2002 basin plans: mainly, that on-site stormwater controls are the most cost-effective way to deal with the water quality impacts of new development. Municipal-scale collection and treatment of stormwater is not being proposed. Retrofitting the existing municipal system through capital projects is another element of the city-wide water quality strategy, but it is more targeted to collection/treatment in high pollutant source areas and opportunistic restoration/rehabilitation of the open and piped system to incorporate water quality features, and is not wholesale collection and treatment.

City-wide Stormwater Development Standards[5], enacted in 2006, include requirements for: destination, pollution reduction, oil controls, source controls, and flow controls for the headwaters area (for water quality). These requirements apply to properties inside city limits as well as any properties annexed to the city from the urban growth boundary.

Stormwater **destination requirements** were already in place in 2006 and apply to all development, for the purposes of providing adequate stormwater conveyance and appropriate levels of flood control. The **water quality requirements** added in 2006 (pollution reduction, oil controls, source controls, and headwater flow controls) apply to new development and re-development that add or replace 1,000 square feet of impervious surface area or more.

The City's code prescribes the basic design standards (flood control design storm and water quality design storm) that must be met and references the *Stormwater Management Manual* for acceptable facility options and detailed siting criteria and design requirements for each facility. The City does not dictate the type of facilities or stormwater management method that must be used to meet the flood control and water quality requirements, but rather provides the "tools" or best management practices to facilitate green infrastructure/low impact development (LID) practices. Facility options in the *Stormwater Management Manual* include those that allow onsite management of stormwater including ecoroofs and roof gardens, pervious pavement, stormwater planters, tree credits, swales, filter strips, soakage trenches, infiltration sumps, drywells and rain gardens. Financial incentives in the form of lower systems development charges and stormwater user fees are provided for certain techniques (pervious pavement, eco-roofs, contained planters, and tree credits) that reduce impervious surface areas. These techniques also results in smaller water quality facilities for treating runoff from the remaining impervious area. Beyond the stormwater development standards code and manual, the City has produced and distributed brochures (e.g. "Planters with a Purpose"), conducted outreach and trainings for the design community, and is setting an example for the community through its public capital improvement projects.

In addition to supporting the Stormwater Development Standards, the RR-SC Plan supports following through on direction provided by the Eugene City Council related to LID. At a January 17, 2007 worksession ("Green Infrastructure and Low Impact Development"), Council directed staff to conduct a review of the Eugene Code and administrative policies and procedures to identify barriers and regulatory or incentive-based approaches to increase the use of LID practices. At a follow-up September 17, 2008 worksession ("Low Impact Development - Results of Review"), Council directed staff to further increase implementation of LID practices. This work is underway, beginning with identifying specific administrative adjustments, incentives, and other LID-related actions or implementation.

[5] Eugene Code Section 9.6790-9.6797

An assessment of the types of facilities constructed in the past year in Eugene shows that a proportionally higher number of green infrastructure/LID[6] facilities over mechanical treatment facilities are being implemented by private development. More specifically, for the period of time from July 1, 2008 through June 30, 2009:

- Of the 124 land use applications reviewed for stormwater development standards purposes, three times as many proposals incorporated green infrastructure/LID facilities, as compared to those that incorporated mechanical water quality treatment facilities (90 vs. 34, respectively).
- With respect to residential building permits issued, 54 of the 55 incorporated green infrastructure/LID facilities, and one incorporated mechanical treatment.
- With respect to commercial building permits issued, 35 of the 69 incorporated green infrastructure/LID facilities (including: 2 filtration planters; 6 vegetated swales; 9 grassy swale; 7 vegetated filter strips; 5 rain gardens; 2 soakage trenches; and 4 pervious pavers), and 34 incorporated mechanical treatment facilities.

In summary, the City's approach to regulating stormwater management is a combination prescriptive- choice- incentive-based approach. The Stormwater Development Standards and *Stormwater Management Manual* prescribe the basic requirements, offer a range of choices including many green infrastructure/LID choices to suit a wide range of site-specific conditions, and incentivize the preferred choices through financial and other means. The owner/developer must meet the stormwater development standards, and is allowed to make choices in terms of stormwater facility type utilized, suitable for each individual property. The City provides outreach and training, and sets an example through its capital projects. In addition, the City is actively working to identify additional incentives and reduce or eliminate barriers to implementing LID, in accordance with City Council direction. The outcome of this approach is that the vast majority of residential developments and a slight majority of commercial/industrial developments are choosing green infrastructure/LID facilities. The City will continue to seek ways to further increase the use of these facilities.

[6] Green infrastructure facilities for purposes of the City's categorization include vegetated swales, filter strips, and rain gardens, which are all pervious in nature. Soakage trenches are infiltration facilities, therefore pervious by design, but are not vegetated. Therefore, soakage trenches are considered LID facilities, but not green infrastructure as the term is commonly used. Mechanical facilities are not pervious in nature.

- ***Development standards to address pollution from private development would be more effective than treatment and infiltration of flows associated with drywell decommissioning and therefore should be a higher priority. [RR-12]***

Both are important and necessary aspects of the stormwater management strategy for RR-SC and are not mutually exclusive actions. Stormwater Development Standards are necessary for meeting the Clean Water Act and associated municipal stormwater permits issued to the City of Eugene (National Pollution Discharge Elimination System, or "NPDES" Phase I permit) and Lane County (NPDES Phase II permit). As described above, the City's stormwater development standards apply to properties inside city limits as well as any properties annexed to the city from the urban growth boundary. These standards address the water quality impacts from new development and re-development sites within city limits. Addressing existing UICs that must be decommissioned for lack of separation to high groundwater levels is also necessary to meet Safe Drinking Water Act regulations (see Department of Environmental Quality, or DEQ, web site for more information about UIC regulations and pending permits for municipalities utilizing UICs: http://www.deq.state.or.us/wq/uic/permits.htm). Providing treatment and conveyance for stormwater currently directed to certain UICs is necessary to address the potential water quality impacts to surface water (of surfacing water currently directed to sub-surface – for UICs decommissioned utilizing a piped system) and groundwater (to provide treatment of water directed to sub-surface, prior to reaching groundwater – for UICs decommissioned utilizing rain gardens).

- ***Reduce projected impervious surface area via development standards, and as a result CPs would be smaller in size. Requiring low impact development standards, pervious pavement for all roads, parking lots and driveways, and on-site storage and infiltration of all stormwater would reduce the size of capital projects. [SC-9]***
  [RR-10]

As described in responses above, the City provides incentives for certain best management practices (e.g. pervious pavement, eco-roofs, contained planters, and tree credits) through lower systems development charges and user fees, and through impervious surface area reduction in sizing stormwater facilities. The City encourages, but does not require, green infrastructure/LID facilities over structural engineered facilities. The majority of residential developments, and slightly more than half of the commercial developments over the past year have chosen to use green infrastructure/LID facilities. Follow through on Eugene City Council direction to further increase implementation of LID is underway. It is anticipated that all of these efforts will reduce the total impervious surface area in the RR-SC basin and throughout the City, as compared to traditional development. However, development standards and incentives affect only the areas undergoing development and re-development, and must be considered in the context of the large amount of existing impervious area not affected by the development standards.

Most proposed flood control capital projects were identified to address problems predicted to occur by the model developed for the major system, for larger storm events, based upon assumed impervious surface area percentages. The City acknowledges that the assumed impervious surface area percentages used in the model are inherently slightly conservative, as they do not reflect assumptions about the degree to which impervious surface area will be reduces through incentives, however it is the City's, County's and consulting engineer's best professional judgment that slight conservatism is appropriate in the assessment of the major flood control elements of the system for purposes of identifying potential flooding problems and capital project needs. It is very important to realize, however, that during capital project design, in advance of any capital project construction, a more detailed storm drainage study is conducted which delineates the drainage areas, impervious areas, and runoff volumes to a greater level of detail than is done in the master planning process and would refine the size of flood control facilities.

- ***Justify why flood control standards do not pencil out compared to flood control capital projects for this basin. [SC-9], [RR-9]***

As with the other stormwater basins, most of the identified flooding problems in RR-SC were anticipated to occur as a result of existing developed conditions. While future development would exacerbate some of the problems, a capital project would already be required to address existing condition flooding. Implementing on-site storage requirements for new development would not address the majority of capacity-related problems as identified by the model.

- ***Require on-site storage and infiltration for all new development. [SC-4], [SC-9], [RR-2]***

As described above, the method for managing stormwater is not prescribed, but acceptable choices are provided in the *Stormwater Management Manual*. The appropriate destination method is site-specific and depends on a number of factors including soil type, slopes, and availability of public and private infrastructure. While on-site storage and infiltration is not explicitly required, certain circumstances prevalent in the RR-SC basin would in effect necessitate on-site retention/infiltration, for example:

  - *Development sites in any area of the City where a public stormwater system does not exist and extension from the public system is not planned.* Figure 4-11 (Project Planning Phase) in the draft basin plan illustrates this situation, which reflects inherent constraints in some areas of the RR-SC basin (as well as other areas within the City, but less so) for piping stormwater off-site. The decision making process reflected in the figure conveys the City's strategy to allow for use of capacity where there is capacity in an existing piped system, and for connection to an existing piped system if it is feasible and there is capacity in the downstream receiving system. Given the RR-SC basin's inherent constraints (including discontinuous stormwater system, flat topography, mixed jurisdictional areas, funding constraints), however, extending the piped system wholesale throughout RR-SC is not feasible nor is it the City's plan to do so. As shown on the figure, new development or infill development, if not located on an improved street that drains to a piped system, will need to assess the feasibility of constructing a piped system (including downstream connection and capacity constraints), and if not feasible or desirable, then the developer would need to select an approved alternative for managing stormwater on-site. Modifications to Figure 4-11 will be made to reflect more clearly that on-site stormwater management (including volume controls) would be necessary under these circumstances.

  - *Future situation, assuming new local "green street" design concepts are incorporated into the City's Local Street Plan (through a separate process).* The local green street design concepts, which are envisioned to be alternatives to current local street standards, as proposed, assume that the linear rain gardens are sized for right of way runoff only, therefore development sites adjacent to a green streets would by necessity need to manage stormwater on-site (including volume controls). The green streets concepts could be employed on new local streets, or in a re-development situation.

- ***Permeable pavement options need to be considered. [RR-8]***

Most street improvements will occur in response to development and most likely only in areas annexed by the City of Eugene. Permeable pavement has been used by the City on a pilot project basis, and is an accepted stormwater impervious surface reduction technique as long as it meets design criteria, but is not acceptable yet for use in the right of way. It should be acknowledged that such pavements accompany a higher construction cost and may be limited in their functionality without significant maintenance to prevent pore clogging. Permeable pavements are not recommended for sites with a likelihood of high oil and grease concentrations, which would include streets with a high number of average daily trips (> 1,000).

Topic: Impervious Surface Area (ISA)

- ***RR-SC highest ISA percentages compared to other basins. [SC-3]***

The amount of impervious surface area (ISA) will increase as vacant or "underdeveloped" (meaning, not yet developed to Metro Plan designation and related densities) properties are developed. The basin plans estimate the future, or "buildout" ISA by assuming properties will be developed in accordance with the Metro Plan designations, and utilizes average ISA percentages by generalized land use categories, and the area of each land use category. The buildout ISA for the RR-SC basin is projected to be 50% (plan page 2-12), an increase from the 2006 ISA of 37.5%. The increase in ISA can be partly attributed to the relatively significant amount of vacant industrial area (326 acres as of 2006) within the basin. The estimated average

ISA for industrial land use is 60%, as compared to 35% for low density residential land use (see Volume I, Appendix B for ISA factors by land use category), which significantly increases the overall basin buildout ISA.

Overall, however, the buildout ISA for RR-SC is similar to that projected for the other basins: Bethel-Danebo (increases from 35% in 2006 to 50% at buildout), Willakenzie (37% in 2006 to 47% at buildout), Amazon (33% to 44%), Willamette River (40% to 44%), Laurel Hill (20% to 43%), and Willow Creek (14% to 42%).

As with the other basins, now that stormwater development standards are in place (since mid-2006), it is expected that the actual buildout ISA will be lower than the 50% calculated since the ISA factors used in the calculations assume buildout using traditional development practices. As described previously, this is appropriately conservative for use in modeling the major stormwater system for purposes of ensuring adequate conveyance and flood control.

Topic: Underground Injection Controls or UICs (Drywells)

- ***It seems that rain garden projects proposed for drywell decommissioning are not needed for flood control, and may not be needed for pollution control either. Is it necessary to replace the lost capacity of drywells since they do not appear to have much of an effect on the overall drainage of the area? Instead of conveying UIC runoff to surface waterways (as part of decommissioning), infiltrate. [RR-7], [RR-16], [SC-12]***

Existing UICs must be decommissioned to meet Safe Drinking Water Act regulations. These facilities manage stormwater runoff primarily generated by impervious surfaces in the existing rights of way with an average contributing area of approximately 2.7 acres per drywell. There are approximately 150 total in RR-SC, with roughly equal numbers owned and managed by Eugene and Lane County. The County and the City must provide alternative means to convey the runoff currently managed by the existing drywells to meet the City and County's goals and policies related to flood control and water quality protection, and to remain in compliance with Oregon Drainage Law. Surface infiltration via rain gardens will be employed in decommissioning isolated drywells where there is no piped system with capacity nearby to connect to. In addition to managing the runoff for flood control, rain gardens provide the added benefit of surface water treatment and groundwater recharge. For the instances where there is capacity in the municipal system and the system is in close enough proximity for connection, the RR-SC plan assumes the runoff originally going to the drywell will be directed to the municipal system. In that case, pre-treatment of runoff utilizing a structural water quality facility prior to discharging to the municipal system will be incorporated.

- ***Why are rain gardens in conjunction with drywell decommissioning such a major focus? [RR-12]***

Due to the discontinuous nature of the stormwater conveyance in this Basin, it was considered impractical to extend new piping to each of the drywells to be decommissioned. Rain gardens are proposed as an alternative solution for isolated drywells or clusters of drywells that are of considerable distance from an existing stormwater pipe and for which no piped extension is planned.

- ***Does drywell decommissioning need to be linked to proposals for new sidewalks, wider streets, replacing existing drainage swales? Could existing swales be "spot renovated" instead? [RR-17]***

Decommissioning of drywells is not necessarily linked to proposals for street improvements. Staff acknowledges that the RR-SC Plan conveys that impression, and will clarify the strategy in that regard. It is most likely that the regulatory timeline for decommissioning drywells will require action by the City and County on all drywells within the next 10-12 years, necessitating the construction of isolated rain gardens and piped connections to the existing system – depending on the specific circumstances for each drywell. In the case of an isolated UIC decommissioned via a rain garden, the rain garden could be configured longitudinally, oriented parallel to the street and coincident with the existing swale(s) if the swale could be engineered to function adequately to infiltrate the City's flood control design storm. Adequate surface area and infiltration rates in a rain garden must be achieved in order to handle the flows currently being managed by a drywell.

Where local street improvements occur in the next 10-12 years, and if the street improvement is in an area with several public drywells to be commissioned, it makes sense to consider incorporating the management of the roadway runoff via rain gardens into the plan to decommission the UICs.

Topic: Local Green Street Design Concepts

- ***Would add too much new impervious area, alter character of the neighborhood, and result in loss of street trees and other vegetation. Would involve costly assessments; who pays? Need more discussion and public review before implemented. [SC-13], [RR-3], [RR-18]***

Staff's objective in developing the local green street concept drawings was to provide alternatives to traditional "improved" local street sections (which include curbs, gutters, pipes). The green street concepts address problems and opportunities inherent in a discontinuous stormwater system, rapidly draining soils, flat topography, and shallow groundwater. They also incorporate feedback received from the RR-SC community groups on maintaining narrower streets and utilizing green infrastructure. The concepts are intended to be used as a starting point for future discussions and a separate public process which will take into account other non-stormwater related concerns before they are implemented. The green street concepts, once finalized, would most likely be utilized in areas annexed to the City of Eugene. Generally speaking, with respect to financing, if a local street improvement is developer driven, it would be paid for by the developer. If it is initiated by the property owners through the formation of a local improvement district, it would be paid for by assessments to the abutting property owners. The UIC decommissioning elements (e.g. rain gardens and appurtenances) would most likely be funded by the City's stormwater utility fund capital improvement budget.

Improvements to arterials and collectors streets may follow the City's "context sensitive" collaborative design process which incorporates significant opportunities for public input on road design, stormwater management, preservation of trees, funding options, and safety.

Topic: Modeling and Capital Projects

- ***Modeled and observed conditions do not match up. Model does not extend far enough. Limited data upon which the model was based and the adjustment of the model to fit observed conditions [model calibration] is inadequate as the basis for major capital projects, and may result in oversized capital projects. [RR-4], [RR-6], [SC-4], [SC-6], [SC-7]***

The stormwater model used to evaluate the capacity of the public drainage system is a generalized representation of the system. Calibrating the model to match measured or observed conditions is an iterative process involving adjusting certain variables (within realistic ranges) and comparing results, adjusting again, and comparing results, until a best fit is obtained. The computer model for the RR-SC basin planning evaluated the capacity of approximately 160 open waterway and pipe segments under existing and future land use conditions. The models were updated using survey data collected by Lane County between October and December 2005. The model was validated and adjusted in response to historic photos and observed freeboard elevations provided by the City and through comparison of actual conditions at the Willamette Overflow using real rainfall data for the period from December 27, 2005 to January 3, 2006.

Through the RR-SC model calibration process, the impervious surface area percentages were modified to reflect "effective impervious area" as opposed to mapped impervious area. This adjustment is realistic because of the relatively disconnected nature of the stormwater system in RR-SC, but it is still somewhat conservative (as evidenced by the fact that the surface water elevations predicted by the model are somewhat higher than observed values). See page 3-7 of the basin plan for a more detailed discussion of the adjustment to ISA factors, and rationale.

The current model is the best fit based upon best available information and professional engineering judgment of the engineering consultants, and the City's engineering staff. It is acknowledged that further refinement to the model based upon measured flow data would be beneficial to confirm capacity issues on the major system. Therefore, installation of a flow meter in the Basin has been added to the capital project list.

The capacity-related capital projects resulting from the modeling will be added to the City's long-term stormwater capital improvement needs. The City's project list (including all stormwater project needs, city-wide) is significantly larger than the budget available, and by necessity a prioritization process is used to identify the highest priority projects for implementation. Prioritization criteria include whether a flooding problem is observed vs. predicted by modeling, which is where the large stormwater projects referred to in the comment would not rise to the top in the foreseeable future. Flow data and model refinement will realistically precede implementation of these capital projects. In effect, these projects are placeholders for potential capital investment in the future to maintain system capacity, and are based upon the best available information and professional engineering judgment. Individual stormwater facility capital projects will be assessed using additional data prior to final design and construction to ensure proper sizing. The County does not currently have funding for stormwater related capital projects.   As the County develops funding for such projects, prioritization will be assigned in a manner similar.

With respect to the extent of the model, basin planning stormwater models were generally limited due to budget and resource constraints to the larger system (pipes 36-inches and larger, and larger waterways), generally inside city limits. The RR-SC basin plan model goes beyond the modeling in other basins in that it extends, for the most part, through the mix of jurisdictional areas to the urban growth boundary. The Willamette Overflow downstream from node 72088 was not included in the model because most of it is on the edge of the UGB, with some located outside the UGB, and is located downstream from subbasin WO-000 which lies entirely outside of the UGB.

- ***It appears redundant to create capacity with facilities to replace drywells and construct large flood control capital projects. [SC-8]***

The City's Stormwater Development Standards require stormwater systems (pipes or drywells) serving less than 40 acres to be designed for a 5-year storm. Open channel systems serving less than 40 acres and all systems serving 40 acres up to 640 acres must be designed for a 10-year storm, except for culverts and bridges for arterial streets which must be designed for a 25-year storm.

The modeling for future (build-out) conditions reflects that the existing drywells do not manage a volume of runoff significant enough to affect capacity needs of the major system. In other words, whether under existing conditions or future buildout conditions, the existing public drywells do not have a significant effect on the major system conveyance needs. The decommissioning of drywells is not driving the capacity-related capital projects. What is driving the capacity related projects is a set of constraints on the major system (for example, on the upper A1 system) that are predicted by the model for the larger contributing area under existing (2006) conditions, and exacerbated by future development.

Topic: Pollutant Estimates

- ***Pollutant load estimates are not based upon basin-specific water quality data. Question use of TSS as an indicator. Question assumption regarding contribution of runoff from decommissioned UICs. [SC-10], [RR-11]***

Although there is limited data on water quality in the Basin, the pollutant load estimates point to the need to address expected increases in pollutants from added impervious surfaces, and provide a means by which pollutant estimates can be compared between basins and contrasted between existing and future build-out conditions. Estimating pollutant loads helps in identifying locations for water quality capital projects. For example, RRSC-2, Water Quality Facilities for High Source Areas, includes specific high pollutant source locations for water quality retrofit facilities. The pollutant load estimates also support the implementation of Stormwater Development Standards and support continuation of the other complimentary best management practices conducted in the City and County's stormwater programs. Estimating pollutant loads from runoff being surfaced by decommissioning drywells supports the strategy for decommissioning drywells via rain gardens or pipe connections with pre-treatment, so as not to adversely affect downstream surface water quality.

With regards to the use of total suspended solids (TSS) as an indicator of pollutant, TSS was used in the basin plans as a surrogate for the suite of pollutants typically associated with stormwater (specifically, sediment, nutrients, heavy metals). This is a common approach, utilized by other large municipalities in the state of Oregon. The TSS amounts are approximations based upon pollutant loading data used by the Phase I municipalities in Oregon.

- ***Estimates assume no water quality BMPs for future development. Estimates assume all runoff from decommissioned drywells will be transferred untreated to surface waters. [RR-10], [SC-11]***

Agree. The pollutant load estimates are based upon pollutant loading concentrations used by Phase I municipalities in Oregon, and the comment is correct in that the loadings assume no water quality BMPs. The pollutant load estimates were generated for illustrative and comparative purposes (e.g. identifying high pollutant source areas within a basin, comparing basin loads), and staff thought it important to use the same approach as for the other stormwater basins completed in 2002.

The City is collaborating with other Phase I municipalities and professionals across the country to compile and utilize effectiveness data for stormwater management facilities so as to better estimate pollutant loadings from urban areas utilizing these facilities.

STAFF CONTACT INFORMATION

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E-mail: daniel.hurley@co.lane.or.us

ATTACHMENTS

Attachment A: Santa Clara Community Organization comments
Attachment B: River Road Community Organization comments
Fact Sheet: Protecting Water Quality and Wildlife Habitat in Eugene

Additional comments received from the Santa Clara Community Organization.

Therese Walch and Dan Hurley March 10, 2010
City of Eugene and Lane County
Re: Comments to accompany RR/SC basin plan

Therese and Dan,
We thank you for meeting with us to review your comments to our criticisms regarding the RR/SC storm water basin master plan. Your offer to include a last set of comments generated by that meeting to accompany the proposal to the various elected officials is appreciated.

We reiterate that the uniqueness of our basin is not adequately reflected in the proposed plan strategies and refer you to the SCCO comments of Oct 23, 2009 that highlight some of our challenges and our need for development standards to help address these problems. No other basin is categorized by our blend of high water table, lack of storm water infrastructure, fertile well-draining soils, and reliance on open waterways for the vast majority of storm water conveyance.

Our proximity to the Willamette River makes us particularly flood-prone and heightens our focus on the importance of all open waterways within our neighborhood. As stressed in our comments, the protection and enhancement of these watercourses is pivotal in averting widespread flooding. Staff comments point to the myriad of overlays and protective measures applied to date. We appreciate these measures, but reiterate that they leave out vital watercourses that are part of our naturally occurring system. Our storm water system is akin to the human circulatory system, and the existing protections apply only to the arteries leaving the veins and capillaries unprotected. The system can not function effectively for the entire body of Santa Clara without adequate mapping and protection of our "lesser" waterways. The protection and enhancement of these create an existing storm water infrastructure that can accommodate development without capital projects. (See Santa Clara Community Organization comments dated Oct. 23, 2009)

Staff uses the terms green infrastructure and low impact development throughout the basin plan, but doesn't differentiate between man-made engineered infrastructure (even "green" infrastructure) and naturally occurring infrastructure. Our neighborhood is riddled with swales, sloughs, channels and waterways that are naturally occurring infrastructure. These serve the long time residents as flood control measures. When they are obliterated by infill development, they are replaced on the development site by something that only serves the storm water needs of the infill, not the rest of the residents along what used to be a continuous storm water system. This places the existing residents at much greater risk of inundation. We would like the basin plan to prioritize the protection and enhancement of naturally occurring infrastructure which can continue to serve the existing residents as well as accommodate infill development.

Finally, we urge the adoption of low impact development standards coupled with post development runoff not exceeding pre-development levels for this basin as a primary means to achieve both storm water quantity and quality goals. These measures make long-term economic and ecological sense. Let these neighborhoods be the trial ground for these principles and create a model which can inform development throughout the watershed.

Sincerely,
Jerry Finigan and
executive board of the Santa Clara Community Organization

Comments from the River Road & Santa Clara Community Organizations to the Lane County Board of Commissioners.

Date: March 31, 2010

To: Lane County Board of Commissioners
From: River Road Community Organization Board
Santa Clara Community Organization Board

Dear Commissioners,

Your board is being asked to adopt the River Road-Santa Clara Stormwater Basin Plan at your work session later today. We urge you to make a simple amendment to this Plan prior to giving your support. The amendment we request is that an Appendix be added that includes the attached summary of points relating to stormwater that have been raised by our organizations in previous comments and discussions over many years, but that have not been incorporated into the Basin Plan or City or County stormwater codes to date. We believe they are important points that need to be addressed in plans and policies for our area, and that they need to be recorded in the Stormwater Basin Plan, a major planning and guidance document.

Of course, we would prefer that these points had been fully incorporated into the Basin Plan document. However, the Appendix we propose would at least capture our input for future planning processes.

Much of River Road and Santa Clara developed in a typical suburban pattern. There are many problems caused by this form of development, but also some benefits and opportunities relating to stormwater management and protection of natural resources. As it stands, we do not believe the River Road-Santa Clara Stormwater Basin Plan provides specific enough guidance to protect our area--the groundwater resource and our domestic wells, small waterways, good soils, natural drainage, big trees, and country-like atmosphere. We hope that additional planning and refinements can be undertaken to address our concerns as outlined in the attachment.

River Road and Santa Clara need neighborhood refinement plans or special overlay zones that identify: a) sites and zones appropriate for compact development, redevelopment and stormwater retrofit; b) sites and zones appropriate for low-density development or that need special protections to maintain natural and existing drainage; and c) development and public works standards that protect natural hydrology and ecology and the beneficial elements of neighborhood character.

Thank you for your support for inclusion of our points in the River Road-Santa Clara Stormwater Basin Plan.

Sincerely,

Carleen Reilly, Co-Chair (for River Road Community Organization board)
395 Marion Lane, Eugene, OR 97404

Jerry Finigan, Chair (for Santa Clara Community Organization board)
1250 Irvington Drive, Eugene, OR 97404

ATTACHMENT to River Road-Santa Clara Stormwater Basin Plan
Summary of Recommendations from River Road Community Organization and Santa Clara Community Organization (March 2010)

The following points are of priority concern to residents of our neighborhoods. We ask that these elements, all related to stormwater management, be considered and incorporated into future City of Eugene and Lane County plans, policies, regulations, agreements, standards, actions and public works projects applicable to or conducted in the River Road and Santa Clara neighborhoods. Some of these points might be incorporated into neighborhood refinement plans or special area zones that identify: a) sites and zones appropriate for compact development, redevelopment and stormwater retrofit; b) sites and zones appropriate for low-density development or that need special protections to maintain natural and existing drainage; and c) development and public works standards that protect natural hydrology and ecology and the beneficial aspects of neighborhood character.

Natural Hydrology and Ecology:
Groundwater, Streams, Soils, Trees, Native Plants and Plant Communities

• **Groundwater recharge:** Ensure that this is a policy goal for River Road and Santa Clara.

• **On-site infiltration (as stormwater destination):** Require on-site infiltration (to the ground and groundwater) to the maximum extent feasible for development, streets, and public works in River Road and Santa Clara.

• **Streams:** Protect and restore naturalized flow volumes and rates in Spring Creek, Flat Creek, E. Santa Clara Waterway, and minor waterways. Also protect these waterways from fill and disturbance, including that done outside the context of "development" and on properties not yet annexed to the City of Eugene.

• **Floodways:** Protect smaller natural flow pathways and floodways not otherwise delineated.

• **Soils, Trees, Plant Communities:** For new development and for public works projects, prioritize non-structural Best Management Practices (preserving soils, trees, native plants and plant communities; minimizing site disturbance; reduced development footprint and amount of impervious surface, etc.) over engineered, structural stormwater "facilities" such as those in the City's Stormwater Management Manual.

Development and Infrastructure:
Streets, Ditches, Parking Lots, Rainwater Catchment

• **Local Streets:** Develop more options for (and public involvement in design of) local streets and street standards that are context-sensitive and recognize the value and stormwater management function of existing large street trees, landscaping, roadside ditches, truly minimal pavement widths, and "shared space" or "home zone" designs that do not require separate sidewalks. Overall, strive for a reduced amount of pavement, especially that dedicated to auto traffic and parking.

• **Roadside Ditches:** Protect (and renovate where needed) existing roadside drainage ditches to preserve their stormwater management function.

• **Parking Lots:** Require stormwater retrofit of existing parking lots that do not meet current City of Eugene stormwater code standards. Reduce parking requirements for future development.

• **Rainwater Catchment:** Allow and encourage rainwater catchment and use, to reduce erosion and runoff during rainstorms, and reduce the capacity required for alternate stormwater management.

Comments from the Junction City Water Control District to the Lane County Board of Commissioners.

HERSHNER HUNTER LLP

STEVE CORNACCHIA
scornacchia@hershnerhunter.com

April 27, 2010

Lane County Board of Commissioners
Attn: Daniel Hurley
Land Management Division
125 E. 8th Avenue
Eugene, OR 08401

Re: Eugene Stormwater Basin Master Plan – River Road/Santa Clara
Junction City Water Control District
Our File No. 10461.20102

Commissioners:

We represent Junction City Water Control District ("District"). The District has requested that we respond on its behalf to the City of Eugene's proposed Stormwater Basin Master Plan (Volume VIII) for River Road/Santa Clara ("Master Plan"). On behalf of our client we wish to thank the Board of Commissioners for delaying Lane County acceptance and approval of the Master Plan until the District has had an opportunity to comment on it.

In general, it must be recognized that the majority of the storm water runoff from the northern developed lands of the City of Eugene will eventually enter the District's system of flood control ditches. The District believes that the Master Plan does not adequately address either that fact or the fact that the District's system was not built to completely handle the discharges of storm water from developed urban lands and uses.

The District has three major concerns regarding the city's plan for discharging storm water from urban development into the District's ditch system:

1. How will the District's system of ditches be maintained following urban development of the land that contains that system?

2. How will flow rates (and the District's policies regarding flow rates) from developed urban lands that exceed historical levels of flow rates from agricultural land be addressed before development is approved?

3. How will potential urban pollution be addressed and be prevented from entering the District's ditches?

Our late arrival on the scene of the Master Plan results from the continuation of a communication problem that exists between the City of Eugene, Lane County and the District. The District has not been directly included in the drafting of the storm water basin planning document and first learned of its existence last month. The District did not directly participate in the drafting of the document even though, on at least two occasions, the District has requested, in writing, that the city and the county communicate with it on matters regarding development of land in the northern River Road/Santa Clara area that is within the boundary of the District. In 2002 and again in 2005 we sent written requests to the city and the county asking that both governmental entities improve communication with the District prior to further development within the northern River Road/Santa Clara area. Copies of the letters containing the District's requests are attached to this correspondence for inclusion in the record of this proceeding.

On December 17, 2002 we requested:

> "... that you assign the appropriate persons within the affected divisions of Lane County Public Works (Surveyor, Building and Planning) to contact and work with us to establish a process that provides a determination of future maintenance responsibility prior to the approval of any planning or building action for property within the subject area. Specifically we suggest that, at a minimum, the process provide the District an opportunity to respond to any application for subdivision or partition of land within the subject area and following that response, for Lane County to place the necessary conditions or restrictions (e.g., C,C&Rs) on the subdivision or partition to ensure that maintenance of the ditches continues after residential development has occurred. We note that the same type of process should be in place regarding any subdivision or partitioning of property in the area north of Beacon Drive and the Urban Growth Boundary that includes either of the subject channels."

On that same date we made the same request to the City of Eugene. The District has not received a response to its 2002 correspondence. In response to a City of Eugene ordinance withdrawing property from the District in 2005, the District again requested that the city communicate with it prior to development of the subject area. The District has received no response to that request.

The District maintains a system of agricultural drainage ditches that extend from the Amazon Channel in west Eugene to the City of Monroe. The District's boundary and its ditch system overlap the City of Eugene's Urban Growth Boundary between Beltline Road and Beacon Drive. Essentially, the District eventually receives all of the city's storm water from that area. The District's A-1 Channel and its F Channel are located in that area.

The District's system was developed over 40 years ago to partially drain agricultural lands in the area between Eugene and the City of Monroe. The District operates and maintains its system pursuant to numerous easements across private property. The District's system was developed to serve flooded agricultural lands—it was not developed to receive water discharges from the impervious surfaces of urban lands and urban uses. The District's system was developed to drain flood waters from agricultural lands and was engineered to limit inundation of those lands to several days in duration—it was not engineered to immediately remove all storm water from those agricultural lands. The District's system has no additional capacity to handle storm water from impervious surfaces of urban land that exceed historical pre-development flow rates.

The impact of discharging storm water from urban lands into the District's system is exacerbated by the development of residential subdivisions over lands that contain the ditches. In the case of the southern end of the two channels between Beltline Road and Beacon Drive, the District is prevented from performing any function on them in areas of residential development. The construction of fences and other residential development serves as a barrier to District efforts to maintain the channels for the free flow of flood and irrigation waters. The Lynnbrook II subdivision is a perfect example of such a situation. Even though C,C&Rs were recorded with the subdivision, many property owners have not provided any maintenance effort and, in some cases, have actually placed structures and vegetation, including trees, within the ditches. Back yard fences prevent the District from any access to the ditches for maintenance purposes.

Out of concern about encroaching urban development from both the cities of Eugene and Junction City, the District retained the services of EGR & Associates, Inc. ("EGR"), to conduct a capacity study of that portion of the Flat Creek basin that contains the F, F-2 and F-2-a Channels (the area closest to Eugene on the south, Junction City on the north and including the site of the planned State of Oregon hospital and corrections facilities). EGR concluded that the District's system of flood control ditches is at capacity during significant rainfall events. It also concluded that high water tables throughout the area limited the amount of storm water absorbed by soil. Concluding that the District's ditch system has no additional capacity for post-development storm water discharges from newly-developed urban land, EGR recommended to the District that it promulgate policies to apply to requests from urban development for the discharge of post-development flow rates of storm water into the District's system. Those policies were adopted by the District's Board of Directors and are as follows:

1. For properties within the Flat Creek basin, post-developed storm water flow rates shall be regulated for the 2-year through 50-

year, 24-hour, rainfall events. Rainfall events in excess of the 50-year, 24-hour, storm will not be regulated.

2. The allowable post-developed flow rate, for each regulated recurrence interval, shall be limited to the greater of:

a. A flow rate equal to 0.116 cfs per acre, or

b. Historic pre-development flow rates considering any constraints up to the point of connection with the District's system.

The Master Plan does not adequately address the three issues presented earlier in this response. The Master Plan does not adequately recognize and implement the District's policies regarding the discharge of storm water from developed urban lands.

The District requests that before adoption of the Master Plan the participating jurisdictions work with the District to modify the Master Plan to address the District's issues and to recognize and implement its policies regarding those issues.

At a minimum, and for example, the following sections of the Master Plan should be modified:

- Section 2.5.1 Waterways needs to be modified to accurately describe the District's system of ditches and the capacity of those ditches to move water from the area (particularly the A-1 Channel and Flat Creek);
- Section 2.5.5 needs to be modified to accurately describe the District's system, its capacity and existing flow rates (and the implementation of District policies regarding the same);
- Section 3.1 needs to be modified to incorporate the District's hydrologic and hydraulic information regarding its capacity and both pre-development and post-development flow rates.

In conclusion, the District requests a simple acknowledgement by Lane County and the City of Eugene that it is an agricultural flood control district whose system of ditches does not have the capacity to absorb additional water from newly-developed urban lands and uses. In concert with that acknowledgement, the District requests that the Master Plan reflect those facts and that the Master Plan include the District's policies regarding storm water discharge from newly-developed urban land and uses.

Please contact me if you have questions regarding this response.

Best regards,

STEVE CORNACCHIA

PSC:nps
Enclosures
cc: District Manager

City of Eugene response to the
Junction City Water Control District

Public Works
Engineering

City of Eugene
99 East Broadway, Suite 400
Eugene, Oregon 97401
(541) 682-5291
(541) 682-8410 FAX

September 22, 2010

Steve Cornacchia
Junction City Water Control District
95282 Hwy 99 E
Junction City, OR 97448

Re: Eugene Stormwater Basin Master Plan – River Road/Santa Clara
Junction City Water Control District

Dear Mr. Cornacchia,

Thank you for your interest and that of the Junction City Water Control District in the River Road – Santa Clara Stormwater Basin Master Plan. We appreciate the District's input reflected in your letter to the Lane County Board of Commissioners provided at their March 31, 2010 work session on the topic. We would like to take this opportunity to respond to the issues that you raised. In particular, you expressed thoughts and concerns about the referral of development proposals to the District, waterway maintenance and the free flow of water, receiving stream capacity, and the water quality of urban discharges to District streams.

As a courtesy, we would be happy to include you in the referral process for development proposals for properties that drain to District waterways. To assist us in ensuring that we have the area delineated as you desire, please provide me with a map showing the boundaries of the area(s) for which you would like referrals. The District's comments will then be reviewed in the context of the City of Eugene's requirements and policies.

Regarding responsibility for maintenance of waterways on properties annexed to the City that may have a District easement, these waterways would fall under City of Eugene maintenance policies and practices upon annexation. The City would determine, on a case by case basis, whether we would have an interest in acquiring any existing easements. You expressed concern about the construction of fences and other obstructions in waterways upstream from District waterways, and a desire to keep these waterways free flowing. Significant progress has been made by the City (and County) in regards to development regulations in and adjacent to waterways. With adoption of the /WR Water Resources Conservation Overlay Zone in 2005, and the /WQ Water Quality Overlay Zone in 2009, the City prohibits the construction of fences and structures in and immediately adjacent to certain waterways including Flat Creek and the A1 Channel – which are of the most concern by the District.

The capacity of receiving streams is of interest to the City. We reviewed the EGR report ("South Highway 99 Stormwater Feasibility Analysis," November 9, 2009) referenced in your letter, but were unable to see how the report's conclusions correlated with specific capacity constraints at the urban growth boundary since the geographic area of primary interest and assessment in the report is quite a bit further north, nearer to Junction City. We would be glad to review any additional information pertinent to the area that you could provide, within the context of City code and policies.

The quality of water going into receiving streams is also of interest to us. The City implements a stormwater program under its National Pollution Discharge Elimination System (NPDES) Phase I municipal stormwater permit to protect and improve water quality. The City's stormwater program includes public education and outreach, erosion prevention, illicit discharge detection and removal, spill response, street sweeping, catching basin cleaning, leaf pick-up, volunteer programs to restore streams and plant trees, regulatory waterway protections, and water quality capital improvement projects. Since the adoption of stormwater development standards in 2006, developments adding or replacing 1,000 square feet of impervious area or more are required to meet pollution reduction requirements. As with other municipalities across the state and country, our stormwater program continues to evolve. On the horizon for the City of Eugene are efforts to further prioritize low impact development, infiltration, and on-site retention of stormwater runoff. If the District has any pertinent information regarding the quality of water going into District streams, we would be happy to review that information within the context of our NPDES permit and City policies.

Thank you again for your interest in the River Road – Santa Clara Basin Plan.

Sincerely,

Therese Walch

Therese Walch, P.E.
Water Resources Manager
City of Eugene Public Works Department

Letter of support from the Santa Clara Community Organization following edits made in September 2012.

SANTA CLARA COMMUNITY ORGANIZATION

established 1977

October 4, 2012

To Lane County Commissioners;

As Board Members of the Santa Clara Community Organization, we would like to give you an update on our continued involvement in the crafting of the River Road/Santa Clara Stormwater Basin Master Plan.

When the plan was last brought to the County Board in March of 2010, your Board received letters from members of the Santa Clara And River Road organizations identifying shortcomings in the plan. Since that time, we have continued to work with both the City and County as they modified and finalized the Plan. Attempts to address the identified shortcomings were made including edits to Section 1 and through other City processes.

We appreciate that our concerns were heard and issues were clarified. We understand this plan is a blueprint that can guide future work. We look forward to our continued involvement as our community plans for the future.

The Santa Clara Community Organization is now supportive of the plan as edited. The SCCO Board members would like you to know that we now endorse the plan.

Sincerely,

Santa Clara Community Organization Board

Jerry Finigan, Chair

a local voice in government

Letter of support from the River Road Community Organization following edits made in September 2012.

HURLEY Daniel M

From: Jon Belcher [jbelcher@efn.org]
Sent: Tuesday, October 09, 2012 2:17 PM
To: HANDY Rob M; BOZIEVICH Jay K; LEIKEN Sid W; SORENSON Pete; STEWART Faye H
Cc: HURLEY Daniel M; WALCH Therese; Bev Barr; REILLY CARLEEN (LCOG List); BELCHER JON (LCOG List); Kate Kelly; Kira Lehman; Michael Lambros; NEFF Ray (SMTP); Tuula Rebhahn ; Will Dixon
Subject: River Road Community Organization Letter of Support for River Raod/Santa Clara Stormwater Basin Master Plan

We wish to thank both Daniel Hurley and Therese Walsh for their assistance and cooperation during our involvement in developing the River Road/Santa Clara Stormwater Basin Master Plan. The following letter was unanimously passed at last night's River Road Community Organization meeting with 22 neighbors participating:

October 8, 2012

To Lane County Commissioners;

We would like to give you an update on our continued involvement in the crafting of the River Road/Santa Clara Stormwater Basin Master Plan.

When the plan was last brought to the County Board in March of 2010, your Board received letters from members of the Santa Clara And River Road organizations identifying shortcomings in the plan. Since that time, we have continued to work with both the City and County as they modified and finalized the Plan. Attempts to address the identified shortcomings were made including edits to Section 1 and through other City processes.
We appreciate that our concerns were heard and issues were clarified. We understand this plan is a blueprint that can guide future work. We look forward to our continued involvement as our community plans for the future.

The River Road Community Organization is now supportive of the plan as edited and we now endorse the plan.

Sincerely,

River Road Community Organization

/signed /signed
Carleen Reilly Jon Belcher
River Road Community Organization Co-chairs

Jon Belcher (jbelcher@efn.org)