

CHAPTER NINE

Basin Plan

Chapter Nine contains the Clear/Clarks Creek Basin Plan (Basin Plan). The chapter contains a set of recommended capital improvement projects¹ (CIP), programmatic measures², and studies that if implemented, will address the storm drainage and surface water management related problems identified in previous chapters.

The Basin Plan establishes the direction that the Water Programs Division will take within the Clear/Clarks Creek Basin over the next five to ten years. All of the recommendations are feasible solutions to achieve the goals of basin plans; i.e., reduce flood and storm drainage hazards, improve water quality, improve aquatic habitat potentially affected by surface water management methods, ensure coordinated and responsible use of public resources, and guide new development.

Chapter Nine is organized as follows:

- 9.1 Summary of Plan recommendations.
- 9.2 Plan Approach to Basin needs; a description of key assumptions and thinking behind the recommendations.
- 9.3 Specific Basin Plan Recommendations; descriptions of individual capital improvement projects, programmatic measures, and studies to close data gaps.
- 9.4 Plan Implementation Strategy and Considerations.
- 9.5 Problems and Solutions

9.1 Summary of Plan Recommendations

The Clear/Clarks Creek Basin Plan contains 65 capital improvement projects, 12 programmatic measures, and four studies to remedy flooding, erosion, water quality, and stream habitat problems resulting from surface water runoff in the Basin.

Capital improvement projects and programmatic measures have been divided into “High-Priority,” “Medium-Priority,” and “Low-Priority”³ groups. Priorities were not established for studies. Estimated costs of recommendations by priority group are as follows:

“High-Priority” Recommendations:	\$33,152,000
“Medium-Priority” Recommendations:	\$27,612,000
“Low-Priority” Recommendations:	\$4,607,000

¹ A capital improvement project has a cost of \$25,000 or more and improves the physical plant of the drainage system, the performance of the system, and/or reduces site-specific or cumulative adverse stormwater impacts.

² Programmatic measures are nonstructural solutions, such as changing particular Pierce County procedures, providing technical assistance, enforcing regulations, and offering public information.

³ “Low-Priority” does not mean “not a priority.” “No Priority” actions have already been excluded from this Basin Plan. Rather, “Low-Priority” means the project rated lower than other needs in the Basin. Examples of these include projects with only a single-benefit; the rating system is weighted toward multiple benefits.

In addition, further studies to fill information gaps totaling \$224,000 have been identified, but not prioritized.

Table 9.1 presents the estimated cost of the Clear/Clarks Creek Basin Plan recommendations by project type and priority group.

Table 9.1 Estimated Costs of Plan Recommendations			
<i>Project Type</i>	<i>High Priority</i>	<i>Medium-Priority</i>	<i>Low-Priority</i>
Capital Improvement Projects	\$30,474,000	\$27,591,000	\$4,585,000
Programmatic Measures	\$2,716,000	\$21,000	\$22,000
Studies	\$224,000		
Total Estimated Cost	\$65,595,000		

Most of the actions provide multiple benefits; for example, a stormwater infiltration pond reduces downstream flooding; reduces erosion, and thus protects water quality; and helps protect base flow by groundwater recharge.

Priority Ranking. The recommended CIPs and programmatic measures have been sorted into high-priority, medium-priority, and low-priority groups based on scores from prioritization worksheets common to all of the basin plans. Worksheets document the project’s or program’s potential for various aspects of flood reduction, improvement of water quality, aquatic habitat protection, and other benefits using approximately 40 criteria. The top 25% of the projects are designated high-priority, 50% become medium-priority, and the remaining 25% are assigned low-priority. The order within each priority group reflects project cost, from least costly to most costly.

Appendix “H” documents the ranking system and its application to each recommended project. It contains a spreadsheet summarizing the scores assigned to each CIP and individual scoring worksheets for each CIP and programmatic measure.

Table 9.2 contains the list of High-Priority projects, rating scores, and estimated costs. Table 9.3 presents the Medium-Priority projects. Table 9.4 shows the Low-Priority projects. Shaded rows indicate programmatic measures.

Table 9.2 High-Priority Recommended Projects			
ID Code	Project Title	Rating Score	Estimated Cost
PRG00-02	Update Stormwater Management Standards (Manual)	380	\$6,200 *
PRG00-01	Low-Impact Development	346	27,600 *
PRG00-11	Enhanced Cooperative Arrangements with Cities & Other Jurisdictions	315	38,000*
PRG00-08	Establish a BMP Manual for Surface Water Maintenance Activities	427	43,600 *
PRG00-09	Invasive Species Management Program	420	43,600 *
PRG00-04	Land Management Program for Flood Hazard Reduction & Storm Drainage Practices Impact Mitigation	389	56,000 *
PRG00-06	Create an Education, Outreach, & Technical Assistance Program	325	212,000 *
PH-IP01	128 th Street East Infiltration Pond	346	469,000
PRG00-05	Riparian & Wetland Restoration Program to Restore Flood Storage and Maintain Water Quality	325	692,000 *
PRG00-07	Surface Water Monitoring Program Basin Specific	244	985,000 * 422,000
CL-RST01	Clear Creek Stream Corridor Restoration	261	Segment 1: 402,000 Segment 2: 402,000 Segment 3: 402,000 TOTAL: 1,207,000
RY-RST01	Rody Creek Stream Corridor Restoration	303	Segment 1: 410,000 Segment 2: 410,000 Segment 3: 410,000 TOTAL: 1,231,000
PRG00-03	Increase Enforcement Inspections	398	1,272,000 *
PH-PL04	144th and 94th Avenue Pipeline	252	1,282,000
SW-AC01	Swan Creek at 112th Street Floodplain Storage/Headwaters Preservation	302	Segment 1: 343,000 Segment 2: 442,000 Segment 3: 442,000 TOTAL: 1,306,000
WO-RST01	Woodland Creek Stream Corridor Restoration	265	Segment 1: 490,000 Segment 2: 490,000 Segment 3: 490,000 TOTAL: 1,470,000

Table 9.2 High-Priority Recommended Projects - <i>continued</i>			
ID Code	Project Title	Rating Score	Estimated Cost
CY-RST01	Canyon Creek Stream Corridor Restoration	238	Segment 1: 472,000 Segment 2: 472,000 Segment 3: 472,000 Segment 4: 472,000 Segment 5: 472,000 Segment 6: 472,000 TOTAL: 2,834,000
CK-RST01	Clarks Creek Stream Corridor Restoration	231	Segment 1: 470,000 Segment 2: 470,000 Segment 3: 470,000 Segment 4: 470,000 Segment 5: 470,000 Segment 6: 470,000 Segment 7: 470,000 TOTAL: 3,287,000
RD-DP01	Portland Avenue Regional Detention Facility, Roosevelt Ditch Area	276	3,884,000
CL-AC01	Clear Creek Floodplain Repetitive Loss Land Acquisition	345	6,455,000
SW-DP01	Swan Creek Regional Detention Facility	259	6,455,000
Total Estimated Cost			\$33,152,200

* indicates the Clear/Clarks Creek Basin share (21.2%) of the estimated cost of a program of County-wide applicability

Table 9.3 Medium-Priority Recommended Projects			
ID Code	Project Title	Rating Score	Estimated Cost
PRG00-12	Stormwater Facility Design Process	206	21,200 *
SW-SBS03	Swan Creek 64th Street East Culvert Outfall Repair .	152	24,000
RD-SWL01	20th Avenue East Drainage Swale, Roosevelt Ditch	214	29,000
CL-SBS03	Clear Creek Streambank Stabilization in vicinity of 49th Street	194	35,000
CL-SBS04	Clear Creek Streambank Stabilization on West Fork Clear Creek Downstream of 64th Street E	194	35,000
DU-SBS01	Diru Creek Streambank Stabilization at 72nd St East	164	35,000
RY-SBS01	Rody Creek Streambank Stabilization at 72nd Street East	155	35,000
CL-CR01	Clear Creek 88th Street E Culvert Replacement	161	53,000
CL-VC01	Clear Creek at 104th Street E Vegetation Control	203	54,000
RY-SBS02	Rody Creek Streambank Stabilization at 80th Street East	160	66,000
CK-SP01	Clarks Creek State Hatchery Sedimentation Basin Retrofit	174	73,000
CL-SBS05	Clear Creek Streambank Stabilization 5000 block of Vickery Avenue East	153	92,000
SW-SBS01	Swan Creek Streambank/Channel Stabilization at 72nd Street E Outfall	157	100,000
SQ-VC01	Squally Creek at Pioneer Way E Vegetation Control	165	150,000
CL-SBS02	Clear Creek Streambank Stabilization on East Fork Downstream of 72nd Street E	194	161,000
CY-SBS03	Canyon Creek Streambank Stabilization on Reach Upstream of Second Canyon Road Crossing	163	161,000
CY-SBS01	Canyon Creek Streambank Stabilization on Reach Downstream of 80th Street East	158	161,000
CY-SBS02	Canyon Creek Streambank Stabilization on Reach Downstream of 72nd Street East	153	161,000
CK-PL01	112th Street East Drainage Improvement (Woodland Elementary School)	133	180,000
CL-SBS01	Clear Creek Streambank Stabilization on West Fork Downstream of 72nd Street E	194	187,000
CK-AC01	Clarks Creek Property Acquisition at 104th Street East	168	188,000
SW-SBS02	Swan Creek Streambank/Channel Stabilization from 72nd Street E to 64th St E	203	283,000
WO-SBS01	Woodland Creek Streambank/Channel Stabilization at 84th Street East	150	305,000

Table 9.3 Medium-Priority Recommended Projects			
ID Code	Project Title	Rating Score	Estimated Cost
CY-SBS04	Canyon Creek Streambank Stabilization Downstream of Second Canyon Road Crossing	163	322,000
WO-SBS02	Woodland Creek Streambank Stabilization at 80th Street E	142	357,000
PH-PL05	Springfield Pothole Pipeline	124	379,000
CK-PL02	Fruitland Avenue Drainage Improvement - 104th Street E to 96th Street E, Clarks Creek	164	399,000
PH-PL03	136 th Street Pipeline, 135 th Street Pothole	190	509,000
CY-SL01	Canyon Creek 58th Avenue East Setback Levee	165	552,000
SW-SBS04	Swan Creek Streambank Stabilization Downstream of 64th Street East	222	Segment 1: 380,000 Segment 2: 380,000 Segment 3: 380,000 TOTAL: 1,140,000
DU-RST01	Diru Creek Stream Corridor Restoration Downstream of Pioneer Way East	226	Segment 1: 410,000 Segment 2: 410,000 Segment 3: 410,000 TOTAL: 1,231,000
RY-DP01	Rody Creek Regional Detention Facility Expansion	123	1,313,000
CY-DP02	Canyon Creek 90th Street East Detention (D138-003)	184	1,586,000
PH-PL06	South Hill Pump Station Pipeline to Puyallup River	181	2,466,000
WO-DP01	Woodland Avenue Flood Control Phase II CIP	155	2,960,000
CL-DP01	West Fork Clear Creek Regional Detention	163	3,021,000
CY-DP01	Canyon Creek Regional Detention	174	3,930,000
CL-DP02	East Fork Clear Creek Regional Detention	163	4,858,000
Total Estimated Cost			\$27,612,200

* indicates the Clear/Clarks Creek Basin share (21.2%) of the estimated cost of a program of County-wide applicability

Table 9.4 Low-Priority Recommended Projects			
ID Code	Project Title	Rating Score	Estimated Cost
RY-SWL01	62nd Avenue East Drainage Swale, Rody Creek	32	17,000
RY-CR01	Rody Creek at Pipeline Road & 96th Street East Culvert Replacement	65	19,000
PRG00-10	Flood Disclosure Statements on Property Titles	128	22,400 *
WO-CR02	Woodland Creek at 80th Street East Culvert Replacement	88	27,000
RY-CR02	Rody Creek at 98th Street East Culvert Replacement	89	31,000
PH-PL01	92nd Ave East Storm Drainage Pipeline, Black Swamp Pothole	115	34,000
SW-PL01	84th Street East Pipeline Storm Drain Replacement, Swan Creek	99	74,000
RY-RD01	90th Street East at Rody Creek Raise Roadway	84	75,000
CY-FP01	Canyon Creek Driveway Culvert Replacement	108	89,000
WO-CR01	Woodland Creek & 72nd Avenue East Culvert Replacement - 93rd Street East to 96th Street East	105	102,000
SW-CR01	Swan Creek 80th Street E Culvert Replacement	82	110,000
CY-RD02	104th Street East Road Raising & Culvert Replacement - East Fork of Canyon Creek	99	113,000
CY-RD01	116th Street East Road Raising - West Fork of Canyon Creek	97	137,000
CY-AC01	Canyon Creek Property Acquisition at 5600 block of 104th Street E	73	204,000
PH-PL02	156th Street East Regional Pipeline	120	288,000
RY-DIV01	85th Street East Diversion, Rody Creek	120	288,000
DU-DP01	Diru Creek Regional Detention	105	2,977,000
Total Estimated Cost			\$4,607,400

* indicates the Clear/Clarks Creek Basin share of the estimated cost of a program of County-wide applicability

9.1.1 Capital Improvement Projects

The Clear/Clarks Creek Basin Plan proposes an array of capital improvement projects distributed by type of problem addressed as follows:

- Road and Property Flooding - 29
- Erosion Control & Streambank Stabilization - 18
- Other Drainage Problems - 5
- Water Quality (including applicable erosion control projects, aquatic habitat restoration projects, and other types of projects with significant water quality benefits) - 42
- Aquatic Habitat Restoration - 4.6 miles

**TABLE 9-5. Summary of CIP Projects for Clear/Clarks Creek Basin
Project Type**

Subbasin	Acquisition	Streambank/Channel Stabilization	Culvert Replacement/ Repair	Detention Pond	Diversion	Infiltration Pond	Fish Passage	Raise Roadway	Pipeline	Setback Levee	Sedimentation Pond	Stream Corridor Restoration	Swale	Vegetation Control	Total Number of Projects	Est. Cost
Swan Creek	1	3	2	1					1						8	\$ 10,086,000
Squally Creek														1	1	\$ 150,000
Clear Creek	1	5	1	2								1		1	11	\$ 16,158,000
Canyon Creek	1	4		2			1	2		1		1			12	\$ 10,250,000
Rody Creek		2	2	1				1				1	1		8	\$ 2,787,000
Diru Creek		1		1								1			3	\$ 4,243,000
Woodland Crk		2	2	1								1			6	\$ 5,221,000
Clarks Creek	1								2		1	1			5	\$ 4,127,000
Potholes						1			6						7	\$ 5,427,000
Roosevelt Ditch				1	1			1					1		4	\$ 4,276,000
Basin Total	4	17	7	9	1	1	1	4	9	1	1	6	2	2	65	\$ 65,595,000

Recommended CIP projects usually fall into several categories. This reflects the interrelationship of environmental factors. For example, habitat problems tend to be a secondary effect of surface water and storm drainage and water quality problems. Culverts that are a barrier to fish passage are frequently too narrow in diameter to convey the surface water volumes generated during storms, so they create backwater flooding or culverts are perched far enough above the stream channel to scour holes and destabilize adjacent areas.

Figures 9-1, 9-2, and 9-3 show the generalized locations of recommended projects. Basin plans present general locations of projects to promote a focus on project concepts and the bigger picture and agreement at this stage before investing considerable funds in detailed analyses of project sites and design details.

CIPs involving riparian or wetland revegetation or restoration will require substantial maintenance during the first two to five years after planting. Irrigation may be required for the first year or two to establish some of the tree and brush species. In addition, annual weed removal or suppression will be needed until the plants are well established. This is particularly critical where reed canary grass and Himalayan blackberry currently predominate. As soon as trees are large enough to create shade and eliminate the conditions that these invasive plants thrive on, weed suppression is generally not necessary.

Section 9.3, Specific Recommendations, contains descriptions of each of capital projects, estimated cost, and how well each capital project measures against the basin plan objectives and key Pierce County Comprehensive Plan policies.

9.1.2 Programmatic Measures

The Basin Plan recommends twelve programmatic (non-structural) measures. The term “programmatic” relates to a plan of action or procedure for addressing a drainage need or problem. Programmatic measures include such actions as regulations, policy guidelines, site design standards, operational policies, technical assistance, enforcement, public outreach, and educational programs. Some of the programmatic recommendations are specific to the Clear/Clarks Creek Basin. Other programmatic activities would be undertaken with countywide applicability in mind with the Basin paying its share of program costs. The Clear/Clarks Creek Basin contributes 21.2% of the revenue from storm drainage and surface water management fees.

The number of programmatic measures and the high-priority reflects a policy in the Pierce County Comprehensive Plan that advocates use of nonstructural solutions to storm drainage problems before committing to hard-engineered solutions. Pierce County Code 19A.30.220.B.2 states, “Nonstructural measures should be preferred over structural measures.”

Recommended programmatic measures are as follows:

High-Priority Programmatic Measures

- Update the Pierce County Stormwater Management and Site Development Manual
- Develop and implement a “Best Management Practices” (BMP) Manual for Pierce County Water Programs Facilities Maintenance Activities
- Develop and implement an “Invasive Species Management Program”

- Develop and implement a “Land Management Program” for Multiple Use, including.
- Develop and implement a “Low Impact Development Program”
- Develop and implement an “Education, Outreach, and Technical Assistance Program”
- Develop and implement a “Restore Degraded Aquatic Habitat and Protect Water Quality and Attenuate Flood Hazards Program”
- Develop and implement a “Surface Water Monitoring Program”
- Increase inspections for compliance with storm drainage and surface water management regulations
- Enhance cooperative arrangements with cities and other jurisdictions

Medium-Priority Programmatic Measures

- Develop and implement a stormwater facility design process

Low-Priority Programmatic Measures

- Require flood disclosure statements on property titles

The estimated cost for the Clear/Clarks Creek Basin of implementing recommended programmatic measures over the ten-year implementation period is \$2,722,000.

9.1.3 Additional Studies

The Basin Plan recommends four basin-specific studies. Priorities were not established for studies.

- **ST03-01 – West Fork Clear Creek Floodplain Analysis**
- **ST03-02 – Upland Sediment Sources Identification**
- **ST03-03 – Roosevelt Ditch Channelization Study**
- **ST03-04 – Swan Creek Upland Riparian Restoration**

The estimated cost of the studies is \$224,000. Study results will provide information needed to address current Basin issues that cannot be resolved without additional data collection and analysis. Study results will assist in the next update of the Basin Plan and implementation of recommended projects with an improved understanding of basin characteristics.

9.1.4 Implementation Strategy

Order of Implementation. In theory, implementation starts with “High-Priority” projects and activities, then “Medium-Priority,” followed by “Low-Priority” projects and activities. In practice, the order of project implementation varies to reflect such factors as availability of funds: availability of staff and professional service resources; links to projects with different

priorities; cooperation with private landowners; projects completed by agencies other than Pierce County Public Works and Utilities; and new information, new regulations, or new public concerns.

The annual Capital Facilities Element of the Comprehensive Plan for Pierce County, Washington reflects the specific annual strategy for CIP's. Programmatic measures and CIP's also appear in the annual budget for Water Programs.

Pierce County Water Programs is primarily the implementer responsible for the recommendations contained in this Basin Plan. Funding of the recommendations is mainly through Pierce County's surface water management fees collected within the Basin, but may also include state and federal grants and other local fund sources. The Clear/Clarks Creek Basin Plan anticipates full implementation over a ten-year period beginning in 2005. Actual duration of full implementation and the timing of specific projects and programs are determined through annual budget decisions of the County Council and County Executive, first in the yearly update of the Capital Facilities Element of the County Comprehensive Plan, and secondly in the operating budget for Pierce County Water Programs.

9.2 Plan Approach to Basin Needs

9.2.1 Preference for Non-Structural Solutions

The 1991 Pierce County Storm Drainage and Surface Water Management Plan and the Capital Facilities Element of the Comprehensive Plan for Pierce County contain the following policy: "Nonstructural measures should be preferred over structural measures". Examples of non-structural solutions and programmatic measures include:

- Adopting an updated Stormwater Management and Site Development Manual
- Increasing inspections for compliance with stormwater requirements and NPDES permits
- Requiring flood disclosure statements on property titles
- Upgrading and administering the county's floodplain regulations to address groundwater and pothole flooding

9.2.2 Low Impact Development

The hydrologic analysis in Chapter 6 described how urbanization alters the hydrologic regime to generate more stormwater runoff, higher velocity runoff, and less infiltration. A way of addressing these adverse effects is through Low Impact Development (LID) practices. LID can substantially reduce the rate of flow and the volume of stormwater runoff from medium and high-density areas. LID emphasizes protection and use of natural on-site features, reduction of impervious surfaces, and small-scale stormwater controls to minimize stormwater runoff and retain pre-development watershed hydrologic functions. LID combines site planning with individual best management practices to preserve natural drainage characteristics (such as soils and vegetation) and to retain and infiltrate stormwater on-site.

LID can reduce development infrastructure and related costs in many settings. LID strategies focus on evaporating, transpiring and infiltrating stormwater on site through native soils, vegetation and bioengineering applications, rather than conveying stormwater through large stormwater facilities, pipes, and other costly, traditionally hard structural drainage systems. In addition to reduced infrastructure costs, LID practices have other economic benefits that can increase a development project's marketability, such as a community's perceived quality of life. LID stormwater facilities can be easier and less costly to maintain over time. Public and private use of LID concepts can also reduce the size of stormwater ponds, resulting in more developable land.

A sample of LID site design applications and BMPs (Wulkan, 2001) follows:

- Developers set aside all sensitive areas and natural drainage, such as streams and wetlands. Portions of a site's trees and native vegetation are integrated into the site design.
- Specially designed bio-retention areas (or landscaped rain gardens) capture, filter and infiltrate stormwater.
- Narrower roads and use of permeable pavements on parking lots and driveways reduces impervious areas. Pervious pavements help to infiltrate stormwater at the site.
- Runoff from remaining impervious surfaces, such as rooftops, can be directed onto landscaped areas with porous soils.
- Rooftop designs can include roof gardens, which retain and slowly release stormwater.
- Soils compacted during construction are amended with compost or other organic soil conditioner that restores their capacity to hold moisture, infiltrate runoff and grow healthy plants.

The Washington Department of Ecology Stormwater Management Manual for Western Washington (Ecology, 2002) emphasizes the use of LID strategies wherever practicable.

LID practices can be used in parts of the Basin zoned for residential and higher density land uses. Seattle and other Puget Sound communities have demonstrated how LID principles can be successfully applied to the retrofit of existing neighborhoods. Public infrastructure improvements such as road and road drainage projects can also embody LID principles.

Programmatic Measure PRG00-01 (Section 9.4.2) calls for the establishment of a Low Impact Development Program that could provide LID outreach services, collaborate with the development industry and citizens to identify and solve problems and impediments to LID implementation, and coordinate LID public and private pilot projects.

9.2.3 Economic Development

Pierce County as a government and provider of public facilities and services works toward the economic health of the County and the region. Sound management of storm drainage facilities, flood hazard reduction, and protection of surface water quality makes Pierce County a more desirable place to live and work, acts as an incentive for new business to locate here, and

encourages existing businesses to stay and expand. Basin plans lay out the surface water management needs of the basins given existing and planned development. These are the facilities and services needed to support planned levels of growth laid out in the County Comprehensive Plan. Facilities bring predictability to businesses. Public funds build facilities and programs that serve economic growth consistent with adopted land use plans and regulations.

9.2.4 Critical Areas Conservation

As described in chapters six and eight, stormwater drainage, flooding, streambank erosion, and loss of aquatic habitat are ongoing surface water management problems in the Clear/Clarks Creek Basin. These problems can be partially addressed through conservation of critical areas, including preservation of lands that are prone to flooding, riparian corridors, wetlands, and associated buffer areas. The basin plans presume that conservation for general public benefit is best achieved through acquisition; either fee-simple or another legal instrument such as a conservation easement. The purchase prices of both are almost the same.

The Clear/Clarks Creek Basin Plan recommends property acquisitions for conservation of critical areas or mitigation of adverse effects of urban development in eight different parts of the Basin. In addition to preventing or removing a flood threat, several of these sites would preserve wetlands. Riparian buffer acquisitions along six creeks are recommended as part of a series of stream corridor restoration CIPs (refer to Section 9.2.8).

9.2.5 Public Involvement and Education

A goal of public involvement is to improve public understanding of the various surface water management issues in the Clear/Clarks Creek Basin, including erosion and sedimentation control, flood hazard reduction, rodent control (and its relationship to water quality), and aquatic habitat restoration and protection. Individual recommendations of this Basin Plan should be incorporated into a comprehensive public education program that informs Clear/Clarks Creek Basin residents about conditions of the creeks and its watersheds, any planned capital improvement projects, and the actions of individual residents that can contribute to restoration and protection of the surface and ground water resources of the Clear/Clarks Creek Basin.

A County-wide watershed education program would help to educate watershed citizens about the consequences of actions and encourage them to change their habits to protect the creeks and watersheds. Specific activities would be targeted to both young and adult audiences and would be related to existing community programs. The publicly-owned parts of creeks lend themselves to citizen involvement in stream and riparian restoration projects and can call attention to watershed activities and events in the Clear/Clarks Creek Basin.

Programmatic measure PRG00-06, Develop and Implement and Education, Outreach and Technical Assistance Program, could include some of the components and recommendations of this Basin Plan and could provide for public involvement and information in the Clear/Clarks Creek Basin as part of the countywide program.

9.2.6 Compliance with Storm Drainage and Flood Hazard Regulations

Compliance with existing storm drainage and critical areas regulations will help to mitigate the adverse effects of future development. For example, filling of floodplain and wetland areas was identified in Chapter Four as a continuing problem in the Clear/Clarks Creek Basin. In addition, existing Washington State, federal and local regulations provide for water quality, habitat, critical areas and land use protection. However, compliance with regulations typically required formal and informal enforcement, inspections, technical assistance, public information, and education.

This Basin Plan reflects Pierce County's commitment to compliance with local regulations related to flooding and water quality management, in addition to the requirements of federal and State regulations such as the federal "Clean Water Act" and Code of Federal Regulations, State water quality standards, "Endangered Species Act," FEMA floodplain regulations and "Community Rating System," State Hydraulic Code, "Shoreline Management Act," and "Growth Management Act." A compliance assurance program, implemented in a fair and consistent manner, would improve natural resource and surface water management within the Clear/Clarks Creek Basin Programmatic measure PRG00-03, Increase Inspections for Compliance with Stormwater Requirements and NPDES Permit, is a measure that addresses compliance assurance.

Protection of stream channels from encroachment by uses with adverse effects can also be addressed through compliance with environmental regulations. The County has development regulations intended to protect critical habitat areas (Title 18E, Pierce County Code) and requirements to control erosion and sedimentation during land clearing, grading, construction and in the long-term. As an NPDES municipal stormwater permit holder, the County is required to have a program that includes the legal authority to investigate drainage problems and inspect development sites to ensure that practices in the County conform to NPDES terms and protect water quality. When administering the regulations is not enough to protect water quality, capital facilities to treat stormwater is required.

Local critical areas rules, NPDES requirements, and other federal and state rules define certain uses and activities that are prohibited within surface waters, stream, and or their buffers. Use and activity regulations prohibit new development and existing landowners from undertaking new activities that could degrade water quality, increase erosion, cause riparian damage, or lead to flooding. Some examples of prohibited activities include: destroying or altering riparian vegetation through clearing, harvesting, cutting, intentional burning, shading, or planting; application of pesticides, fertilizers, and/or other chemicals; constructing, reconstructing, demolishing, or altering the size of any structure; or activities which alter water temperature.

9.2.7 Drainage and Flood Hazard Management

Chapter Six described existing and future drainage and flood hazard problem areas throughout the Clear/Clarks Creek Basin. The Basin Plan identifies projects and programs that will reduce flood hazards.

The Plan contains a range of approaches to meet that goal. Pierce County participates in the National Flood Insurance Program administered by the Federal Emergency Management Agency (FEMA). FEMA also offers communities the opportunity to receive additional benefits through

the “Community Rating System” (CRS). This program makes subsidized flood insurance available to citizens in communities that voluntarily take actions to reduce flood hazards. A community’s rating affects the flood insurance rates its citizens pay. Pierce County has one of the lowest flood insurance rates available. Pierce County was the first county in the nation to achieve a “Class 5” rating” through implementation of programs that reduced flood risks. This Basin Plan includes all the necessary program elements for the County to achieve a “Class 4” or better rating.

Flood Hazards

Mapping of flood hazard areas should be improved. Over 100 individual flooding and drainage problems were identified in the Clear/Clarks Creek Basin. *Figure 5-1* shows the distribution of problems is widespread and occur in all parts of the Basin.

According to the current Pierce County Flood Hazard area maps (see *Figure 4-10*), approximately 940 acres (4.5%) of the Clear/Clarks Creek Basin are located within an unnumbered Flood Zone A, the area that statistically is anticipated to be flooded once every 100 years. Flood Hazard maps also show more than 1,300 acres (approximately 6.3%) within the Flood Zone B, the area that statistically is flooded once every 500 years (see *Figure 4-10*).

Unnumbered Zone A and Flood Zone B floodplain designations do not provide sufficient information (in the form of base flood elevations) to ensure appropriate protection. These mapped floodplains do not always reflect the actual topographic and hydrologic conditions in the Basin.

Recent two-foot contour interval mapping shows that the mapped floodplain in many areas does not align with the topography. The hydrologic analysis also showed that peak flow rates were substantially higher than rates used by FEMA to develop the original floodplain maps.

Programmatic Measures for Flood Hazard Reduction

The Basin Plan supports programmatic measures that will serve to reduce flood hazard impacts. These include:

- **PRG00-02**, Adopt Updated Stormwater Management Standards.
- **PRG00-04**, Develop and Implement a Land Acquisition Program for Riparian and Wetland Habitat Protection and Flood Hazard Reduction.
- **PRG00-01**, Develop and Implement a Low Impact Development Program.
- **PRG00-06**, Develop and Implement an Education, Outreach and Technical Assistance Program.
- **PRG00-07**, Develop and Implement a Surface Water Management Monitoring Program.
- **PRG00-10**, Require Flood Disclosure Statements on Property Titles.
- **PRG00-11**, Enhanced Coordination with Cities and Other Agencies

Studies Benefiting Flood Hazard Reduction

Several studies could lead to additional capital improvement projects that reduce flood hazards. The studies recommended include:

- **ST03-01**, Floodplain analysis for West Fork Clear Creek from 88th Street East to 84th Street East
- **ST03-02**, Sediment Sources Identification
- **ST03-03**, Roosevelt Ditch Channelization Study
- **ST03-04**, Swan Creek Upland Riparian Restoration Program

In addition, a number of CIP projects have been proposed in the Clear/Clarks Creek Basin to alleviate localized flooding problems through stormwater facility improvements. Other CIP projects involve the acquisition of ponding or flood-prone areas.

Major Drainage Systems

Most of the creeks in the Clear/Clarks Creek Basin show signs of channel erosion in the steeper portions as they flow north into the Puyallup Valley. This is especially the case for Swan and Woodland Creeks, where long reaches of the stream channel have suffered from down-cutting. CIP projects are recommended along portions of most of the creeks to stabilize eroding stream channels and restore aquatic habitat. A number of the studies and programmatic measures in the previous sub-section would also alleviate stream channel erosion. In the plateau area in the southern portion of the Basin, there are several locations where stream channels are undersized and channel overflows cause property flooding. Numerous road culverts have been identified which are undersized and where high flows can overtop the road. The CIP improvements in this Plan address these flooding problems.

Minor Drainage Systems

Many of the roadway drainage systems in older developments were installed before current stormwater management standards were implemented. In some neighborhoods, the ditch and culvert system is undersized, or has been filled with sediment and no longer works as designed. As a result, there are many locations where extended stormwater inundation occurs after heavy periods of rain. Some of these areas are widespread and documented in Chapter Five, but others are more localized and may only affect one or two properties. In addition, the topography across much of the southern portion of the Basin is flat and frequently forms shallow depressions. CIP projects are recommended to alleviate flooding in some neighborhoods. However, most of these problems are assumed to be small and better addressed through maintenance activity or as a “Small Works Project.”

Homes with an existing stormwater inundation problem have limited options. The home may be physically raised in place or moved. Both are expensive approaches for a homeowner.

Proposals for major new development in the County require, among other things, that an assessment be made of the drainage conditions downstream from the development. For the Clear/Clarks Creek Basin, this downstream assessment should explicitly review whether the project will be impacted by, or drain to, a depression. If this is the case, the hydrologic analysis provided by the project proponent should demonstrate that the project would not be impacted by

onsite flooding nor contribute substantially to an offsite flooding problem. In addition to site-specific flooding information provided by the County, information regarding past flooding incidents should be sought from the local residents.

9.2.8 Water Quality

The Washington State Department of Ecology has issued Pierce County a “Phase 1” Municipal Stormwater NPDES Permit, conditioned to required Pierce County administer and enforce water quality standards adopted by the State of Washington and the federal government. One condition of the permit requires Pierce County to adopt standards equivalent to the State’s Stormwater Manual. Pierce County adopted the 1997 Stormwater Management and Site Development Manual as a step in demonstrating the County’s intent to comply with State and federal requirements. The manual sets standards for public and private activities that affect the quality of stormwater runoff. Adoption of the manual assumes effective administration and enforcement. Failing this, other methods such as costly stormwater treatment facilities and restoration projects become necessary. The permit also requires the County to update the manual to be equivalent with the State’s most recent (2001) manual.

9.2.9 Aquatic (Floodplain) Habitat Protection

Channel erosion and associated reduction of aquatic habitat is common in the Clear/Clarks Creek Basin. This is due to large increases in both the frequency and magnitude of high-volume flows, resulting from development within the Basin. Reduced infiltration due to increases in impervious area may also result in reduced stream base flows and intermittent flow conditions in the upper portions of some streams. The altered hydrologic regimes of the creeks in the Clear/Clarks Creek Basin are a major reason for habitat degradation. Another important reason for degraded stream conditions is a lack of riparian buffer along many of the upper reaches of the streams. The hydrologic changes combined with a lack of riparian buffers have resulted in generally poor fish habitat within the Basin. The Basin Plan addresses these problems, recommending 17 stream channel stabilization CIPs to prevent further serious channel erosion. A Stream Corridor Restoration CIP is recommended in each of six creeks: Clear, Canyon, Rody, Diru, Woodland and Clarks creeks. Finally, the eight detention ponds CIPs recommended by the Plan would reduce peak flows in the streams. These ponds may also be able to mitigate the impacts of the altered hydrology in the basin due to development if streamflow duration is considered when setting the target release rate from the facility. Some of these ponds can also improve base flow in the creeks if designed to encourage infiltration.

Degraded riparian areas that would benefit from enhancement were selected based on field investigation and aerial photography. Primary riparian enhancement sites were defined as those reaches that directly benefit salmonid habitat. These sites are generally located on the lower canyon and floodplain reaches where salmonids are known to be present. Enhancement measures at these sites could include, alone or in combination, instream habitat improvements, riparian zone planting, and control of invasive aquatic vegetation. Secondary riparian enhancement sites were defined as those reaches that indirectly benefit salmonid habitat. These sites are generally located on the plateau upstream of the known fish habitat locations, and benefit salmonid production by providing food-generating leaf litter and water quality treatment. Riparian enhancement in these reaches would mainly consist of riparian zone planting.

9.3 Specific Recommendations

The CIP and programmatic measures have been individually ranked according to a common ranking system used by all the basin plans for Pierce County. Each of the potential capital improvement projects and programmatic recommendations were evaluated using a spreadsheet that assigned points for the project/program’s potential for various aspects of flood reduction (approximately 35% of the total score), water quality protection or improvement (30%), natural resource improvement (30%), and other factors such as multiple use, education, and recreation (5%). Each project and program was reviewed and scored using approximately 40 specific criteria. This ranking system is documented in *Appendix “H”*. The appendix also contains a spreadsheet summarizing the scores assigned to each CIP and project estimating spreadsheet. An individual score sheet is included for each programmatic measure.

Recommended projects and programs were then put in rank order, based on their numeric benefit score (project score). Then, high, medium, or low status was assigned as follows:

- High-Priority: 25% of total number of recommendations
- Medium-Priority: 50% of total number of recommendations
- Low-Priority⁴: 25% of total number of recommendations

Within each priority category, projects and programs were ranked from lowest cost to highest cost. This directs County financial resources to where they do the most good for the financial resources invested. *Tables 9-2, 9-3, and 9-4* present the recommended capital improvement projects and programmatic measures.

9.3.1 Project Identification Codes

Each recommendation has a unique project identification code. The code contains the following information:

Project Category	Basin No.	Project Type	Order Number
CIP	03	RST	01
PRG	03	----	01
ST	03	----	01

Basin No.: This is a County designated number for identifying major divisions of drainage basins. The basin number for the Clear/Clarks Creek Basin is 03. Measures of Countywide applicability are 00.

Subbasin: The reach or subbasin identified within the Basin Plan.

⁴ Note: “Low-Priority” does not mean “no benefit” for flood control, water quality protection, or natural resource protection. All of the recommendations in the Basin Plan benefit the objectives. “No benefit” proposals were screened out prior to writing the Plan. “Low-Priority” means that the proposed project or program scored lower than other projects and programs, based on the net environmental benefits that would occur from the project or program as determined by the score sheet criteria. Some projects that are ranked “Medium-Priority” or “Low-Priority” may be built before high-priority projects to ensure the optimal benefit from other projects, such as upstream fish habitat improvements synchronized with downstream barrier removal.

Project Type: The general category of project that best fits the project’s activities.

Project Category Codes:	AC	Property Acquisition	OUT	Outfall
	C	Culvert	RD	Raised Road
	CHN	Channelization	REF	Retrofit
	CP	Culvert/Pipe	RP	Retention Pond
	DP	Detention Pond	SBS	Streambank/Channel Stabilization
	DS	Drainage Study	SP	Sedimentation Pond
	FP	Fish Passage	ST	Study
	IP	Infiltration Pond	SWL	Swale
	PL	Pipeline	VC	Vegetation Control
	PRG	Programmatic	WL	Wetland
	PS	Pump Station	WQ	Water Quality

9.3.2 Capital Improvement Projects

The Basin Plan contains more than 60 capital improvement projects to solve the flooding, storm drainage, water quality, and related habitat problems in the Clear/Clarks Creek Basin. This section presents CIP projects by subbasin, moving from the westerly subbasin of Roosevelt Ditch to the Clear Creek drainage system to the Clarks Creek drainage system and concluding with the Potholes area in the east. *Appendix “H”* contains the Project Analysis sheets for each of the projects listed below. Maps showing the general location of recommended projects are distributed in this section proximal to the project descriptions associated with the projects.

Roosevelt Ditch Subbasin Projects

Four projects were developed for the Roosevelt Ditch Subbasin. These projects will solve five flooding problems. *Figure 9-1* shows the location of the projects outlined below.

Table 9.6 ROOSEVELT DITCH Recommended CIPs				
<i>ID</i>	<i>Project Name</i>	<i>Project Score</i>	<i>Estimated Cost</i>	<i>Priority</i>
RD-DP01	Portland Avenue (Swan Creek) Regional Detention, Roosevelt Ditch	276	3,884,000	High
RD-SWL01	20th Avenue East Drainage Swale, Roosevelt Ditch	214	29,000	Medium
RD-DIV01	85th Street East Diversion	120	288,000	Low
RD-RD01	90 th Street East Road Surface Raising	84	75,000	Low
Total Estimated Cost for Roosevelt Ditch CIPs			\$4,276,000	

Project Number: CIP03-RD-DP01

Project Name: Portland Avenue (Swan Creek) Regional Detention Facility

Cost Estimate: \$3,884,000

Project Score: 276 **High-Priority**

Problem: The hydraulic analysis showed that roadway and property flooding occur in 7600 block of Portland Avenue during the 1-year peak flood event for existing and future land use conditions. The existing 24-inch-diameter storm drain system is undersized and overtops Portland Avenue causing roadway and property flooding.

Solution: Acquire properties on east (upstream) side of Portland Avenue between 80th Street East and Shopping Center property to preserve and expand floodplain storage. The existing topographic mapping shows that this area currently has 36 acre-feet of natural detention storage. The project would excavate an additional 8 acre-feet of storage in this area.

Benefit: This project eliminates roadway and private property flooding at Portland Avenue East. The project preserves also preserves wetland and floodplain in the Roosevelt Ditch Subbasin. This project solves flooding problem RD-7.

Project Number: CIP03-RD-SWL01

Project Name: 20th Avenue East Drainage Swale

Cost Estimate: \$29,000

Project Score: 214 **Medium-Priority**

Problem: Road and property flooding occur in the 7300 and 7400 block of 20th Avenue East due to an obstructed outfall from the 20th Avenue East storm drain system. The receiving ditch for this system is filled in downstream of the road. Fill has also been placed in the roadside ditch near 7403 20th Avenue East.

Solution: Excavate a 650-foot-long trapezoidal channel along the natural drainage alignment to connect 20th Avenue storm drain system to Roosevelt Ditch. Clean culvert near 7400 block of 20th Avenue East. Purchase 20-foot-wide easement from adjacent landowners.

Benefit: This project restores the drainage system on 20th Avenue East and eliminates roadway and private property flooding at this location. The project solves flooding problem RD-11.

Project Number: CIP03-RD-DIV01

Project Name: 85th Street East Diversion

Cost Estimate: \$311,000

Project Score: 86 Low-Priority

Problem: The hydraulic analysis predicted roadway and property flooding in the 1600 block of 85th Street East during the 10-year peak flood event under existing and future land use conditions. The culvert crossing 85th Street East diverts high flows from the south to the north side of the street. The roadside ditch and culvert system on the north side does not have the capacity to carry the diverted flow. Private property and roadway flooding also occurs on the west side of 18th Avenue East in the 8700 block of 18th Avenue East due to the undersized ditch and culvert system. Stormwater from this area is currently routed through the Portland Avenue drainage system and discharges to Roosevelt Ditch immediately downstream of 80th Street East.

Solution: Divert stormwater from downstream of 80th Street East to downstream of 85th Street East. Construct a 2,000-foot-long, 18-inch-diameter diversion pipeline from the northeast corner of Portland Avenue and 85th Street East to Roosevelt Ditch downstream of 85th Street East. A 40-foot-long, 18-inch-diameter cross culvert would also be installed to connect 18th Avenue ditch and culvert system to new storm drain at intersection of 18th Avenue East and 85th Street East. A flood easement would be acquired upstream of 80th Street East because the 100-year peak flood stage would increase by 0.2 feet at this location. There is an unclassified, unverified wetland present at this location.

Benefit: This project eliminates flooding on 80th Street East and also preserves wetland floodplain. The project solves flooding problems RD-13 and RD-15.

Project Number: CIP03-RD-RD01

Project Name: 90th Street East Roadway Improvement

Cost Estimate: \$75,000

Project Score: 84 Low-Priority

Problem: The hydraulic analysis showed roadway overtopping at 90th Street East during the 25-year peak flood event under existing land use conditions and increasing to the 10-year peak flood event under future land use conditions.

Solution: Raise 165 lineal feet of roadway 2.0 feet to elevation 416.0 NGVD and purchase floodplain easement. There is an unclassified, verified wetland present at this location.

Benefit: This project eliminates flooding at 90th Street East and also preserves wetland floodplain. This project solves flooding problem RD-17.

Swan Creek Subbasin CIP Projects

Eight projects were developed for Swan Creek and the area that drains to the creek. The projects will solve two flooding, four erosion, and five aquatic habitat problems. Figure 9-1 shows the location of the projects described below.

Table 9.7 SWAN CREEK Recommended CIP Projects				
<i>ID</i>	<i>Project Name</i>	<i>Project Score</i>	<i>Estimated Cost</i>	<i>Priority</i>
SW-AC01	Swan Creek at 112th Street Floodplain Storage/Headwaters Preservation	302	1,306,000	High
SW-DP01	Swan Creek Regional Detention	259	7,049,000	High
SW-SBS03	Swan Creek 64th Street East Culvert Outfall Repair	152	24,000	Medium
SW-SBS01	Swan Creek Streambank Stabilization at 72nd Street E Outfall	157	100,000	Medium
SW-SBS02	Swan Creek Stream Bank/Channel Stabilization from 72nd Street E to 64th Street E	203	283,000	Medium
SW-SBS04	Swan Creek Streambank Stabilization Downstream of 64th Street East	222	Segment 1: 380,000 Segment 2: 380,000 Segment 3: 380,000 TOTAL: 1,140,000	Medium
SW-PL01	84th Street East Pipeline Replacement, Swan Creek	99	74,000	Low
SW-CR01	Swan Creek 80th Street E Culvert Replacement	82	110,000	Low
Total Estimated Cost for Swan Creek CIPs			\$10,086,000	

Project Number: CIP03-SW-AC01

Project Name: 112th Street Floodplain Storage/Headwaters Preservation

Cost Estimate: \$1,306,000

Project Score: 302 **High-Priority**

Problem: The hydrologic analysis predicted that peak flows from this area will increase by 10 to 20 % under future land use conditions. A Class III wetland is located in headwaters of Swan Creek above 112th Street East. The flat topography and saturated soils found in this area result in excessive stormwater inundation and overall poor drainage condition. This condition is problematic for urban development but ideally suited for floodwater storage and riparian habitat. The area is zoned for Mixed-Use District and High Density Residential. Conversion to these types of land uses permitted in these zones usually results in filling of floodplain and a large increase in effective impervious area.

Solution: Purchase 34 acres of floodplain and wetland to preserve the existing floodwater storage, base stream flow, and wetland values.

Acquisition of the full 34 acres will be broken down by segments divided as follows:

Segment 1: Class III, delineated wetland located between SR 512 and 112 th Street East	\$343,000
Segment 2: Unclassified, delineated wetland located primarily on vacant land north of 116 th Street East	\$442,000
Segment 3: Unclassified, delineated wetland located south of 116 th Street East	\$442,000

Benefit: This project preserves floodplain and wetland storage in this flat sloped, poorly drained area helping to prevent further alteration of Swan Creek hydrology.

Project Number: CIP03-SW-DP01

Project Name: Swan Creek Regional Detention

Cost Estimate: \$7,049,000

Project Score: 259 **High-Priority**

Problem: The streambank stabilization projects at the 72nd Street East culvert (CIP03-SW-SBS02) and between CIP03-SW-SBS04 will require peak flow reduction if they are to maintain viability over the long-term. This is demonstrated by the fact that high stream flow rates have damaged some of the log weirs installed with previous stabilization efforts. Peak flow reduction is also needed to reduce or eliminate streambank erosion in the streams in the future.

Solution: Construct 80 acre-feet of detention storage (at one or more locations) in Swan Creek Subbasin upstream or near 72nd Street East. Additional hydrologic analysis and a geotechnical investigation prior to project design is needed to accurately define detention volume and the target release rate. The type of streambank stabilization measures should also be considered when establishing the target release rate.

Benefit: Reduces peak stream flow rates in the Swan Creek Subbasin that reduces erosion and helps to maintain the long-term viability of the channel stabilization projects. With proper design of the outlet structure, it may be possible to provide a mitigate some of the impacts of the altered hydrology of the system. This project solves erosion and riparian/aquatic habitat problems SW-3, SW-22, SW-23, SW-25, SW-26. This project has the potential to provide a flood control benefit and solve flooding problem SW-1 if the facility is located upstream 80th Street East.

Project Number: CIP03-SW-SBS03

Project Name: 64th Street East Culvert Outfall Repair

Cost Estimate: \$24,000

Project Score: 152 **Medium-Priority**

Problem: High stream flows have scoured a 4- to 5-foot-deep scour hole at 64th Street East culvert outlet and undermined the culvert apron so that the apron has completely separated from the culvert. If left unchecked, the culvert will continue to be undermined, which may cause failure to the roadway embankment. This culvert is also a barrier to fish passage.

Solution: Repair the culvert headwall and install boulder clusters at the culvert outfall for energy dissipation.

Benefit: Provides a public safety benefit by maintaining structural stability of the culvert and roadway embankment. Stabilizes the stream channel by preventing further scour erosion. This project solves erosion and riparian/aquatic habitat problem SW-23.

Project Number: CIP03-SW-SBS01

Project Name: Streambank Stabilization at 72nd Street East Outfall

Cost Estimate: \$100,000

Project Score: 157 **Medium-Priority**

Problem: High flow velocity at the 72nd Street East culvert outfall has eroded the west bank and is compromising bank stability. A house is located less than 50 feet from the eroded bank.

Solution: Stabilize 200 feet of west bank below home with log cribwall, barbs or other energy deflecting technique. Place boulder cluster in scour hole at culvert outlet to provide energy dissipation.

Benefit: Provides a public safety benefit by maintaining stability of the west streambank protecting the adjacent structure. This project solves erosion and riparian/aquatic habitat problem SW-3.

Project Number: CIP03-SW-SBS02

Project Name: Streambank Stabilization from 72nd Street East to 64th Street East

Cost Estimate: \$283,000

Project Score: 203 **Medium-Priority**

Problem: Channel erosion downstream of 72nd Street East to 64th Street East due to high streamflow. Exposed vertical banks 2- to 3-feet high.

Solution: Install streambank stabilization measures such as porous rock weirs or drop structures every 50 feet in 3,000 foot reach from 72nd Street East to 64th Street East. Purchase 40-foot-wide easement from adjacent landowners.

Benefit: Stabilizes streambank and reduces erosion in Swan Creek. This project in conjunction with downstream projects will protect instream habitat in lower Swan Creek. This project will also help to eliminate a source of fine sediments to Clear Creek. This project solves problem erosion and riparian/aquatic habitat SW-22.

Project Number: CIP03-SW-SBS04

Project Name: Streambank Stabilization Downstream of 64th Street East

Cost Estimate: \$1,141,000

Project Score: 222 **Medium-Priority**

Problem: High streamflow in Swan Creek has caused significant erosion in the 8,000 foot-long reach downstream of 64th Street East. In some locations, exposed vertical banks in the channel were observed to be greater than 10-feet high.

Solution: Install streambank stabilization measures such as porous rock weirs and drop structures every 50 feet. These types of structures direct the energy of the flowing water away from the streambanks and towards the center of the stream. Because much of the area is steep, inaccessible ravine, use of a helicopter for construction may be necessary. The reach flows through public land so no easement acquisition required.

Stabilization of the full 8,000 foot reach can be broken down by segments divided as follows:

Segment 1: 64 th Street East to 57 th Street Ct. East (extended)	\$380,000
Segment 2: 57 th Street Ct. East to 48 th Street East	\$380,000
Segment 3: 48 th Street East to 40 th Street East (extended)	\$380,000

Benefit: Stabilizes streambanks and reduces erosion along Swan Creek. This project in conjunction with upstream projects will improve instream habitat in lower Swan Creek. The project will also help to eliminate a source of fine sediment to Clear Creek. The project solves erosion and riparian/aquatic habitat problem SW-23.

Project Number: CIP03-SW-PL01

Project Name: 84th Street East Storm Drain Replacement

Cost Estimate: \$74,000

Project Score: 99 **Low-Priority**

Problem: Hydraulic analysis predicted road and property flooding on 84th Street East, from Waller Road East to 400 feet east of Waller Road East, during the 25-year peak flood event under existing and future land use conditions. Flooding is due to insufficient conveyance capacity and backwater conditions in the 84th Street East storm drain system that connects this area to Waller Road Pond #4.

Solution: Replace existing 24-inch diameter concrete pipe with 350-feet of 36-inch diameter concrete pipe from Waller Road East to catch basin east of Waller Road East. Replace existing 12-inch inlet culvert to catch basin with 50-feet of 24-inch diameter concrete pipe. Field survey and detailed hydraulic analysis should be performed before project implementation.

Benefit: This project eliminates flooding on 84th Street East west of Waller Road East. This project solves flooding problem SW-4.

Project Number: CIP03-SW-CR01

Project Name: 80th Street East Culvert Replacement

Cost Estimate: \$110,000

Project Score: 82 **Low-Priority**

Problem: Hydraulic analysis predicted roadway overtopping of Swan Creek at 80th Street East during 25-year peak flood event under existing and future land use conditions. Roadway runoff causes property flooding at 2600 block of 80th Street East. This culvert has also been identified by the PCD as a barrier to fish passage; however, it is unknown if fish are present in this reach.

Solution: Raise low-chord of existing structure 1.5 feet. Lower Invert by 0.3 feet. Raise 375 feet of road 0.8 feet to elevation 400.8 feet NGVD⁵. Install thickened pavement edge on north side to contain runoff on roadway. Field survey and detailed hydraulic analysis should be performed before project implementation.

Benefit: This project lowers the peak water surface elevation at the 80th Street East bridge by about 0.2 feet and eliminates flooding at this location. The water surface elevation upstream of this culvert is controlled by channel conditions so floodplain storage is essentially unchanged. This project also provides for limited fish passage however, the benefit is likely reduced due to downstream fish passage barriers and the lack of base flow during the summer months. This project solves flooding problem SW-1.

Insert Figure 9-1

Squally Creek Subbasin Project

One project was developed for the Squally Creek Subbasin to solve one habitat problem. *Figure 9-1* shows the location of the projects described below.

Table 9.8 SQUALLY CREEK Recommended CIP Projects				
<i>ID</i>	<i>Project Name</i>	<i>Project Score</i>	<i>Estimated Cost</i>	<i>Priority</i>
SQ-VC01	Squally Creek at Pioneer Way E Vegetation Control	165	\$150,000	Medium
Total Estimated Cost for Squally Creek CIPs			\$150,000	

Project Number: CIP03-SQ-VC01

Project Name: Pioneer Way East Riparian Area Enhancement and Restoration

Cost Estimate: \$150,000

Project Score: 165 **Medium-Priority**

Problem: The riparian area of the 1,000-foot-long reach above Pioneer Way East has become overgrown with reed canary grass, creeping purple nightshade, and other invasive species. This reach flows through verified but unclassified wetland. The USBEM Phase II habitat condition assessment rated this reach as having "Poor" habitat conditions.

Solution: Remove reed canary grass and other invasive aquatic vegetation and plant conifers to provide shade. May also want to provide large woody debris. Implementation of this project should be coordinated with a programmatic measure to develop a long-term invasive species management program. Purchase 200-foot-wide easement from adjacent landowners.

Benefit: Improves floodplain habitat of this impaired reach. The project solves problem water quality and aquatic habitat problem SQ-6.

Clear Creek Subbasin Projects

Eleven projects were developed for the Clear Creek Subbasin. The projects will solve two flooding, five erosion, and nine habitat problems. Figure 9-1 shows the location of the projects described below.

Table 9.9 CLEAR CREEK Recommended CIP Projects				
<i>ID</i>	<i>Project Name</i>	<i>Project Score</i>	<i>Estimated Cost</i>	<i>Priority</i>
CL-RST01	Clear Creek Stream Channel Restoration	261	Segment 1: 402,000 Segment 2: 402,000 Segment 3: 402,000 TOTAL: 1,206,000	High
CL-AC01	Clear Creek Floodplain Repetitive Loss Acquisitions	345	6,455,000	High
CL-SBS03	Clear Creek Streambank Stabilization in vicinity of 49th Street E	194	35,000	Medium
CL-SBS04	Clear Creek Streambank Stabilization on West Fork Clear Creek Downstream of 64th Street E	194	35,000	Medium
CL-CR01	Clear Creek at 88th Street E Culvert Replacement	161	53,000	Medium
CL-VC01	Clear Creek at 104th Street E Vegetation Control	203	54,000	Medium
CL-SBS05	Clear Creek Streambank Stabilization 5000 block of Vickery Avenue East	153	92,000	Medium
CL-SBS02	Clear Creek Streambank Stabilization, East Fork Downstream of 72nd Street E	194	161,000	Medium
CL-SBS01	Clear Creek Streambank Stabilization, West Fork Downstream of 72nd Street E	194	187,000	Medium
CL-DP01	West Fork Clear Creek Regional Detention	163	3,021,000	Medium
CL-DP02	East Fork Clear Creek Regional Detention	163	4,858,000	Medium
Total Estimated Cost for Clear Creek CIPs			\$16,158,000	

Project Number: CIP03-CL-RST01
Project Name: Clear Creek Stream Corridor Restoration
Cost Estimate: \$1,206,000
Project Score: 261 **High-Priority**

Problem: This 3,000-foot reach of Clear Creek between Pioneer Way East and Gay Road has been channelized and disconnected from the floodplain. The reach has a reduced buffer and invasive riparian and aquatic vegetation has replaced the native species. The channel has filled with fine sediment due to upstream erosion activity. Most of this reach is glide aquatic habitat with very few pools and a complete absence of large woody-debris. A large unclassified wetland area abuts the stream at this location. The Port of Tacoma (POT) has purchased property for a future restoration project in the 1,400 foot-long reach upstream of Gay Road.

Solution: Restore 3,000-foot reach between Port of Tacoma property and Pioneer Way. Remove invasive vegetation and enhance riparian community with conifer plantings to provide shade. Install large woody-debris in channel to form pool aquatic habitat. Purchase 300-foot-wide easement from adjacent landowners where practical. The proposed corridor is adjacent to several vacant parcels. This project should be coordinated with the Port of Tacoma project restoration project planned for the reach downstream of this location.

Restoration of the full 3,000 foot reach will be broken down by segments divided as follows:

- Segment 1:** Pioneer Way East to 400 feet east of Squally Creek confluence \$402,000
- Segment 2:** 400 feet east to 600 feet west of Squally Creek confluence \$402,000
- Segment 3:** 600 feet west of Squally Creek confluence to POT property \$402,000

Benefit: This project provides high quality floodplain habitat in lower Clear Creek. The project solves riparian/aquatic habitat problems CL-1, CL-17, CL-18 and CL-24.

Project Number: CIP03-CL-AC01
Project Name: Clear Creek Floodplain Repetitive Loss Land Acquisition
Cost Estimate: \$6,455,000
Project Score: 345 **High-Priority**

Problem: Widespread flooding occurs in the area of 47th Avenue East, 50th Avenue East, 40th Street East, and 55th Street East. Sixty-five (65) properties are located within the 100-year floodplain. Federal funds have already been used to purchase 17 properties to be held for their floodplain value. The remaining 48 properties have flooded several times. Several of the properties abut Canyon Creek.

Solution: Purchase 48 properties (61 acres) that experience frequent flooding in the Clear Creek floodplain.

Benefit: This project eliminates the flood hazard by removing structures in the floodplain and may also benefit floodplain habitat if the acquired property is restored to its natural function. The project solves flooding problem CL-33.

Project Number: CIP03-CL-SBS03

Project Name: Streambank Stabilization in vicinity of 49th Street East

Cost Estimate: \$35,000

Project Score: 194 Medium-Priority

Problem: Streambank erosion due to high stream flow in 100-foot-long reach in vicinity of 49th Street East (extended).

Solution: Install streambank stabilization measures such as roughened rock toes, porous weirs or drop structures in a 100-foot reach in vicinity of 49th Street East. The site is located in a steeply sloped ravine and may be difficult to access. Purchase 100-foot-wide easement from adjacent landowners.

Benefit: Stabilizes streambanks and reduces erosion in Clear Creek. This project in conjunction with upstream other Clear Creek streambank stabilization projects will protect instream habitat in lower Clear Creek. This project will also help to eliminate a source of fine sediment to Clear Creek. The project solves problem erosion and riparian/aquatic habitat CL-21.

Project Number: CIP03-CL-SBS04

Project Name: Streambank Stabilization on West Fork Clear Creek Downstream of 64th Street East

Cost Estimate: \$35,000

Project Score: 194 Medium-Priority

Problem: Streambank erosion in West Fork due to high stream flow in 100-foot-long reach downstream of 64th Street East.

Solution: Install streambank stabilization measures such as roughened rock toes, porous weirs or drop structures in 100-foot reach in vicinity of 64th Street East. The site is located in a steeply sloped ravine and may be difficult to access. Pierce County has existing easement on 64th Street East.

Benefit: Stabilizes streambanks and reduces erosion in Clear Creek. This project in conjunction with other upstream Clear Creek streambank stabilization projects will protect instream habitat in lower Clear Creek. The project will also help to eliminate a source of fine sediment to Clear Creek. It solves erosion and riparian/aquatic habitat problem CL-22.

Project Number: CIP03-CL-CR01

Project Name: 88th Street East Culvert Replacement

Cost Estimate: \$53,000

Project Score: 161 **Medium-Priority**

Problem: Hydraulic analysis showed that flooding occurs at 88th Street East during the 5-year peak flood event under existing and future land use conditions.

Solution: Replace the existing twin 18-inch diameter culverts under 88th Street East with 6.5' span x 2' rise box culvert.

Benefit: This project eliminates roadway flooding at 88th Street East. The project solves flooding problem CL-5.

Project Number: CIP03-CL-VC01

Project Name: 104th Street East Riparian Area Enhancement

Cost Estimate: \$54,000

Project Score: 203 **Medium-Priority**

Problem: The East Fork reach below 104th Street East is overgrown with reed canary grass, which causes chronic road and property flooding on an annual basis. The length of impaired reach is about 400 feet.

Solution: Remove reed canary grass and other invasive aquatic vegetation and plant conifers to provide shade. Purchase 40-foot-wide easement from adjacent landowners.

Benefit: This project eliminates roadway flooding at this location and improves floodplain habitat of this impaired reach. This project solves flooding problem CL-4.

Project Number: CIP03-CL-SBS05

Project Name: Streambank Stabilization 5000 block of Vickery Avenue East

Cost Estimate: \$92,000

Project Score: 153 **Medium-Priority**

Problem: Streambank erosion in the West Fork in a 100-foot-long reach in vicinity of 5000 block of Vickery Avenue East. Uncontrolled saturated fill caused mass wasting of the hillside on west bank with 200-foot-long landslide chute to Clear Creek. Approximately 100 feet of the west bank of Clear Creek was damaged.

Solution: Install woody plantings (willow and conifer) in landslide chute to permanently stabilize hill slopes. Also install woody plantings on west bank of Clear Creek to stabilize streambank. Cut back over steepened slope at top of ravine near slide. Temporary construction easement will be needed from landowner.

Benefit: Stabilizes streambanks and reduces source of fine sediment to Clear Creek. This project in conjunction with other Clear Creek streambank stabilization projects will protect instream habitat in lower Clear Creek. This project solves erosion and riparian/aquatic habitat problem CL-33.

Project Number: CIP03-CL-SBS02

Project Name: Streambank Stabilization on East Fork Downstream of 72nd Street East

Cost Estimate: \$161,000

Project Score: 194 **Medium-Priority**

Problem: Streambank erosion due to high stream flow in 500-foot-long reach downstream of 72nd Street East. A 3-foot deep scour hole is present downstream at culvert outlet. .

Solution: Acquire 100-foot-wide easement from adjacent landowners. Place boulder clusters in scour hole at culvert outlet to provide energy dissipation. Install streambank stabilization measures such as roughened rock toes, porous weirs or drop structures in 500-foot reach downstream of 72nd Street East.

Benefit: Stabilizes streambanks and reduces erosion in Clear Creek. This project in conjunction with upstream other Clear Creek streambank stabilization projects will protect instream habitat in lower Clear Creek. This project will also help to eliminate a source of fine sediment to Clear Creek. The project solves erosion and aquatic habitat problem CL-20.

Project Number: CIP03-CL-SBS01

Project Name: Streambank Stabilization on West Fork Downstream of 72nd Street East

Cost Estimate: \$187,000

Project Score: 194 **Medium-Priority**

Problem: Streambank erosion due to high streamflow. Exposed vertical banks 12-feet-high in reach 500 feet downstream and 5-feet high in reach 100-feet upstream of 72nd Street. A 3-foot deep scour hole is present downstream at culvert outlet.

Solution: Place boulder clusters in scour hole at culvert outlet to provide energy dissipation. Install streambank stabilization measures such as porous weirs or drop structures in 600 foot reach in vicinity of 72nd Street East. Purchase 100-foot-wide easement from adjacent landowners.

Benefit: Stabilizes streambanks and reduces erosion in Clear Creek. This project in conjunction with upstream other Clear Creek streambank stabilization projects will protect instream habitat in lower Clear Creek. This project will also help to eliminate a source of fine sediment to Clear Creek. The project solves erosion and riparian/aquatic habitat problem CL-19.

Project Number: CIP03-CL-DP01

Project Name: West Fork Clear Creek Regional Detention

Cost Estimate: \$3,021,000

Project Score: 163 **Medium-Priority**

Problem: High stream flow rates have caused extensive channel erosion in vicinity of 72nd Street East and less extensive erosion in the vicinity of 64th Street East and 49th Street East. Eroded sediments wash down in the floodplain channel and accumulate on the channel bottom. Streambank stabilization projects CIP03-CL-SBS01, 03, and 04 will require peak flow reduction if they are to maintain viability over the long-term. Peak flow reduction is also needed to reduce or eliminate streambank erosion in the streams in the future.

Solution: Construct 26 acre-feet of detention storage (at one or more locations) in West Fork Clear Creek Subbasin upstream of 72nd Street East. Conduct an additional hydrologic analysis and a geotechnical investigation prior to project design to accurately define detention volume and the target release rate. The blend of streambank stabilization measures should also be considered when establishing the target release rate.

Benefit: This project reduces peak streamflow rates in the Clear Creek Subbasin, which reduces erosion and helps to maintain the long-term viability of the channel stabilization projects. With proper design of the outlet structure, it may be possible to provide a mitigate some of the impacts of the altered hydrology of the system. This project solves erosion and riparian/aquatic habitat problems CL-17, CL-19, CL-21, and CL-22. This project has the potential to provide flood control benefit and solve flooding problem CL-5 if some or all of the detention is located upstream 88th Street East.

Project Number: CIP03-CL-DP02

Project Name: East Fork Clear Creek Regional Detention

Cost Estimate: \$4,858,000

Project Score: 163 **Medium-Priority**

Problem: High stream flow rates have caused extensive channel erosion in vicinity of 72nd Street East and less extensive erosion in the vicinity of 64th Street East and 49th Street East. Eroded sediments wash down in the floodplain channel and accumulate on the channel bottom. The streambank stabilization projects CIP03-CL-SBS02, 03, and -04 will require peak flow reduction if they are to maintain viability over the long-term. Peak flow reduction is also needed to reduce or eliminate streambank erosion in the streams in the future.

Solution: Construct 42 acre-feet of detention storage (at one or more locations) in East Fork Clear Creek Subbasin upstream of 72nd Street East. Additional hydrologic analysis and a geotechnical investigation prior to project design is needed to accurately define detention volume and the target release rate. The type of streambank stabilization measures should also be considered when establishing the target release rate.

Benefit: Reduces peak stream flow rates in the Clear Creek Subbasin, which reduces erosion and helps to maintain the long-term viability of the channel stabilization projects. With proper design of the outlet structure, it may be possible to provide a mitigate some of the impacts of the altered hydrology of the system. The project solves erosion and riparian/aquatic habitat problems CL-17, CL-20, CL-21, and CL-22.

Canyon Creek Subbasin Projects

Twelve projects were developed for the Canyon Creek Subbasin. The projects will solve six flooding, four erosion, and eight habitat problems. *Figure 9-1* shows the location of the projects described below.

Table 9.10 CANYON CREEK Recommended CIPs				
<i>ID</i>	<i>Project Name</i>	<i>Project Score</i>	<i>Estimated Cost</i>	<i>Priority</i>
CY-RST01	Canyon Creek Stream Corridor Restoration	238	Segment 1: 472,000 Segment 2: 472,000 Segment 3: 472,000 Segment 4: 472,000 Segment 5: 472,000 Segment 6: 472,000 TOTAL: 2,834,000	High
CY-SBS01	Canyon Creek Streambank Stabilization, Reach Downstream of 80th Street East	158	161,000	Medium
CY-SBS02	Streambank Stabilization, Reach Downstream of 72nd Street East	153	161,000	Medium
CY-SBS03	Streambank Stabilization on Reach Upstream of Second Canyon Road Crossing	163	161,000	Medium
CY-SBS04	Canyon Creek Streambank Stabilization Downstream of Second Canyon Road Crossing	163	322,000	Medium
CY-SL01	58th Avenue East Setback Levee from Canyon Creek	165	552,000	Medium
CY-DP02	90th Street East Detention Facility (D138-003)	184	1,586,000	Medium
CY-DP01	Canyon Creek Regional Detention	174	3,930,000	Medium
CY-FP01	Canyon Creek Driveway Culvert Replacement	108	89,000	Low
CY-RD02	104th Street East Road Raising & Culvert Replacement - East Fork of Canyon Creek	99	113,000	Low
CY-RD01	116th Street East Roadway Improvement - West Fork of Canyon Creek	97	137,000	Low
CY-AC01	Canyon Creek Property Acquisition at 5600 block of 104th Street E	73	204,000	Low
Total Estimated Cost for Canyon Creek CIPs			\$10,250,000	

Project Number: CIP03-CY-RST01
Project Name: Canyon Creek Stream Corridor Restoration
Cost Estimate: \$2,834,000
Project Score: 238 **High-Priority**

Problem: This 7,000-foot reach of Canyon Creek between Pioneer Way East and the Clear Creek confluence is severely degraded with a straightened channel, disconnected floodplain, and reduced riparian buffer with invasive riparian and aquatic vegetation. The channel has also filled with fine sediment due to upstream erosion. Most of this reach is glide habitat with very few pools and a complete absence of large woody-debris. A large unclassified wetland area abuts the stream at this location. The USBEM Phase II habitat condition assessment rated this reach as having "Poor" habitat condition.

Restoration of the full 7,000 foot reach will be broken down by segments divided as follows:

Solution: Restore 7,000-foot reach between Pioneer Way East and the confluence with Clear Creek. Remove invasive vegetation and restore riparian community with conifer plantings to provide shade. Install large woody-debris in channel to form pool aquatic habitat. Purchase 300-foot-wide easement from adjacent property owners where practical.

Restoration of the full 7,000 foot reach will be broken down by segments divided as follows:

- Segment 1:** Pioneer Way East to 400' south of BNSF Railroad crossing \$472,000
- Segment 2:** 400' south to 800' northwest of BNSF Railroad crossing \$472,000
- Segment 3:** 800' northwest of BNSF Railroad crossing to 4700 block of Pioneer Way East \$472,000
- Segment 4:** 4700 block of Pioneer Way East to 600' southwest of 44th Street East \$472,000
- Segment 5:** 600' southeast to 600' northwest of 44th Street East \$472,000
- Segment 6:** 600' northwest of 44th Street East to Clear Creek confluence \$472,000

Benefit: This project provides high quality floodplain habitat in lower Canyon Creek. The project will solve riparian/aquatic habitat problems CY-23, CY-25, and CY-26.

Project Number: CIP03-CY-SBS01

Project Name: Streambank Stabilization on Reach Downstream of 80th Street East

Cost Estimate: \$161,000

Project Score: 158 **Medium-Priority**

Problem: Streambank erosion due to high stream flow in reach 500 feet downstream of 80th Street East.

Solution: Place boulder clusters in scour hole at culvert outlet to provide energy dissipation. Install streambank stabilization measures such as porous weirs or drop structures in 500-foot reach in vicinity of 80th Street East. Purchase 40-foot-wide easement from adjacent landowners.

Benefit: This project stabilizes streambanks and reduces erosion in Canyon Creek. This project will help to reduce a source of fine sediment to Canyon and Clear Creek. This project solves erosion and riparian/aquatic habitat problem CL-18.

Project Number: CIP03-CY-SBS02

Project Name: Streambank Stabilization on Reach Downstream of 72nd Street East

Cost Estimate: \$161,000

Project Score: 153 **Medium-Priority**

Problem: Streambank erosion due to high stream flow in 500-foot-long reach downstream of 72nd Street East. Exposed vertical banks 12-feet-high and culvert perched 3 feet above eroded stream channel.

Solution: Install streambank stabilization measures such as roughened rock toes, porous weirs or drop structures in 500-foot reach downstream of 72nd Street East. Install boulder cluster at culvert outfall for energy dissipation. Purchase 40-foot-wide easement from adjacent landowners.

Benefit: Stabilizes streambanks and reduces erosion in Canyon Creek. This project will help to reduce a source of fine sediment to Canyon and Clear Creek. This project solves problem erosion and riparian/aquatic habitat CL-22.

Project Number: CIP03-CY-SBS03

Project Name: Streambank Stabilization on Reach Upstream of Second Canyon Road Crossing

Cost Estimate: \$161,000

Project Score: 163 Medium-Priority

Problem: Streambank erosion due to high stream flow in 500-foot-long reach upstream of second Canyon Road crossing.

Solution: Install streambank stabilization measures such as roughened rock toes, porous weirs or drop structures in reach upstream of second Canyon Road crossing. Purchase 40-foot-wide easement from adjacent landowners.

Benefit: Stabilizes streambanks and reduces erosion in Canyon Creek. This project will help to reduce a source of fine sediment to Canyon and Clear Creek. The project solves problem erosion and riparian/aquatic habitat CL-20.

Project Number: CIP03-CY-SBS04

Project Name: Streambank Stabilization Downstream of Second Canyon Road Crossing

Cost Estimate: \$322,000

Project Score: 163 Medium-Priority

Problem: Streambank erosion due to high stream flow in 500-foot-long reach upstream of second Canyon Road crossing.

Solution: Install streambank stabilization measures such as roughened rock toes, porous weirs or drop structures in reach upstream of second Canyon Road crossing. These types of structures direct the energy of the flowing water away from the streambanks and towards the center of the stream. Purchase 40-foot-wide easement from adjacent landowners.

Benefit: Stabilizes streambanks and reduces erosion in Canyon Creek. This project will help to reduce a source of fine sediment to Canyon and Clear Creek. This project solves problem erosion and riparian/aquatic habitat CL-21.

Project Number: CY-SL01

Project Name: 58th Avenue East Property Acquisition with Setback Levee

Cost Estimate: \$552,000

Project Score: 165 **Medium-Priority**

Problem: The East Fork of Canyon Creek has limited conveyance capacity in this reach due to a flat slope and a shallow channel. Road and property flooding occurs during the 10-year peak flood event under existing land use conditions, increasing to the 2-year peak flood event under future land use conditions. Flooding also occurs on 58th Street East due to an obstructed ditch and culvert system. The problem was validated during field reconnaissance in February 2003. This area is zoned for High-Density Residential. Conversion to this type of land use can result in loss of floodplain and an increase in effective impervious area. This area also contains a partially verified, unclassified wetland.

Solution: Acquire 11 acres of floodplain and wetland in this area to preserve the existing floodplain storage. A 625-foot-long setback levee would be installed on west side of 58th Avenue East to prevent flooding on 58th Avenue East. The project also includes the installation of new storm drain system on 124th Street Court East and 59th Avenue East to reestablish the drainage system in this area.

Benefit: This project eliminates roadway flooding at 58th Avenue East. This project also provides a habitat benefit by preserving wetland floodplain storage. The project solves flooding problem CY-5.

Project Number: CIP03-CY-DP02

Project Name: 90th Street East Detention

Cost Estimate: \$1,586,000

Project Score: 184 **Medium-Priority**

Problem: Extensive flooding occurs at 90th Street East crossing of Canyon Creek.

Solution: The County is in the process of designing an off-channel detention pond to address the problem. Install twin 48-inch-diameter concrete culverts at 88th Street East. Excavate 8-acre-feet of compensatory storage in the floodplain south of 90th Street East. This project is partially documented in the Canyon Creek Bypass Pipeline Design Report (Pierce County, 2002).

Benefit: This project eliminates property flooding at 90th Street East. The project solves flooding problem CY-1.

Project Number: CIP03-CY-DP01

Project Name: Canyon Creek Regional Detention

Cost Estimate: \$3,930,000

Project Score: 174 **Medium-Priority**

Problem: High stream flow rates have caused extensive channel erosion in vicinity of 80th Street E, 72nd Street East and the second Canyon Road Crossing. Eroded sediments wash down in the floodplain channel and accumulate on the channel bottom. The streambank stabilization projects CIP03-CY-SBS01, 02, 03, and -04 will require peak flow reduction if they are to maintain viability over the long-term. Peak flow reduction is also needed to reduce or eliminate streambank erosion in the streams in the future.

Solution: Construct 34 acre-feet of detention storage (at one or more locations) in the Canyon Creek Subbasin upstream of 72nd Street East. Additional hydrologic analysis and a geotechnical investigation prior to project design is needed to accurately define detention volume and the target release rate. The type of streambank stabilization measures should also be considered when establishing the target release rate.

Benefit: Reduces peak stream flow rates in the Canyon Creek Subbasin, which reduces erosion and helps to maintain the long-term viability of the channel stabilization projects. With proper design of the outlet structure, it may be possible to provide a mitigate some of the impacts of the altered hydrology of the system. This project solves erosion and riparian/aquatic habitat problems CY-18, CY-20, CY-22, and CY-23. The project has the potential to provide a flood control benefit and solve flooding problems CY-3, CY-5, CY-10 if some or all of the detention is located upstream of these problem locations.

Project Number: CIP03-CY-FP01

Project Name: Private Driveway Culvert Replacement

Cost Estimate: \$89,000

Project Score: 108 **Low-Priority**

Problem: The driveway culverts located in the public right-of-way of the 4200 block of Pioneer Way East have been classified as a barrier to fish passage by the Pierce Conservation District. A second culvert is located upstream at an abandoned driveway, but the barrier status is unknown.

Solution: Replace the existing driveway culvert with a 53-foot-long, 12-foot-span, 5-foot rise box culvert countersunk into the channel by 20 %. Removal of the upstream culvert with the unknown barrier status is recommended because the stream crossing is not used anymore.

Benefit: Replacing this structure will improve access to an additional 3,900 feet of fish habitat in Canyon Creek. This project will solve riparian/aquatic habitat problem CY-28.

Project Number: CY-RD02
Project Name: 104th Street East Roadway Improvement & Culvert Replacement Problem - East Fork
Cost Estimate: \$113,000
Project Score: 99 **Low-Priority**

Problem: The hydraulic analysis showed that roadway overtopping occurs during the 10-year peak flood event under existing land use conditions increasing to the 2-year peak flood event under future land use conditions.

Solution: Raise roadway 2.0 feet to 422.0 feet NGVD and install a 4-foot-span by 1-foot-rise concrete box culvert above the existing culvert. This project would result in a 0.5-foot reduction in the water surface elevation for the 100-year event. No downstream impacts area expected because channel conditions control the water surface upstream of the culvert and the floodplain storage is essentially unchanged.

Benefit: This project eliminates roadway flooding at 104th Street East. This project solves flooding problem CY-5.

Project Number: CY-RD01
Project Name: 116th Street East Roadway Improvement - West Fork
Cost Estimate: \$137,000
Project Score: 97 **Low-Priority**

Problem: The hydraulic analysis predicted roadway overtopping at the Canyon Creek crossing of 116th Street E, just west of Canyon Rd during the 2-year peak flood event under existing and future land use conditions. Water on Road sign and evidence of roadway overtopping was observed during site visit in February 2003. Also, downstream culverts on 112th Street East and SR-512 cause excessive backwater in this area. A 15-inch-diameter pipeline is located at 112th Street East and frequently becomes clogged with debris and causes additional flooding at 116th Street East.

Solution: Raise 200-lineal-feet of road 1.5 feet to elevation 462.0 feet NGVD. Install additional 18-inch diameter culvert adjacent to existing culvert to equalizing surface water ponding levels on both sides of the road. Replace 15-inch-diameter pipe at 112th Street East with a 24-inch-diameter pipe.

Benefit: This project eliminates roadway flooding at 116th Street East. The project solves flooding problem CY-3.

Project Number: CY-AC01

Project Name: Property Acquisition at 5600 block of 104th Street East

Cost Estimate: \$205,000

Project Score: 73 **Low-Priority**

Problem: A resident reported flooding on at least two occasions, probably due to backwater from the 103rd Street East culvert.

Solution: Buy the property at this location. The 1991 Plan showed this culvert having insufficient conveyance capacity.

Benefit: This project solves flooding problem CY-30.

Rody Creek Subbasin Projects

Seven projects were developed for the Rody Creek Subbasin. The projects will solve three flooding, two erosion, and three habitat problems. *Figure 9-2* shows the location of the projects described below.

Table 9.11 RODY CREEK Recommended CIPs				
<i>ID</i>	<i>Project Name</i>	<i>Project Score</i>	<i>Estimated Cost</i>	<i>Priority</i>
RY-RST01	Stream Corridor Restoration	303	Segment 1: 410,000 Segment 2: 410,000 Segment 3: 410,000 TOTAL: 1,231,000	High
RY-SBS01	Streambank Stabilization Project at 72nd Street East	155	35,000	Medium
RY-SBS02	Streambank Stabilization at 80th Street East	160	66,000	Medium
RY-DP01	Rody Creek Regional Detention Facility Expansion	123	1,313,000	Medium
RY-SWL01	62nd Avenue East Drainage Swale, Rody Creek Basin	32	17,000	Low
RY-CR01	Rody Creek at Pipeline Road & 96th Street East Culvert Replacement	65	19,000	Low
RY-CR02	Rody Creek 98th Street East Culvert Replacement	89	31,000	Low
RY-RD01	Rody Creek 90th Street East Raise Roadway	84	75,000	Low
Total Estimated Cost for Rody Creek CIPs			\$2,787,000	

Project Number: CIP03-RY-RST01

Project Name: Rody Creek Stream Corridor Restoration

Cost Estimate: \$1,231,000

Project Score: 303 **High-Priority**

Problem: This 2,200-foot reach of Rody Creek between Pioneer Way East and the Clarks Creek confluence is severely degraded with a straightened channel, disconnected floodplain, and reduced riparian buffer with invasive riparian and aquatic vegetation. The channel has also filled with fine sediment due to upstream erosion. This reach is classified as riffle habitat with no pools and only a few pieces of large woody-debris. The USBEM Phase II habitat condition assessment rated this reach as having "Poor" habitat condition.

Solution: Restore 2,200-foot reach between Pioneer Way East and Clarks Creek confluence, removing invasive vegetation and enhancing the riparian community with conifer plantings to provide shade. Install large woody-debris in channel to form pool aquatic habitat. Purchase 300-foot-wide conservation easement from adjacent landowners.

Restoration of the full 2,200 foot reach will be broken down by segments divided as follows:

- Segment 1:** Reach 700 feet downstream of Pioneer Way East \$410,000
- Segment 2:** 700 feet reach downstream of Pioneer Way East to 700 feet upstream of Clarks creek confluence \$410,000
- Segment 3:** Reach 700 feet upstream of Clarks creek confluence \$410,000

Benefit: This project provides high quality aquatic habitat in lower Rody Creek. The project solves riparian/aquatic habitat problem RY-16.

Project Number: CIP03-RY-SBS01
Project Name: Streambank Stabilization at 72nd Street East
Cost Estimate: \$35,000
Project Score: 155 Medium-Priority

Problem: High stream flow in Rody Creek has caused channel downcutting downstream of 72nd Street East. The culvert outlet at this location is perched three-feet above the channel.

Solution: Install streambank stabilization measures such as roughened rock toes, porous weirs and drop structures. These types of structures direct the energy of the flowing water away from the streambanks and towards the center of the stream. Boulder clusters should be installed at the 72nd Street East culvert outlet for energy dissipation. Purchase 40-foot-wide easement from adjacent landowners.

Benefit: This project stabilizes streambanks and reduces erosion in Rody Creek. The project will help to reduce a source of fine sediment to Clarks Creek. This project will solve erosion and riparian/aquatic habitat problems RY-14.

Project Number: CIP03-RY-SBS02
Project Name: Streambank Stabilization at 80th Street East
Cost Estimate: \$66,000
Project Score: 160 Medium-Priority

Problem: Streambank stabilization measures of Rody Creek at 6100 block of 80th Street East appear to be weakening and may cause property damage if they fail.

Solution: Install streambank stabilization measures such as porous weirs or drop structures in 200-foot reach downstream of 80th Street East. Purchase 40-foot-wide easement from adjacent landowners.

Benefit: This project stabilizes streambanks and reduces erosion in Rody Creek. This project will help to reduce a source of fine sediment to Clarks Creek. The project also provides a public safety benefit by restabilizing the streambank and protecting the adjacent structure. The project will solve erosion and riparian/aquatic habitat problem RY-3.

Project Number: CIP03-RY-DP01

Project Name: Rody Creek Regional Detention Facility Expansion

Cost Estimate: \$1,313,000

Project Score: 123 **Medium-Priority**

Problem: The streambank stabilization projects described above will require peak flow reduction if they are to maintain viability over the long-term. Peak flow reduction is also needed to reduce or eliminate streambank erosion in the streams in the future. Floodplain storage lost with culvert improvement projects CIP03-RY-CR01 and -02 needs to be replaced.

Solution: Expand existing Rody Creek regional detention facility by 10 acre-feet. Optimize pond operation to fully utilize detention storage volume. Additional hydrologic analysis and a geotechnical investigation prior to project design is needed to accurately define detention volume and the target release rate. The type of streambank stabilization measures should also be considered when establishing the target release rate.

Benefit: This project will reduce peak stream flow rates in the Rody Creek Subbasin, which reduces erosion and helps to maintain the long-term viability of the channel stabilization projects. With proper design of the outlet structure, it may be possible to provide a mitigate some of the impacts of the altered hydrology of the system. The project solves erosion and riparian/aquatic habitat problems RY-1 and RY-3 and also provides detention storage for increases in peak flow due to projects CIP03-RY-CR01 and CIP03-RY-CR02.

Project Number: CIP03-RY-SWL01

Project Name: 62nd Avenue East Drainage Swale

Cost Estimate: \$17,000

Project Score: 32 **Low-Priority**

Problem: Private property flooding at 11600 block of 62nd Avenue East due to roadway runoff from 62nd Avenue East.

Solution: Install 4-inch driveway berm at 11600 block of 62nd Avenue East. Obtain drainage easement through property and excavate drainage swale from 62nd Avenue East to Rody Creek.

Benefit: This project will eliminate private property flooding at the 11600 block of 62nd Street East. The project will solve flooding problem RY-5.

Project Number: CIP03-RY-CR01

Project Name: Pipeline Road and 96th Street East Culvert Replacement

Cost Estimate: \$19,000

Project Score: 65 **Low-Priority**

Problem: Hydraulic analysis predicted road and property flooding of Rody Creek at Pipeline Road and 96th Street East during the 25-year and 10-year peak flood events under existing and future land use conditions, respectively. This problem was validated during field reconnaissance in February 2003.

Solution: Replace existing 18-inch diameter culvert at 96th Street East with a 30-inch diameter culvert. The existing Rody Creek detention facility located downstream has excess capacity and would be used to mitigate the expected increase in peak flows caused by this project.

Benefit: This project will eliminate flooding at 96th Street East. This project will solve flooding problem RY-7.

Project Number: CIP03-RY-CR02

Project Name: 98th Street East Culvert Replacement

Cost Estimate: \$31,000

Project Score: 89 **Low-Priority**

Problem: The hydraulic analysis predicted road and property flooding of Rody Creek at 98th Street East during the 100-year peak flood events under existing and future land use conditions. A resident of the area reported that this culvert clogs with debris on an annual basis, flooding private property and septic drain fields.

Solution: This project replaces the existing 24-inch diameter culvert with a 30-inch diameter culvert. An emergency overflow pipe should be installed on the upstream end of the culvert to allow overflow should the inlet become obstructed. The existing Rody Creek detention facility located downstream has excess capacity and would be used to mitigate the expected increase in peak flows caused by this project.

Benefit: This project will eliminate flooding at 98th Street East. The project will solve flooding problem RY-8.

Diru Creek Subbasin Projects

Three projects were developed for the Diru Creek Subbasin. The projects will solve one flooding, two erosion, and three habitat problems. *Figure 9-2* shows the location of the projects described below.

Table 9.12 DIRU CREEK Recommended CIPs				
<i>ID</i>	<i>Project Name</i>	<i>Project Score</i>	<i>Estimated Cost</i>	<i>Priority</i>
DU-SBS01	Diru Creek Streambank Stabilization at 72nd St East	164	35,000	Medium
DU-RST01	Diru Creek Stream Restoration Downstream of Pioneer Way East	226	Segment 1: 410,000 Segment 2: 410,000 Segment 3: 410,000 1,231,000	Medium
DU-DP01	Diru Creek Regional Detention	105	2,977,000	Low
Total Estimated Cost for DIRU Creek CIPs			\$4,243,000	

Project Number: CIP03-DU-SBS01

Project Name: Streambank stabilization at 72nd Street East

Cost Estimate: \$35,000

Project Score: 164 **Medium-Priority**

Problem: High stream flow in Diru Creek has caused channel downcutting downstream of 72nd Street East. Channel incision is about 8 feet deep. The culvert outlet at this location is perched above the channel.

Solution: Install streambank stabilization measures such as roughened rock toes, porous weirs and drop structures. These types of structures direct the energy of the flowing water away from the streambanks and towards the center of the stream. Boulder clusters should be installed at the 72nd Street East culvert outlet for energy dissipation. Purchase 40-foot-wide easement from adjacent landowners.

Benefit: This project stabilizes streambanks and reduces erosion in Diru Creek. This project will help to reduce a source of fine sediment to Clarks Creek. The project will solve erosion problem DU-11.

Project Number: CIP03-DU-RST01
Project Name: Diru Creek Stream Corridor Restoration Downstream of Pioneer Way East
Cost Estimate: \$1,231,000
Project Score: 226 **Medium-Priority**

Problem: The 2,200-foot reach of Diru Creek between Pioneer Way East and the Clarks Creek confluence is severely degraded with a straightened channel, disconnected floodplain, and reduced riparian buffer with invasive riparian and aquatic vegetation. The channel has also filled with fine sediment due to upstream erosion. This reach was not included in the field investigation. However, poor habitat conditions, similar to conditions observed in Clear, Canyon and Rody Creek were noted during field reconnaissance. Private property flooding has been reported due to an undersized driveway culvert upstream of Clarks Creek.

Solution: Restore a 2,200-foot reach between Pioneer Way East and Clarks Creek confluence, removing invasive vegetation and enhancing the riparian community with conifer plantings to provide shade. Install large woody-debris in the channel to form pool aquatic habitat. Purchase a 300-foot-wide conservation easement from adjacent landowners where practical. The existing driveway culvert would be removed when the stream is relocated which would eliminate property flooding.

Restoration of the full 2,200 foot reach will be broken down by segments divided as follows:

- Segment 1:** Reach 700 feet downstream of Pioneer Way East \$410,000
- Segment 2:** 700 feet reach downstream of Pioneer Way East to 700 feet upstream of Clarks creek confluence \$410,000
- Segment 3:** Reach 700 feet upstream of Clarks creek confluence \$410,000

Benefit: This project provides high quality floodplain habitat in lower Diru Creek. This project solves riparian/aquatic habitat problem DU-10, DU-13, and flooding problem DU-14.

Project Number: CIP03-DU-DP01
Project Name: Diru Creek Regional Detention
Cost Estimate: \$2,977,000
Project Score: 105 **Medium-Priority**

Problem: High stream flow rates have caused extensive channel erosion in vicinity of 80th Street East, 72nd Street East and the second Canyon Road Crossing. Eroded sediments wash down in the floodplain channel and accumulate on the channel bottom. The streambank stabilization projects CIP03-DU-SBS01 will require peak flow reduction if they are to maintain viability over the long-term. Peak flow reduction is also needed to reduce or eliminate streambank erosion in the streams in the future.

Solution: Construct 20 acre-feet of detention storage (at one or more locations) in the Diru Creek Subbasin upstream of 72nd Street East. Additional hydrologic analysis and a geotechnical investigation prior to project design is needed to accurately define detention volume and the target release rate. The type of streambank stabilization measures should also be considered when establishing the target release rate.

Benefit: This project will reduce peak stream flow rates in the Diru Creek Subbasin, which reduces erosion and helps to maintain the long-term viability of the channel stabilization projects. With proper design of the outlet structure, it may be possible to provide a mitigate some of the impacts of the altered hydrology of the system. The project solves erosion problem DU-11

Woodland Creek Subbasin Projects

Six projects were developed for the Woodland Creek Subbasin. These projects will solve three flooding, two erosion, and five habitat problems. *Figure 9-2* shows the location of the projects described below.

Table 9.13 WOODLAND CREEK Recommended CIPs				
<i>ID</i>	<i>Project Name</i>	<i>Project Score</i>	<i>Estimated Cost</i>	<i>Priority</i>
WO-RST01	Woodland Creek Stream Corridor Restoration	265	Segment 1: 490,000 Segment 2: 490,000 Segment 3: 490,000 TOTAL: 1,470,000	High
WO-SBS01	Woodland Creek Streambank Stabilization at 84th Street East	150	305,000	Medium
WO-SBS02	Woodland Creek Stream Bank Stabilization at 80th Street E	142	357,000	Medium
WO-DP01	Woodland Avenue Flood Control Phase II	155	2,960,000	Medium
WO-CR02	Woodland Creek 80th Street East Culvert Replacement	88	27,000	Low
WO-CR01	Woodland Creek & 72nd Avenue East Culvert Replacement Project - 93rd Street East to 96th Street East	105	102,000	Low
Total Estimated Cost for Woodland Creek CIPs			\$5,221,000	

Project Number: CIP03-WO-RST01

Project Name: Woodland Creek Stream Corridor Restoration

Cost Estimate: \$1,470,000

Project Score: 265 **High-Priority**

Problem: The 1,800 reach of Woodland Creek between Pioneer Way East and the confluence with Clarks Creek has been channelized and disconnected from the floodplain. This reach has a reduced buffer and invasive riparian and aquatic vegetation have replaced the native species. The 1000-foot-long culvert under the WSU Experimental Farm is a velocity barrier to fish passage. This reach was not included in the field investigation. However, poor habitat conditions, similar to conditions observed in Clear, Canyon and Rody Creek were noted during field reconnaissance.

Solution: Widen the floodplain and restoring stream meanders, removing invasive vegetation and enhancing the riparian community with conifer plantings to provide shade. Install large woody-debris to form pool aquatic habitat. Purchase 300-foot-wide conservation easement from adjacent landowners where practical. Replace culvert with two 20-foot long, single-span bridge.

Restoration of the full 1,800 foot reach will be broken down by segments divided as follows:

Segment 1: Pioneer Way East to Pipeline Inlet	\$490,000
Segment 2: South 550 feet of pipeline	\$490,000
Segment 3: North 550 feet of pipeline	\$490,000

Benefit: This project provides high quality floodplain habitat in lower Canyon Creek. Replacing WSU culvert will improve access to an additional 4,000 feet of fish habitat in Woodland Creek. The project solves riparian/aquatic habitat problems WO-23 and WO-29.

Project Number: CIP03-WO-SBS01

Project Name: Streambank/Channel Stabilization at 84th Street East

Cost Estimate: \$305,000

Project Score: 150 **Medium-Priority**

Problem: High stream flows have caused channel down cutting with 5-foot-deep channel incision in reach downstream of 84th Street East. Local scour at outlet of culvert under 84th Street East with 12-foot-high cascade immediately downstream. Sedimentation in channel and floodplain upstream of 80th Street East caused by upstream erosion activity.

Solution: Install streambank stabilization measures such as drop structures and bank reshaping in 750 foot-long reach downstream of 84th Street. Plant woody material and herbaceous cover in floodplain upstream of 80th Street East to stabilize deposited material.

Benefit: This project stabilizes streambanks and reduces erosion in Woodland Creek. This project will help to reduce a source of fine sediment to Clarks Creek. This project solves erosion problems WO-24, and WO-25, and riparian/aquatic habitat problem WO-26.

Project Number: CIP03-WO-SBS02

Project Name: Streambank Stabilization at 80th Street E

Cost Estimate: \$357,000

Project Score: 142 **Medium-Priority**

Problem: Streambank erosion and channel down cutting downstream of 80th Street East due to high stream flow. Three-foot deep channel incision. Reduced riparian buffer.

Solution: Install streambank stabilization measures such as porous weirs or drop structures in 800-foot reach downstream of 80th Street East. Remove reed blackberry and other invasive aquatic vegetation and plant conifers to provide shade. Purchase 200-foot-wide easement from adjacent landowners.

Benefit: This project stabilizes streambanks and reduces erosion in Woodland Creek. This project will help to reduce a source of fine sediment to lower Woodland and Clarks Creek. This project solves problems erosion and riparian/aquatic habitat problem WO-27.

Project Number: CIP03-WO-DP01

Project Name: Woodland Avenue Flood Control Phase II CIP

Cost Estimate: \$2,960,000

Project Score: 155 **Medium-Priority**

Problem: Long term and extensive inundation south of 102nd Street East caused by limited conveyance capacity of storm drain system under 102nd Street East. This area has a limited surface outlet with outflow controlled by the storm drain system under 102nd Street East. The hydraulic and hydrologic analysis predicted roadway flooding would occur at 105th Street E, 106th Street E, 112th Street E, 104th Street E, and Woodland Avenue East. There were also numerous reports of property flooding in this area during the 1997 flood event.

Solution: The County is currently designing two regional detention ponds for this area. These ponds would have a combined volume of almost 40 acre-feet and would reduce the 100-year flood elevation by 1.7 feet.

Benefit: This project will reduce private property flooding and eliminate roadway flooding in the Woodland Avenue and 112th Street East area. This project solves flooding problem WO-2.

Project Number: CIP03-WO-CR02

Project Name: 80th Street East Culvert Replacement

Cost Estimate: \$27,000

Project Score: 88 **Low-Priority**

Problem: The hydraulic analysis predicted road flooding at a 2-year peak flood event under existing land use conditions and the 1-year peak flood event under future land use conditions.

Solution: Replace the existing culvert with 4-foot-span by 4-foot-rise concrete box culvert. This project is not expected to increase flows downstream because the Woodland Creek channel is relatively steep and narrow in this reach with very little floodplain storage. This culvert was also identified as a fish passage barrier during the field habitat investigation.

Benefit: This project eliminates roadway flooding at 80th Street East. Replacing this structure will improve access to an additional 300 feet of fish habitat in Woodland Creek. The project solves flooding and riparian/aquatic habitat problem WO-8.

Project Number: CIP03-WO-CR01

Project Name: 72nd Avenue East Culvert Replacement - 93rd Street East to 96th Street E

Cost Estimate: \$102,000

Project Score: 105 **Low-Priority**

Problem: The hydraulic analysis showed that Woodland Creek overtops 93rd Street Court E, 94th Street Court East and two driveway culverts at a 1-year peak flood event under existing and future land use conditions.

Solution: Replace two existing 20-inch diameter concrete culverts under driveways at 9500 block of 72nd Avenue East with 3-foot-span by 1.5-foot-rise concrete box culverts. Replace two 24-inch diameter CPEP culverts under 93rd Street East and 94th Street East with 3-foot-span by 1.5-foot-rise concrete box culverts. Maintain existing invert elevations. Total length of replacement culverts is 300 lineal feet. Recommend surveying of design area and reanalyzing before project implementation. This project is not expected to increase flows downstream because the Woodland Creek channel is relatively steep and narrow in this reach with very little floodplain storage.

Benefit: This project eliminates roadway flooding in the 9500 block of 72nd Street East. The project solves flooding problem WO-6.

Clarks Creek Subbasin Projects

Six projects were developed for the Clarks Creek Subbasin. These projects will solve three flooding, and four habitat problems. *Figure 9-2* shows the location of the Clarks Creek CIP projects.

Table 9.14 CLARKS CREEK Recommended CIPs				
<i>ID</i>	<i>Project Name</i>	<i>Project Score</i>	<i>Estimated Cost</i>	<i>Priority</i>
CK-RST01	Clarks Creek Stream Corridor Restoration	231	Segment 1: 470,000 Segment 2: 470,000 Segment 3: 470,000 Segment 4: 470,000 Segment 5: 470,000 Segment 6: 470,000 Segment 7: 470,000 TOTAL: 3,287,000	High
CK-SP01	Clarks Creek State Hatchery Sedimentation Basin Retrofit	174	73,000	Medium
CK-PL01	112th Street East Pipeline (Woodland Elementary School)	133	180,000	Medium
CK-AC01	Clarks Creek Property Acquisition at 104th Street East	168	188,000	Medium
CK-PL02	Fruitland Avenue Pipeline - 104th Street E to 96th Street E	164	399,000	Medium
Total Estimated Cost for Clarks Creek CIPs			\$4,127,000	

Project Number: CIP03-CK-RST01

Project Name: Clarks Creek Stream Corridor Restoration

Cost Estimate: \$3,287,000

Project Score: 231 **High-Priority**

Problem: The 2.4-mile reach of Clarks Creek between the Puyallup River confluence and Puyallup City Limits has filled with fine sediment due to upstream erosion activity. This reach also has a reduced buffer and invasive riparian and aquatic vegetation has replaced the native species. All of this reach is glide habitat with no pools and very few pieces of large woody-debris. Sedimentation and the excessive growth of elodea and other nuisance aquatic plants have caused Clarks Creek to overflow its banks resulting in property flooding in the vicinity of Tacoma Road, Stewart Avenue, and 66th Avenue East. The USBEM Phase II habitat condition assessment rated the portion of this reach upstream of Stewart Road as having "Poor" habitat condition.

Solution: Enhance the floodplain in the 2.4-mile reach between Pioneer Way East and the confluence with Clear Creek. Based on current development patterns, it is likely that enhancement is practical in only about 2/3 of the reach, or 8,000 feet. Remove the invasive vegetation and plant the riparian community would be planted with conifers to provide shade. Purchase 150-foot-wide conservation easement from adjacent landowners where practical. The scope of this project may be significantly reduced if the restoration projects for Rody, Diru, and Woodland Creeks.

Restoration of the 2.4 mile reach will be broken down by segments divided as follows:

Segment 1: Puyallup City Limits to Woodland Creek confluence	\$470,000
Segment 2: Woodland Creek confluence to 400-feet downstream of Diru Creek confluence	\$470,000
Segment 3: 400-feet downstream of Diru Creek confluence to Stewart Avenue East	\$470,000
Segment 4: Stewart Avenue East to second crossing of 66 th Avenue East	\$470,000
Segment 5: Second crossing of 66 th Avenue East to 56 th Street East	\$470,000
Segment 6: 56 th Street East to 52 nd Street East (extended)	\$470,000
Segment 7: 52 nd Street East (extended) to Puyallup River	\$470,000

Benefit: This project improves floodplain habitat Clarks Creek. The project solves problems riparian/aquatic habitat CK-1, CK-13 CK-14 CK-16.

Project Number: CIP03-CK-SP01

Project Name: State Hatchery Sedimentation Basin Retrofit

Cost Estimate: \$73,000

Project Score: 174 **Medium-Priority**

Problem: Erosion from peak storm surges upstream of the WDFW hatchery. Upstream erosion has filled the Clarks Creek channel with fine sediments. These sediments have covered the native gravels used for fish spawning, contributed to water quality problems, and caused flooding problems due to restricted conveyance capacity.

Solution: Retrofit existing basin above State fish hatchery to serve as a sedimentation basin. Excavate sediment from existing facility and install a control structure. Implementation of this project will require coordination with the City of Puyallup and Washington State Department of Fish and Wildlife. A reduced sediment load is expected to allow flow in Clarks Creek channel to flush out the existing fine sediments over time.

Benefit: This project eliminates a source of sediment in Clarks Creek. A reduced sediment load is expected to allow flow in Clarks Creek channel to flush out the existing fine sediments over time. This project solves riparian/aquatic habitat problem CK-14.

Project Number: CIP03-CK-PL01

Project Name: 112th Street Drainage Improvement (Woodland Elementary School)

Cost Estimate: \$180,000

Project Score: 133 **Medium-Priority**

Problem: Hydraulic analysis predicted road and property flooding due to undersized storm drain system under Woodland Elementary School during the 10-year peak flood event under existing land use conditions increasing to the 2-year peak flood event under future land use conditions.

Solution: Replace existing storm drain system with 850-foot-long, 48-inch-diameter storm drain system from 112th Street East crossing to discharge outfall to detention pond behind school.

Benefit: This project eliminates private property and roadway flooding at 112th Street East. The project solves flooding problem CK-9.

Project Number: CIP03-CK-AC01

Project Name: Property Acquisition - 9200 Block of 104th Street E

Cost Estimate: \$188,000

Project Score: 168 **Medium-Priority**

Problem: Property and structure flooding occur at this location because the structure is located in the floodplain. The structure is nearly at the level of the creek.

Solution: Acquire flood-prone property.

Benefit: This project eliminates a flood hazard at this location by acquiring property and removing the flood-prone structure. This project may also benefit floodplain habitat if the acquired property is restored to its natural function. This project solves flooding problem CK-2.

Project Number: CIP03-CK-PL02

Project Name: Fruitland Avenue Pipeline - 104th Street East to 96th Street E

Cost Estimate: \$399,000

Project Score: 164 **Medium-Priority**

Problem: The existing ditch and culvert system on Fruitland Avenue East near 104th Street East is undersized and a chronic maintenance problem. Plugged culverts and ditch overtopping have been reported at Fruitland Avenue, 104th Street E, 109th Street E, 146th Street E, and 142nd Avenue East.

Solution: Replace the existing ditch and culvert system with a 2,800-foot-long 12- to 24-inch-diameter storm drain system along the west side of Fruitland Avenue East from 104th Street East to 96th Street East. Connect the new system to the existing ditch and culvert system on the south side of 96th Street East, which discharges to Clarks Creek.

Benefit: This project eliminates nuisance roadway flooding on Fruitland Avenue East. The project solves flooding problem CK-10.

Potholes Subbasin Projects

Seven projects were developed for the Potholes Subbasin. These projects will solve six flooding problems. *Figure 9-3* shows the location of the projects described below.

Table 9.15 POTHOLES Recommended CIPs				
<i>ID</i>	<i>Project Name</i>	<i>Project Score</i>	<i>Estimated Cost</i>	<i>Priority</i>
PH-1P01	128 th Street East Infiltration Pond	346	469,000	High
PH-PL04	144th and 94th Avenue E Pipeline 135 th Street Pothole	252	1,282,000	High
PH-PL05	Springfield Pothole Pipeline Project	124	379,000	Medium
PH-PL03	136th Street Pipeline, 135 th Street Pothole	190	509,000	Medium
PH-PL06	South Hill Pump Station Discharge Pipeline	181	2,466,000	Medium
PH-PL01	92nd Ave East Storm Drainage Pipeline	115	34,000	Low
PH-PL02	156th Street East Regional Pipeline	120	288,000	Low
Total Estimated Cost for Potholes CIPs			\$5,427,000	

Project Number: CIP03-PH-IP01

Project Name: 128th Street East Infiltration Facility

Cost Estimate: \$469,000

Project Score: 346 **High-Priority**

Problem: Frequent roadway and private property flooding occurs at the 10300 block of 128th Street East due to undersized and clogged dry wells.

Solution: Construct a 1.2 acre-foot infiltration facility near 128th Street East, east of Meridian Avenue. Construct 1,000 feet of 24-inch-diameter storm drain along 128th Street East to convey stormwater from Meridian Avenue and residential areas to infiltration facility.

Benefit: This project solves flooding in the 10300 block of 128th Street East. The problem solves flooding problem PH-1.

Project Number: CIP03-PH-PL04

Project Name: 144th Street East and 94th Avenue East Regional Drainage Improvement (D174-003)

Cost Estimate: \$1,282,000

Project Score: 252 **High-Priority**

Problem: Drainage problems exist in three depressions along 144th St East between Meridian and 86th Ave. Drainage courses are not well defined and are easily overwhelmed by increased runoff due to the change from semi-rural character to medium residential and high-density commercial and public uses.

Solution: Acquire property at 9600 block of 144th Street East and excavate 12-acre-foot detention pond (D174-006 Alternative 3). Install 1500 lineal-feet of 24-inch-diameter and 580-lineal-feet of 36-inch-diameter CPEP storm sewer pipe from the 9600 block of 144th Street East to the Collingswood channel. Excavate Collingswood channel to Afdem Pit to provide additional conveyance capacity (D174-006 Alternative 1). Project CIP03-PH-PL02 is proposed to connect to this pipeline.

Benefit: Eliminates frequent roadway and private property flooding on 144th Street East. This project with CIP03-PH-PL04 solves flooding problems PH-14, PH15 and PH-18.

Project Number: CIP03-PH-PL05

Project Name: Springfield Pothole Pipeline

Cost Estimate: \$379,000

Project Score: 124 **Low Priority**

Problem: Springfield Pothole overflows during large storm events and floods surrounding properties and adjacent low-lying residential areas.

Solution: Construct a 36-inch-diameter pipeline from the Springfield Pothole to the South Hill Pump Station. Install an additional 150 hp pump at the South Hill Pump Station. Acquire 6.4 acres surrounding Springfield pothole. Replace existing 24-inch-diameter culvert at 152nd Street East with a 36-inch-diameter pipe.

Benefit: This project solves extensive flooding in the Springfield Pothole Subbasin. The project will solve flooding problem PH-23.

Project Number: CIP03-PH-PL03

Project Name: 136th Street Pipeline

Cost Estimate: \$509,000

Project Score: 190 Medium-Priority

Problem: The Willow Tree subdivision on 98th Avenue Court East and 152nd Street East (west of Meridian Avenue) was constructed in a low-lying area adjacent to a natural wetland. The subdivision has a private infiltration facility, which overflows during periods of high groundwater. As a result, roads and property experience chronic flooding during heavy rains.

Solution: Construct 1600-lineal-feet of 24-inch diameter CPEP storm sewer due north from the 9600 block of 144th Street East to the 9th Street Pit located at 131Street East and 86th Avenue East. Acquire property at 9600 block of 144th Street East.

Benefit: This project eliminates roadway and property flooding in the Willow Tree subdivision and restores floodplain storage. The project with CIP03-PH-PL03 solves flooding problem PH-18.

Project Number: CIP03-PH-PL06

Project Name: South Hill Pump Station Discharge Pipeline

Cost Estimate: \$2,466,000

Project Score: 181 Medium-Priority

Problem: The South Hill Pump Station leases a 42-inch pipeline owned by Tacoma Public Utilities (TPU) to transport floodwaters to the Puyallup River. The TPU pipeline exists to drain the McMillan Reservoir when maintenance is required. Pierce County Water Programs pays \$30,000 annually for the right to use the TPU pipeline and energy dissipater on a temporary basis. A dedicated discharge pipeline is needed to protect the long-term viability of the South Hill Pump Station and related improvements and the investment of public funds associated with the improvements.

Solution: Construct a 42-inch force main from the existing force main that connects to the McMillan Reservoir outlet pipeline to the Puyallup River.

Benefit: This project provides a dedicated, permanent discharge line for the South Hill Pump Station.

Project Number: CIP03-PH-PL01
Project Name: 92nd Avenue East Storm Drain Improvement
Cost Estimate: \$34,000
Project Score: 115 **Low-Priority**

Problem: The hydraulic analysis predicted road and property flooding on 11500 block of 92nd Avenue East on a 5-year recurrence interval under existing land use conditions and a 2-yr recurrence interval under future land use conditions. The drainage system from 92nd Avenue East discharges into a 24-inch diameter pipeline located between two properties on 92nd Avenue East. The storm drain is undersized and causes surcharging in the catch basin inlet located in the front yard of one of the properties. The catch basin inlet is also located lower than the street.

Solution: Abandon the existing inlet and install a new inlet at the edge of the roadway. Construct a berm on the edge of the roadway to direct roadway runoff to the new inlet and away from private property.

Benefit: This project eliminates private property and roadway flooding in the 11500 block of 92nd Avenue East. This project solves problem PH-6.

Project Number: CIP03-PH-PL02
Project Name: 156th Street East Regional Drainage Improvements
Cost Estimate: \$288,000
Project Score: 120 **Low-Priority**

Problem: The hydraulic analysis showed that roadway and property flooding occurs at 156th Street East and on properties located in the 9700 block of 156th Street East and the 15700 block of 97th Avenue Court East. The existing storm drain system discharges north to a closed depression and is unable to freely discharge from the site.

Solution: Connect the 156th Street storm drain system to the proposed 144th Street East pipeline installed as part of the 144th Street East and 94th Avenue East Regional Drainage Improvement Project (CIP03-PH-PL03, D174-003) (KCM, 2002). Install 1500-foot-long, 24-inch diameter pipeline from outlet at 156th Street East to 152nd Street East. Outfall new pipeline to existing ditch on 152nd Street East and 96th Avenue East (private) and connect to proposed 144th Street East and 94th Avenue East regional drainage improvement project (D174-003). Purchase 20-foot-wide drainage easement along 96th Avenue East from adjacent landowners.

Benefit: This project eliminates private property and roadway flooding in the vicinity of 156th Street East and 97th Avenue Court East. This project solves flooding problem PH-15.

9.3.3 Programmatic Measures

Twelve (12) programmatic measures address drainage, water quality and habitat issues in the Clear/Clarks Creek Basin.

Table 9.16 Recommended Programmatic Measures by Priority			
<i>ID</i>	<i>Project Name</i>	<i>Project Score</i>	<i>Estimated Cost</i>
High-Priority			
PRG00-02	Update Stormwater Management Standards (Manual)	380	6,200
PRG00-01	Low Impact Development Program	346	27,600
PRG00-11	Enhanced Cooperative Arrangements with Cities & Other Jurisdictions	315	38,000
PRG00-08	Establish a BMP Manual for Surface Water Maintenance Activities	427	43,600
PRG00-09	Invasive Species Management Program	420	43,600
PRG00-04	Land Acquisition Program for Flood Hazard Reduction & Storm Drainage Practices Impact Mitigation	389	56,100
PRG00-06	Create an Education, Outreach, & Technical Assistance Program	325	212,000
PRG00-05	Riparian & Wetland Restoration Program to Restore Flood Storage and Maintain Water Quality	325	692,100
PRG00-07	Surface Water Monitoring Program Basin Monitoring	244	985,000 422,000
PRG00-03	Increase Enforcement Inspections	398	1,272,000
Subtotal for High-Priority Measures			2,678,200
Medium-Priority			
PRG00-12	Stormwater Facility Design Process	195	21,200
Subtotal for Medium-Priority Measures			21,200
Low-Priority			
PRG00-10	Flood Disclosure Statements on Property Titles	128	22,400
Subtotal for Low-Priority Measures			22,400
Total Estimated Cost of Recommended Programmatic Measures			\$2,721,800

Each programmatic measure is described below.

Project Number: PRG00-02
Project Name: Adopt Updated Stormwater Management Standards
Cost Estimate: \$6,200
Cost Assumptions: Includes 0.25 FTE as a one-time, one-year cost. Prorated for the Clear/Clarks Creek Basin share of the countywide cost (21.2 %)
Project Score: 380 **High-Priority**

The Washington State Department of Ecology provided local jurisdictions, including Pierce County, with updated guidance on stormwater management standards with issuance of the 2001 Stormwater Management Manual for Western Washington. Adoption of either Ecology's manual or an equivalent manual is required for all municipalities currently covered under the National Pollutant Discharge Elimination System (NPDES) Municipal Stormwater Permit. The County should also consider adopting the optional flow duration standard for systems that drain to canyon reaches. This standard matches the existing flow duration and helps to prevent erosion in the steep, erosion-prone reaches.

Project Number: PRG00-01
Project Name: Establish a Low Impact Development Program
Cost Estimate: \$130,000 County-Wide, Clear/Clarks Creek Basin share would be \$27,600
Cost Assumptions: Includes 1.0 FTE and \$30,000 per year in professional services
Project Score: 346 **High-Priority**

Establish a program that would work with development industry, agencies, environmental groups, and communities in the County to actively promote the use of LID in new development and redevelopment. Program activities might include developing standards for use of LID principles in public road construction and reconstruction where it makes sense, initiating and coordinating pilot projects, providing training and technical assistance in the application of LID techniques and principles, investigating regulatory and other barriers to LID and identifying solutions, and educating citizens about LID and its benefits.

- Project Number:** PRG-00-11
- Project Name:** Enhanced Cooperative Arrangements with Cities and Other Jurisdictions”
- Cost Estimate:** \$150,000 County-Wide, Clear/Clarks Creek Basin share would be \$38,000
- Cost Assumptions:** 1.0 FTE per year countywide over a 10-year period life-cycle cost; prorated for the Clear/Clarks Creek Basin share of the countywide cost (21.1%) plus additional at SWAB direction to increase commitment to Clear/Clarks Creek to 0.5 FTE
- Project Score:** 315 **Priority:** High

Problem: Pierce County has an established countywide surface water management program that emphasizes drainage basins. Basin planning is an effective way to identify and evaluate problems, analyze and select solutions, monitor their effectiveness, and inform and educate citizens. However, there are limitations that hinder the program’s effectiveness and ability to reduce flood impacts and improve and preserve water quality and aquatic habitat. The principal limitation is that Water Programs is the surface water management utility for the unincorporated areas of Pierce County only. Most of its programs and services begin and end at the incorporated limits of cities, whereas flooding, water quality, and aquatic habitat problems do not recognize political boundaries. Although the primary statutory drivers for stormwater management are the same for incorporated and unincorporated Pierce County (i.e., federal Clean Water Act, in particular Sections 402, 404, 303d, and 319); federal Endangered Species Act; and federal National Flood Insurance Program, each jurisdiction develops and manages its own approach. The Puyallup River and Carbon River levee system is an exception. It protects citizens from both incorporated and unincorporated areas from flood hazards. However, the levee system is managed and maintained by Water Programs with funds from unincorporated County citizens.

In 2005-2006, cities in the Basin will come under the state’s municipal stormwater National Pollution Discharge Elimination System (NPDES) permit requirements. The permit requirements have applied to unincorporated Pierce County and the City of Tacoma since 1995. Water Program’s experience in complying with NPDES permit provisions, its current and planned programs, could help cities to meet the new standards.

Solution: The Pierce County Storm Drainage and Surface Water Management Advisory Board (SWM Advisory Board) recommended that Water Programs initiate more cooperative arrangements for surface water management services with cities and other jurisdictions within the Clear/Clarks Creek Basin and countywide. Arrangements can be formal (such as interlocal agreements) or informal as long as they maintain the objectives of reducing flooding, protecting water quality, and protecting aquatic habitat.

Benefits: This approach will foster cooperation between the County and cities to address watershed management issues. It will increase deliberative and informed discussions of the costs and benefits of various choices being considered and will provide opportunities for collaboration. An increase in cooperative efforts will enhance the results of recommended projects and programs in this Basin Plan and lead to more efficient surface water management countywide.

Project Number: PRG00-04

Project Name: Develop and Implement a Land Management Program for Flood Hazard Reduction, Water Quality and Habitat Impact Mitigation

Cost Estimate: \$56,100

Cost Assumptions: Includes 0.5 FTE for one year to develop the inventory and establish the policies and procedures for acquisition and management; also, a 0.25 FTE per year for nine years to pursue acquisitions and oversee property management. Prorated Clear/Clarks Basin share of the countywide cost (21.2 %)

Project Score: 389 **High-Priority**

Develop a system for acquiring and managing properties for multiple benefits. The program should have the following elements:

- **Standards for Property Management:** Develop standard procedures for determining which properties or types to acquire and how they can be managed for multi-use.
- **Inventory Development:** Develop, reconcile, and maintain an electronic inventory of existing holdings and desired properties.
- **Consultation with other Stakeholders:** Develop standards for coordination with other departments, agencies, or groups of citizens that have a stake in property acquisitions sites or the program.
- **Management:** Develop a program to manage properties. The program would address issues such as access, preventing vandalism and illegal dumping, restoration, maintenance, and liability. Pierce County may consider working with private or non-governmental agencies on mapping certain parcels where appropriate.
- **Acquisition through various methods:** Pursue acquisition through fee-simple and alternatives (e.g., conservation and flood easements, rights of entry, purchase of development rights, and other legal instruments) in order to preserve high quality and flood-prone properties and to restore degraded acquisition systems.

Project Number: PRG00-05

Project Name: Develop and Implement a Program to Enhance Degraded Riparian Habitat and Water Quality and Attenuate Flood Hazard

Cost Estimate: \$692,100

Cost Assumptions: Includes 1 FTE to establish and run the program (costs estimated for a 10-year period); prorated for the Clear/Clarks Creek Basin share of the countywide cost (21.2 %)

Project Score: 325 **High-Priority**

Build internal capacity to implement restoration and enhancement projects in riparian and wetland areas to improve ecosystem functions, where property owners have given permission and on properties owned by Pierce County Water Programs. Soft bank engineering techniques, such as those contained in the WDFW’s Integrated Streambank Protection Guidelines should be developed and enhanced. The primary function of the program would be to manage the restoration sites contained in the Basin Plan. Duties would include identifying potential projects, obtaining access, developing restoration plans, identifying resources to help in the restoration including recruiting volunteers where appropriate or hiring contractors, ordering supplies, and publicizing planting events or completed projects. The County could form partnerships with volunteer groups and other organizations such as the Conservation District, Port of Tacoma, and the Puyallup Tribes to work cooperatively on enhancement projects. This program would be applicable to all creeks in the Clear/Clarks Creek Basin.

Project Number: PRG00-08

Project Name: Develop and Implement a BMP Manual for Surface Water Maintenance Activities

Cost Estimate: \$43,600

Cost Assumptions: Includes a one-time cost for 0.5 FTE plus \$75,000 for a consultant contract to develop a BMP manual and an additional 0.1 FTE annually to support on-going training sessions and updates; life-cycle cost over 10 years, prorated for the Clear/Clarks Creek Basin share of the countywide cost (21.2 %).

Project Score: 427 **High-Priority**

Develop a maintenance manual containing BMPs for Pierce County's surface water management facilities. The manual would address pond, river, and levee maintenance activities. The maintenance manual would be patterned after the Tri-County transportation facilities approach and the Pierce County Stormwater Management and Site Development Manual. The manual would include practices and techniques that protect water quality and habitat while preserving the flood control functions of the facilities. The manual would provide standard operating procedures for work crews. It would also be designed to achieve compliance with Pierce County's NPDES permit. Distribution of the manual would be accompanied by training sessions on its purpose and use.

Project Number: PRG00-09

Project Name: Develop and Implement an Invasive Species Management Program

Cost Estimate: \$43,600

Cost Assumptions: Includes one-time cost for 0.5 FTE and \$7,500 for a consultant to develop the Best Management Practices (BMP) document, complete the inventory and data layer, and 0.1 FTE annually for on-going volunteer organization and implementation; life-cycle cost over 10 years then prorated for the Clear/Clarks Creek Basin share of the countywide cost (21.2 %).

Project Score: 420

High-Priority

Develop a program for addressing invasive species impacts to surface water and County surface water management facilities. Pursue an Integrated Pest Management approach, and use a variety of methods, including hand pulling, mechanical harvesting, and herbicides, as appropriate. A general inventory of invasive plant problems in Pierce County would be conducted and entered into Pierce County's GIS database. A BMP manual would be developed to offer guidance in identifying problematic species, information on their preferred conditions, and options for controlling each problem species. Water Programs would confer with other agencies, including the Noxious Weed Control Board, Ecology, WDFW, and the Washington State University Cooperative Extension programs in developing the guidance document. Upon completion of the guidance document, invasive species training would be provided to drainage system maintenance personnel and invasive species issues would be included in public outreach and education programs. Water Programs would survey their facilities and properties to identify the presence of invasive species and the extent to which they are impacting the facility. This information will be incorporated into division work plans. Implementation of this recommendation could also include organizing and orchestrating volunteer groups and working with other groups and agencies to conduct invasive species control such as hand or mechanical harvesting, native species plantings, and other techniques. This program would be applicable to all creeks and storm drainage facilities in the Clear/Clarks Creek Basin.

Project Number:	PRG00-06
Project Name:	Develop and Implement an Education, Outreach, and Technical Assistance Program
Cost Estimate:	\$212,000
Cost Assumptions:	Includes 0.25 FTE per year countywide over a 10-year life-cycle cost; prorated for the Clear/Clark Creek Basin share of the countywide cost (21.2%)
Project Score:	325 High-Priority

Develop a comprehensive education, outreach, and technical assistance program for floodplain preservation that includes the following elements:

- **Public Awareness:** Activities under this element include public notification of department activities, availability of data such as updated floodplain and groundwater information and mapping, and Basin Plan-related information as it is developed.
- **Topics:** Topics may address specific pollutants such as pathogens, metals, nutrients; or issues such as flooding, lawn and garden chemicals, native plant landscaping, maintaining instream flow, or small farm management. Generally, increasing public awareness of “Best Management Practices” (BMPs) that they can implement to reduce water quality, flooding, and habitat impacts in their basin will be the focus of each educational effort. Emergency information related to flooding needs to be well coordinated and easily accessible.
- **Target Audiences:** Audiences would include Basin residents but may also target specific stakeholders such as floodplain residents, business owners, real estate professionals, or homebuyers. Coordination with other education providers such as schools and non-governmental organizations would be addressed.
- **Methods:** Means to distribute information may include a variety of techniques such as posting information on the internet, use of libraries and public bulletin boards, speakers, news releases, newsletters, utility bill inserts, targeted mailings, fair booth displays, billboards, Pierce County Speaks segments, and other options. Methods used should be based on the information to be distributed and the target audience.
- **Technical/Financial Assistance:** In addition to basin awareness, Pierce County’s education program could include an assistance program to directly aid residents in taking desired actions. This may include supporting volunteer monitoring programs, offering technical and financial assistance to floodplain residents, offering incentives for establishing buffers, and coordinating with other agencies that provide technical support such as the Conservation District. Additional incentives might come in the form of free native plants, discounts at local stores, free workshops, tax breaks, or other methods.
- **Coordination:** In order to efficiently communicate Water Programs messages, the education, outreach and other technical assistance program will include a coordination element with other agencies, groups, or jurisdictions. Coordination efforts will include other education providers but also technical staff.

Project Number:	PRG00-07
Project Name:	Develop and Implement a Surface Water Monitoring Program
Cost Estimate:	\$985,000 (Clear/Clarks Creek Basin is 21.2 % of cost of Countywide program) + basin specific of \$422,000 = \$1,407,000
Cost Assumptions:	County-wide estimate assumes total of 3.75 FTEs countywide plus a \$91,000 life-cycle cost over 10 years.
	Actual monitoring assumes purchase and setup of gauges. A more detailed cost estimate is included in Appendix J.
Project Score:	244 High-Priority

Develop and implement a monitoring program that would include the following aspects for the Clear/Clarks Creek Basin:

- **Water Quantity:** Monitor base and flood flow volumes on each of the Clear/Clarks Creek Basin tributaries and Roosevelt Ditch. No flow data currently exists that can be used to determine rates of erosion or the rate at which peak flows are increasing or decreasing. Before flow curves can be established and rates of erosion on Clear/Clarks Creek Basin streams can be quantified, stream flows must be monitored for a period of at least 10 years. Groundwater depths and pothole flooding should be measured in areas where septic systems may interact with groundwater and in pothole areas where infiltration is poor and flooding is frequent.
- **Water Quality:** Compliance with State water quality standards in areas of the County's stormwater facilities and trends elsewhere.
- **Biological Health:** Currently, Pierce County participates in macroinvertebrate sampling which follows the protocols established for the Benthic-Index of Biological Integrity (B-IBI). Continue this sampling program unless a more effective protocol or methodology is identified to assess the biological health of water bodies.
- **Aquatic Habitat:** Assess aquatic habitat by arranging to have selected streams surveyed at least once every five years. Use the Tri-County Urban Issues assessment methodology to maintain consistency with surveys performed to characterize the original basin plans. Compare the results of the surveys to identify trends and to analyze the effectiveness of regulations, education programs, public acquisition efforts, restoration projects, and incentives for protecting riparian habitat.
- **Waterbodies:** Include methodologies for evaluating conditions in streams, wetlands, and surfacing groundwater in the sampling/monitoring program.
- **Dissemination/Mapping:** Evaluate and share with information collected under this monitoring program with other agencies. Where feasible, data can be recorded in GIS systems and mapped, enabling the posting of updated information on the internet.
- **Adaptive Management:** As the monitoring program generates data, information would be shared and used to assess the effectiveness of policies, programs, and procedures. Every

three to five years, Pierce County Water Programs would perform an in-depth analysis of available data and publish a report on the overall health of the Basin and on the effectiveness of applicable programs.

- **Training:** Competent personnel are needed to generate reliable data. Water Programs would train existing staff, hire or consult with experts, work with other agency personnel with capable staff, or develop a pool of volunteers that can competently collect data.
- **Basin Specific:**

ST0301 Flow and Water Quality Monitoring.

Measure flow volumes on all of the creeks and Roosevelt Ditch to establish flow curves. Sample water quality in all of the subbasins to ensure reliable water quality data is available when the Ecology establishes the State of Washington 303(d) List.

Estimated Cost: \$422,000

Stream flow monitoring gauges maintained by Pierce County and the USGS should be maintained in order to build a long-term record of the hydrology of the Clear/Clarks Creek Basin. Flow curves are needed to document peak flow volumes and duration as a baseline for measuring change. Continuing monitoring is needed to gauge how well this Basin Plan has addressed water quantity concerns over the next ten years.

Table 9.17 sets out the recommended locations for flow monitoring gauges and water quality sampling.

Table 9.17 Recommended Flow and Water Quality Monitoring	
<p>Roosevelt Ditch <i>No water quality or flow data exists</i></p>	<p>Sample for standard water quality parameters, plus temperature, total suspended solids (TSS) and turbidity during storm events Gauge flow Recommended sampling & gauge location: near the point of entry into the City of Tacoma in road right-of-way</p>
<p>Swan Creek <i>On current 303(d) list for fecal coliform. Deep incising in canyon section Provides water to City of Tacoma & Port of Tacoma wetland mitigation banks</i></p>	<p>Microbial source tracking for fecal coliform bacteria Sample for standard water quality parameters, plus temperature; sample for turbidity and TSS during storm events. Gauge flow. Recommended sampling & gauge location: below the sedimentation pond before the City of Tacoma diversion weir. Additional gauge location before the stream enters the canyon reach.</p>
<p>Squally Creek <i>No water quality or flow data</i></p>	<p>Sample for standard water quality parameters & temperature Recommended sampling & gauge location: upstream of Pioneer Way E</p>
<p>Clear Creek <i>On current 303(d) list for fecal coliform. Provides water to Trout Lodge Hatchery & Port of Tacoma off-channel rearing & wetland mitigation bank</i></p>	<p>Microbial source tracking for fecal coliform bacteria Sample for standard water quality parameters, plus temperature. Recommended sampling & gauge locations: Gauge at representative upstream location with an additional gauge in the valley prior to intersection with Canyon Creek. Sample near valley gauge for standard water quality parameters & temperature.</p>
<p>Canyon Creek <i>Major tributary to Clear Creek Contributes water to Port of Tacoma off channel rearing & wetland mitigation bank</i></p>	<p>Sample for standard water quality parameters, plus temperature. Sample for turbidity and TSS during storm events. Recommended sampling & gauge location: Lower reach prior to merging with Clear Creek</p>
<p>Rody Creek <i>Contributes flow to Clarks Creek</i></p>	<p>Sample for standard water quality parameters, plus temperature Recommended sampling & gauge location: Lower reach prior to merging with Clarks Creek</p>
<p>Diru Creek <i>Provides water to the Puyallup Tribe's Fish Hatchery & Clarks Creek</i></p>	<p>Sediment – sampling for turbidity and TSS during storm events Sample for standard water quality parameters, plus temperature Recommended sampling & gauge location: Not identified</p>

<p>Woodland Creek <i>Deep incising in canyon sections</i></p>	<p>Sample for turbidity and TSS during certain storm events Sample for standard water quality parameters, plus temperature Recommended sampling & gauge location:</p>
<p>Clarks Creek <i>On current 303(d) list for fecal coliform and pH.</i> <i>Provides water to new Puyallup Tribe Fish Hatchery</i> <i>Provides water to the WDFW Fish Hatchery</i></p>	<p>Sample for standard water quality parameters, plus temperature Recommended sampling & gauge location:</p>
<p>Hemlock Pond</p>	<p>Sample for standard water quality parameters, plus temperature</p>
<p>Afdem Pond</p>	<p>Sample for standard water quality parameters</p>

Project Number: PRG00-03

Project Name: Increase Enforcement Inspection for Compliance with Stormwater Requirements and NPDES Permit

Cost Estimate: \$1,272,000

Cost Assumptions: Includes 6.0 FTEs per year countywide. Life-cycle cost prorated for the Clear/Clarks Creek Basin share of the countywide cost (21.2 %)

Project Score: 398 High-Priority

Increase inspection of public and private stormwater facilities to ensure compliance with current regulations (including NPDES requirements). Both existing and new stormwater facilities would be inspected to confirm that regular maintenance is occurring and that maintenance standards and agreements are being met. When a violation is identified, inspectors would offer education and technical assistance, but enforcement actions would be taken when necessary.

Project Number: PRG00-12

Project Name: Develop a stormwater facility design process that integrates public involvement and alternatives for multiple uses of facility sites

Cost Estimate: \$21,200

Cost Assumptions: Includes 1.0 FTEs for one year countywide. The Clear/Clarks Creek Basin share of the countywide cost is 21.2% of the total estimate.

Project Score: 195 **Medium-Priority**

Initiate, coordinate with other County agencies and develop a stormwater facility design and project scope approach that can be included in Water Programs CIP project management manual. Include objectives of design process transparency and public involvement, facilities that complement the vision expressed in community plans, public safety, water quality, economic development and aquatic habitat enhancement.

Project Number: PRG00-10

Project Name: Require Flood Disclosure Statements on Property Titles

Cost Estimate: \$53,000

Cost Assumptions: Includes 0.25 FTE per year countywide over a 10-year life-cycle cost; prorated for the Clear/Clarks Creek Basin share of the countywide cost (21.2 %)

Project Score: 128 **Low-Priority**

Require that a disclosure statement of flood hazard designation be placed on the titles of buildings located in Special Flood Hazard Areas (SFHAs). Some measure of protection for buyers is provided through RCW 64.06.020 (1994), a state law that requires sellers of real property to disclose to buyers if a property is within a designated floodplain or designated flood hazard zone. Disclosure is based on the seller’s actual knowledge of the flood hazard when the disclosure form is completed. Response options for floodplain disclosure are “yes,” “no,” and “don’t know,” with no further explanation or documentation required. Because the basis for this disclosure is the seller’s knowledge of flood hazard rather than a determination based on scientific and historical evidence, this disclosure has limited effectiveness in informing potential buyers about flood hazard risk.

9.3.4 Recommendations for Monitoring and Additional Studies

Study Number	Name	Estimated Cost
ST03-01	West Fork Clear Creek Floodplain Analysis	\$33,000
ST03-02	Sediment Sources Identification	\$35,000
ST03-03	Roosevelt Ditch Channelization Study	\$78,000
ST03-04	Swan Creek Upland Riparian Restoration	\$78,000
Total Estimated Cost		\$224,000

ST03-01—Analyze the Floodplain for West Fork Clear Creek from 88th Street East to 84th Street East.

Estimated Cost: \$33,000

Extensive road and property flooding has been reported in this area. Several structures appear to be located in the floodplain. However, accurate elevations of structure low-water entry and culvert elevation information are not available. A detailed hydrologic and hydraulic analysis is needed to quantify the extent of the flooding problem. The floodplain should be mapped and the Base-Flood elevation established so that flood hazard regulations apply and floodplain storage is protected.

ST03-02 Identify Sediment Sources in the Basin

Estimated Cost: \$35,000

The stream survey performed to support the habitat analysis did not cover every reach in the system. Therefore, it is unlikely that all eroding sections of stream channels and associated sediment sources in the basin were identified during the development of this plan. For this reason, a comprehensive survey of the creeks upstream of the areas investigated in the Basin Plan should be performed with the purpose of identifying locations of eroding streambanks and other sources of fine sediment. The study should provide an estimate of the amount of sediment and develop appropriate control measures.

ST03-03 Roosevelt Ditch Channelization Study

Estimated Cost: \$78,000

The history of Roosevelt Ditch is sketchy, but signs exist that the ditch conveys water that formerly had a natural channel. Development decisions in the drainage reinforce the use of the ditch as urban infrastructure. Filling of wetlands and enclosing the channel during property

development continue to affect the quantity, the peaks, and the duration of stormwater conveyed by the ditch.

The scope of work for the Clear/Clarks Creek Basin Plan did not include a survey of aquatic habitat conditions for Roosevelt Ditch. Citizens have asked for additional analysis of conditions in and along the ditch followed by collaborative problem solving with key stakeholders. The product would be a set of recommendations (an action plan) for managing the ditch. Concerned citizens have asked that the County work with other agencies, groups, businesses, and citizens to research and record the historical facts, help them (1) to articulate a vision for the drainage and (2) the steps to achieve the vision. Pierce County Water Programs would sponsor, lead, and participate in collaborative development of a conceptual plan for Roosevelt Ditch

ST03-04 Swan Creek Upland Riparian Restoration Program

Estimated Cost: \$78,000

The scope of work for the Clear/Clarks Creek Basin Plan did not include a survey of aquatic habitat conditions upstream of the culvert barrier to fish passage at 72nd St E. Citizens have asked for additional analysis of conditions in and along the creek followed by collaborative problem solving with property owners, the drainage district, the Puyallup Tribe, and other key stakeholders. The product would be a set of recommendations (an action plan) for restoration of aquatic habitat and floodplain in the upland portion of the creek.

Sponsor, lead, and participate in the collaborative development of an action plan for restoring aquatic habitat and floodplain in the upland portion of the Swan Creek drainage area, south of 72nd Street East.

Some upstream reaches of Swan Creek have been channelized and diked. Floodplain wetlands have been filled and replaced with detention ponds and urban development. Riparian cover has been removed. Areas that historically drained to the creek may have been routed to adjacent drainages.

9.4 Implementation

9.4.1 Capital Facilities Element of Pierce County Comprehensive Plan

The annually updated Capital Facilities Element of the *Comprehensive Plan for Pierce County, Washington* (Pierce County Code 19E) is the capital improvement program for Pierce County Water Programs. It lays out the capital projects over \$100,000 that Water Programs intends to construct in a six-year period. It also presents the non-capital (non-structural) alternatives that can be used with capital projects to help meet the level of service standard for storm drainage and surface water management facilities. Water Programs has two entries in the Capital Facilities Plan: 19E.50.130, River Improvement Facilities; and 19E.50.170, Surface Water Management. The Capital Facilities Plan sets the stage for Water Programs annual budget.

9.4.2 Annual Budget for Pierce County Water Programs

The Pierce County budget each year authorizes the activities of Water Programs. Programmatic measures, studies, and capital improvement projects appear in the detailed annual budget. Capital improvement projects in the annual budget generally come from the Capital Facilities Element of the County's Comprehensive Plan described in [Section 9.4.1](#) or in response to an unexpected problem.

9.4.3 Order of Implementation

Implementation of the recommended actions will generally follow the prioritization groupings of High-Priority, Medium-Priority, and Low-Priority in a logical order of sequencing. To realize the full benefits of projects, implementation will not follow the exact progression of the first project to the last project in the High category, followed by the first action in the Medium category, and so forth. Several factors exist that will result in implementation of actions that are not in the exact order of the recommended actions depicted in [Table 9.2, High-Priority Recommended Projects](#); [Table 9.3, Medium-Priority Recommended Projects](#); and [Table 9.4, Low-Priority Recommended Projects](#). Influencing factors include the following:

- Availability of funds;
- The completion of other projects or activities on which a project relies;
- Available staff and professional services;
- Cooperation from private landowners;
- Identification of a implementing agency other than Pierce County Public Works and Utilities; and
- New information, regulations, or emerging issues.

9.4.4 Economic Development Criteria

Implementing projects and programs recommended in the Basin Plan is expected to reduce flood hazards, and preserve or protect water quality and floodplain habitat. Collectively and individually, these projects are aimed at protecting Pierce County's quality of life. Projects and programs in the Basin Plan will:

- Afford resource protection as the community develops
- Preserve, enhance or protect natural floodplain functions
- Balance structural and nonstructural approaches
- Reduce potential County environmental liabilities
- Help achieve environmental compliance and long term sustainability

Collectively, these attributes help make Pierce County a livable community where quality of life issues will provide indirect, passive economic development benefits to businesses and individuals looking to locate or stay in Pierce County.

In addition, Water Programs will consider the following criteria in developing its annual proposed capital facilities plan updates:

- Is the project located in an employment center zone (or handle flow from those zones)?
- Is the project located in another type of commercial zone (or handle flow from those zones)?
- Will the project reduce permitting timelines for industrial/commercial projects?
- Will the project assure access to an employment center via road and /or rail?
- Will the project increase the supply of developable property?
- Will the project reduce overall development costs?
- Are there partners willing to contribute to the development costs of the project?
- Does the project allow / provide for land development?

In light of these and other factors, following action on the Basin Plan, Pierce County will develop an implementation strategy designed to sequence, schedule and assign resources for the various recommended actions. This implementation strategy will be developed in collaboration and coordination with other potential implementers and in consideration with available financial and staff resources. The implementation strategy will include performance measurements and provide for periodic evaluation of progress.

9.4.5 Voluntary Actions by Other Interested Parties

Broad, multi-stakeholder groups such as the Puyallup River Watershed Council can be instrumental in implementation of the Basin Plan. Representatives of environmental interest groups, tribes, business, economic development, and individual citizens provide valuable suggestions about specific activities. Their support of specific activities and the ongoing progress of Basin Plan implementation will be an essential component of successful implementation. For example, these groups can be instrumental in carrying out effective public education.

Businesses in the Basin can be involved in implementation of the Basin Plan recommendations. The private sector will need to comply with regulations to protect the water resources and habitat of the Clear/Clarks Creek Basin. Additionally, businesses can be partners in developing creek

and natural resource protection strategies, and may also offer funding assistance for individual and/or ongoing watershed activities.

Farmers and other large landowners with extensive property along the creeks can play a critical role in addressing the temperature and sedimentation problems. The establishment and revegetation of riparian buffers is the single most important measure for improving water quality within the Basin.

9.5 Problems and CIP Solutions Cross-Reference

Table 9.9. Problems and CIP Solutions Cross-Reference		
RECOMMENDED ACTION		PROBLEMS ADDRESSED
HIGH-PRIORITY		
PH-IP01	128 th Street East Infiltration Pond	PH-1 (Flooding, also Water Quality - instream flows)
CL-RST01	Clear Creek Stream Corridor Restoration	CL-1 (Flooding), CL-16 (Water Quality)
RY-RST01	Rody Creek Stream Corridor Restoration	RY-16 (Habitat), RY-19 (Water Quality)
PH-PL04	144th and 94th Avenue Pipeline	PH-14 (Flooding), PH-15 (Flooding), PH-18 (Flooding)
SW-AC01	Swan Creek at 112th Street Floodplain Storage/Headwaters Preservation	SW-5 (Flooding), SW-10(Flooding), SW-27 (Water Quality-Instream Flow), SW-30 (Flooding)
WO-RST01	Woodland Creek Stream Corridor Restoration	WO-23 (Water Quality, Habitat), WO-29 (Habitat), WO-30 (Habitat), WO-31 (Water Quality)
CY-RST01	Canyon Creek Stream Corridor Restoration	CY-25 (Water Quality, Habitat), CY-26 (Habitat)
CK-RST01	Clarks Creek Stream Corridor Restoration	CK-1 (Flooding), CK-12 (Water Quality), CK-13 (Water Quality, Habitat), CK-14 (Water Quality, Habitat), CK-16 (Flooding), CK-21 (Water Quality)
RD-DP01	Portland Avenue Regional Detention Facility, Roosevelt Ditch Area	RD-7 (Flooding)
CL-AC01	Clear Creek Floodplain Repetitive Loss Land Acquisition	CL-1 (Flooding)
SW-DP01	Swan Creek Regional Detention Facility	SW-3 (Habitat), SW-4 (Flooding), SW-6 (Flooding), SW-21 (Water Quality, Habitat), SW-22 (Water Quality, Habitat), SW-23 (Water Quality, Habitat), SW-30 (Flooding), SW-35 (Water Quality, Habitat), SW-36 (Water Quality), SW-37 (Water Quality)

MEDIUM-PRIORITY		
SW-SBS03	Swan Creek 64th Street East Culvert Outfall Repair	SW-21 (Water Quality, Habitat), SW-23 (Water Quality, Habitat),
RD-SWL01	20th Avenue E Drainage Swale, Roosevelt D	RY-5 (Flooding), RY-6 (Flooding)
CL-SBS03	Clear Creek Streambank Stabilization in vicinity of 49th Street	CL-17 (Habitat, Water Quality), CL-21 (Habitat, Landslide)
CL-SBS04	Clear Creek Streambank Stabilization on West Fork Clear Creek Downstream of 64th Street E	CL-17 (Habitat, Water Quality), CL-22 (Habitat, Water Quality)
DU-SBS01	Diru Creek Streambank Stabilization at 72nd St East	DU-11 (Landslide, Habitat, Water Quality)
RY-SBS01	Rody Creek Streambank Stabilization at 72nd Street East	RY-14 (Habitat, Water Quality)
CL-CR01	Clear Creek 88th Street E Culvert Replacement	CL-5 (Flooding)
CL-VC01	Clear Creek at 104th Street E Vegetation Control	CL-4 (Flooding, Water Quality)
RY-SBS02	Rody Creek Streambank Stabilization at 80th Street East	RY-3 (Water Quality, Habitat)
CK-SP01	Clarks Creek State Hatchery Sedimentation Basin Retrofit	CK-14 (Habitat, Water Quality), CK-15 (Habitat, Water Quality)
CL-SBS05	Clear Creek Streambank Stabilization 5000 block of Vickery Avenue East	CL-33 (Habitat, Water Quality)
SW-SBS01	Swan Creek Streambank/Channel Stabilization at 72nd Street E Outfall	SW-3 (Habitat, Water Quality), SW-21 (Habitat, Water Quality), SW-35 (Habitat)
SQ-VC01	Squally Creek at Pioneer Way E Vegetation Control	SQ-4 (Habitat, Water Quality), SQ-6 (Flooding, Habitat, Water Quality)
CL-SBS02	Clear Creek Streambank Stabilization on East Fork Downstream of 72nd Street E	CL-17 (Habitat, Water Quality), CL-20 (Habitat, Water Quality)
CY-SBS03	Canyon Creek Streambank Stabilization on Reach Upstream of Second Canyon Road Crossing	CY-20 (Habitat, Water Quality), CY-23 (Habitat, Water Quality)
CY-SBS01	Canyon Creek Streambank Stabilization on Reach Downstream of 80th Street East	CY-18 (Habitat, Water Quality), CY-23 (Habitat, Water Quality)
CY-SBS02	Canyon Creek Streambank Stabilization on Reach Downstream of 72nd Street East	CY-22 (Habitat, Water Quality), CY-23 (Habitat, Water Quality)
CK-PL01	112th Street East Drainage Improvement (Woodland Elementary School)	CK-9 (Flooding)
CL-SBS01	Clear Creek Streambank Stabilization on West Fork Downstream of 72nd Street E	CL-17 (Habitat, Water Quality), CL-10 (Habitat, Water Quality)
CK-AC01	Clarks Creek Property Acquisition at 104th Street East	CK-2 (Flooding)
SW-SBS02	Swan Creek Streambank/Channel Stabilization from 72nd Street E to 64th St E	SW-4 (Habitat, Water Quality), SW-21 (Habitat, Water Quality)
WO-SBS01	Woodland Creek Streambank/Channel Stabilization at 84th Street East	WO-24 (Habitat, Water Quality), WO-25 (Habitat, Water Quality), WO-26 (Habitat, Water Quality)
CY-SBS04	Canyon Creek Streambank Stabilization Downstream of Second Canyon Road Crossing	CY-21 (Habitat, Water Quality), CY-23 (Habitat, Water Quality)

MEDIUM-PRIORITY		
WO-SBS02	Woodland Creek Streambank Stabilization at 80th Street E	WO-26 (Habitat, Water Quality), WO-27 (Habitat, Water Quality),
PH-PL05	Springfield Pothole Pipeline	PH-7 (Flooding)
CK-PL02	Fruitland Avenue Drainage Improvement - 104th Street E to 96th Street E, Clarks Creek	CK-10 (Flooding)
PH-PL03	136 th Street Pipeline, 135 th Street Pothole	PH-3 & PH-4 (Flooding)
CY-SL01	Canyon Creek 58th Avenue East Setback Levee	CY-1 (Flooding), CY-5 (Flooding), CY-6 (Flooding)
SW-SBS04	Swan Creek Streambank Stabilization Downstream of 64th Street East	SW-21 (Habitat, Water Quality), SW-24 (Habitat, Water Quality), SW-35 (Habitat, Water Quality)
DU-RST01	Diru Creek Stream Corridor Restoration Downstream of Pioneer Way East	DU-9 (Water Quality), DU-10 (Water Quality, Habitat)
RY-DP01	Rody Creek Regional Detention Facility Expansion	RY-14 (Water Quality, Habitat)
CY-DP02	Canyon Creek 90th Street East Detention (D138-003)	CY-1 (Flooding), CY-6 (Flooding), CY-18 (Habitat, Water Quality)
PH-PL06	South Hill Pump Station Pipeline to Puyallup River	PH-23 (Flooding)
WO-DP01	Woodland Avenue Flood Control Phase II	WO-1 (Flooding), WO-2 (Flooding), WO-5 (Flooding), WO-24 (Habitat, Water Quality), WO-25 (Habitat, Water Quality), WO-26 (Habitat, Water Quality)
CL-DP01	West Fork Clear Creek Regional Detention	CL-5 (Flooding), CL-17 (Habitat, Water Quality, Flooding), CL-19 (Habitat, Water Quality), CL-21 (Habitat, Water Quality), CL-22 (Habitat, Water Quality)
CY-DP01	Canyon Creek Regional Detention	CY-1 (Flooding), CY-6 (Flooding), CY-18 (Habitat, Water Quality)
CL-DP02	East Fork Clear Creek Regional Detention	CL-17 (Habitat, Water Quality, Flooding), CL-20 (Habitat, Water Quality), CL-21 (Habitat, Water Quality), CL-22 (Habitat, Water Quality)

LOW-PRIORITY		
RY-SWL01	62nd Avenue East Drainage Swale, Rody Creek	RY-5 (Flooding), RY-6 (Flooding)
RY-CR01	Rody Creek at Pipeline Road & 96th Street East Culvert Replacement	RY-7 (Flooding)
WO-CR02	Woodland Creek at 80th Street East Culvert Replacement	WO-8 (Flooding, Habitat)
RY-CR02	Rody Creek at 98th Street East Culvert Replacement	RY-8 (Flooding)
PH-PL01	92nd Ave East Storm Drainage Pipeline, Black Swamp Pothole	PH-6 (Flooding)
SW-PL01	84th Street East Pipeline Storm Drain Replacement, Swan Creek	SW-16 (Flooding)
RY-RD01	90th Street East at Rody Creek Raise Roadway	RY-17 (Flooding)
CY-FP01	Canyon Creek Driveway Culvert Replacement at Pioneer Way East	CY-28 (Habitat)
WO-CR01	Woodland Creek & 72nd Avenue East Culvert Replacement - 93rd Street East to 96th Street East	WO-6 (Flooding)
SW-CR01	Swan Creek 80th Street E Culvert Replacement	SW-1 (Flooding, Habitat)
CY-RD02	104th Street East Road Raising & Culvert Replacement - East Fork of Canyon Creek	CY-10 (Flooding)
CY-RD01	116th Street East Road Raising - West Fork of Canyon Creek	CY-3 (Flooding)
CY-AC01	Canyon Creek Property Acquisition at 5600 block of 104th Street E	CY-30 (Flooding)
PH-PL02	156th Street East Regional Pipeline	PH-15 (Flooding)
DU-DP01	Diru Creek Regional Detention	DU-9 (Habitat, Water Quality)

Also, see Appendix J for a cross-reference table that lists all identified problems followed by the recommended solutions, both capital improvement projects and programmatic measures.

