# *2009 Stormwater Needs Assessment*

## Rock Creek
## Salmon Creek (r.m. 22.20)

Clark County Clean Water Program
*Protecting water through stormwater management*

CLARK COUNTY, WASHINGTON

# 2009 Stormwater Needs Assessment Program

## Rock Creek/Salmon Creek (RM 22.20)
## Subwatershed Needs Assessment Report

Clark County Public Works Clean Water Program

March 2010

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## Acknowledgements

## Acronyms and Abbreviations

| | |
|---|---|
| B-IBI | Benthic Macroinvertebrate Index of Biological Integrity |
| BOCC | Board of County Commissioners |
| BMP | Best Management Practices |
| CCD | Clark Conservation District |
| CIP | Capital Improvement Program |
| CPU | Clark Public Utilities |
| CRFPO | Columbia River Fisheries Program Office |
| CWA | Clean Water Act |
| CWC | Clean Water Commission |
| CWP | Clean Water Program |
| DNR | Department of Natural Resources |
| EDT | Ecosystem Diagnostic and Treatment model |
| EIA | Effective Impervious Area |
| EIM | Environmental Information Management |
| EMAP | Environmental Mapping and Assessment |
| EPA | Environmental Protection Agency |
| ESA | Endangered Species Act |
| FPIA | Focused Public Investment Area |
| FWS | Fall, Winter, Spring |
| GCEC | Gee Creek Watershed Enhancement Committee |
| GIS | Geographic Information System |
| GMA | Growth Management Act |
| GPS | Geographic Positioning System |
| HPA | Hydraulic Project Approval |
| IDDE | Illicit Discharge Detection and Elimination |
| LCFEG | Lower Columbia Fish Enhancement Group |
| LCFRB | Lower Columbia Fish Recovery Board |
| LID | Low-Impact Development |
| LiDAR | Light Detection and Ranging |
| LISP | Long-term Index Site Project |
| LWD | Large Woody Debris |
| MS4 | Municipal Separate Storm Sewer System |
| MOP | Mitigation Opportunities Project |
| NOAA | National Oceanic and Atmospheric Administration |
| NPDES | National Pollution Discharge Elimination System |
| NTU | Nephelometric Turbidity Unit |
| NWIFC | Northwest Indian Fisheries Commission |
| ODEQ | Oregon Department of Environmental Quality |

| | |
|---|---|
| OWQI | Oregon Water Quality Index |
| PFC | Properly Functioning Condition |
| RM | River Mile |
| SCIP | Stormwater Capital Improvement Program |
| SCIPIT | Stormwater Capital Improvement Program Involvement Team |
| SCMP | Salmon Creek Monitoring Project |
| SCWC | Salmon Creek Watershed Council |
| SNAP | Stormwater Needs Assessment Program |
| SWMP | Stormwater Management Program |
| SWMMWW | Stormwater Management Manual for Western Washington |
| TIA | Total Impervious Area |
| TIP | Transportation Improvement Program |
| TIR | Technical Information Report |
| TMDL | Total Maximum Daily Load |
| TP | Total Phosphorus |
| UGA | Urban Growth Area |
| UIC | Underground Injection Control |
| USFS | U.S. Forest Service |
| USEPA | U.S. Environmental Protection Agency |
| USFWS | U.S. Fish and Wildlife Service |
| VBLM | Vacant Buildable Lands Model |
| VLWP | Vancouver Lake Watershed Partnership |
| WAC | Washington Administrative Code |
| WCC | Washington Conservation Commission |
| WDFW | Washington Department of Fish and Wildlife |
| WRIA | Water Resource Inventory Area |
| WSDOT | Washington Department of Transportation |
| WSU | Washington State University |

## Executive Summary

### Study Area

This Stormwater Needs Assessment report includes the Rock Creek and Salmon Creek (RM 22.20) subwatersheds in the upper Salmon Creek watershed.

### Intent

Stormwater Needs Assessment reports compile and provide summary information relevant to stormwater management, propose stormwater-related projects and activities to improve stream health, and assist with adaptive management of the county's Stormwater Management Program. Assessments are conducted at a subwatershed scale, providing a greater level of detail related to stormwater management than regional Water Resource Inventory Area (WRIA) or Endangered Species Act (ESA) plans. Stormwater Needs Assessments are not comprehensive watershed plans or stormwater basin plans.

### Findings

#### Watershed Conditions
The table on the following page summarizes conditions in the two study area subwatersheds including water quality, biological health, habitat, hydrology, and the stormwater system.

#### Ongoing Projects and Involvement
The Salmon Creek Watershed Council, Clark Public Utilities, and Ecology are actively involved in improving and protecting Salmon Creek and its tributaries through local grass-roots organizing, riparian enhancement work, and ongoing TMDL adaptive management.

Clark County Clean Water Program (CWP) participates in the TMDL process through implementation of the Stormwater Management Program, provides water quality monitoring, and supports various local organizations working within this assessment area.

As of December 2009, there is one potential stormwater project listed in the CWP Capital Planning database. This project, NE 229th Street Stormwater Control Facility, includes construction of a new facility to manage stormwater and an opportunity for wetland enhancement/reforestation.

There are no major road projects in this assessment area under the Public Works 2010-2015 Transportation Improvement Program.

| Category | Status |
|---|---|
| **Water Quality** Overall Fecal coliform bacteria Temperature pH Turbidity | • Good to excellent in Salmon Creek (RM 22.20), data shows decreasing over time • TMDL implementation ongoing for both subwatersheds; concentrations have declined from 1995 levels; SMN080 meets TMDL targets • In TMDL development for both subwatersheds • TMDL required for Salmon Creek (RM 22.20) • TMDL implementation ongoing for both subwatersheds; SMN080 meets TMDL targets; no data in Rock Creek |
| **Biological** Benthic macroinvertebrates Anadromous fish | • Moderate for Rock Creek and Salmon Creek (RM 22.20); it is likely that biological integrity could be increased by improving habitat and stream conditions • Coho and winter steelhead use; presumed fall Chinook in limited reaches. |
| **Habitat** NOAA Fisheries criteria Riparian Wetland | • Forest cover Properly Functioning in Salmon Creek (RM 22.22); slightly below functioning in Rock Creek • Road density for both subwatersheds fall into the Non-Functioning category • Stream crossing density and estimated effective impervious area for both subwatersheds fall into the Properly Functioning category • Forest cover is between 60 and 68 percent and is found in stream valleys and some upland areas • Large woody debris recruitment potential is poor to fair in Salmon Creek (RM 22.20); poor in Rock Creek • Potential wetlands in riparian corridors and floodplains; a few depressional headwater wetlands; scattered isolated wetlands • Ecology Characterization Management Level is Protection |
| **Hydrology and Geomorphology** Overall hydrology Future condition | • Hydrologic data indicates a relatively un-urbanized basin; TQmean (flashiness metric) is significantly lower than what might be expected for a forested basin • Projected impervious area should remain at levels that do not alter hydrology if forest cover is retained or expanded |
| **Stormwater (unincorporated areas)** System description Inventory status System adequacy System condition Retrofit opportunity Maintenance evaluation Offsite assessment | • Primarily field drains and road-side ditches; no public stormwater facilities • Complete; 2600 stormwater infrastructure features mapped • Adequate treatment is probably provided by vegetation in ditches • Minimum flow control other than infiltration in ditches • Largely undocumented but presumed functional; no outfall screening performed • Limited to ditches • No public stormwater facilities • Five priority outfalls assesses; all in compliance |

## Opportunities

Projects listed in the SNAP report represent only a small part of those needed to protect and restore streams within the assessment area. Field work and review of existing information identified numerous projects and actions that can improve stream conditions, including the following:

- Maintain frequency of offsite assessment activities; conduct offsite assessment activities focusing on Priority 2 Outfalls

- Potential large-scale stormwater control projects within Rock Creek and Salmon Creek (RM 22.20) to treat road runoff

- Evaluation of five potential wetland enhancement projects and two riparian enhancement/reforestation projects

- Technical assistance visits to landowners and businesses with potential source control problems and water quality ordinance issues.

- Numerous small and large-scale invasive plant removal and riparian restoration projects

- Evaluation/maintenance of several clogged and undersized culverts

- Evaluation of numerous potential channel rehabilitation projects

Non-project stormwater management recommendations address areas where CWP programs or activities could be modified to better address NPDES permit components or promote more effective mitigation of stormwater problems. Management recommendations relevant to the assessment area include:

- Continue to coordinate with Washington Department of Ecology during Salmon Creek TMDL adaptive management (fecal coliform and turbidity), and TMDL development (temperature)

- Continue mapping all new storm sewer infrastructure as development increases with the goal of maintaining a complete stormwater infrastructure inventory

- New facility construction focusing on stormwater infiltration to increase baseflow

- Develop literature and distribute to landowners educating about the water quality impacts and other potential hazards on on-line and off-line ponds

- Encourage in-stream habitat improvement projects to increase biological integrity

- Replace deteriorated stream name signs at road crossings

- Coordinate and leverage opportunities with groups and agencies active in the Salmon Creek watershed

- Continue to encourage and support riparian planting efforts by private landowners

- Continue to expand efforts to design and build runoff reduction strategies in county right-of-way

- Continue to encourage Agricultural Best Management Practices that emphasize soil and water conservation and reduction in nutrient load to streams

- Continue to promote streambank stabilization/rehabilitation strategies by private landowners

- Educate private landowners on importance of native riparian vegetation and intact riparian forests for shading streams and preserving hydrology. Emphasize conservation of undeveloped and forested areas, especially within the riparian corridor and floodplain.

- Continue education and public outreach efforts regarding Clark County's Stormwater Facility Maintenance Manual focused on private stormwater facility owners to maintain county stormwater facility maintenance standards.

- Protect first-order tributary streams from further stormwater impacts by creating stream buffers, establishing conservation easements, and eliminating existing stormwater and agricultural runoff inputs. Encourage reforestation of lower gradient headwaters.

- Encourage riparian forest restoration in areas degraded by residential land use and road improvement/realignment projects.

- Acquisition of existing forest land for future protection of streams and watersheds.

- Continue to encourage riparian preservation by employing strategies to prevent riparian degradation, and riparian large wood enhancement by hardwood conversion, conifer release, or riparian plantings.

## Introduction

This Stormwater Needs Assessment includes the Rock Creek and Salmon Creek (RM 22.20) subwatersheds. The Clean Water Program (CWP) is gathering and assembling information to support capital improvement project (CIP) planning and other management actions related to protecting water bodies from stormwater runoff.

### Purpose

The Stormwater Needs Assessment Program (SNAP), initiated in 2007, creates a system for the CWP to focus activities, coordinate efforts, pool resources, and ensure the use of consistent methodologies. SNAP activities assess watershed resources, identify problems and opportunities, and recommend specific actions to help meet the CWP mission of protecting water quality through stormwater management.

The overall goals of the SNAP are to:

- Analyze and recommend the best, most cost effective mix of actions to protect, restore, or improve beneficial uses consistent with NPDES permit objectives and the goals identified by the state Growth Management Act (GMA), ESA recovery plan implementation, Total Maximum Daily Load (TMDLs), WRIA planning, floodplain management, and other local or regional planning efforts.

- Inform county efforts to address the following issues related to hydrology, hydraulics, habitat, and water quality:

  - Impacts from current or past development projects subject to lesser or non-existent stormwater treatment and flow control standards.

  - Subwatershed-specific needs due to inherent sensitivities or the present condition of water quality or habitat.

  - Potential impacts from future development.

The CWP recognizes the need to translate assessment information into on-the-ground actions to improve water quality and habitat. Facilitating this process is a key requirement for the program's long-term success.

Results and products of needs assessments promote more effective implementation of various programs and mandates. These include identifying mitigation opportunities and providing a better understanding of stream and watershed conditions for use in planning county road projects. Similar information is also needed by county programs implementing critical areas protection and salmon recovery planning under the state GMA and the federal ESA.

### Scope

This report summarizes and incorporates new information collected for the SNAP, as well as pre-existing information. In many cases it includes basic summary information, or incorporates by reference longer reports which may be consulted for more detailed information.

SNAP reports produce information related to three general categories:

- Potential stormwater capital projects for county implementation or referral to other organizations.

- Management and policy recommendations.

- Natural resource information.

Descriptions of potential projects and recommended program management actions are provided to county programs, including: Department of Environmental Services Clean Water, Stormwater Capital Planning, Legacy Lands, and ESA; Public Works Operations, Development Engineering, and CIP; Community Planning and; Public Health. Potential project or leveraging opportunities are also referred to local agencies, groups, and municipalities as appropriate.

## Assessment Approach

### Priorities for Needs Assessment in Rock Creek and Salmon Creek (RM 22.20)

Clark County subwatersheds were placed into a five year schedule for assessment using the procedures described in Prioritizing Areas for Stormwater Basin Planning (Swanson, July 2006).

For SNAP purposes, Rock Creek and Salmon Creek (RM 22.20) subwatersheds are categorized as "Rural Residential with No UGA". Subwatersheds in this category are generally not heavily forested but have limited stormwater management needs due to the lack of urbanization. Assessment efforts for these subwatersheds focus primarily on summarizing existing information to identify potential restoration projects.

### Assessment Tools Applied in Rock Creek and Salmon Creek (RM 22.20)

The SNAP utilizes a standardized set of tools for subwatershed assessment; including desktop mapping analyses, modeling, outreach activities, and a variety of field data collection procedures. Tools follow standard protocols to provide a range of information for stormwater management. Though not every tool is applied in every subwatershed, the use of a standard toolbox ensures the consistent application of assessment activities county-wide.

Table 1 lists the set of tools available for use in the SNAP. Tools with an asterisk (*) are those for which new data was gathered or new analyses were conducted during this needs assessment. The remaining tools or chapters were completed based on pre-existing information where available.

**Table 1: Stormwater Needs Assessment Tools**

| | |
|---|---|
| Outreach And Involvement * | Riparian Assessment |
| Coordination with Other Programs * | Floodplain Assessment |
| Drainage System Inventory and Condition* | Wetland Assessment |
| Review Of Existing Data | Macroinvertebrate Assessment * |
| Illicit Discharge Screening | Fish Use And Distribution |
| Broad Scale GIS Characterization * | Water Quality Assessment |
| Rapid Stream Reconnaissance * | Hydrologic Modeling |
| Physical Habitat Assessment | Hydraulic Modeling |
| Geomorphology And Hydrology Assessment | Source Control |

## Assessment Actions

### Outreach Activities

SNAP outreach activities in 2009 focused primarily on raising awareness about the SNAP effort and following up on issues discovered in 2008. Letters were sent to landowners regarding trash accumulations and various agriculture management issues observed on their property during the 2008 SNAP effort.

The following activities were completed:

- July 2009 – Press release to local media.

- The Clean Water Program E-Newsletter is distributed to 265 subscribers. SNAP articles and updates were included in three E-Newsletter editions in 2009:

  - April 2009 – 2008 SNAP reports available

  - August 2009 – 2009 SNAP update

  - December 2009 – Article highlighting SNAP landowner litter pick-up success.

- April 2009 – SNAP information distributed with Clean Water Program information at Small Farm Expo: 69 participants.

- August 2009 – Letters were sent to sixty-two landowners with accumulations of trash in or near the stream on their property. Twenty-two landowners responded with phone calls to the SNAP lead for more information or to inform the CWP that cleanup activities had been completed. One landowner reported removing 1200 pounds of trash and another picked up three garbage bags and four five-gallon buckets or litter, six tires, three washing machines, drain pipe, and aluminum siding.

- August 2009 – Information on the SNAP was distributed at the 10-day Clark County Fair.

- November 2009 – Letters were sent to twenty-one landowners with identified agriculture-related issues on their property. The letters described the problem found (e.g. improper manure storage, livestock access to the stream, etc.) and identified a suggested management practice to lessen negative impacts on water quality (e.g. cover manure piles, fence livestock from the stream). A list of local resources and a brochure highlighting small acreage best management practices were included in the mailing. No follow-up calls or questions from landowners were received by the SNAP lead resulting from these letters, and it is unknown whether other agencies listed as resources were contacted by property owners for technical advice.

- Clean Water Program SNAP web pages were updated as needed on an on-going basis; (note, no web visitor/download statistics are available as Clark County had (has) no tracking software during this timeframe).

- A description of the SNAP was included in Clark County's annual stormwater management program plan submitted to Ecology.

Clark County Clean Water Commission members were updated periodically on SNAP progress.

Actions available to educate in response to identified problem areas include:
- Site visits by CWP technical assistance staff.

- Letters detailing specific problems and solutions to individual landowners.

- General educational mailings to selected groups of property owners.

- Workshops on best management practices, including septic maintenance and mud, manure and streamside property management.

- Referral to other agencies, such as Clark Conservation District or WSU Extension, for educational follow-up.

## Coordination with Other Programs

Purpose
Coordination with other county departments and with local agencies or organizations helps to explore potential cooperative projects and ensure that the best available information is used to complete the assessment.

Coordination is a two-way relationship; in addition to bringing information into the needs assessment process, coordinating agencies may use needs assessment results to inform and enhance their programs.

Methods
The CWP maintains a list of potential coordinating programs for each subwatershed area. Coordination takes the form of phone conversations, meetings, or electronic correspondence, and is intended to solicit potential project opportunities, encourage data and information sharing, and promote program leveraging.

Potential opportunities for coordination exceeded the scope of CWP and SNAP resources; therefore, not all potentially relevant coordination opportunities were pursued. Coordination was prioritized to include departments and groups most likely to contribute materially to identifying potential projects and compiling information to complete the needs assessment.

Results
See Analysis of Potential Projects for an overall list and locations of potential projects identified during the needs assessment process. Projects suggested or identified through coordination with other agencies are included.

The following list includes departments, agencies, and groups contacted for potential coordination in the Rock Creek and Salmon Creek (RM 22.20) needs assessment area:
- Lower Columbia Fish Recovery Board

- Clark County Transportation Improvement Program

- Clark County Legacy Lands Program

- Clark County Parks and Recreation

- Washington Department of Ecology

- Clark County Endangered Species Act program

- Salmon Creek Watershed Council

- Clark Public Utilities

## Review of Existing Data

Data and information review is incorporated throughout this report in pertinent sections. A standardized list of typical data sources created for the overall SNAP effort is supplemented by subwatershed-specific sources as they are discovered. Data sources consulted for this report include, but are not limited to those listed below:

- Ecology Watershed Characterization and Analysis of Clark County (2009)

- LCFRB Habitat Characterization (2004)

- LCFRB 6-Year Habitat Workplan

- Ecology 303(d) list

- Ecology EIM data

- Clark County 2004 Subwatershed Characterization

- Clark County 2004 Stream Health Report

- Clark County LISP/SCMP/ Project data (2002 – 2008)

- CPU Salmon Creek Watershed Plan (2002)

- Clark County 6-Year TIP

## Broad-Scale GIS Characterization and Metrics

The broad-scale characterization is a GIS-based exercise providing an overview of the biophysical setting for each subwatershed, background information for use in implementing other SNAP tools, and identification of potential acquisition or project sites. GIS data describes many subwatershed characteristics such as topography, geology, soils, hydrology, land cover, land use, and GMA critical areas. A standard GIS workspace, including shape files for over 65 characteristics forms the basis for the characterization.

GIS data are generally used as a tool to complete the report and not presented in the report itself. Summary metrics are taken from existing reports and data; for example, Wierenga (2005) summarized many GIS characteristics for Clark County subwatersheds. Some of these characteristics are described in greater detail in later sections.

The characterization includes three components:
- A set of four standard map products, as paper maps for SNAP use

- A summary table of selected subwatershed-scale metrics

- A brief narrative including comparison of metrics to literature values, and conclusions about general subwatershed condition and potential future changes

<u>Map Products</u>
The four standard SNAP map products are: 1) Stormwater Infrastructure and Hydrologic Soil Groups, 2) Critical Areas information, 3) Vacant Buildable Lands within UGAs, and 4) Orthophoto. These maps are printed out for tabletop evaluations.

<u>General Conditions and Subwatershed Metrics</u>
*General Geography*
The study area comprises two subwatersheds in rural to forested upper Salmon Creek: Rock Creek and Salmon Creek (RM 22.20). Salmon Creek (RM 22.20) subwatershed is the uppermost part of Salmon Creek watershed and includes several streams draining west from the Cascade Mountains foothills to the main stem near the west edge of the subwatershed. Rock Creek subwatershed has a similar drainage pattern, with tributary streams draining west to the main stem. The area is on the transition from upper Willamette Valley terraces (or Troutdale Bench) to the Cascade Mountain foothills (Figure 1). Land use is rural residential in lower elevations and forested on steeper hills and higher elevations in the eastern part of the study area. The entire area is rural, outside of the urban growth areas.

*Topography*
The study area is generally sloping west from a ridgeline separating Salmon Creek watershed from the East Fork Lewis River watershed. The highest points on this ridge are Bells Mountain in Rock Creek subwatershed and Elkhorn Mountain in Salmon Creek (RM 22.20), both of which are about 2200 foot elevation. Salmon Creek is at about 350 feet above sea level where it exits the study area below the confluence with Rock Creek. Salmon Creek and Rock Creek occupy a north-south trending valley between 400 and 500 feet elevation. Tributary streams are generally in steep gradient, shallow canyons. Except for low gradient reaches near their confluence, both Salmon Creek and Rock Creek lack significant floodplains.

*Geology and Soils*
The oldest rocks in the study are lava flows deposited by volcanoes east of the study area. Along the western edge of the study area, sedimentary rocks deposited by the Missoula Floods of the Columbia River and local streams cap hilltops (Troutdale Formation). Recent alluvium deposits occur in flood plains.

Moderately well drained mountain soils (Hydrologic Soil Group B) underlie much of the study area. Soils formed in the Troutdale Formation gravel deposits tend to be less well drained Hydrologic Soil Group C soils.

*Hydrology*
Geology and topography play the main role in determining study area hydrologic framework. The relatively steep slopes and hard volcanic rock geology promote steep streams and relatively low

amounts of recharge. Summer base flow is relatively low compared to subwatersheds underlain by sedimentary deposits.

Most of the study area is forested or low density rural areas. Parcels cleared for pasture or crops are limited to small areas in northeastern Rock Creek subwatershed. Consequently, stream hydrology is not highly altered from a natural forested condition.

Clark Public Utilities operates a stream gauge just below the confluence of Rock Creek and Salmon Creek. Pacific Groundwater Group (October 2002) used historical data from this gauge to estimate that typical yearly low flow is about 3 to 4 cfs. They also examined high discharge events from 1943 to 1999 and found a slight increase but no statistically significant trend. The TQmean, a flashiness metric calculated from daily flow data, averaged 0.33 for the period since 2002, and changed little from year to year. A TQmean of 0.33 indicates a relatively un-urbanized basin but is significantly lower that what might be expected for a forested basin. Modeled flows (MGS, March 2003) showed that stream hydrology is compatible with stable stream channels in Rock Creek and Salmon Creek main stem reaches.

**SUBWATERSHED:**
**Rock Creek**
**Salmon Creek rm 22.20**

**Legend**

| | |
|---|---|
| ✕ | Bridges |
| 🏫 | School |
| ⚒ | Active Mine |
| ╫╫╫╫ | Railroad |
| ── | Trails |
| ▭ | Selected Subwatersheds |
| ▨ | Park Land |
| ▨ | Golf Course |
| ▨ | School Land |
| ▨ | Military Reserve |
| ▨ | Fish & Wildlife |
| ▨ | State/Federal Lands |
| ▨ | Incorporated |
| ▭ | UGA Boundary |

1:42,000

Miles
0    0.45    0.9    1.8    2.7

CLARK COUNTY
Department of Assessment and GIS

Information shown on this map was collected from several sources. Clark County accepts no responsibility for any inaccuracies that may be present.

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Project: Q:\Projects\iconSrvs\PubWrks\20048\SNAP\SNAPmapPDFs_2009\SNAP1_Atlas_11x17.mxd (whitcom)

**Figure 1: Subwatershed Map: Salmon Creek (RM 22.20) and Rock Creek Subwatersheds**

*Subwatershed Metrics*

Subwatershed scale metrics provide a simple way to summarize overall conditions. Metrics are calculated from Landsat land cover analysis and current GIS data. Benchmarks for properly functioning and not properly functioning are based on NOAA fisheries standards for salmon protection and restoration (1996 and 2003).

Overall, these metrics suggest that the study area has generally functioning stream habitat (Table 2).

**Table 2: Watershed Scale Metrics**

| Metric | Rock Creek | Salmon Creek RM 22.20 | Functioning | Non-functioning |
|---|---|---|---|---|
| Percent Forested (2000 Landsat) | 60 | 68 | > 65 % | < 50 % |
| Percent TIA (2000 Landsat) | 10 | 10 | < 5 % | > 15 % |
| Road Density 2007 data (miles/mile2) | 6 | 5 | < 2 | > 3 |
| Stream Crossing Density (crossings per stream mile) | 2.3 | 1.6 | < 3.2/mile | > 6.4/mile |
| Percent EIA estimated from the Comprehensive Plan | 2 | 1 | < 10 % | > 10 % |

*Forest Cover*

The proportion of a watershed in forest cover is known to have a profound influence on watershed processes. Forest cover estimates are taken from a report summarizing land cover for Clark County (Hill and Bidwell, January 2003). Research in the Pacific Northwest has shown that when forest cover declines below approximately 65 percent, watershed forming processes become degraded (Booth and Jackson, 1997). These include reducing riparian shade, less wood debris delivery to streams, increased stormwater runoff, and increased fine sediment delivery due to mass wasting.

The study area forest cover is substantial but somewhat fragmented where residential development occurs outside of zoned forest lands. Metrics suggest that Salmon Creek is functioning and Rock Creek is slightly below functioning.

*TIA (Total Impervious Area)*

Total impervious area is one of the most widely used indicators of urbanization and coincident watershed degradation (Center for Watershed Protection, March 2003). Total impervious areas are estimated from land cover data in Hill and Bidwell (January 2003). While various organizations and publications categorize stream condition based on TIA, the NOAA fisheries standard is less than five percent as fully functional and greater than 15 percent as non-

functioning. Values for both subwatersheds are between the thresholds for non-functioning and functioning habitat. This estimate carries the caveat that the estimation method tended to overestimate impervious area in mixed cleared and forested areas and clear cuts.

*Road Density*
Road density, including all public and private roads, is an easily calculated development measure. Based on criteria set by NOAA Fisheries to protect salmon habitat, road densities are higher than thresholds for non-functioning (>3 road miles/mi2).

*Stream Crossing Density*
Stream crossing densities are easily measured using available road and stream channel data. The salmon protection standard considers larger fills over 60 feet wide, which would be approximately five to ten foot high road fill. The study area subwatersheds both have stream crossing densities within the functioning category (<3.2 crossings/stream mile NOAA Fisheries criteria).

*Future Effective Impervious Area*
Effective impervious area is the amount of impervious area that actually drains to a water body. Depending on factors such as soil types and level of development, effective impervious area is about half (lower intensity development) to almost equal (high intensity development) the TIA value.

The 2008 Comprehensive Plan guides development for the next few years and when used to estimate effective impervious area it can provide a metric for potential hydrologic impacts due to expected development. Expected EIA places the study area in the functioning category.

*Estimated Channel Stability Based on Forest and EIA*
In a recent publication by Booth, Hartley, and Jackson (June 2002), a relationship between forest and percent EIA was presented as a graphic (**Error! Reference source not found.**). According to this figure, streams in both subwatersheds would be expected to have marginally stable channels.
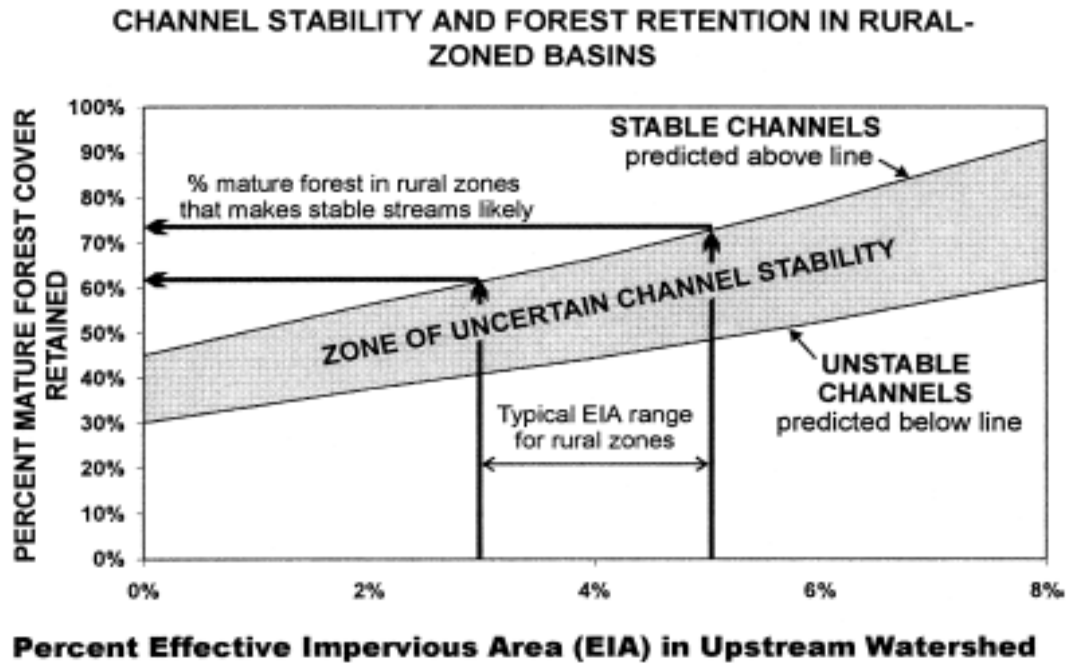
**Figure 2: Channel stability in rural areas (Booth, Hartley, and Jackson, June 2002)**

## Water Quality Assessment

This section briefly summarizes and references available water quality data from the Rock Creek and Salmon Creek (RM 22.20) subwatersheds. A description of applicable water quality criteria is included, along with discussions of beneficial use impacts, likely pollution sources, and possible implications for stormwater management planning.

Water Quality Criteria
For a full explanation of current water quality standards see the Ecology website at:
http://www.ecy.wa.gov/programs/wq/swqs/index.html

Under Washington state water quality standards, Salmon Creek from below the Cougar Creek confluence to the headwaters, including tributaries, is to be protected for the designated uses of: "Core Summer Salmonid Habitat; primary contact recreation; domestic, industrial, and agricultural water supply; stock watering; wildlife habitat; harvesting; commerce and navigation; boating; and aesthetic values" (WAC 173-201A-600, Table 602).

Table 3 summarizes currently applicable water quality criteria for the assessment area.

**Table 3: Applicable Water Quality Criteria for Rock Creek and Salmon Creek (RM 22.20) Subwatersheds**

| Characteristic | Ecology criteria |
|---|---|
| Temperature | ≤ 16 °C (60.8 °F) |
| Dissolved Oxygen | ≥ 9.5 mg/L |
| Turbidity | shall not exceed 5 NTU over background when background is 50 NTU or less |
| pH | 6.5 – 8.5 units |
| Fecal coliform bacteria | Geometric mean fecal coliform concentration not to exceed 100 colonies/100mL, and not more than 10% of samples exceeding 200 colonies/100mL. |
| Aesthetics | Aesthetic values must not be impaired by the presence of materials or their effects…which offend the senses of sight, smell, touch, or taste |
| Toxics | Toxic substances shall not be introduced… which have the potential…to adversely affect characteristic water uses, cause acute or chronic toxicity to the most sensitive biota dependent upon those waters, or adversely affect public health |

Source: Washington Department of Ecology (http://www.ecy.wa.gov/programs/wq/swqs/index.html)


303(d) Listed Impairments
The 2008 303(d) list of impaired waters is on the Ecology website at:
http://www.ecy.wa.gov/programs/wq/303d/index.html

Salmon Creek within the Salmon Creek (RM 22.20) subwatershed is Category 4a listed (polluted waters with an approved TMDL) for fecal coliform bacteria, and Category 5 listed (polluted waters that require a TMDL) for pH. There are no specific listings for Rock Creek.

Both subwatersheds are included in ongoing Salmon Creek TMDL implementation for fecal coliform and turbidity, and in TMDL development for water temperature.


Clark County Stream Health Report
In 2004, the CWP compiled available data and produced the first county-wide assessment of general water quality.

Based on the available dataset including fecal coliform bacteria, general water chemistry (temperature, pH, and dissolved oxygen), and benthic macroinvertebrate scores, overall stream health in the Rock Creek subwatershed scored in the fair to good range, while Salmon Creek (RM 22.20) scored fair.

The 2004 Stream Health Report may be viewed on the county website at:
http://www.clark.wa.gov/water-resources/stream.html.

Available Data

A considerable dataset is available for the assessment area; however, the majority of this data comes from the Salmon Creek (RM 22.20) subwatershed. Limited data exists from the Rock Creek subwatershed.

A full review and summary of available data and studies is beyond the scope of this document. This summary focuses primarily on recent water quality data collected by the CWP, including monthly water quality data from upper Salmon Creek (2002 through 2008) and temperature data collected during the summer of 2003. Associated reports may be viewed on the CWP website at: http://www.clark.wa.gov/water-resources/documents-monitoring.html#strmac

In 2009, Ecology (Collyard, 2009) completed a report titled Salmon Creek Nonpoint Source Pollution Total Maximum Daily Load: Water Quality Effectiveness Monitoring (Publication No. 09-03-042). The report incorporates much of the County's available water quality data and is available on the Salmon Creek TMDL website at: http://www.ecy.wa.gov/programs/wq/tmdl/SalmonCr/SalmonCr.html.

Some information from the Ecology report is summarized in this assessment.

Data and information sources reviewed or summarized as part of this water quality characterization are listed in Table 4.

**Table 4: Data Sources**

| Source | Data and/or Report |
|--------|-------------------|
| Clark County Clean Water Program | 2002-2008 Salmon Creek Monitoring Project <br> 2004 Stream Health Report <br> Salmon Creek Watershed Summer 2003 Stream Temperature |
| Ecology | Salmon Creek Nonpoint Source Pollution Total Maximum Daily Load: Water Quality Effectiveness Monitoring Report |

Water Quality Summary

Figure 3 shows the location of monitoring stations referenced in this assessment. Long-term monthly data was collected at Station SMN080 (Salmon Creek at NE 199th Street) from 2002-2008.

Two stations in this assessment area were included in the Salmon Creek Watershed Summer 2003 Stream Temperature study:

- ROC010 (Rock Cr upstream of Salmon Creek confluence (formerly RCK010))

- SMN075 (Salmon Creek at Risto Road Bridge 217)

**Figure 3: Location of monitoring stations**

*Oregon Water Quality Index (OWQI) Scores*

The OWQI was developed by the Oregon Department of Environmental Quality (ODEQ) as a way to improve understanding of water quality issues by integrating multiple characteristics, and generating a score that describes water quality status (Cude, 2001). It is intended to provide a simple and concise method for expressing ambient water quality.

The OWQI integrates eight water quality variables: temperature; dissolved oxygen; biochemical oxygen demand; pH; ammonia + nitrate nitrogen; total phosphorus; total solids; and fecal coliform. For each sampling event, individual sub-index scores and an overall index score are calculated. Overall index scores are aggregated into low flow (June through September) and high flow (October through May) seasons and a seasonal mean value is then calculated.

Index scores are categorized as follows:
very poor = 0 to 59; poor = 60 to 79; fair = 80 to 84; good = 85 to 89, and; excellent = 90 to 100.

Figure 4 shows seasonal average OWQI scores for Station SMN080 from 2002 through 2008. Among 15 long-term monitoring stations county-wide, Station SMN080 ranked second best in overall water quality during the time period from 2002-2006 (Hutton and Hoxeng, 2007).

Monthly OWQI values since 2002 ranged from Very Poor to Excellent, although for most months (69 out of 74 months sampled) OWQI values were in the excellent category. Monthly sub-index scores for all subindices were typically excellent, with occasional poor or fair scores. The lowest monthly OWQI recorded (24 in November 2003) was due to a very low score for inorganic nitrogen.
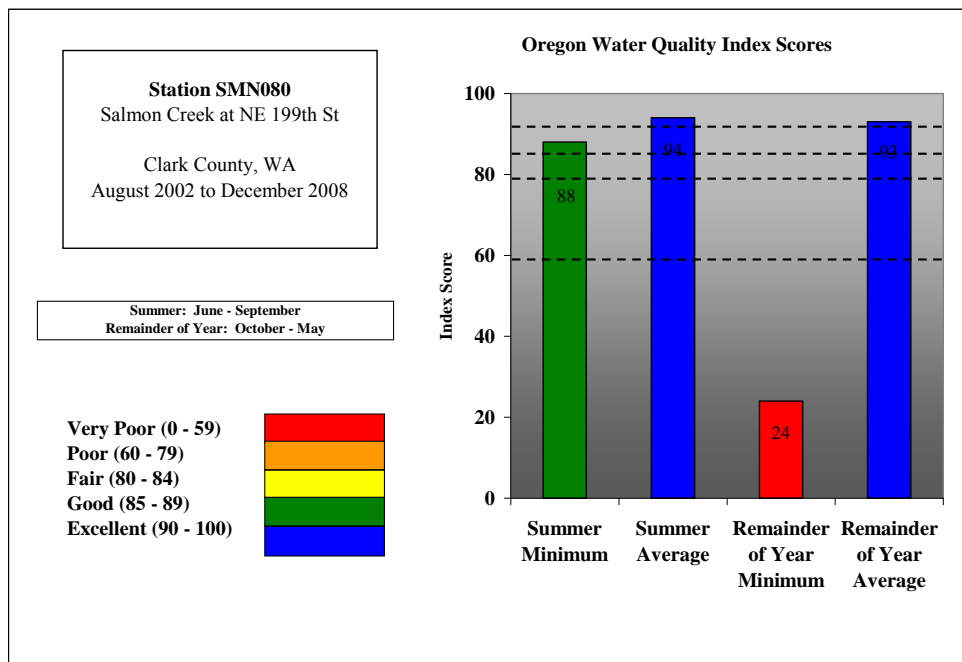


**Figure 4: Average Water Quality, Salmon Creek station SMN080, 2002 through 2008, Oregon Water Quality Index**

*Trends Over Time*
An analysis of potential trends based on the 2002 through 2006 dataset found statistically significant trends in overall OWQI and turbidity scores at Station SMN080 (Hutton and Hoxeng, 2007). OWQI scores appear to be decreasing over time, largely due to increasing turbidity (lower turbidity scores). If the current trend continues, Station SMN080 was predicted to fall out of the excellent category for overall OWQI within about two years.

Ecology (Collyard, 2009) used a step-trend analysis to evaluate nutrient data collected at SMN080 between 1988 and 2007. No statistically significant trends were found in nitrate-nitrite or total phosphorus concentration. Although no trend was identified, SMN080 was the only Salmon Creek station where the data suggested a possible increase in phosphorus over the sampling period; most other stations showed statistically significant decreases in phosphorus.

*Nutrients*
Nutrient criteria are not established for Washington streams. EPA suggests a total phosphorus criterion of 0.100 mg/L for most streams, and 0.050 mg/L for streams which enter lakes (EPA, 1986). EPA nitrate criteria are focused on drinking water standards and are not generally applicable to aquatic life issues.

Phosphorus and nitrogen in excess may contribute to elevated levels of algal or plant growth, especially in slower moving, low gradient streams, or in downstream water bodies.

Total phosphorus samples from Station SMN080 between August 2002 and December 2008 ranged from <0.020 mg/L to 0.092 mg/L. No samples exceeded the EPA criterion, and only 12 of 79 samples during this period were above 0.020 mg/L.

*Turbidity*
Station SMN080 serves as the background site for Ecology's turbidity TMDL implementation, against which all other stations are measured for compliance. Therefore, no target for turbidity reduction at SMN080 is set in the TMDL.

Between June 2002 and December 2008, the median of 79 turbidity samples at Station SMN080 was 3.1 NTU, with individual samples ranging from 1 NTU to 15 NTU.

*Fecal Coliform Bacteria*
For a full analysis based on the fecal coliform TMDL, see Collyard, 2009. General results from that report are summarized below.

Based on monthly data from 2005 – 2007, geometric mean fecal coliform concentrations at Station SMN080 declined 79% and 35% during the wet and dry seasons, respectively, when compared to values from the 1995 TMDL (Table 5). Station SMN080 is one of two Salmon Creek stations meeting both the wet and dry season criteria for geometric mean.

90th percentile values decreased by 89% and 69% during the wet and dry seasons, respectively (Table 6). Station SMN080 is the only station meeting the criteria for both seasons, and is

therefore the only Salmon Creek station in full compliance with the state criteria and TMDL targets.

Based solely on fecal coliform data, this station ranked third-best among 15 long-term stations in Clark County from 2002 through 2006 (Hutton and Hoxeng, 2007).

**Table 5: 1995 TMDL study fecal coliform criteria compared to 2005-7 Clark County data (from Collyard, 2009)**

*Geometric mean values for wet and dry seasons.*

| Station | Wet season | | | | | Dry season | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | TMDL | 05-07 | % change[1] | Meets criterion? | % Required change[2] | TMDL | 05-07 | % change[1] | Meets criterion? | % Required change[2] |
| SMN010 | 313 | 59 | -82 | Yes | none | 129 | 90 | -30 | Yes | none |
| CGR020 | 722 | 143 | -80 | No | 30 | 899 | 696 | -23 | No | 86 |
| SMN030 | 182 | 42 | -77 | Yes | none | 281 | 151 | -46 | No | 34 |
| MIL010 | 839 | 50 | -94 | Yes | none | 282 | 106 | -62 | No | 6 |
| CUR020 | 1155 | 23 | -98 | Yes | none | 743 | 116 | -84 | No | 14 |
| SMN050 | 234 | 21 | -91 | Yes | none | 751 | 106 | -86 | No | 6 |
| WDN | 534 | 71 | -87 | Yes | none | 857 | 184 | -79 | No | 46 |
| SMN080 | 28 | 6 | -79 | Yes | none | 54 | 34 | -35 | Yes | none |

[1] Percent change required to meet TMDL target limits.
[2] Additional change required to meet TMDL target limits.

**Table 6: 2001 TMDL report fecal coliform criteria compared to 2005-7 Clark County data (from Collyard, 2009)**

*90th percentile values for wet and dry seasons.*

| Station | Wet season | | | | | Dry season | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | TMDL | 05-07 | % change[1] | Meets criterion? | % Required change[2] | TMDL | 05-07 | % change[1] | Meets criterion? | % Required change[2] |
| SMN010 | 1917 | 321 | -83 | No | -38 | 301 | 347 | -15 | No | -42 |
| CGR020 | 9243 | 601 | -93 | No | -67 | 1803 | 1577 | -13 | No | -87 |
| SMN030 | 1261 | 194 | -85 | Yes | none | 806 | 342 | -58 | No | -36 |
| MIL010 | 8763 | 381 | -96 | No | -48 | 1121 | 483 | -57 | No | -59 |
| CUR020 | 4409 | 93 | -98 | Yes | none | 2608 | 472 | -82 | No | -58 |
| SMN050 | 1125 | 138 | -88 | Yes | none | 1404 | 346 | -75 | No | -42 |
| WDN | 9204 | 468 | -95 | No | -57 | 6509 | 628 | -90 | No | -68 |
| SMN080 | 200 | 22 | -89 | Yes | none | 318 | 98 | -69 | Yes | none |

[1] Percent change required to meet TMDL target limits.
[2] Additional change required to meet TMDL target limits.

*Stream Temperature*

One summer of continuous temperature monitoring (2003) at Station SMN075 and Station RCK010 was conducted as part of the Salmon Creek Watershed Summer 2003 Stream Temperature project.

Figure 5 shows 7-DADMax temperatures during the summer of 2003 for 15 stations throughout the Salmon Creek watershed. The 7-DADMax is the maximum of the 7-day moving average of daily maximum temperatures. Ecology standards utilize this metric to determine temperature compliance (currently the criterion for this assessment area is 60.8 degrees F. At the time of the study, the criterion was 64 degrees F).

Neither station within this assessment area met the current state criterion, though Station SMN075 was considerably cooler than RCK010 and spent significantly less time with temperatures exceeding the criterion. Among tributary stations, the RCK010 station was among the warmest and appeared especially susceptible to temperature changes; average daily temperature fluctuation at RCK010 was greater than at any other station.
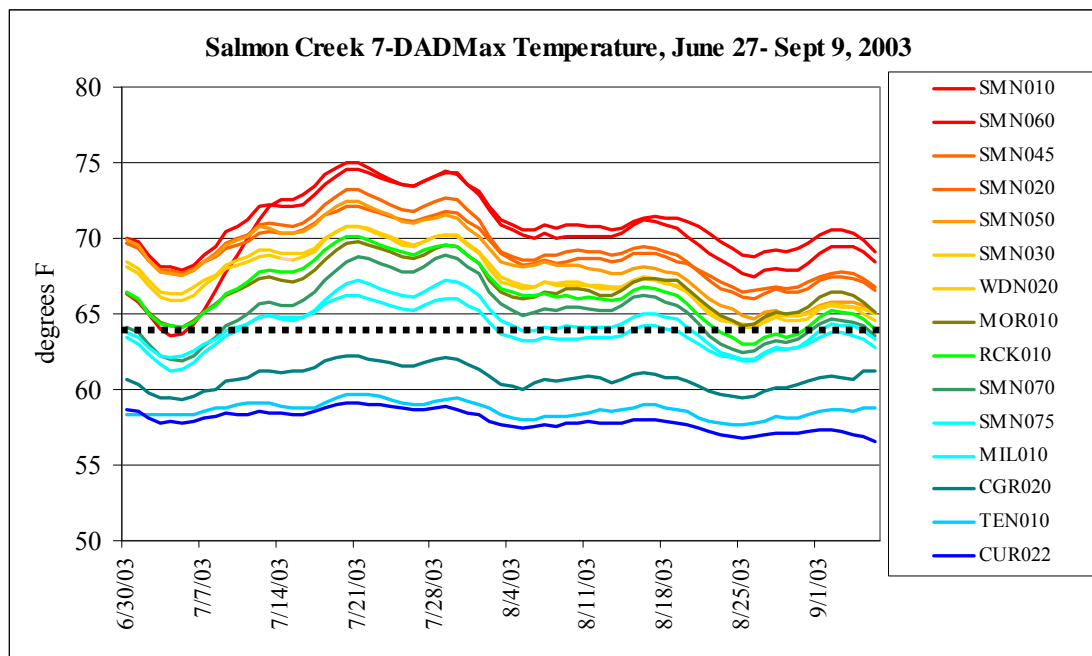


**Figure 5: Time series plot of 7-DADMax temperatures, Salmon Creek, summer 2003 (from Schnabel, 2004). Dotted line at 64 F represents the pre-2006 Washington state stream temperature criterion. The current criterion is 60.8 F.**

Impacts to Beneficial Uses and Potential Sources

General water quality in this assessment area is good to excellent in upper Salmon Creek and largely unknown in Rock Creek except for elevated stream temperatures, according to the overall OWQI and other measures discussed above. Significant impacts to listed beneficial uses appear limited, consisting of potential impacts to core summer salmonid habitat from elevated temperatures. Though measured values are still very low, evidence of increasing turbidity in

upper Salmon Creek is also a concern. Table 7 at the conclusion of this section summarizes the primary water quality impacts to beneficial uses in Rock Creek and Salmon Creek (RM 22.20), and probable sources of the observed impact.

Implications for Stormwater Management

Table 7 lists the primary known water quality concerns and potential solutions for each. Solutions listed in bold indicate areas where CWP activities can have a positive impact. It should be noted that CWP activities, though important, are not likely to achieve water quality improvement goals on their own. Other county departments, local agencies, and not least of all, the public, must all contribute to water quality improvement.

**Table 7: Known Water Quality Concerns, Sources, and Solutions for Rock Creek and Salmon Creek (RM 22.20)**

| Characteristic | Beneficial Use Affected | Potential Sources | Mechanism | Solutions (bold indicates direct Clean Water Program involvement) |
|---|---|---|---|---|
| Water temperature | Core summer salmonid habitat | vegetation removal<br><br>low summer flows | direct solar radiation<br><br>decreased resistance to thermal inputs | **Stormwater infiltration to increase baseflow**<br>**Streamside planting/vegetation enhancement/riparian preservation through acquisition**<br>**Education programs**<br>Pond removal or limitation |
| Turbidity | Core summer salmonid habitat | erosion *(development projects; land clearing; cropland; impervious surfaces; channel erosion)* | overland runoff<br>roadside ditches<br>channel dynamics | Erosion control regulations<br>**Storm sewer system cleaning and maintenance**<br>Agricultural Best Management Practices<br>Stream bank stabilization/rehabilitation<br>**Storm water outfall/facility retrofits to reduce flow-induced channel erosion** |

## Drainage System Inventory and Condition

*Inventory*

Clark County's drainage system inventory resides in the StormwaterClk GIS database and is available to users through the county's Department of Assessment and GIS, or viewable on the internet through the Digital Atlas located at:
http://gis.clark.wa.gov/imf/imf.jsp?site=mapsonline

Drainage system inventory is an ongoing CWP work effort focused on updating the StormwaterClk database to include all existing stormwater drainage infrastructure. During 2008 and 2009, the inventory was a significant priority for the CWP, with a major work effort focused on identifying and mapping previously unmapped infrastructure and reviewing existing records for completeness and accuracy.

Table 8 indicates the number of features currently inventoried in StormwaterClk. Of the total 14 stormwater facilities, none is identified as publicly owned and operated.

**Table 8: Drainage System Inventory Results, Rock Creek (SC)/Salmon Creek RM 22.20**

| Database Feature Category | Inventoried prior to 2007 | Added during 2007-2009 | Total Features |
|---|---|---|---|
| Inlet | 15 | 30 | 45 |
| Discharge Point (outfall) | 1 | 349 | 350 |
| Flow Control | 5 | 4 | 9 |
| Storage/Treatment | 54 | 20 | 74 |
| Manhole | 8 | 0 | 8 |
| Filter System | 0 | 0 | 0 |
| Channel | 144 | 1242 | 1386 |
| Gravity Main | 181 | 572 | 753 |
| Facilities | 4 | 10 | 14 |

*Condition*

Stormwater system condition is assessed based on three components:

- An evaluation of retrofit opportunities at public stormwater facilities

- An inspection and maintenance evaluation at public stormwater facilities

- An off-site assessment to check for outfall-related problems in downstream receiving waters

*Component 1: Retrofit Evaluation*

Purpose
The purpose of this component is to identify existing public stormwater facilities that may be retrofitted to provide additional storage or treatment, beyond the level intended during original construction.

Methods
The evaluation is conducted at all public stormwater facilities that contain the following facility components: detention ponds, treatment wetlands, wet ponds, pre-settling cells, open filters, or bioswales; and discharge to surface waters or to the stormwater drainage infrastructure that eventually discharges to surface waters.

The retrofit evaluation includes a review of the drainage area, stormwater infrastructure condition, facility lot size, ownership of adjacent parcels, and the functionality of the facility objects listed above. Facilities or parcels with the potential to provide additional storage and/or treatment of stormwater are referred as "potential retrofit" opportunities for further evaluation as Capital Improvement Projects.

Results
Based on the county's StormwaterClk database, as of July 2009, there were no mapped public stormwater facilities in either the Rock Creek or Salmon Creek (RM 22.20) subwatersheds.

*Component 2: Inspection and Maintenance Evaluation*

Purpose
The inspection and maintenance evaluation verifies that maintenance activities are implemented and facilities are properly functioning.

Methods
The inspection and maintenance evaluation is conducted at public stormwater facilities in conjunction with retrofit evaluations. Public stormwater facilities that contain the following facility components are evaluated: detention ponds, treatment wetlands, wet ponds, pre-settling cells, open filters, or bioswales; and discharge to surface waters or to the stormwater drainage infrastructure that eventually discharges to surface waters.

Public stormwater facilities that contain filter systems, buried detention or retention vaults, and facilities that infiltrate stormwater are typically not included in this evaluation, but may be inspected on a case-by-case basis as resources allow.

The evaluation is conducted using county and state standards equivalent to maintenance standards specified in Chapter 4 of Volume V of the 2005 Stormwater Management Manual for Western Washington. The standards list the part or component of the facility, the condition when repair or maintenance is needed, and the results expected when maintenance is performed. Individual components of a facility are referred to as "facility objects."

The inspection and maintenance evaluation process involves inspecting all facility objects to determine if maintenance complies with the standards. If any facility object fails to meet the maintenance standards, the entire facility is not in compliance. Noncompliant stormwater facilities are referred to the appropriate department for repairs or maintenance.

Results
Based on the county's StormwaterClk database, as of July 2009, there were no mapped public stormwater facilities in either the Rock Creek or Salmon Creek (RM 22.20) subwatersheds.

*Component 3: Offsite Assessment*

Purpose
Discharges from stormwater outfalls can cause moderate to severe erosion as stormwater moves through the riparian zone and to the receiving water. Erosion creates a source of sediment to the stream due to incision and slope failures.  It can also increase slope instability problems.

The Offsite Assessment looks for offsite or downstream problems associated with the county's storm sewer system, particularly from facility outfalls that discharge to critical areas.

Methods
County-owned and operated stormwater outfalls meeting one or more of the following criteria are included in the offsite assessment:
- Within 200 feet of a critical area (e.g. riparian, wellhead protection, landslide hazard, etc)

- Within 300 feet of a headwater stream

- Located on public land

- Originates from a public-dedicated facility currently under the two-year maintenance warranty bond

Stormwater outfalls are prioritized into three categories:
- Priority 1 outfalls are stormwater outfalls that discharge to landslide hazard areas outside of county road rights-of-way.

- Priority 2 outfalls are stormwater outfalls that discharge to all other critical areas outside of county road rights-of-way

- Priority 3 outfalls are stormwater outfalls that discharge to critical areas within county road rights-of-way

At a minimum, all Priority 1 outfalls are inspected.  As resources allow, Priority 2 and Priority 3 outfalls may be inspected.  If an outfall fails to meet the general outfall design criteria or is contributing to a downstream erosion problem, the outfall is not in compliance. Non-compliant outfalls are referred to the appropriate Public Works program for maintenance or repair, or in some cases referred as potential Capital Projects.

Results

Based on the county's StormwaterClk database, as of June 2009 there were 144 mapped outfalls in the Rock Creek subwatershed; four Priority 1 outfalls, two Priority 2 outfalls, and 138 Priority 3 outfalls.

In the Salmon Creek (RM 22.20) subwatershed there were 199 mapped outfalls; one Priority 1 outfalls, no Priority 2 outfalls, and 198 Priority 3 outfalls.

Table 9 summarizes offsite assessment results from the Rock Creek subwatershed. There were 144 mapped outfalls discharging to critical areas. Four Priority 1 outfalls were assessed, of which all were found to be in compliance. One Priority 2 outfall was assessed and found to be in compliance. No Priority 3 outfalls were assessed.

**Table 9: 2009 Off-site Assessment Project Activity Summary for Rock Creek subwatershed**

| Metric | Number of Outfalls | | |
|---|---|---|---|
| | **Priority 1** | **Priority 2** | **Priority 3** |
| Total number of mapped outfalls | 4 | 2 | 138 |
| # of outfalls assessed | 4 | 1 | 0 |
| # of outfalls compliant | 4 | 1 | n/a |
| # of noncompliant outfalls | n/a | n/a | n/a |
| # of referrals initiated | n/a | n/a | n/a |
| # of referrals ongoing | n/a | n/a | n/a |
| # of outfalls fixed | n/a | n/a | n/a |

Table 10 summarizes offsite assessment results from the Salmon Creek (RM 22.20) subwatershed. There were 199 mapped outfalls discharging to critical areas. One Priority 1 outfall was inaccessible and not assessed. No Priority 3 outfalls were assessed.

**Table 10: 2009 Off-site Assessment Project Activity Summary for Salmon Creek (RM 22.20) subwatershed**

| Metric | Number of Outfalls | | |
|---|---|---|---|
| | Priority 1 | Priority 2 | Priority 3 |
| Total number of mapped outfalls | 1 | 0 | 198 |
| # of outfalls assessed | 0 | n/a | 0 |
| # of outfalls compliant | n/a | n/a | n/a |
| # of noncompliant outfalls | n/a | n/a | n/a |
| # of referrals initiated | n/a | n/a | n/a |
| # of referrals ongoing | n/a | n/a | n/a |
| # of outfalls fixed | n/a | n/a | n/a |

Potential Projects
The offsite assessment project yielded no potential project opportunities.

*Management Recommendations*

Since there were no mapped public stormwater facilities found in the Rock Creek or Salmon Creek (RM 22.20) subwatersheds, retrofit evaluations and the inspection and maintenance evaluations were not conducted. However, education and public outreach efforts regarding Clark County's Stormwater Facility Maintenance Manual focused on private stormwater facility owners would help maintain county stormwater facility maintenance standards.

Outfall assessments generated no potential project opportunities. Future efforts should be made to assess Priority 2 outfalls. Maintaining the frequency of offsite assessment activities may reduce downstream erosion problems by discovering potential issues before they become a more serious erosion problem.

## Source Control

Purpose
Source control visits to Clark County businesses provide both an educational and technical assistance purpose. An initial site visit allows staff to educate owners and employees by providing basic information about nearby water resources and Clark County's Water Quality Ordinance (13.26A). The initial site visit also provides information on how Clark County's storm sewer system works, how the site is connected to this storm system, and how the activities performed by the business may impact their subwatershed.

Most importantly, the purpose of the source control visit is to find, then eliminate or change, business activities that are negatively impacting stormwater runoff.

Methods

Under the County's 2007 NPDES municipal stormwater permit, each year staff is required to visit 20% of businesses that perform one of many potential pollution-generating activities listed in the permit. Additionally, the permit requires visits to any business with a paved parking area. To simplify project planning and tracking, the CWP plans to visit 20% of all county businesses each year.

To determine which specific businesses will be inspected each year, the Stormwater Needs Assessment Program (SNAP) prioritizes a list of subwatersheds where source control visits will be performed. Once those subwatersheds are determined, GIS maps are developed to highlight all parcels paying the Type 4 (commercial and industrial property) and Type 3 (Multi-Family property) Clean Water Fee. Each highlighted parcel is labeled with the parcel number (Property Account Number).

At each site, staff asks the business manager or owner to lead a tour of the business, inside and out. By closely observing business activities and asking questions, staff gains information about site-specific conditions and current stormwater best management practices (BMPs).

If any business related activities allow contaminants to enter stormwater runoff, specific BMPs are suggested to the business manager or owner. Following the tour, BMP sheets explaining the issue and required fixes are left with the manager or owner. If the BMP will take some time to implement, a follow up visit date is agreed upon. Letters are sent to businesses when multiple activities require BMPs and/or when a specific BMP may take some time to implement. Letters usually give a deadline for completion of BMP implementation.

Following the deadline date, a follow up visit is made to the business to confirm BMP implementation. As long as some corrective effort has been made the source control staff will continue working with the business until they are in compliance. However, if the business fails to take any corrective action, despite repeated visits, a referral to Clark County Code Enforcement and possibly the Washington Department of Ecology is made to assist with compliance through enforcement.

During or immediately after each site visit, a Business Site Visit Report Form is completed for entry into the Tidemark database.

Results

In 2009, staff visited 100% of the businesses required under the NPDES permit in the Salmon Creek (RM 8.96) subwatershed. Table 11 summarizes source control activities.

**Table 11: Source Control Project Summary, Salmon Creek (RM 22.20) subwatershed**

| Metric | Number |
|---|---|
| Number of sites visited | 17 |
| Number of sites with source control issues | 8 |
| Number of repeat visits | 9 |
| Number of sites with issues successfully resolved | 8 |
| Number of sites referred to other agencies | 0 |

Overview

Salmon Creek (RM 22.20) subwatershed includes all businesses in Brush Prairie, as well as commercial properties in the Meadow Glade and Manor neighborhoods southwest of the city of Battle Ground. This subwatershed contains relatively small areas of light industrial businesses. The businesses are located in the urban centers of these rural neighborhoods. Most are small companies with less than ten employees.

Businesses within Salmon Creek (RM 22.20) subwatershed engage in a wide range of activities that rate highly for potential stormwater contamination. Typical activities include automotive servicing, printing, restaurants, and commercial painters.

After initial site visits, most businesses required only basic education and limited technical assistance. A handful of businesses were causing regular stormwater pollution. These businesses required some cleanup as well as BMP instruction and informational handouts.

Currently, the number of businesses in Salmon Creek (RM 22.20) is small relative to other subwatersheds, but this is an area of growth within the county with new business development expected. Despite the small number, the types of businesses commonly found in this area need regular site visits to ensure proper BMPs are installed and maintained.

*Success stories*

The following success story highlights project activities at a location where significant pollution discharges to surface water were discovered.

Case 1:

- A commercial paint and sheetrock company was found to be washing their equipment and tools on a concrete pad in the back of the shop.

- This concrete pad drained into a catch basin then into the county's storm system and eventually to Salmon Creek.

- County staff required clean up, including vacuuming out the catch basin of the waste water.

- Following the technical assistance from county staff, the business implemented new stormwater BMPs to manage their wastewater, eliminating the improper discharge to the county's storm system.

## Illicit Discharge Detection and Elimination Screening

Illicit Discharge Detection and Elimination Screening assessment was not conducted.

## Stream Reconnaissance and Feature Inventory

<u>Purpose</u>
The Feature Inventory records the type and location of significant stream impairments, potential environmental and safety hazards, and project opportunities in selected stream reaches.

Feature Inventory results are used primarily to document conditions and identify potential improvement projects or management actions for implementation by the CWP or other agencies. They also provide an extensive GIS database of sites that can be evaluated for project mitigation needs and as a county-wide planning tool for riparian and habitat enhancement projects.

<u>Methods/Limitations</u>
Geographic scope of the Feature Inventory was established by the CWP, taking into consideration projected TIA, DNR water types, stream gradient, zoning, Clark County development permitting authority, and land ownership.

The Feature Inventory recorded significant conditions in the stream corridor relevant to SNAP components. Feature types are listed in Table 12.

The in-stream assessment approach allowed investigators to observe stream corridor features that are not always identifiable through desk methods, such as analysis of existing aerial photographs and GIS data.

A GPS position, one or more digital photos, and relevant attribute information were collected for each logged feature. All data and linked photos are stored in the Feature Inventory Geodatabase located on the Clark County server at: W:\PROJECT\011403, Needs Assessment Planning and Reports\GIS\Data\CWP Project Planning Database. Feature data includes field observations, estimated measurements, and notes describing important feature characteristics or potential projects.

The Feature Inventory project is not intended to be an exhaustive inventory of all human alterations to the stream corridor. Rather, the project seeks to identify the most significant features pertaining to stormwater management and potential stormwater mitigation projects.

Feature dimensions and other attribute data are estimates, and should not be utilized for quantitative calculations.

*Study Area*
The extent of the completed Feature Inventory in the Rock Creek and Salmon Creek (RM 22.20) subwatersheds is shown in **Error! Reference source not found.**.

Since both subwatersheds fall into the "Rural Residential with No UGA" category and have limited stormwater management needs due to the lack of urbanization, the Feature Inventory was limited to Road Reconnaissance surveys only. Full Feature Inventory field efforts and resources are focused on higher priority areas in more urbanized subwatersheds.

Results/Findings

Only a Road Reconnaissance survey was performed in both Rock Creek and Salmon Creek (RM 22.20) subwatersheds. No other feature types were recorded. A total of 25 features were assessed during the Road Reconnaissance survey; 19 in the Rock Creek subwatershed and six in the Salmon Creek (RM 22.20) subwatershed. A breakdown of recorded features by type is presented in Table 11.

**Table 12: Summary of Features Recorded in Rock Creek and Salmon Creek (RM 22.20) Subwatersheds**

| | Number Recorded | |
|---|---|---|
| **Feature Type** | **Rock Creek** | **Salmon Creek (RM 22.20)** |
| RR – Road Reconnaissance feature | 19 | 6 |
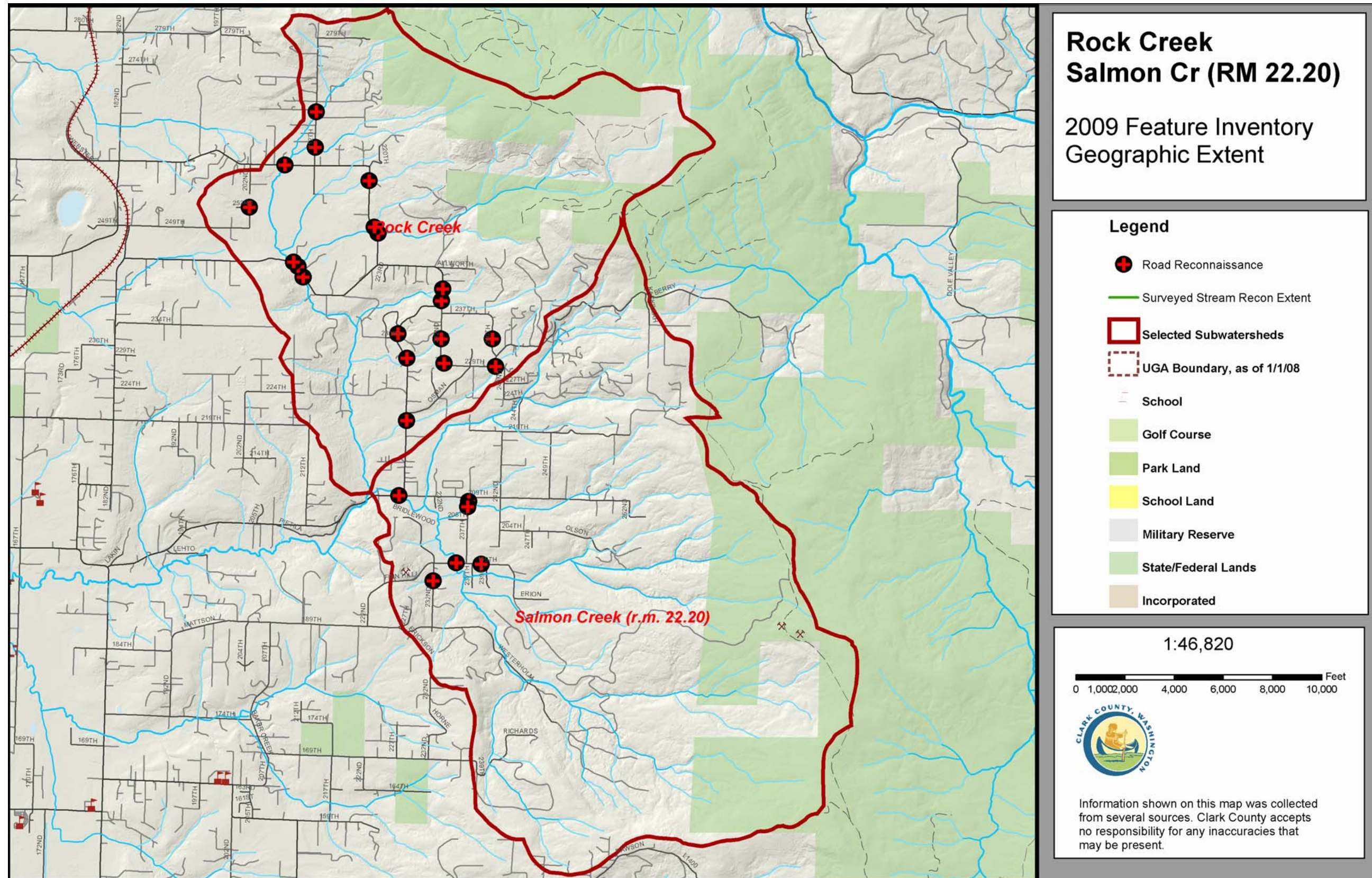
**Figure 6: Rock Creek and Salmon Creek (RM 22.20) Geographic Extent of 2009 Feature Inventory**

The following subsections contain general descriptions of the Rock Creek and Salmon Creek (RM 22.20) subwatershed conditions. The descriptions include observations, trends, and issues that were identified either during the field work or during subsequent review of collected information.

*Stormwater Infrastructure*
The stormwater conveyance to Rock Creek and its tributaries in the western portion of the subwatershed is mainly via agricultural field and roadside ditches. The eastern portion of the subwatershed is primarily forested.  Flow in the subwatershed is predominately north to south for larger tributaries, with first order inputs and smaller drainage pathways (manmade and otherwise) flowing to the primary streams from the east and west.

The stormwater conveyance to Salmon Creek (RM 22.20) and its tributaries in the northwestern portion of the subwatershed is mainly via agricultural field and roadside ditches. The eastern portion of the subwatershed is primarily forested.  Flow in the subwatershed is predominately east to west for larger tributaries, first order inputs, and smaller drainage pathways (manmade and otherwise).

The predominant source of stormwater in both subwatersheds appear to be runoff from agricultural land and rural residential developments draining to streams via small open channels such as field drain ditches, grassy swales, and roadside ditches. There are no public facilities that treat consolidated stormwater flow in either subwatershed.

*Riparian Vegetation*
Although riparian conditions were only observed from the roads surveyed during the Road Reconnaissance, it is clear that impacted stream buffers are common in both Rock Creek and Salmon Creek (RM 22.20) subwatersheds. In the western portion of Rock Creek subwatershed and the northwestern portion of Salmon Creek (RM 22.20) in particular, widespread agricultural land use has led to an overall lack of woody riparian vegetation that is adversely affecting water quality and stream bank stability. In general, blackberry is more common in areas with somewhat dense canopy cover. Reed canary grass is more common in areas with less dense canopy cover and wetter soil conditions. In most of the observed agricultural areas, invasive plant species are being kept in check through grazing or field mowing.

In the eastern parts of both subwatersheds, riparian areas are wider and more natural, with woody vegetation and canopy cover. Invasive reed canary grass and blackberry are prevalent adjacent to road crossings.

*Additional Results*
It is worth noting that the most significant impairments observed in the Rock Creek subwatershed were potential water quality impacts and widespread hydrologic impacts associated with agricultural land use. The alteration of natural drainage patterns by agriculture and the consolidation of surface flows at road crossings are having clear and significant impacts on stream stability, habitat, and riparian health.

<u>Potential Project Opportunities</u>
Listed opportunities represent potential projects or project areas. They are not fully developed projects, and therefore require additional evaluation and development by Clark County or consultant staff. Identifying them as potential projects in this document is the first step in the process of developing SCIP projects.

Potential project opportunities were identified based on the results of the Feature Inventory conducted in the Rock Creek and Salmon Creek (RM 22.20) subwatersheds. The CWP evaluated the potential projects for further development or referral to the appropriate organization. Each potential project is listed in tables, including the basis for the project and a description of the potential project. The location of each potential project is shown in Figure 7, Figure 8, and Figure 9, below. Potential project opportunities were categorized into six groups based on the nature of the potential work. Nine potential projects were identified. A summary of identified project opportunities by potential project category is shown in Table 13.

**Table 13: Breakdown of Potential Project Opportunities by Category**

| Table 12: Breakdown of Potential Project Opportunities by Category | | |
|---|---|---|
| **Potential Project Category** | **Potential Projects Identified in Rock Creek** | **Potential Projects Identified in Salmon Creek (RM 22.20)** |
| Emergency/Immediate Actions | 0 | 0 |
| Stormwater Facility Capital Improvement Projects | 0 | 0 |
| Stormwater Infrastructure Maintenance Projects | 0 | 0 |
| Habitat Restoration/Enhancement Projects | 0 | 0 |
| Property Acquisition for Habitat Preservation | 0 | 0 |
| Referral Projects for other Agencies | 7 | 2 |

**Rock Creek
Salmon Cr (RM 22.20)**

Location of Potential
Project Sites
(Sheet 1 of 3)

**Legend**

**Potential Project Types**

🔴 Emergency/Immediate Actions

🟪 Stormwater Facility Capital Improvement Projects

🔵 Stormwater Infrastructure Maintenance Projects

🔺 Habitat Restoration/Enhancement Project

⬠ Referral Projects for other Groups/Agencies

▭ Selected Subwatersheds

▯ UGA Boundary, as of 1/1/08

− School

1:3,341

Information shown on this map was collected
from several sources. Clark County accepts
no responsibility for any inaccuracies that
may be present.

**Figure 7: Rock Creek Location of Potential Project Sites**

**Rock Creek
Salmon Cr (RM 22.20)**

Location of Potential
Project Sites
(Sheet 2 of 3)

**Legend**

**Potential Project Types**

● Emergency/Immediate Actions

▪ Stormwater Facility Capital Improvement Projects

● Stormwater Infrastructure Maintenance Projects

▲ Habitat Restoration/Enhancement Project

⬠ Referral Projects for other Groups/Agencies

▭ Selected Subwatersheds

▭ UGA Boundary, as of 1/1/08

— School

1:4,239

| | | | | | | Feet |
|---|---|---|---|---|---|---|
| 0 | 120 | 240 | 480 | 720 | 960 | 1,200 |

Information shown on this map was collected
from several sources. Clark County accepts
no responsibility for any inaccuracies that
may be present.

**Figure 8: Rock Creek Location of Potential Project Sites**

**Rock Creek
Salmon Cr (RM 22.20)**

Location of Potential
Project Sites
(Sheet 3 of 3)

**Legend**

**Potential Project Types**

- 🔴 Emergency/Immediate Actions
- 🟪 Stormwater Facility Capital Improvement Projects
- 🔵 Stormwater Infrastructure Maintenance Projects
- 🔺 Habitat Restoration/Enhancement Project
- ⬟ Referral Projects for other Groups/Agencies
- ▭ Selected Subwatersheds
- ▭ UGA Boundary, as of 1/1/08
- School

1:8,659

| 0 | 245 | 490 | 980 | 1,470 | 1,960 | Feet 2,450 |

Information shown on this map was collected
from several sources. Clark County accepts
no responsibility for any inaccuracies that
may be present.

**Figure 9: Rock Creek and Salmon Creek (RM 22.20) Location of Potential Project Sites**

*Emergency/Immediate Actions*

Emergency/Immediate Actions require an immediate site response project to address a potential or imminent threat to public heath, safety, or the environment.

No projects of this type were identified during the Road Reconnaissance survey.

*Stormwater Facility Capital Improvement Projects*

Stormwater Facility Capital Improvement Projects are projects that create new or retrofit existing stormwater flow control or treatment facilities. Facility retrofits include projects that will increase an existing facility's ability to control or treat stormwater in excess of the original facility's design goals.

No projects of this type were identified during the Road Reconnaissance survey.

*Stormwater Infrastructure Maintenance Projects*

Stormwater Infrastructure Maintenance Projects include potential projects which address and repair maintenance defects affecting existing stormwater infrastructure. Infrastructure maintenance projects are required by the County NPDES municipal stormwater permit. Projects in this category with estimated costs exceeding $10,000 are considered under the SCIP process. Projects addressing simpler maintenance defects are referred directly to the County Public Works Operations and Maintenance staff.

No projects of this type were identified during the Road Reconnaissance survey.

*Habitat Restoration/Enhancement Projects*

Habitat Restoration/Enhancement Projects include potential projects which result in the restoration or enhancement of wetlands, upland forest, or riparian habitat. In-stream channel habitat and bank protection projects do not fall within the scope of Clark County's CWP, and are placed under the category of Referral Projects for other Groups/Agencies.

No projects of this type were identified during the Road Reconnaissance survey.

*Property Acquisition for Habitat Preservation*

Property Acquisition for Stormwater Mitigation Projects includes potential acquisitions of properties for any purpose that meets permit requirements to mitigate for stormwater impacts. This includes preservation or restoration of upland forest and riparian habitat zones.

No projects of this type were identified during the Road Reconnaissance survey.

*Referral Projects for Other Groups/Agencies*

Referral Projects for other Groups/Agencies includes potential projects that do not fall within the defined scope of Clark County's CWP. This includes, but is not limited to, in-channel restoration, agricultural BMPs, fish-passage barrier removals, and invasive plant management. It also includes referrals for projects such as trash removal, stream culvert repairs/maintenance, and

drainage projects. Referral Projects for other Groups/Agencies identified based on the results of the Feature Inventory are described in Table 14 and Table 15.

**Table 14: Description of Potential Referrals to Other Groups/Agencies – Rock Creek**

| Description of Potential Project Opportunities - Rock Creek | | |
|---|---|---|
| **ID** | **Basis for Project** | **Project Description** |
| RR-83 | Culvert under NE 212th Avenue (north of NE 266th Street) is a fish passage barrier due to an estimated 4-foot drop height at the outlet and lack of streambed material in barrel. | Conduct additional barrier analysis and replace crossing and restore channel to facilitate fish passage. |
| RR-68 RR-82 | Seasonal stream is channelized/ditched through agricultural field. Hayfields/pasture along both banks. | Reestablish native undergrowth and canopy vegetation to shade out invasive plants and enhance riparian habitat. |
| RR-81 | Small stream has been channelized both upstream and downstream of the NE 259th Street culvert crossing. The channel appears to be incising due to lack of LWD or other energy dissipating features. Right bank is sparsely wooded, but left bank is mowed hayfield to the top-of-bank. This is a potential source of nutrient loading and sediment contribution through channel erosion. | Develop a project to revegetate the riparian corridor with the cooperation of the landowner to reduce erosion and improve shading. Educate them on the importance of native riparian vegetation. Look into opportunities for channel stabilization using LWD. |
| RR-86 | Seasonal stream is channelized/ditched in some areas; widespread invasive plant species within floodplain. | Reestablish native undergrowth and canopy vegetation to shade out invasive plants and enhance riparian habitat. |
| RR-79 | Culvert not flow-aligned. | Investigate further. Culvert may require replacement to improve capacity and potential to pass fish. |
| RR-77 | Culvert not flow-aligned; Debris barrier functioning and may contribute to flooding issues if not replaced. | Investigate further. Culvert may require replacement to improve capacity and potential to pass fish. |

**Table 15: Description of Potential Referrals to Other Groups/Agencies – Salmon Creek (RM 22.20)**

| Description of Potential Project Opportunities - Salmon Creek (RM 22.20) | | |
|---|---|---|
| **ID** | **Basis for Project** | **Project Description** |
| RR-65 | Man made inline ponds; lack of riparian vegetation | Reestablish native undergrowth and canopy vegetation to shade stream and pond areas. |
| RR-66 | Widespread invasive plant species within the floodplain. Predominantly reed canary grass. | Eradicate reed canary grass. Reestablish native undergrowth and canopy vegetation on floodplain to shade out invasive plants and enhance riparian habitat. |

Stormwater Management Recommendations

A number of general stormwater management measures should be implemented throughout the Rock Creek subwatershed:

Due to the agricultural nature of the subwatershed, stormwater management recommendations should be closely coordinated with agricultural extension services, soil and water conservation districts, and other agencies that regularly work with farms and ranches. These agencies may already have educational and financial assistance programs available.

- Educate private landowners concerning importance of invasive plant removal, and suggest removal techniques.

- Educate private landowners on importance of native riparian vegetation for shading streams.

- Encourage appropriate agricultural practices that emphasize soil and water conservation and reduction in nutrient load to streams.

- Post stream identification signs where roads cross streams. Repair or replace deteriorated signs if necessary.

- Do not overlook stormwater and agricultural runoff inputs to small tributary streams that were not surveyed as a part of this Feature Inventory. These inputs may be more numerous than originally anticipated and likely represent the most significant source of water quality impairment in the subwatershed.

- Protect first-order tributary streams from further stormwater impacts by creating stream buffers, establishing conservation easements, and eliminating existing stormwater and agricultural runoff inputs. Encourage reforestation of lower gradient headwaters.

- Consider conducting additional investigation to locate water quality problems in reaches that are dominated by agricultural land use. Numerous ponds are evident in the aerial photography, and lack of riparian vegetation is widespread.

A number of general stormwater management measures should be implemented throughout the Salmon Creek (RM 22.20) subwatershed:

- Educate private landowners concerning importance of invasive plant removal and suggest removal techniques.

- Educate private landowners on importance of native riparian vegetation and intact riparian forests for shading streams and preserving hydrology. Emphasize conservation of undeveloped and forested areas, especially within the riparian corridor and floodplain.

- Post stream identification signs where roads cross streams. Repair or replace deteriorated signs if necessary.

- Do not overlook stormwater and agricultural runoff inputs to small tributary streams that were not surveyed as a part of this Feature Inventory. These inputs may be more numerous than originally anticipated and likely represent the most significant source of water quality impairment in the subwatershed.

- Protect first-order tributary streams from further stormwater impacts by creating stream buffers, establishing conservation easements, and eliminating existing stormwater and agricultural runoff inputs. Encourage reforestation of lower gradient headwaters.

## Physical Habitat Assessment

Purpose
Physical habitat assessments provide direct measurements of stream channel morphology, habitat conditions, and riparian conditions for specific stream reaches. This information can be used for planning projects and interpreting hydrologic, macroinvertebrate, and geomorphologic information at reach and subwatershed scales.

Methods
Physical habitat measurements were made for multiple reaches of Rock Creek (Rock 1, RM 0.0 to RM 0.3 and Rock 2, RM 0.3 to RM 1.1) and multiple reaches of Salmon Creek (Salmon 27, RM 21.3 to RM 22.3 and Salmon 32, RM 23.8 to RM 24.6) by R2 Resource Consultants, Inc. (December 2004) for the Lower Columbia Fish Recovery Board. The project followed modified USFS Level II protocols.

Results
The R2 Resource Consultants, Inc. (R2) report includes a good narrative summary of the habitat survey results, including figures and tables, some of which are presented here. The full report may be found on the CWP website at:
http://www.clark.wa.gov/water-resources/documents-monitoring.html#strmac

The Rock 1 survey reach is classified as a moderate gradient mixed control channel type. The reach has a map gradient of 1.0 percent. The channel is strongly controlled by bedrock; however, because of the small stream size, confinement is moderate. Habitat consists primarily of pools, which represents 59 percent of the survey reach habitat by length. Large and small riffles comprise the remainder of the habitat. The maximum depth of pools averages greater than 0.9 meters.

R2 noted that the dominant and subdominant substrate classes of streambed riffles are comprised of gravel (54 percent) and sand (29 percent). Embeddedness is rated in each habitat unit according to four categories (0-25%, 25-50%, 50-75%, and 75-100%). The overall mean embeddedness level is 31 percent. Table 16 summarizes habitat evaluations based on Washington Conservation Commission and NOAA Fisheries Properly Functioning Condition standards.

The Rock 2 survey reach is classified as a moderate gradient mixed control channel type. The reach has a map gradient of 1.1 percent. The valley appears to be controlled by bedrock; however, because of the small stream size, confinement is moderate, and there may be areas of low confinement in wider sections of the valley. Habitat consists primarily of pools, which represents 74 percent of the survey reach habitat by length. Small riffles and glides comprise the remainder of the habitat. The maximum depth of pools averages greater than 1.0 meter.

R2 noted that the dominant and subdominant substrate classes of streambed riffles are comprised of gravel (56 percent) and sand (34 percent). The overall mean embeddedness level is 47 percent. Table 17 summarizes habitat evaluations based on Washington Conservation Commission and NOAA Fisheries Properly Functioning Condition standards.

**Table 16 Summary of Habitat Evaluations of Rock Creek (Rock 1 Survey Reach) Based on Washington Conservation Commission and NOAA Fisheries Properly-Functioning Condition Standards**

| Parameter | WCC[1] | PFC[2] |
|---|---|---|
| % Pool by Surface Area | Good | |
| Pool Frequency | | Not properly functioning |
| Pool Quality | Fair | Not properly functioning |
| LWD | Poor | Not properly functioning |
| Substrate | Poor | Not properly functioning |
| Streambank Stability | Good | Properly functioning |
| Water temperature | Poor | Not properly functioning |

[1] Available Ratings: Good; Fair; Poor

[2] Available Ratings: Properly Functioning; At Risk; Not Properly Functioning

**Table 17: Summary of Habitat Evaluations of Rock Creek (Rock 2 Survey Reach) Based on Washington Conservation Commission and NOAA Fisheries Properly-Functioning Condition Standards**

| Parameter | WCC[1] | PFC[2] |
|---|---|---|
| % Pool by Surface Area | Good | |
| Pool Frequency | | Not properly functioning |
| Pool Quality | Fair | Not properly functioning |
| LWD | Poor | Not properly functioning |
| Substrate | Poor | Not properly functioning |
| Streambank Stability | Good | Properly functioning |
| Water temperature | | |

[1] Available Ratings: Good; Fair; Poor

[2] Available Ratings: Properly Functioning; At Risk; Not Properly Functioning

The upper Salmon 27 survey reach encompasses the lower portion of the Salmon Creek (RM 22.20) subwatershed. This survey reach is classified as a large, contained channel type. The reach has a map gradient of 1.4 percent. The channel is strongly controlled by bedrock. The lower section likely becomes semi-alluvial to alluvial, and has a lower gradient (0.5%). Habitat consists primarily of pools, which represents 49 percent of the survey reach habitat by length, followed by small riffle (40 percent), and lesser amounts of glide. The maximum depth of pools averages greater than 1.0 meter.

R2 noted that the dominant and subdominant substrate classes of streambed riffles are comprised of gravel (49 percent) and cobble (24 percent). The overall mean embeddedness level is 32 percent.

Table 18 summarizes habitat evaluations based on Washington Conservation Commission and NOAA Fisheries Properly Functioning Condition standards.

The Salmon 32 survey reach is classified as an incised footslope channel. The reach has a map gradient of 4.5 percent. The channel is strongly controlled by bedrock. Due to the high confinement and gradient, stream power is high. Habitat consists primarily of riffles, which represents 53 percent of the survey reach habitat by length, followed by pools (32 percent), and lesser amounts of glide. The maximum depth of pools averages greater than 0.6 meters.

R2 noted that the dominant and subdominant substrate classes of streambed riffles are comprised of gravel (47 percent) and sand (38 percent). The overall mean embeddedness level is 57 percent. Table 19 summarizes habitat evaluations based on Washington Conservation Commission and NOAA Fisheries Properly Functioning Condition standards.

# 2009 Stormwater Needs Assessment Program

**Table 18: Summary of Habitat Evaluations of Salmon Creek (Salmon 27 Survey Reach) Based on Washington Conservation Commission and NOAA Fisheries Properly-Functioning Condition Standards**

| Parameter | WCC[1] | PFC[2] |
|---|---|---|
| % Pool by Surface Area | Fair | |
| Pool Frequency | | Not properly functioning |
| Pool Quality | Good | Properly functioning |
| LWD | poor | Not properly functioning |
| Substrate | poor | Not properly functioning |
| Streambank Stability | good | Properly functioning |
| Water temperature | | |

[1] Available Ratings: Good; Fair; Poor

[2] Available Ratings: Properly Functioning; At Risk; Not Properly Functioning

**Table 19: Summary of Habitat Evaluations of Salmon Creek (Salmon 32 Survey Reach) Based on Washington Conservation Commission and NOAA Fisheries Properly-Functioning Condition Standards**

| Parameter | WCC[1] | PFC[2] |
|---|---|---|
| % Pool by Surface Area | Fair | |
| Pool Frequency | | Not properly functioning |
| Pool Quality | Poor | Not properly functioning |
| LWD | Fair | Properly functioning |
| Substrate | poor | Not properly functioning |
| Streambank Stability | good | Properly functioning |
| Water temperature | | |

[1] Available Ratings: Good; Fair; Poor

[2] Available Ratings: Properly Functioning; At Risk; Not Properly Functioning

## Geomorphology Assessment

A geomorphology assessment was not conducted.

## Riparian Assessment

### Purpose
The riparian assessment characterizes existing conditions based on available data, to identify general riparian needs, and potential areas for rehabilitation projects. Riparian enhancement projects, such as installation or protection of native plantings within riparian areas, can provide for increased future shading and woody debris recruitment which can further provide an opportunity for stormwater-related watershed improvement.

The need for riparian rehabilitation tends to be widespread and exceeds the scope and resources of the CWP mission of stormwater management. Therefore, potential riparian projects are usually referred to agencies such as the LCFRB, Lower Columbia Fish Enhancement Group (LCFEG), Clark Public Utilities, Fish First, the Washington State University (WSU) Watershed Stewards Program, and the Clark Conservation District for possible implementation.

This section focuses on opportunities likely to be considered by the CWP SCIP, which are primarily on publicly owned lands within high priority salmon-bearing stream reaches as defined by LCFRB salmon recovery priorities.

Method
Where possible, the assessment is based on GIS data from existing reports, primarily the Habitat Assessment reports prepared for the Lower Columbia Fish Recovery Board (R2 Resource Consultants, Inc., 2004), but also with analysis of the Salmon Creek Limiting Factors Analysis Report (HDR Engineering, Inc., 2002). These reports apply primarily to salmon-bearing stream reaches and therefore do not provide information for many smaller streams. Results are based on aerial photo interpretation using Washington Forest Practices Board methods for LWD delivery and channel shade estimates.

In streams where no data exists from the LCFRB characterization, an examination of current orthophotographs is used to make a general assessment of riparian condition and identify areas where restoration or preservation projects may be appropriate.

Many riparian project opportunities are discovered through other SNAP activities, including Rapid Stream Reconnaissance feature inventories and geomorphological assessments. Potential projects discovered through these activities are discussed in their respective sections, and most are included on a final list for referral to outside agencies.

The 2002 Salmon Creek Limiting Factors Analysis and 2002 Salmon Creek Watershed Analysis, along with the 2004 LCFRB Habitat Assessment report were also reviewed for specific project opportunities within each subwatershed. Potential project sites have been reviewed and verified through field reconnaissance and are detailed in the results.

Results
Results are based primarily on the 2004 LCFRB Habitat Assessment for the Salmon Creek (RM 22.20) and Rock Creek subwatersheds. The full characterization report is available on the Clark County website at:
http://www.clark.wa.gov/water-resources/documents.html#mon

For areas within the subwatersheds not included in the habitat assessment (several unnamed tributaries to Salmon Creek, Rock Creek, and Little Salmon Creek), LWD recruitment potential and shade rating analyses were based on a qualitative review of 2007 orthophotographs.

*Riparian (Large Woody Debris (LWD) Delivery)*

LWD recruitment potential frequency values as predicted by the Ecosystem Diagnosis and Treatment Model (EDT) for Salmon Creek (RM 22.20) and Rock Creek subwatersheds are summarized in Table 20.

Within the Salmon Creek (RM 22.20) subwatershed, the assessment reaches include portions of the mainstems of Salmon Creek and Little Salmon Creek, as well as several unnamed tributaries to Salmon Creek. Based on predicted LWD recruitment potential frequency, the mainstem of Salmon Creek is shown as having primarily "Fair" LWD recruitment potential (64% of reaches) along the distance assessed. The mainstem of Little Salmon Creek is shown as having "Poor" (~63% of reaches) and "Fair" (~37% of reaches) LWD recruitment potential along distance assessed.

A field surveyed reach of Salmon Creek (RM21.3 to RM 22.3) includes an approximately 0.75 mile reach of "Low" LWD recruitment potential on the mainstem of Salmon Creek, starting at about NE 206th St, continuing upstream (south) to approximately 0.3 miles south of NE199th St

Within the Rock Creek subwatershed, the assessment reaches include the mainstems of Rock Creek, as well as several unnamed tributaries to Rock Creek. Based on predicted LWD recruitment potential frequency, the mainstem of Rock Creek is shown as having mostly "Poor" (~44% of reaches) and "Fair" (~46% of reaches) LWD recruitment potential along distance assessed. Several unnamed tributaries to Rock Creek were also assessed having a similar mix of Poor (~52% of reaches), Fair (~37% of reaches), and Good (~11% of reaches) LWD recruitment potential.

A field surveyed reach of Rock Creek from NE 212th Ave, downstream to the confluence with Salmon Creek near NE 209th St/Risto Rd, contains areas of Poor (~42% of reaches), Fair (~47% of reaches), and Good (~11% of reaches) LWD recruitment potential.

Based on a qualitative review of 2007 orthophotographs, many of the unsurveyed riparian areas in the headwaters of both Rock Creek and Salmon Creek (RM 22.20) subwatersheds contain forest vegetation and are likely to have "Medium" or "High" LWD recruitment potential.

Figure 10 shows the Salmon Creek (RM 22.20) and Rock Creek subwatersheds LWD delivery potential.

**Table 20: Large Wood Recruitment for Salmon Creek (RM 22.20) and Rock Creek; EDT frequency based on 2002/2003 photo data sets (R2 Resource Consultants, Inc. 2004)**

| Condition | Frequency | |
|-----------|-----------|-------------------------|
|           | Rock Creek | Salmon Creek (RM 22.20) |
| Good      | 10%       | 15%                     |
| Fair      | 46%       | 64%                     |
| Poor      | 44%       | 21%                     |
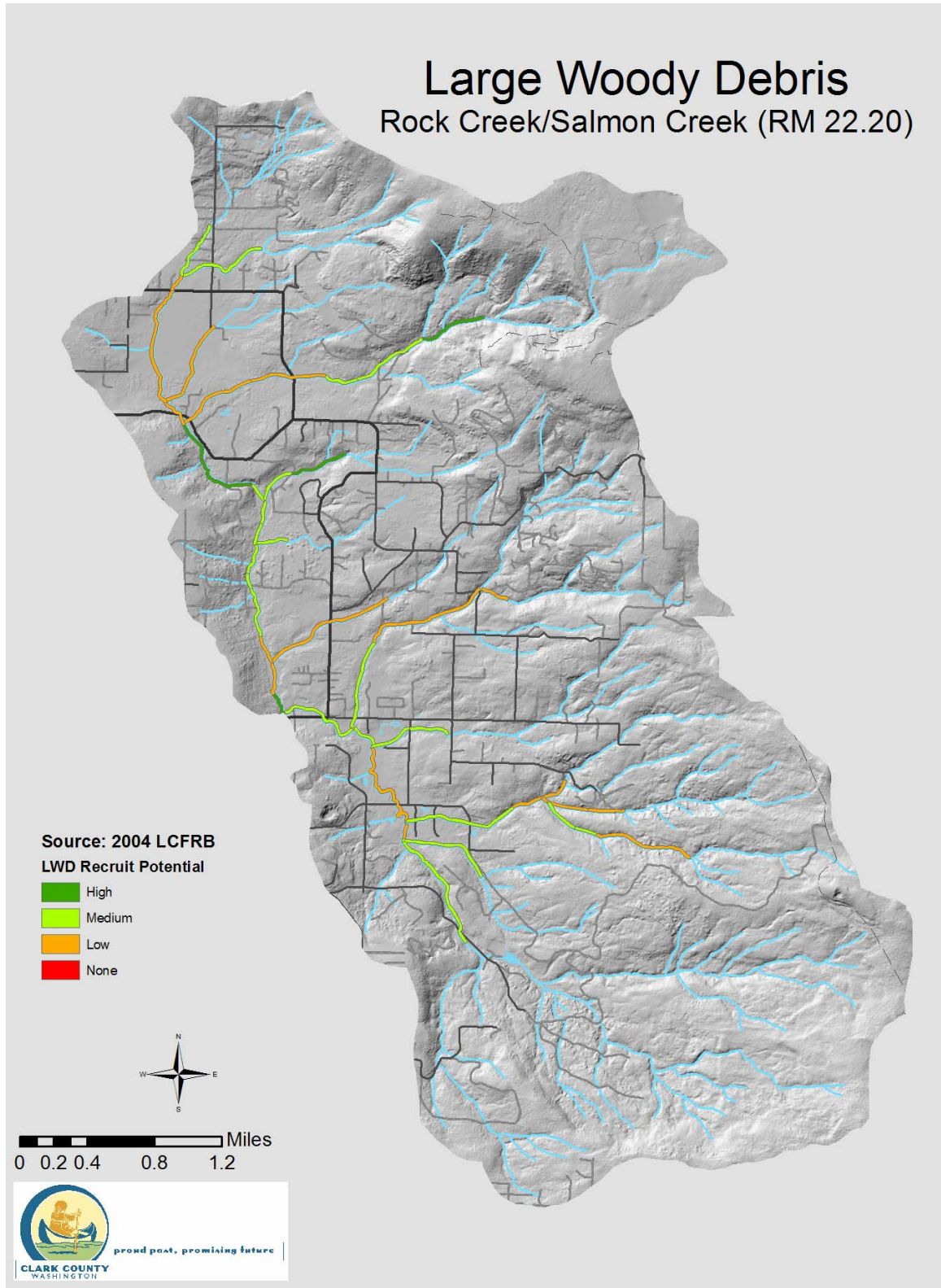
**Figure 10: Rock Creek and Salmon Creek (RM 22.20) LWD Recruitment Potential (adapted from R2 Resource Consultants, Inc., 2004)**

*Shade*

The Salmon Creek (RM 22.20) and Rock Creek subwatersheds shade ratings from the 2004 LCFRB Habitat Assessment are illustrated on Figure 11. Within the Salmon Creek (RM 22.20) subwatershed, the survey includes portions of the mainstems of Salmon Creek and Little Salmon Creek, as well as several unnamed tributaries to Salmon Creek. The mainstem of Salmon Creek within the Salmon Creek (RM 22.20) subwatershed has shade levels ranging from 10 percent to 30 percent along the approximately 2.3 mile distance surveyed. Surveyed tributaries to Salmon Creek within this subwatershed also score generally low for shade, with most levels ranging from 0 percent to 30 percent with the exception of one reach measuring 55 percent for approximately 0.25 miles. Many of the non-surveyed tributaries to Salmon Creek contain forest vegetation and are thus likely to have relatively high levels of shade.

The mainstem of Little Salmon Creek within the Salmon Creek (RM 22.20) subwatershed has shade levels ranging from 30 percent to 55 percent along the approximately 1.5 miles surveyed. Review of the non-surveyed areas of Little Salmon Creek contain forest vegetation and are thus likely to have relatively high levels of shade, based on orthophotography review.

Within the Rock Creek subwatershed, shade ratings were in the range of 10 to 55 percent in the surveyed reaches of the mainstem of Rock Creek The uppermost reaches of Rock Creek (which were not formally surveyed) contain mostly forested vegetation which would lead to relatively high shade values, but also contain smaller areas where tributaries pass through more open fields.

The LCFRB habitat assessment for the Salmon Creek (RM 22.20) and Rock Creek subwatersheds indicated that the majority of the reaches are currently off-target with respect to the State Forest Practices shade/elevation screen standards.

Management Recommendations

Overall recommended management activities for the Salmon Creek (RM 22.20) and Rock Creek subwatersheds include riparian forest restoration in areas degraded by residential land use and road improvement/realignment projects, acquisition of existing forest land for future protection of streams and watersheds, and invasive species removal.

Potential Projects

Potential riparian restoration projects for the Salmon Creek (RM 22.20) and Rock Creek subwatersheds were identified from review of the 2004 LCFRB Habitat Assessment report, along with the 2002 Salmon Creek Limiting Factors Analysis and 2002 Salmon Creek Watershed Analysis, with orthophotography analysis in areas not formally surveyed. Recommended restoration projects in the Salmon Creek (RM 22.20) subwatershed included riparian preservation by employing strategies to prevent riparian degradation on the mainstem of Salmon Creek, and large wood enhancement by placing wood in low gradient portions of tributaries. The mainstem of Salmon Creek, as well as some if its tributaries, are characterized as having low LWD recruitment potential and shade, and based on aerial photography would benefit from riparian plantings. However, there is no publicly owned land within the potential riparian restoration areas.

Recommended opportunities for the Rock Creek subwatershed included riparian preservation by employing strategies to prevent riparian degradation, and riparian large wood enhancement by hardwood conversion, conifer release, or riparian plantings.  Several reaches within the mainstem of Rock Creek (Rock1, Rock5, Rock6, Rock7) are characterized as having Poor LWD recruitment potential, as are several of its tributaries (LBtrib 9, LBtrib 8-1). These reached would likely benefit from riparian plantings. However, there is no publicly owned land within these potential riparian restoration areas.
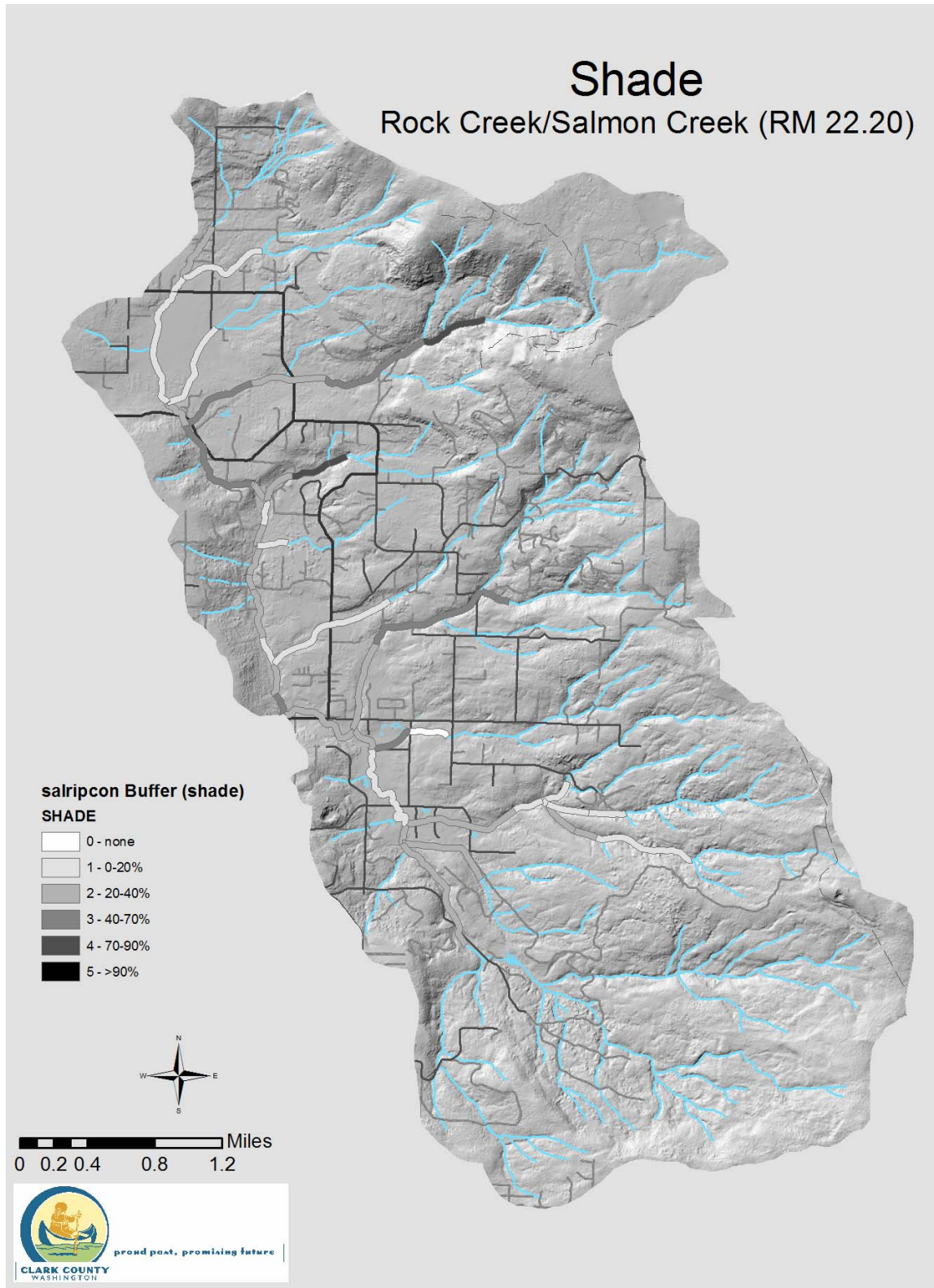
**Figure 11: Rock Creek and Salmon Creek (RM 22.20) Shade Values (adapted from R2 Resource Consultants, Inc, 2004)**

## Floodplain Assessment

A floodplain assessment was not conducted.

## Wetland Assessment

Purpose

Wetlands perform important hydrologic, water quality, and habitat functions. The primary reasons for the wetlands assessments are to:

- Describe wetland conditions related to how they influence hydrology, water quality, and habitat

- Identify priority potential wetland projects to mitigate for stormwater impacts

- Make management recommendations for wetlands related to stormwater management

A primary objective of the wetland assessment is to identify sites containing modestly sized, degraded or ditched wetlands where minor construction projects can be used to improve wetland hydrology. Improved wetland function can reduce peak storm discharges, increase groundwater recharge, and improve habitat through increasing biodiversity, species population health, and organic input.

Methods

The assessment includes review of existing GIS data for wetlands. Primary information sources are the county wetlands atlas, Draft Watershed Characterization of Clark County Version 3 (Ecology, 2007), and personal communication with other county programs.

Potential project sites have been reviewed and verified through field reconnaissance and are detailed in the results section below.

Tax-exempt parcels often indicate the presence of publicly owned land, schools, or churches where large parcel sizes and opportunities for leveraging may exist. Potential wetlands were overlaid with tax-exempt parcels and with county vacant buildable lands model (VBLM) information to identify possible wetland enhancement opportunities.

Results

Figure 12 shows potential wetland areas within the Rock Creek/Salmon Creek (RM 22.20) subwatersheds based on data from the county wetlands atlas, including the Clark County wetland model, National Wetlands Inventory, and high-quality wetlands layer.

The Rock Creek/Salmon Creek (RM 22.20) subwatersheds have potential wetland areas associated with the riparian corridors and floodplain areas. There is also a large complex of sloped wetlands in the headwater area of Rock Creek. A few depressional headwater wetlands and isolated wetlands are scattered in the southwestern portion of the Salmon Creek (RM 22.20) subwatershed. Table 21 shows the total area and proportion of wetland classes estimated to be present in the subwatershed.

**Table 21 Distribution of Wetlands by Hydrogeomorphic Class**

| HGM Class | Area (ac.) | % of Sub-basin* | % of total wetland |
|---|---|---|---|
| Slope Wetlands | 108 | 0.9% | 32% |
| Depressional Wetlands | 71 | 1.4% | 21% |
| Riverine Wetlands | 159 | 0.6% | 47% |
| All Wetlands | 588 | 2.9% | |

*Subwatershed area 11,754 Ac.

A majority of the wetlands outside the stream floodplains have been cleared and partially drained for agricultural or forestry use. There is some restoration potential; however there is no publicly held or tax-exempt land containing significant wetlands in these subwatersheds. With the exception of the Rock Creek headwater area these subwatersheds are a low priority for restoration of wetland functions.
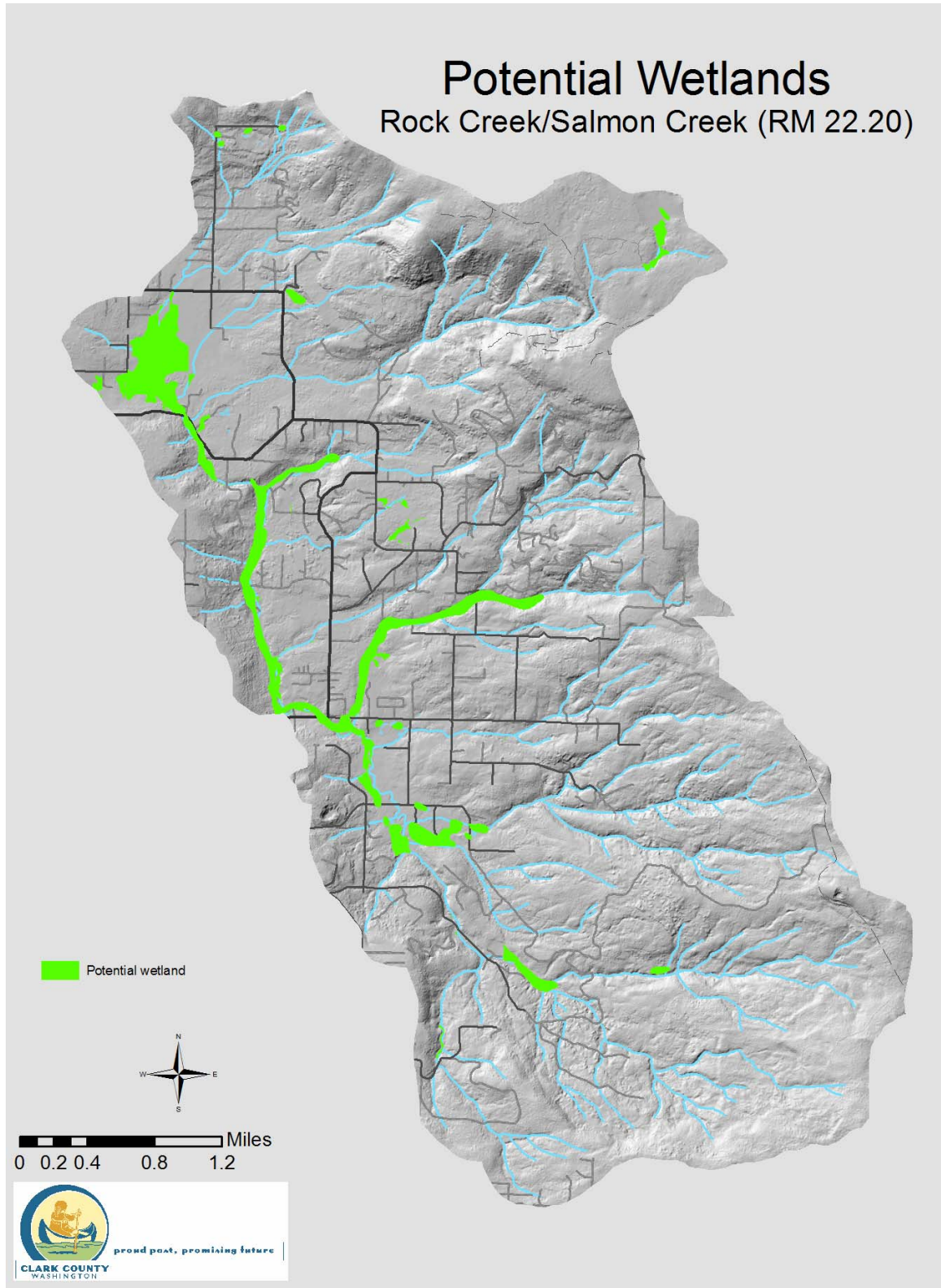
**Figure 12: Rock Creek and Salmon Creek (RM 22.20) Potential Wetlands**

*Watershed Characterization*

The Washington Department of Ecology completed a prototype watershed assessment to assist in planning wetland and riparian habitat restoration and preservation projects. The Watershed Characterization and Analysis of Clark County (Washington Department of Ecology, 2009) may be found on the Ecology website at:

http://www.ecy.wa.gov/mitigation/docs/09-06-019_small.pdf

Results pertaining to the Rock Creek/Salmon Creek (RM 22.20) subwatersheds are summarized below.

The Rock Creek/Salmon Creek (RM 22.20) subwatersheds are part of the Terrace hydrogeologic unit. This unit is dominated by rain; has a westward to southwestern trending groundwater flow pattern; a large delta (now a terrace) formed by glacial floods consisting of gravels, sand, silts and clay; and a relatively level to moderately steep topography in the foothills and slopes above the Columbia River (Ecology, 2009).

Figure 13 depicts priority areas for protection and restoration of hydrologic processes county-wide based on an analysis of the relative importance and level of alteration in each subwatershed.
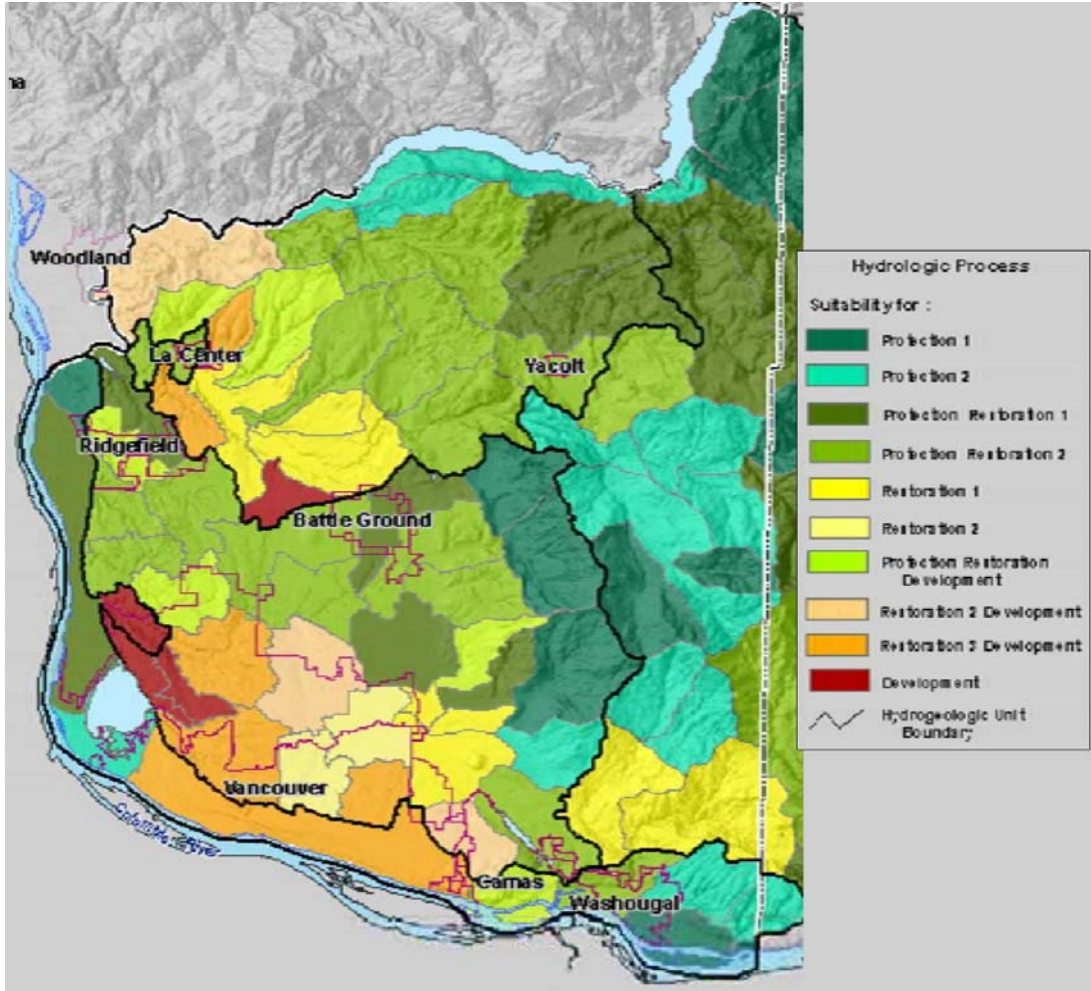
**Figure 13: Priority areas for protection and restoration of hydrologic processes (from Watershed Characterization and Analysis of Clark County (Ecology, 2009))**

In general, blue and green areas have higher levels of importance for watershed hydrologic processes and limited alteration and should be considered for protection. Yellow areas have a higher level of importance for watershed processes and a higher level of alteration and should be considered for restoration unless watershed processes are permanently altered by urban development. Orange to red areas have lower levels of importance for watershed processes and higher levels of alteration and should be considered as more suitable for development. Because orange areas represent a transition from restoration areas, planning measures employing both restoration and appropriately sited development should be considered (Ecology, 2007).

Protection (dark blue-green) is the hydrologic process priority for the Rock Creek/Salmon Creek (RM 22.20) subwatersheds.

# 2009 Stormwater Needs Assessment Program

## Macroinvertebrate Assessment

Purpose

The Benthic Macroinvertebrate Index of Biological Integrity or B-IBI (Karr, 1998) is a widely used measurement of stream biological integrity or health based on macroinvertebrate populations. Macroinvertebrates spend most of their lives in the stream substrate before emerging as adults. While in the stream, they are subject to impacts from continuous and intermittent pollutant sources, hydrology and habitat changes, and high summer water temperatures.

The B-IBI score is an index of ten metrics describing characteristics of stream biology, including: tolerance and intolerance to pollution, taxonomic richness, feeding ecology, reproductive strategy, and population structure. Each metric was selected because it has a predictable response to stream degradation. For example, stonefly species are often the most sensitive and the first to disappear as human-caused disturbances increase, resulting in lower values for the metric "Number of Stonefly taxa".

In addition to the overall B-IBI scores, examining individual metric scores gives insight into stream conditions and better explains differences in the overall score.

Methods

All field and laboratory work followed CWP protocols for macroinvertebrate sampling and analyses (June 2003). Samples are collected during late summer, preserved, and delivered to a contracted lab for organism identification, enumeration, and calculation of B-IBI metrics.

Raw data values for each metric are converted to a score of one, three, or five, and the ten individual metrics are added to produce an overall B-IBI score ranging from 10 to 50. Scores from 10 to 24 indicate low biological integrity, from 25 to 39 indicate moderate integrity, and greater than 39 indicate high biological integrity.

Results are influenced by both cumulative impacts of upstream land use and reach-specific conditions at or upstream of sampling sites. Thus, samples from a reach integrate local and upstream influences. Many of the B-IBI metrics are also influenced by naturally occurring factors in a watershed; for example, the absence of gravel substrate can lower scores.

Macroinvertebrate monitoring in the assessment area has occurred at multiple locations and varying frequencies. Rock Creek macroinvertebrate samples were collected near NE 224th Street for Clark Public Utilities in 2001 (Clark Public Utilities, 2002), and by the CWP above the Salmon Creek confluence near NE 209th Street (station ROC005 in 2004 and station ROC010 in 2008). Salmon Creek (RM 22.20) macroinvertebrate samples were collected near NE 199th Street in 1996 and 2001 (Clark Public Utilities, 2002) and from the creek's upper main stem near Salmon Creek Falls (station SMN085) by the CWP during 2004 (Clark County Public Works, 2005).

Results

Rock Creek total BIBI scores of 28 in 2001, 26 at ROC010 in 2004 and 34 at ROC005 in 2008 place them in the lower (2001 and 2004) to upper (2008) portions of the moderate biological integrity category.

Table 22 shows three low, six moderate, and one high score among the average yearly individual metrics at Station ROC010, compared to two low, four moderate, and four high at Station ROC005. Among metric scores there was one shift from low to moderate score and three shifts from moderate to high scores. Consistently low scoring intolerant taxa and percent predator taxa metrics for Stations ROC010 and ROC005 suggest degraded water and habitat quality, as well as decreasing diversity in prey items (Fore, 1999).

**Table 22: Station ROC010 and Station ROC005 Annual Macroinvertebrate Community Metrics and Total Scores from 2004 and 2008**

| B-IBI Metrics | ROC010 2004 | | | ROC005 2008 | | |
|---|---|---|---|---|---|---|
| | Value | Score | Category | Value | Score | Category |
| Total number of taxa | 36 | 3 | moderate | 45 | 5 | high |
| Number of Mayfly taxa | 7 | 3 | moderate | 6 | 3 | moderate |
| Number of Stonefly taxa | 3 | 1 | low | 7 | 3 | moderate |
| Number of Caddisfly taxa | 7 | 3 | moderate | 7 | 3 | moderate |
| Number of long-lived taxa | 8 | 5 | high | 5 | 5 | high |
| Number of intolerant taxa | 1 | 1 | low | 2 | 1 | low |
| Percent tolerant taxa | 34.3 | 3 | moderate | 15.1 | 5 | high |
| Percent predator taxa | 5.2 | 1 | low | 6.1 | 1 | low |
| Number of clinger taxa | 19 | 3 | moderate | 29 | 5 | high |
| Percent dominance (3 taxa) | 55 | 3 | moderate | 65 | 3 | moderate |
| Summary of avg. metric scores | 26 | moderate | | | 34 | moderate |
| | | | | | | |

Upper Salmon (RM 22.20) Creek's total B-IBI scores for 26 (1996) and 24 (2001) are on the boundary between the low and moderate categories while a more recent score of 38 (2004) at station SMN085 places it in the upper portion of the moderate biological integrity category. Table 23 shows two low, two moderate, and six high scores among the average yearly individual metrics at Station SMN085. Similar to Rock Creek, SMN085's low scoring intolerant taxa and

percent predator taxa metrics suggest signs of degraded water and habitat quality as well as decreasing diversity in prey items.

**Table 23: Station SMN085 Annual Macroinvertebrate Community Metrics and Total Score from 2004**

| B-IBI Metrics | SMN085 2004 | | |
|---|---|---|---|
| | **Value** | **Score** | **Category** |
| Total number of taxa | 44 | 5 | high |
| Number of Mayfly taxa | 7 | 3 | moderate |
| Number of Stonefly taxa | 7 | 3 | moderate |
| Number of Caddisfly taxa | 10 | 5 | high |
| Number of long-lived taxa | 9 | 5 | high |
| Number of intolerant taxa | 2 | 1 | low |
| Percent tolerant taxa | 17.1 | 5 | high |
| Percent predator taxa | 9.1 | 1 | low |
| Number of clinger taxa | 28 | 5 | high |
| Percent dominance (3 taxa) | 42.1 | 5 | high |
| Summary of avg. metric scores | | 38 | moderate |
| | | | |

Booth et al. (2004) found that there is a wide but well defined range of B-IBI scores for most levels of development, but observed overall that B-IBI scores decline consistently with increasing watershed total impervious area (TIA).

By comparing Rock Creek and Upper Salmon Creek B-IBI scores to the likely range of conditions for watersheds with similar amounts of development, measured as total impervious area, it is possible to make some general statements about the potential benefits from improving stream habitat.

Figure 14 shows that Station ROC010 and ROC005 B-IBI scores are generally in the middle of the range of expected scores (estimated 2000 Total Impervious Area from Wierenga, 2005). Figure 15 shows that the Station SMN085 B-IBI score is in the upper third of the range of expected scores.

Given all three of these B-IBI scores fall near the middle of the typical range for subwatersheds with about 10 percent impervious area, it is likely that factors other than impervious area are contributing to the relatively low scores. It is likely that biological integrity could be increased by improving habitat and stream conditions, particularly in the Rock Creek subwatershed which significantly underperforms given its relatively low TIA.

**Rock Creek (Salmon Creek Watershed)**
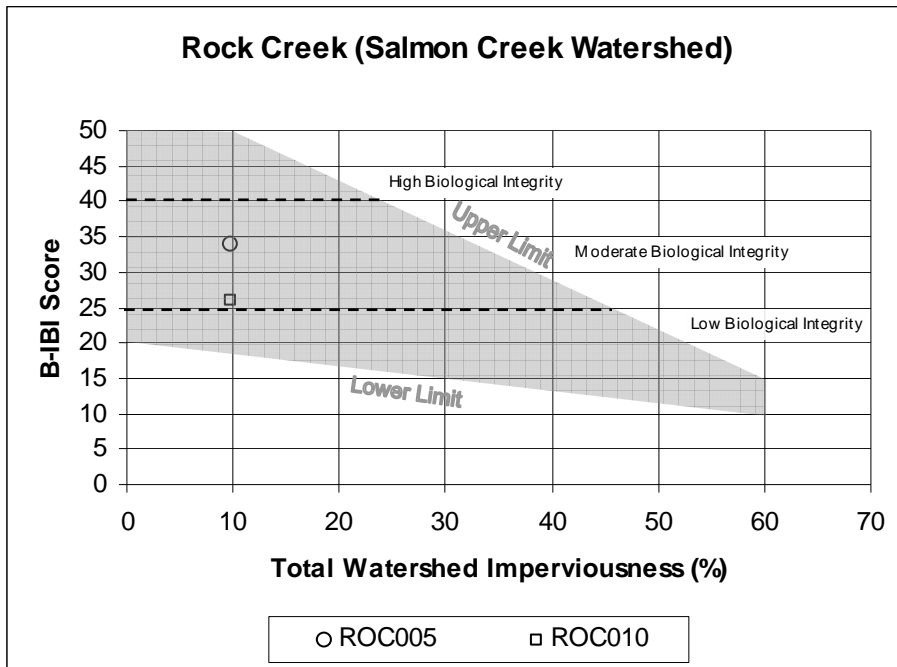
**Figure 14: Approximate range of B-IBI in Puget Lowland watersheds, showing progressive decline with increasing imperviousness in the upstream watershed. Adapted from Booth et. al., 2004. Markers indicate Total B-IBI scores at Station ROC005 and Station ROC010 for particular years, versus estimated 2000 subwatersheds TIA.**

**Salmon Creek (r.m. 22.2)**
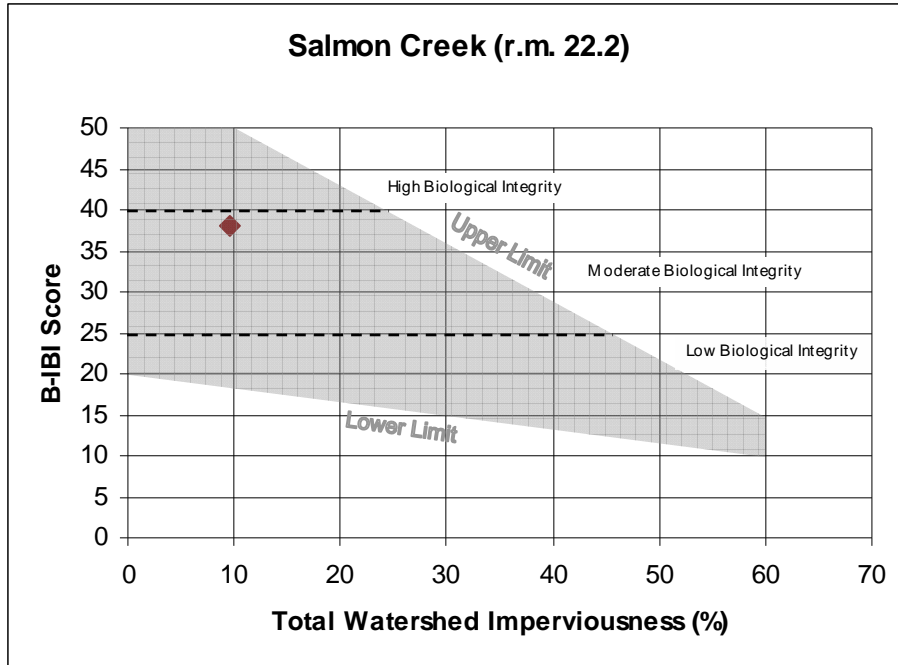


**Figure 15: Approximate range of B-IBI in Puget Lowland watersheds, showing progressive decline with increasing imperviousness in the upstream watershed. Adapted from Booth et. al., 2004. Markers indicate Total B-IBI scores at Station SMN085 for particular years, versus estimated 2000 subwatershed TIA.**

Management Recommendations

Rock Creek's moderate biological integrity significantly underperforms with respect to its relatively low TIA and suggests the need for management strategies that rehabilitate impaired habitat and minimize water quality impacts. To a slightly lesser extent, the same applies in Salmon Creek (RM 22.20) with a greater focus on protection and targeted rehabilitation.

Strategies might include protecting forested riparian areas and rehabilitating those that are impaired, promoting forestry best management practices, increasing overall forest cover, and minimizing sediment loading to streams.

## Fish Use and Distribution

Purpose

Fish distribution refers to salmon and steelhead use. This information helps to identify stream segments where land-use changes may impact fish populations, informs management decisions, and aids in identifying and prioritizing potential habitat improvement and protection projects.

Methods

Fish distribution for the Salmon Creek (RM 22.20) and Rock Creek subwatersheds is mapped from existing GIS information in the WDFW SalmonScape database, and is available at http://wdfw.wa.gov/mapping/salmonscape/

Several sources of barrier assessment data are available and are briefly summarized here, including:

- WDFW passage barrier database

- SalmonScape

- Clark County 1997 passage barrier data

- Clark Conservation District/LCFRB passage barrier dataset

Many stream crossings have not been assessed for passage barrier potential, and the extent of public and private road crossings is a good indicator of the potential for additional barriers. Road crossings were mapped by overlaying the county road layer with LiDAR-derived stream data.

The barrier assessment data was also reviewed for specific project opportunities within each subwatershed. Potential project sites have been reviewed and verified through field reconnaissance and are detailed in the results section below.

Results/Summary

*Distribution*

The available evidence suggests that anadromous fish use within the Salmon Creek (RM 22.20) subwatershed includes Coho salmon and winter steelhead (Figure 16 and Figure 17). SalmonScape also identifies the presumed presence of fall Chinook within a small portion of the mainstem of Salmon Creek (Figure 18). Chinook presence further upstream is likely constrained by the species limited spawning capability in headwater habitats.

The Rock Creek subwatershed also contains Coho salmon and steelhead, and fall Chinook are presumed present within the lower reaches of Rock Creek.
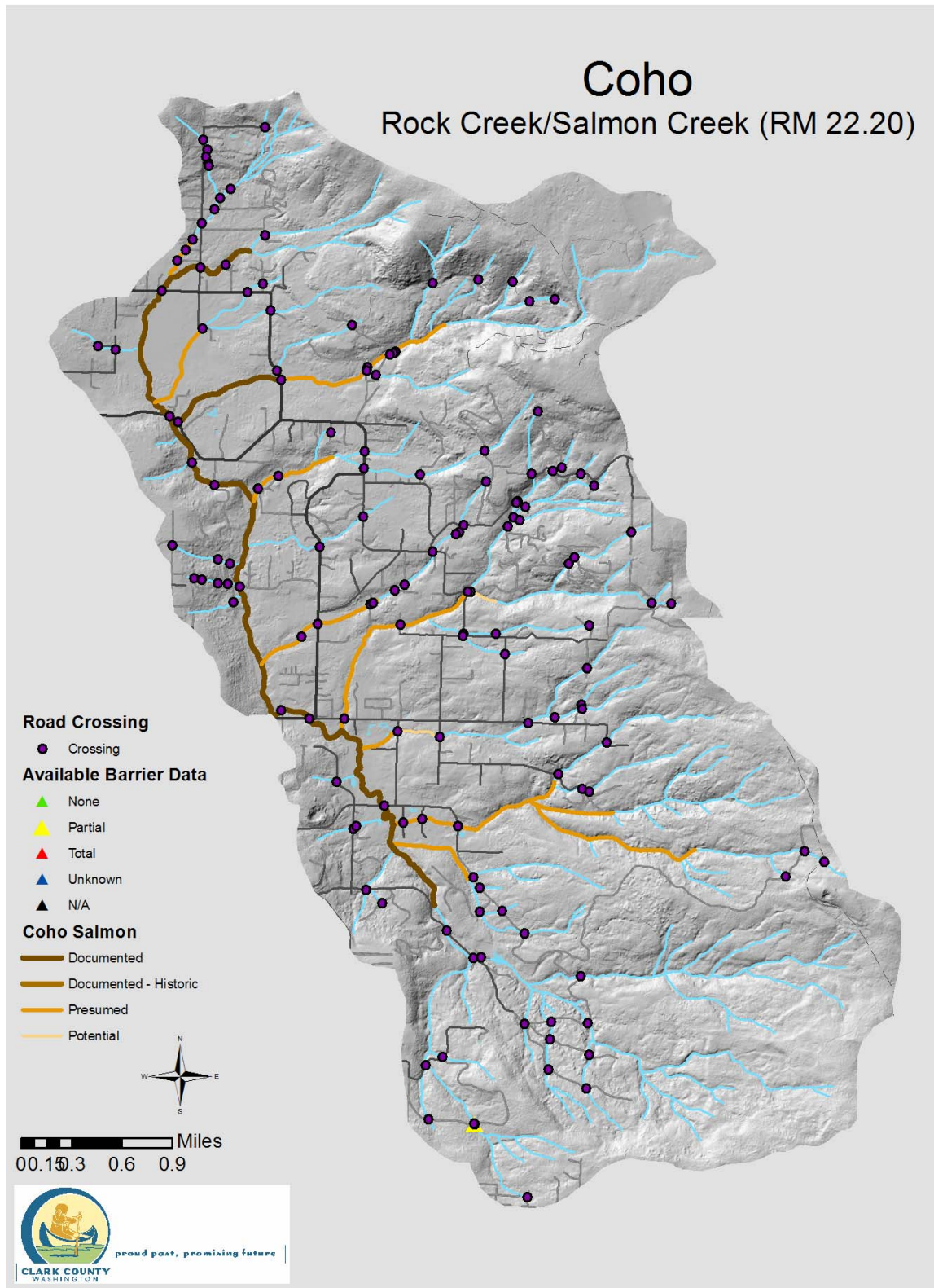
**Figure 16: Salmon Creek (RM 22.20) and Rock Creek Fish Distribution and Barriers**
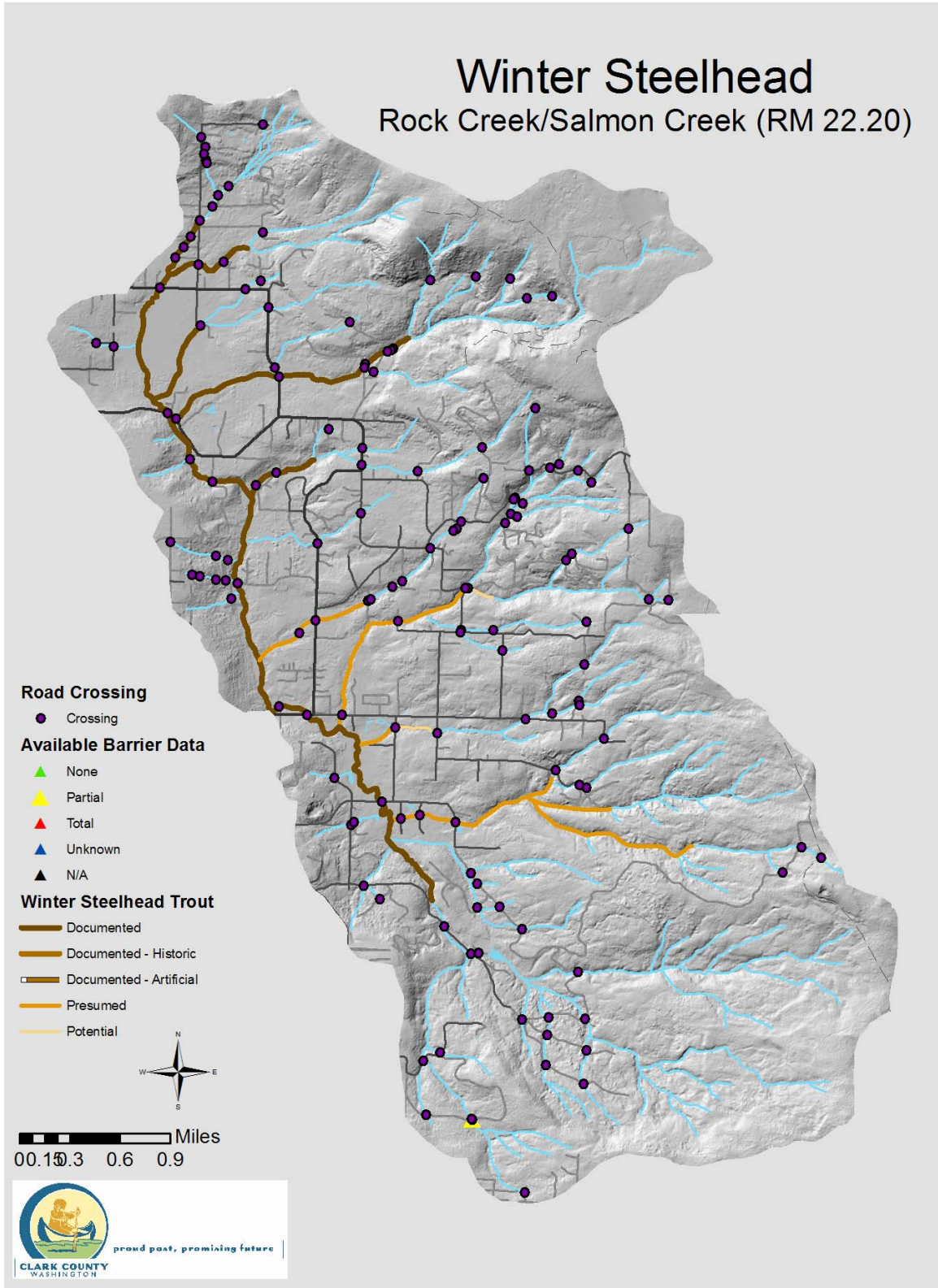
**Figure 17: Salmon Creek (RM 22.20) and Rock Creek Fish Distribution and Barriers**
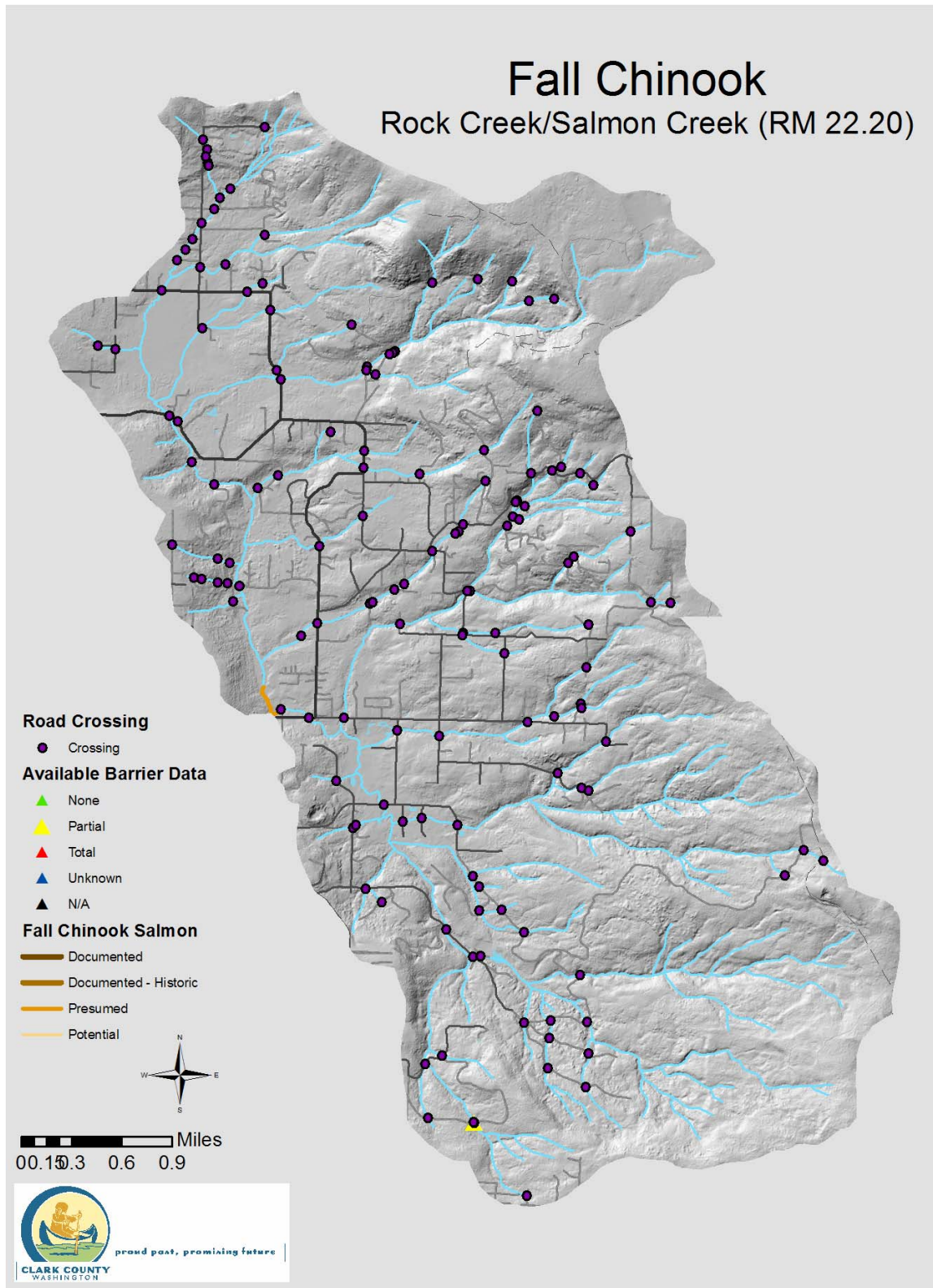
**Figure 18: Salmon Creek (RM 22.20) and Rock Creek Fish Distribution and Barriers**

Barriers

The WDFW barrier database provides the most complete assessment of barriers in the Salmon Creek (RM 22.20) and Rock Creek subwatersheds (Figure 16, Figure 17, and Figure 18).

The mapping does not show any known human-made barriers exist at this time. One partial barrier is mapped at Salmon Falls near the headwaters of Salmon Creek. However, Salmon Falls is a complete natural barrier to all anadromous fish passage.

Recommendations

There are no recommended fish passage projects for the Salmon Creek (RM 22.20) and Rock Creek subwatersheds at this time.

## Hydrologic and Hydraulic Models

A Hydrologic and Hydraulic Models analysis was not conducted.

## Analysis of Potential Projects

The analysis of potential projects:

- Briefly summarizes stormwater conditions, problems and opportunities.

- Notes recently completed or current projects within the study area that may be relevant to SNAP project selection.

- Describes the analytical approach.

- Lists recommended projects and activities for further evaluation.

Projects or activities are placed in one of several categories.

Project descriptions summarize more detailed descriptions found in report sections. Project planners are encouraged to reference the longer descriptions and also to utilize the information found for each potential project in the SNAP GIS database available from the Clean Water Program. Reference IDs for the database are included in the tables for each project.

## Summary of Conditions, Problems, and Opportunities

Conditions and Problems
This section briefly summarizes important results from the assessment chapters and identifies overall stormwater-related problems.

*Coordination with Other Programs*
The Washington Department of Ecology coordinates local agency actions as part of ongoing TMDL implementation and adaptive management. The Clean Water Program actively participates in TMDL development and implementation, and coordinates on an ongoing basis with the Lower Columbia Fish Recovery Board, Clark County Legacy Lands, and Vancouver-Clark Parks and Recreation. Clark Public Utilities is active in riparian habitat rehabilitation. The Salmon Creek Watershed Council provides a forum for citizens and organizations to participate in on the ground restoration, water quality and advocacy. The Clean Water Program regularly communicates with all of these entities.

*Broad-Scale Characterization*
Both of the study area subwatersheds are located in rural unincorporated Clark County. The study area is generally sloping west from a ridgeline separating Salmon Creek watershed from the East Fork Lewis River watershed and includes several streams draining west from the Cascade Mountains foothills to the main stem of Salmon Creek. The area is on the transition from upper Willamette Valley terraces (or Troutdale Bench) to the Cascade Mountain foothills. Land use is rural residential in lower elevations and forested on steeper hills and higher elevations in the eastern part of the study area.

Salmon Creek is at about 350 feet above sea level where it exits the study area below the confluence with Rock Creek. Salmon Creek and Rock Creek occupy a north-south trending

valley between 400 and 500 feet elevation. Tributary streams are generally in steep gradient, shallow canyons. Except for low gradient reaches near their confluence, both Salmon Creek and Rock Creek lack significant floodplains.

Standard subwatershed scale metrics such as percent forest, percent total impervious area, road density, and effective impervious area, when compared to NOAA fisheries standards, suggest stream habitat is generally properly functioning. These metrics include forest cover, TIA and EIA, road density, and stream crossing density.  Both subwatersheds have substantial forest cover, but forest cover is somewhat fragmented where residential development occurs outside of zoned forest lands. The forest cover metric suggests that Salmon Creek is properly functioning and Rock Creek is slightly below functioning. Percent TIA values are between the thresholds for non-functioning and functioning habitat for both subwatersheds.  Road density values are higher than thresholds for non-functioning for both subwatersheds.  Both stream crossing density and percent EIA values are in the properly functioning category. Based on the latest Clark County Comprehensive Plan, the estimated future subwatershed EIA for both subwatersheds is expected to change little in the near term.

*Water Quality Assessment*
Multiple stream segments within this assessment area are included on the 2008 303(d) Ecology list of impaired water bodies. The Salmon Creek (RM 22.20) subwatershed is Category 4a listed (polluted waters with an approved TMDL) for fecal coliform bacteria, and Category 5 listed (polluted waters that require a TMDL) for pH. There are no specific listings for Rock Creek.

A relatively large water quality dataset (2002-2009) is available for the area, as Clark County maintains a long-term station on Salmon Creek (SMN080; Salmon Creek at NE 199th Street) and has conducted a 2003 stream temperature study in this assessment area.

General water quality in this assessment area is good to excellent in upper Salmon Creek and largely unknown in Rock Creek. In upper Salmon Creek, trend analysis suggests that water quality is decreasing over time, largely due to increasing turbidity (lower turbidity scores).  If the current trend continues, Station SMN080 was predicted to fall out of the excellent category within about two years.

Fecal coliform bacteria are a concern throughout these subwatersheds.  Based on monthly data from 2005 - 2007, geometric mean fecal coliform concentrations and 90th percentile values decreased at station SMN080 significantly when compared to values from the 1995 TMDL making this station the only Salmon Creek station in full compliance with the state criteria and TMDL targets.

Continuous stream temperature monitoring (2003) in upper Salmon Creek and in Rock Creek indicated that neither stream met the current state criterion (7-day moving average of daily maximum temperatures) of 60.8 degrees F. Rock Creek was among the warmest locations and appeared especially susceptible to temperature changes; average daily temperature fluctuation in Rock Creek was greater than at any other station monitored.

*Drainage System Inventory and Condition*
The drainage system inventory is complete in this assessment area. Significant stormwater infrastructure inventory updates took place in 2008 and 2009; 2257 new features added, 2639 total features in assessment area.

Due to the absence public stormwater facilities in this assessment area, retrofit evaluations and inspection and maintenance evaluations were not conducted.

Off-site assessments were conducted at five priority outfalls discharging to critical areas and generated no potential project opportunities.

*Illicit Discharge Screening*
Illicit Discharge Detection and Elimination Screening assessment was not conducted.

*Stream Reconnaissance Feature Inventory*
A limited feature inventory, restricted to road reconnaissance survey only, was conducted within the assessment area. A total of 25 road crossing points were assessed; stormwater outfalls and culverts. Nine potential opportunities were identified in one category and included culvert analysis, invasives removal, and reestablishing native vegetation.

*Physical Habitat*
Physical habitat measurements in this assessment area were made in 2004 (R2 Resource Consultants, Inc., 2004) on portions of both the mainstem of Salmon Creek (RM 21.3 to RM 22.3 and RM 23.8 to RM 24.6) and Rock Creek (RM 0.0 to RM 1.1).

The upper end of the survey reach in Salmon Creek is classified as an incised footslope channel strongly controlled by bedrock. Due to the steep gradient of 4.5, high confinement and gradient, stream power is high. The lower end of the survey reach has a gradient of 1.4 percent and is strongly controlled by bedrock. Overall mean embeddedness level was 57 percent in the upper end of the survey reach and 32 percent in the lower end of the survey reach. Pool frequency and substrate were rated not properly functioning in both the upper and lower survey reaches. Streambank stability was rated as properly functioning in both the upper and lower survey reaches. Pool quality was rated as properly functioning in the lower survey reach, but rated not properly functioning in the upper survey reach.  LWD was rated as not properly functioning in the lower survey reach, but rated properly functioning in the upper survey reach.

Rock Creek is classified as a moderate gradient mixed control channel type and is strongly controlled by bedrock. Overall mean embeddedness level was between 31 and 47 percent. Pool frequency and streambank stability were rated as properly functioning. Pool quality, LWD, and substrate were rated not properly functioning.

*Geomorphology and Hydrology*
A geomorphology assessment was not conducted.

*Riparian Assessment*
The most reliable riparian assessment data for the study area's two subwatersheds are from the 2004 LCFRB Habitat Assessment. Their mainstem streams were both included in this assessment, while more recent qualitative assessments were made from orthophotos for their tributaries. In both Salmon Creek and Rock Creek, LWD recruitment potential is generally low to medium for the mainstem and medium to high for the headwater areas. Overall, shade levels for both subwatersheds were low, from 10 to 30 percent, with some areas of greater shade. The LCFRB habitat assessment indicated that the majority of the reaches are currently off-target with respect to the State Forest Practices shade/elevation screen standards.

*Wetland Assessment*
The Rock Creek and Salmon Creek (RM 22.20) subwatersheds have potential wetland areas associated with the riparian corridors and floodplain areas. There is also a large complex of sloped wetlands in the headwater area of Rock Creek. A few depressional headwater wetlands and isolated wetlands are scattered in the southwestern portion of the Salmon Creek (RM 22.20) subwatershed.

Ecology's watershed characterization of Clark County places the assessment area in a category suitable for protection. Under this category is defined as any activity that ensures that the watershed process remains relatively unimpaired.

*Macroinvertebrate Assessment*
Based on samples collected in 2001, 2004, and 2008, biological integrity is moderate throughout the Rock Creek assessment area. In Salmon Creek (RM 22.20), samples collected in 1996, 2001, and 2004, biological integrity is moderate throughout the assessment area.

B-IBI scores for both Rock Creek and Salmon Creek (RM 22.20) fall near the middle of the typical range for subwatersheds with about 10 percent impervious area. It is likely that factors other than impervious area are contributing to the relatively low scores. It is likely that biological integrity could be increased by improving habitat and stream conditions, particularly in the Rock Creek subwatershed which significantly underperforms given its relatively low TIA.

*Fish Use and Distribution*
The available information suggests that anadromous fish use in the Salmon Creek (RM 22.20) subwatershed includes Coho salmon, winter steelhead, and the presumed presence of fall Chinook within a small portion of the mainstem of Salmon Creek. Chinook presence further upstream is likely constrained by the species limited spawning capability in headwater habitats. The Rock Creek subwatershed also contains Coho salmon, steelhead, and the presumed presence of fall Chinook within the lower reaches of Rock Creek.

Mapping does not show any known human-made barriers to exist at this time. One unknown barrier is mapped at Salmon Falls near the headwaters of Salmon Creek. However, Salmon Falls is a complete natural barrier to all anadromous fish passage.

## Recently Completed or Current Projects

As of December 2009, there is one potential stormwater project listed in the CWP Capital Planning Database. This project, NE 229th Street Stormwater Control Facility, includes construction of a new facility to manage stormwater and an opportunity for wetland enhancement/reforestation.  There are no proposed stormwater projects in the assessment area in the Public Works 2010-2015 TIP.

## Analysis Approach

<u>Purpose</u>
The Analysis of Potential Projects narrows the initial list of possible opportunities to a manageable subset of higher priority potential projects. Listed opportunities in sections of the SNAP report include sites requiring immediate follow-up, possible stormwater capital improvement projects, referrals to ongoing programs, and potential projects for referral to other county departments or outside agencies.

Stormwater capital improvement project opportunities are recommended for further evaluation by engineering staff, and potential development into projects for consideration through the SCIP process. Referrals to ongoing programs such as illicit discharge screening, operations and maintenance, and source control outreach receive follow-up within the context and schedules of the individual program areas. Referrals to other county departments, such as Public Health, or to outside agencies such as Clark Conservation District and Clark Public Utilities, may lead to additional activities outside the CWP scope.

<u>Methods</u>
An initial review is conducted for all potential projects identified during the stormwater needs assessment. Field notes, descriptions, field photos, and other associated information are reviewed. In some cases, additional field reconnaissance is performed.

In general, potential capital projects are evaluated by CWP staff considering problem severity, estimated cost and benefits, land availability, access, proximity and potential for grouping with other projects, and potential for leveraging resources. Staff considers supporting data and information from throughout the SNAP report to assist in the initial project review.

Based on this review, lower priority opportunities are removed and higher priority projects are recommended for further consideration by the CWP.

## Emergency/Immediate Actions

No projects of this type were identified.

## Potential Stormwater Capital Projects

Stormwater Facility Capital Improvement Projects

| ID | Basis for Project | Project Description | Action |
|---|---|---|---|
| **Rock Creek** | | | |
| OS-159 | Large parcel with favorable topography and hydrology for riparian enhancement and reforestation project. Drainage receives untreated stormwater from roads; potential source of water quality impairments. | Investigate the feasibility of obtaining property (Tax lot 235375000) and restoring/enhancement of riparian habitat, reforesting parcel, and construction of facility to treat stormwater runoff for water quality improvement. | Refer to CWP Capital Planning |
| **Salmon Creek (RM 22.20)** | | | |
| OS-160 | Large parcel with favorable topography and hydrology for construction of stormwater facility. Drainage receives untreated stormwater from roads; potential source of water quality impairments. | Investigate the feasibility of obtaining property (Tax lot 201164000) and restoring/enhancement of riparian habitat, reforesting parcel, and construction of facility to treat stormwater runoff for water quality improvement. | Refer to CWP Capital Planning |

Stormwater Infrastructure Maintenance CIPs
No projects of this type were identified.


Stormwater Class V Underground Injection Control (UIC) Projects
No projects of this type were identified.


Habitat Rehabilitation/Enhancement Projects

| ID | Basis for Project | Project Description | Action |
|---|---|---|---|
| **Rock Creek** | | | |
| OS-161 OS-162 OS-163 | Three potential projects:<br><br>Large parcels with favorable topography and hydrology for wetland creation/ enhancement projects. Located downstream of large agricultural areas and other potential sources of water quality impairments. | Investigate the feasibility of obtaining properties (tax lot 235683000, 235681000, and 235611000) and developing wetland complexes for habitat enhancement and water quality improvement. | Refer to CWP Capital Planning |

| OS-164 | Large parcel with favorable topography and hydrology for riparian enhancement and reforestation project. Property contains about 3000 feet of Rock Creek upstream of Salmon Creek confluence. | Investigate the feasibility of obtaining property (Tax lot 986027543) and restoring/enhancement of riparian habitat, reforesting parcel for stormwater mitigation. | Refer to CWP Capital Planning |
|---|---|---|---|
| **Salmon Creek (RM 22.20)** | | | |
| OS-165 OS-166 | Two potential projects:<br><br>Large parcels with favorable topography and hydrology for wetland creation/ enhancement projects. Drainages receive untreated stormwater from roads; potential source of water quality impairments. | Investigate the feasibility of obtaining properties (Tax lot 1213890444 and 202570000) and developing wetland complexes for habitat enhancement and construction of facility to treat stormwater runoff for water quality improvement. | Refer to CWP Capital Planning |
| OS-167 | Large parcel with favorable topography and hydrology for riparian enhancement and reforestation project. | Investigate the feasibility of obtaining property (Tax lot 121389027) and restoring/enhancement of riparian habitat, reforesting parcel for stormwater mitigation. | Refer to CWP Capital Planning |

Property Acquisition for Habitat Preservation

| ID | Basis for Project | Project Description | Action |
|---|---|---|---|
| **Salmon Creek (RM 22.20)** | | | |
| OS-168 OS-169 | Two potential acquisitions:<br><br>Large parcels with intact forest in headwater areas. | Investigate the feasibility of obtaining properties (Tax lot 236838000 and 236742000) for habitat preservation. | Refer to CWP Capital Planning |
| OS-170 | Large streamside property parcel containing Salmon Creek with intact forest. | Investigate the feasibility of obtaining property (Tax lot 200974000) for habitat preservation. | Refer to CWP Capital Planning |

## Follow-up Activities for Referral within CWP

Private Stormwater Facilities Maintenance
No projects of this type were identified.

Public Works Stormwater Infrastructure Maintenance
No projects of this type were identified.

CWP Outreach/Technical Assistance

| ID | Basis for Project | Project Description | Action |
|---|---|---|---|
| **Rock Creek** | | | |
| RR-68 RR-82 | Two locations:<br><br>Seasonal streams channelized/ditched through agricultural fields. Hayfields/pasture along both banks. | Reestablish native undergrowth and canopy vegetation to shade out invasive plants and enhance riparian habitat. | Refer to DES Outreach |
| RR-81 | Small stream has been channelized both upstream and downstream of the NE 259th Street culvert crossing. The channel appears to be incising due to lack of LWD or other energy dissipating features. Right bank is sparsely wooded, but left bank is mowed hayfield to the top-of-bank. This is a potential source of nutrient loading and sediment contribution through channel erosion. | Revegetate the riparian corridor to reduce erosion and improve shading. Educate landowner on the importance of native riparian vegetation. Look into opportunities for channel stabilization using LWD. | |
| RR-86 | Seasonal stream is channelized/ditched in some areas; widespread invasive plant species within floodplain. | Reestablish native undergrowth and canopy vegetation to shade out invasive plants and enhance riparian habitat. | |
| **Salmon Creek (RM 22.20)** | | | |
| RR-65 | Man made inline ponds; lack of riparian vegetation | Reestablish native undergrowth and canopy vegetation to shade stream and pond areas. | Refer to DES Outreach |
| RR-66 | Widespread invasive plant species within the floodplain. Predominantly reed canary grass. | Eradicate reed canary grass. Reestablish native undergrowth and canopy vegetation on floodplain to shade out invasive plants and enhance riparian habitat. | |

CWP Infrastructure Inventory
No projects of this type were identified.

CWP Illicit Discharge Screening
No projects of this type were identified.

# 2009 Stormwater Needs Assessment Program

Projects for Referral to Other County Departments, Agencies, or Groups

| ID | Basis for Project | Project Description | Action |
|---|---|---|---|
| **Rock Creek** | | | |
| RR-83 | Culvert under NE 212th Avenue (north of NE 266th Street) is a fish passage barrier due to an estimated 4-foot drop height at the outlet and lack of streambed material in barrel. | Conduct additional barrier analysis; add to passage barrier database. | Refer to WDFW |
| RR-79 | Culvert not flow-aligned. | Investigate further. Culvert may require replacement to improve capacity and potential to pass fish. | Refer to Public Works Operations |
| RR-77 | Culvert not flow-aligned; Debris barrier functioning and may contribute to flooding issues if not replaced. | Investigate further. Culvert may require replacement to improve capacity and potential to pass fish. | |

## Non-Project Management Recommendations

Non-project stormwater management recommendations address areas where county programs or activities could be modified to better address NPDES permit components or promote more effective mitigation of stormwater problems. Information of this type contributes to adaptive management strategies and more effective stormwater management during the permit term.

Management and programmatic recommendations in the study area subwatersheds, by NPDES permit component, include:

Storm Sewer Mapping and Inventory
- Mapping complete for existing storm sewer infrastructure. Continue mapping all new storm sewer infrastructure as development increases with the goal of maintaining a complete stormwater infrastructure inventory

Coordination of Stormwater Activities
- Continue participation in Ecology's TMDL development process

- Continue to pursue collaborative habitat restoration projects along the mainstem of Salmon Creek

Mechanisms for public involvement
- Publish SNAP reports on CWP web page

Development Regulations for Stormwater and Erosion Control
- None

Stormwater Source Control Program for Existing Development
- Continue to expand efforts to design and build runoff reduction strategies in county right-of-way

- Focus on protecting reaches that are currently unstable or sensitive to future disturbance

Operation and Maintenance Actions to Reduce Pollutants
- None

Education and Outreach to Reduce Behaviors that Contribute Stormwater Pollution
- Encourage landowners to adopt appropriate agricultural practices that emphasize soil and water conservation and reduction in nutrient load to streams.

- Perform targeted technical assistance responding to results of field assessments

- Develop literature and distribute to landowners educating about the water quality impacts and other potential hazards on on-line and off-line ponds

- Educate private landowners on importance of native riparian vegetation and intact riparian forests for shading streams and preserving hydrology

- Replace missing or deteriorated stream name signs

- Continue education and public outreach efforts regarding Clark County's Stormwater Facility Maintenance Manual focused on private stormwater facility owners to maintain county stormwater facility maintenance standards.

TMDL Compliance

- Continue collaboration on Salmon Creek TMDL development. Clark County fulfills its TMDL compliance obligations through ongoing implementation of the Stormwater Management Program

Monitoring Stormwater Program Effectiveness

- None

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