2009 Stormwater Needs Assessment

Flume Creek

Clark County Clean Water Program

Protecting water through stormwater management

2009 Stormwater Needs Assessment Program

Flume Creek
Subwatershed Needs Assessment Report

Clark County Public Works Clean Water Program

March 2010

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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 Flume Creek subwatershed in western Clark County.

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 Flume Creek subwatershed including water quality, biological health, habitat, hydrology, and the stormwater system.

Ongoing Projects and Involvement

There are no ongoing stormwater projects specifically designated for the Flume Creek subwatershed. However, several county-wide Clean Water Program (CWP) ongoing activities such as outreach, stormwater regulations, and maintenance programs indirectly benefit Flume Creek by reducing potential negative impacts. Recent aquatic insect monitoring by the CWP has also provided baseline information for assessing future stream health.

Category	Status
Water Quality	
Overall	• Estimated poor, based on amount of developed area and intact forest
Biological	
Benthic macroinvertebrates	• Moderate biological integrity; potential for improvement through habitat rehabilitation
Anadromous fish	• Presumed presence of Coho salmon and winter steelhead • No known fish barriers
Habitat	
NOAA Fisheries criteria	• Forest cover, total impervious area, and road density metrics suggest habitat is Non-Functioning • Stream crossing density and estimated effective impervious area fall at the margin of the Properly Functioning category
Riparian	• Riparian areas mostly forested; streams run in steep valleys • Large woody debris recruitment potential is good • Relatively high levels of streamside shade
Wetland	• Primarily limited to riparian areas with some in headwater areas • Ecology watershed characterization management category is protection and restoration
Hydrology and Geomorphology	
Overall hydrology	• No hydrologic data is available but likely typical for a partly forested watershed and altered by runoff from developed areas
Future condition	• Projected impervious area suggests stream habitat is at margin between functioning and non-functioning • Given the subwatershed's proximity to the City of Ridgefield, future impervious area likely will increase over current levels • Unless increased impervious area impacts are mitigated, further altering of hydrology and more unstable channels are likely
Stormwater (unincorporated areas)	
System description	• Primarily road-side ditches with limited piped infrastructure
Inventory status	• Complete; 800 stormwater infrastructure features mapped
System adequacy	• Adequate treatment is probably provided by vegetation in ditches • No flow control other than infiltration in ditches
System condition	• No public stormwater facilities or retrofit opportunities in subwatershed • One high priority outfall assessed and found in compliance

Opportunities

Opportunities for stormwater-related projects are limited in this assessment area. However, field work and review of existing information identified several projects and actions that can improve stream conditions, including the following:

- Focused stormwater outreach and education for streamside landowners based on assessment results
- Evaluation of one potential reforestation / habitat enhancement project

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:

- Encourage coordination between Clark County and the City of Ridgefield for leveraged stormwater capital project opportunities
- Clark County should encourage off-site wetland mitigation where feasible to restore or enhance wetland functions, particularly in the headwater areas
- City of Ridgefield should consider emphasizing protection and restoration of limited existing wetlands as the city expands to the south
- Clark County should consider increasing the frequency and scope of off-site assessments for stormwater outfalls in critical areas especially given the study area's steep valley slopes
- Encourage appropriate agricultural practices that emphasize soil and water conservation, livestock exclusion fencing, and reduction in nutrient loads to streams
- Educate private landowners on importance of native riparian vegetation and intact riparian forests for shading streams and preserving hydrology

Introduction

This Stormwater Needs Assessment includes the Flume Creek subwatershed. 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 Flume Creek

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, Flume Creek subwatershed is categorized as "Rural Residential Including City Serviced Fringes of Urban Growth Area".

Subwatersheds in this category typically include rural areas bordering cities. These subwatersheds often score a high priority for stormwater management in general, but are a lower priority for Clark County due to the rural nature of unincorporated portions. Stormwater management needs tend to be limited in these areas. Urban development in this assessment area is controlled by the city of Ridgefield.

Assessment Tools Applied in Flume Creek

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 coordinator 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 of 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 (improper manure storage, livestock access to the stream, etc.) and identified a suggested management practice to lessen negative impacts on water quality (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 coordinator 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 the following:

- 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 Flume Creek needs assessment area:

- Clark County Public Works Private Stormwater Facility Inspections
- Clark County Legacy Lands Program
- Vancouver/Clark County Parks and Recreation

- City of Ridgefield Public Works Department

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 303(d) list
- Ecology Watershed Characterization and Analysis of Clark County (2009)
- Ecology EIM data
- Clark County 2004 Subwatershed summary
- Clark County 2004 Stream Health Report
- 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

Map Products

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.

General Conditions and Subwatershed Metrics

General Geography

Flume Creek subwatershed includes Flume Creek and several other smaller creeks draining to Lake River between Whipple Creek and Gee Creek. Most of the area is outside the urban growth area boundary, but a part of the subwatershed is within the Ridgefield urban growth area. Generally, the creeks are small unnamed creeks that headwater in rolling hills and form canyons draining to Lake River. The area is on the relatively level Willamette Valley floor (Figure 1). Land use is rural, with urbanization in Ridgefield.

Topography

The study area is generally low rolling hills between 200 and 300 feet in elevation, with a high point at about 450 foot elevation in upper Flume Creek. The rolling hills are cut by tributary streams to Lake River. Lake River, running along the east edge of the Columbia River flood plain, forms the west boundary for Flume Creek subwatershed. Streams in Flume Creek subwatershed lack flood plains except for the lowermost parts on the Columbia River flood plain.

Geology and Soils

The oldest rocks in the study area are sedimentary rocks deposited by the ancestral Columbia and local streams. These gravel and sandstone deposits are exposed where streams have cut through Ice age Cataclysmic Flood deposits of sand and silt that blanket the area below about 350 feet elevation. Weathered gravel deposits are also exposed on higher hills above 350 feet in elevation.

Fine-grained Ice Age Cataclysmic Flood deposits mantle most of the area and form fine loamy soils. These deposits are easily eroded and are prone to landslides in steep canyons.

Recent sandy deposits underlie floodplains, and were deposited within the last few thousand years.

Hydrology

Geology and topography play the main role in determining the study area's hydrologic framework. The relatively flat lying sedimentary deposits are capable of retaining relatively large amounts of rainfall as recharge. This groundwater recharge returns to the streams in summer months from seeps and springs.

Flat hilltop areas of Flume Creek subwatershed were cleared for agriculture during the 1800s and now are largely grassy rural residential lots outside the UGA and urban residential areas inside the UGA. Consequently, stream hydrology is altered considerably from a natural forested condition. No hydrologic data is available for Flume Creek.

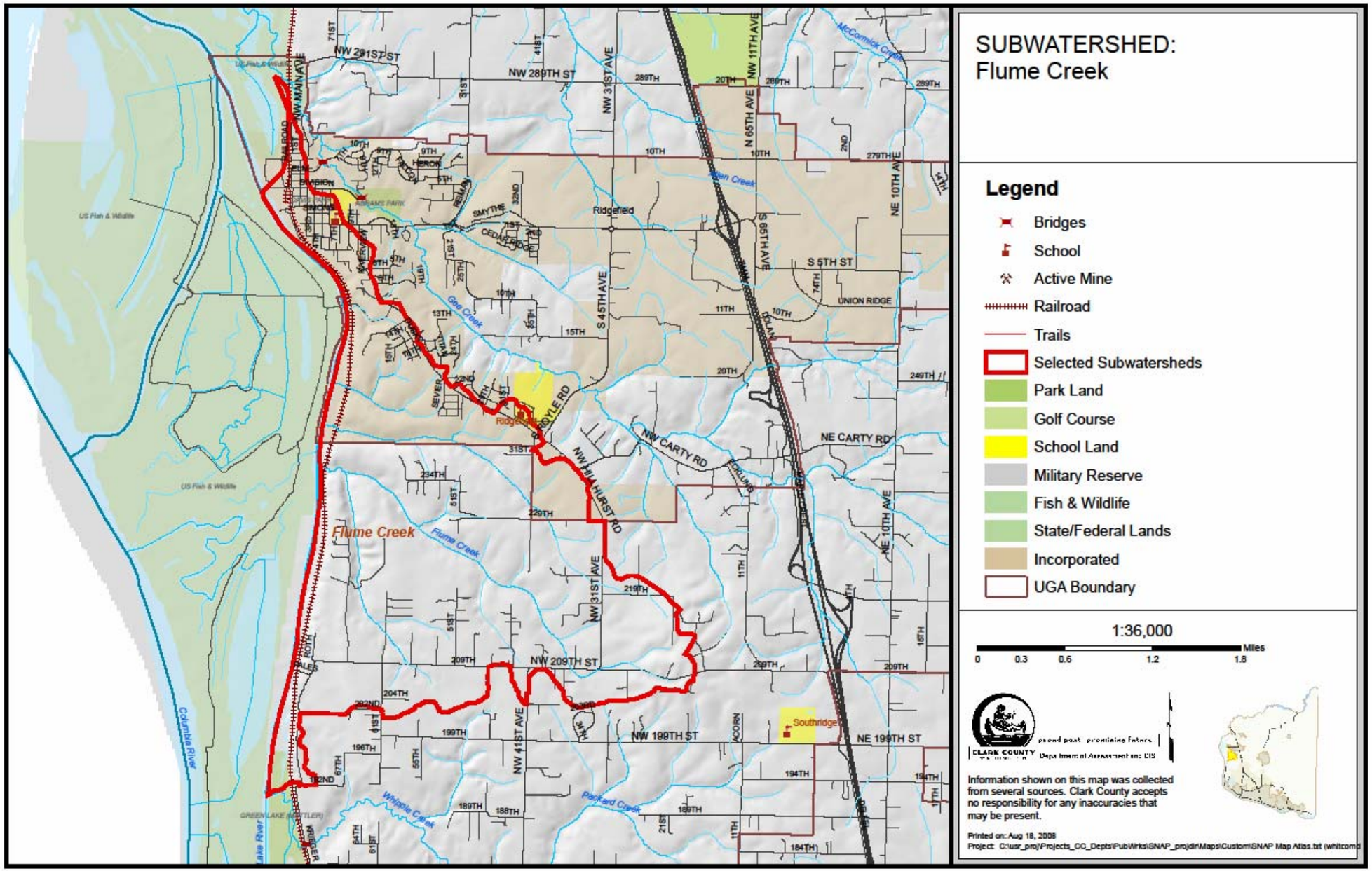

Figure 1: Subwatershed Map: Flume Creek Subwatershed

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 marginally non-functioning stream habitat (Table 2).

Table 2: Watershed Scale Metrics

Metric	Flume Creek	Functioning	Non-functioning
Percent Forested (2000 Landsat)	23	> 65 %	< 50 %
Percent TIA (2000 Landsat)	18	< 5 %	> 15 %
Road Density 2007 data (miles/mile2)	7	< 2	> 3
Stream Crossing Density (crossings per stream mile)	1.5	< 3.2/mile	> 6.4/mile
Percent EIA estimated from the Comprehensive Plan	10	< 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.

Much of the Flume Creek subwatershed is developed for agriculture and home sites. Forest cover is generally limited to steep valley walls along stream corridors.

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 Flume Creek qualify as non-functioning habitat.

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 approximately double the threshold for non-functioning (>3 road miles/mi^2).

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. Flume Creek subwatershed topography has limited the number of stream crossings by public and private roads. Only one public road crosses Flume Creek or any of the other creeks. Consequently, stream crossing densities fall 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 at the boundary between functioning and non-functioning categories.

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 (
Figure 2). According to this figure, streams in Flume Creek subwatershed should be expected to have unstable channels.

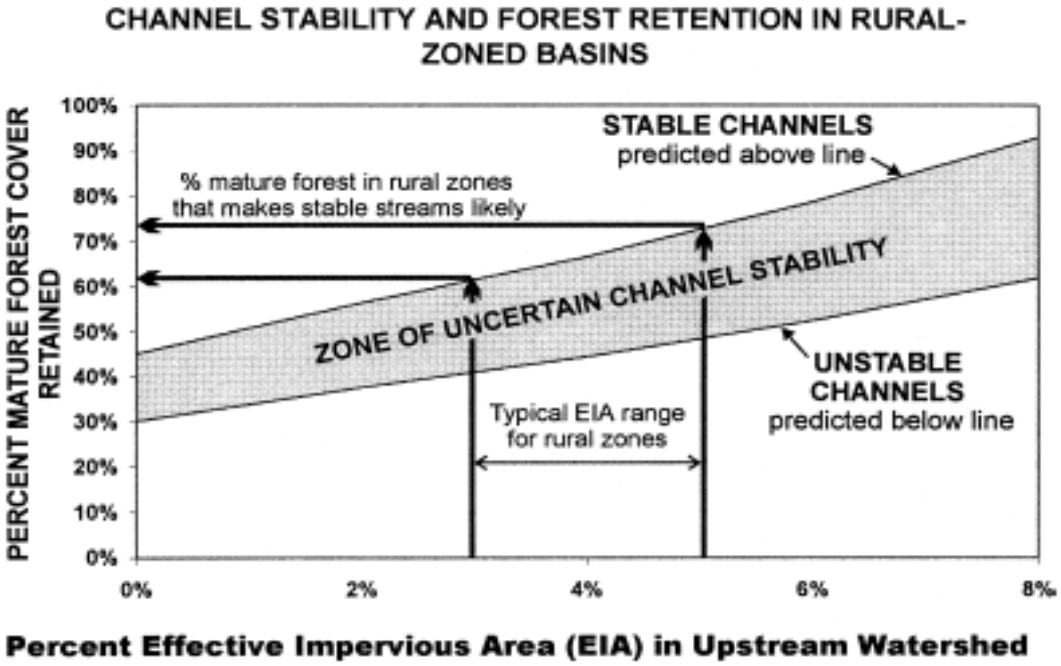

Figure 2: Channel stability in rural areas (Booth, Hartley, and Jackson, June 2002).

Water Quality Assessment

This section briefly summarizes and references available water quality data from the Flume Creek subwatershed. 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, Flume Creek subwatershed streams are to be protected for the designated uses of: "Salmonid spawning, rearing, and migration; 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 3 summarizes currently applicable water quality criteria for the assessment area.

Table 3: Applicable Water Quality Criteria for Flume Creek Subwatershed

Characteristic	Ecology criteria
Temperature	≤ 17.5 °C (63.5 °F)
Dissolved Oxygen	≥ 8.0 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

Flume Creek is not included on the 2008 303(d) list.

Clark County Stream Health Report

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

While no stream data were available for Flume Creek, the report utilized a simple predictive model to assign probably stream health. Based on the amount of forested and developed area within the subwatershed, the probable health score for Flume Creek was poor.

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

Available Data

Ecology and CWP databases contain no records for water quality samples in Flume Creek. While other data sources may exist, from an agency perspective water quality data is virtually non-existent for this subwatershed.

Water Quality Summary

Stream Health

The most complete predictor of current stream health in the assessment area is likely the simple land-use model utilized by the CWP for the 2004 Stream Health Report. Based on that model, it is likely that water quality in Flume Creek is impaired by similar pollutants as other subwatersheds with relatively limited intact forest areas and significant levels of rural development, which may include temperature, sediment, fecal coliform bacteria, nutrients, and flow extremes. The actual extent of impairment is unknown.

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 4 indicates the number of features currently inventoried in StormwaterClk. Of the total 6 stormwater facilities, none are identified as publicly owned and operated.

Table 4: Drainage System Inventory Results, Flume Creek

Database Feature Category	Inventoried prior to 2007	Added during 2007-2009	Total Features
Inlet	6	0	6
Discharge Point (outfall)	1	119	120
Flow Control	2	2	4
Storage/Treatment	27	3	30
Manhole	2	2	4
Filter System	0	0	0
Channel	31	399	430
Gravity Main	66	145	211
Facilities	0	6	6

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 the Flume Creek subwatershed.

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 the Flume Creek subwatershed.

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 119 mapped outfalls in the Flume Creek subwatershed; one Priority 1 outfall, thirteen Priority 2 outfalls, and 105 Priority 3 outfalls.

Figure 3 summarizes notable outfall assessment activities including general outfall locations in Flume Creek subwatershed.

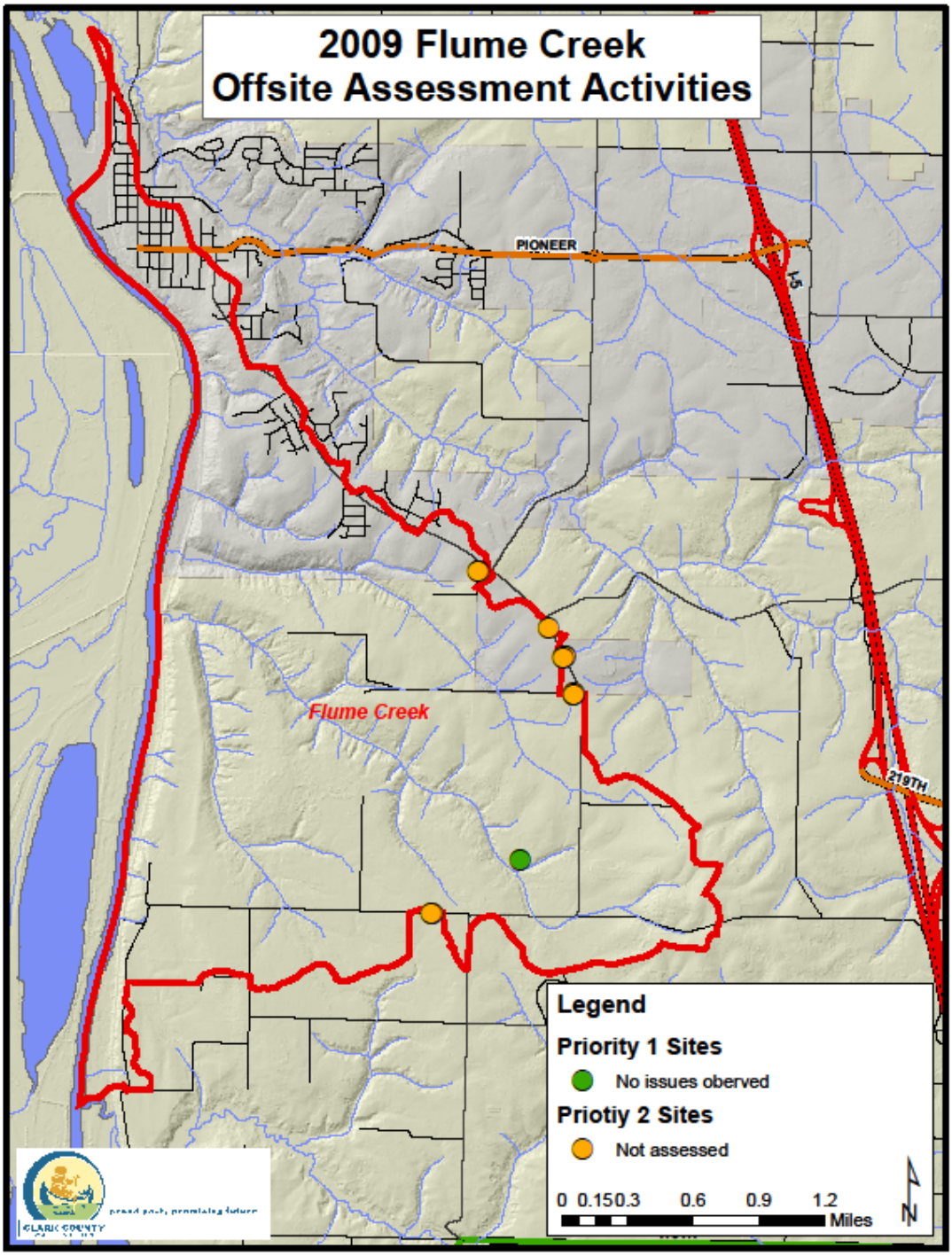

Figure 3: Summary of 2009 Off-site Assessment Activities in the Flume Creek subwatershed

Table 5 summarizes offsite assessment results from the Flume Creek subwatershed. One Priority 1 outfall was assessed and was found to be in compliance. No Priority 2 or Priority 3 outfalls were assessed.

Table 5: 2009 Off-site Assessment Project Activity Summary for Flume Creek subwatershed

Metric	Number of Outfalls		
	Priority 1	Priority 2	Priority 3
Total number of mapped outfalls	1	13	105
# of outfalls assessed	1	0	0
# of outfalls compliant	1	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 Flume Creek subwatershed, retrofit evaluations and the inspection and maintenance evaluations were not conducted. However, livestock access in a private facility was observed during the offsite assessment process. This water quality issue was reported to maintenance and operations private stormwater facility inspector. 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. Maintaining the frequency of offsite assessment activities may reduce downstream erosion problems by discovering potential issues before they become a more serious erosion problem.

Illicit Discharge Detection and Elimination Screening

An illicit discharge detection and elimination screening assessment was not conducted.

Stream Reconnaissance and Feature Inventory

A stream reconnaissance and feature inventory assessment was not conducted.

Physical Habitat Assessment

A physical habitat assessment was not conducted.

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). 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 such as Flume Creek 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.

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

Results

Because Flume Creek was not included in the 2004 LCFRB Habitat assessment, LWD recruitment potential and shade rating analyses were based mostly on qualitative review of 2007 orthophotographs and limited site visits by staff.

Riparian (Large Woody Debris (LWD) Delivery)

Review of the Flume Creek subwatershed, including Flume Creek, several unnamed tributaries to Flume Creek, and several other unnamed streams, indicated relatively high LWD recruitment levels. This subwatershed may have localized areas of low LWD recruitment where the streams pass through unforested, agricultural areas. In general, the streams in the Flume Creek subwatershed flow through areas where forest vegetation is dominant, presenting good opportunities for LWD production.

Shade

Shade ratings for the Flume Creek subwatershed were not included in the 2004 LCFRB Habitat Assessment. Review of this subwatershed, including Flume Creek, several unnamed tributaries to Flume Creek, and several other unnamed streams, indicated relatively high levels of shade. This subwatershed may have localized areas of low shade where the streams pass through unforested, agricultural areas. In general, the streams in the Flume Creek subwatershed flow through areas where forest vegetation is dominant, presenting good opportunities for shade.

Management Recommendations

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

Potential Projects

Potential riparian restoration projects for the Flume Creek subwatershed were identified through GIS analysis and analysis of orthophotography.

Potential restoration projects in the Flume Creek subwatershed may be limited by a seeming lack of publicly owned land adjacent to streams. The only exception is parcel # 190862-000 (see Table 6), located in the southwest corner of the subwatershed, which is adjacent to Lake River and an unnamed tributary. This parcel is dominated by herbaceous vegetation and may benefit from restoration activity. However, the parcel is part of the Vancouver Lake Lowlands and may be subject to flooding, which may inhibit the growth of forest vegetation.

An unnamed stream to the north of Flume Creek would benefit from reforestation activities in an approximately 0.75 mile section where it passes through herbaceous agricultural land upstream of NW 221st St (at approx. 45.78121, -122.70523 decimal degrees).

Table 6: Tax Exempt Parcels Overlapping Potential Riparian Restoration Areas

ASSR_SN	ASSR_AC	OWNER	PT1DESC	Description
190862-000	70.63 acres	Clark County	Unused or vacant land	Areas of potential reforestation on Lake River and an unnamed tributary to Lake River

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 4 shows potential wetland areas within the Flume Creek subwatersheds based on data from the county wetlands atlas, including the Clark County wetland model, National Wetlands Inventory, and high-quality wetlands layer.

The Flume Creek subwatershed has fringes of potential riverine and depressional wetlands associated with the larger streams and the east banks of Lake River. There are also areas of slope and depressional wetlands in some of the headwaters. Table 7 shows the total area and proportion of wetland classes estimated to be present in the subwatershed.

Table 7 Distribution of Wetlands by Hydrogeomorphic Class

HGM Class	Area (ac.)	% of Sub-basin*	% of total wetland
Slope Wetlands	76	2%	22%
Depressional Wetlands	129	4%	37%
Riverine Wetlands	145	4%	41%
All Wetlands	350	10%	

*Subwatershed area 3350 Ac.

In the Flume Creek subwatershed approximately half of the potential wetland area is associated with the headwaters and stream channel floodplains of Flume Creek, its tributaries and two other small streams that flow into Lake River. The remaining wetland areas are associated with the Columbia River Floodplain and the riparian area along Lake River.

A majority of the wetlands are located in landscape positions (deep ravines or along Lake River) where there are limited opportunities to improve water quality or hydrologic functions within the subwatershed. Review of the wetland inventories and studies did not identify any significant project opportunities within publicly held or tax-exempt land.

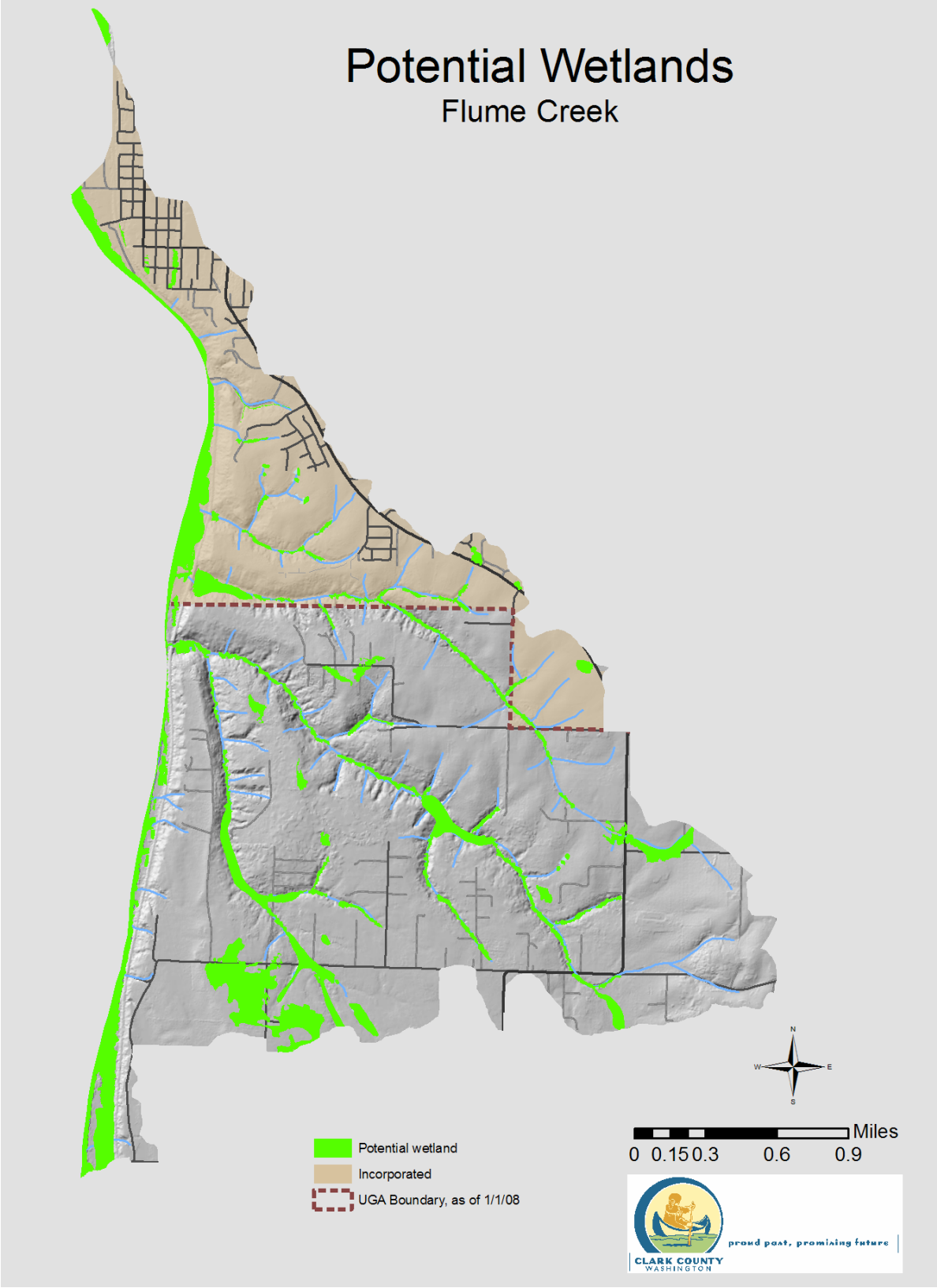

Figure 4: Flume Creek Potential Wetlands

Draft 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 Flume Creek subwatersheds are summarized below.

The Flume Creek 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 5 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.

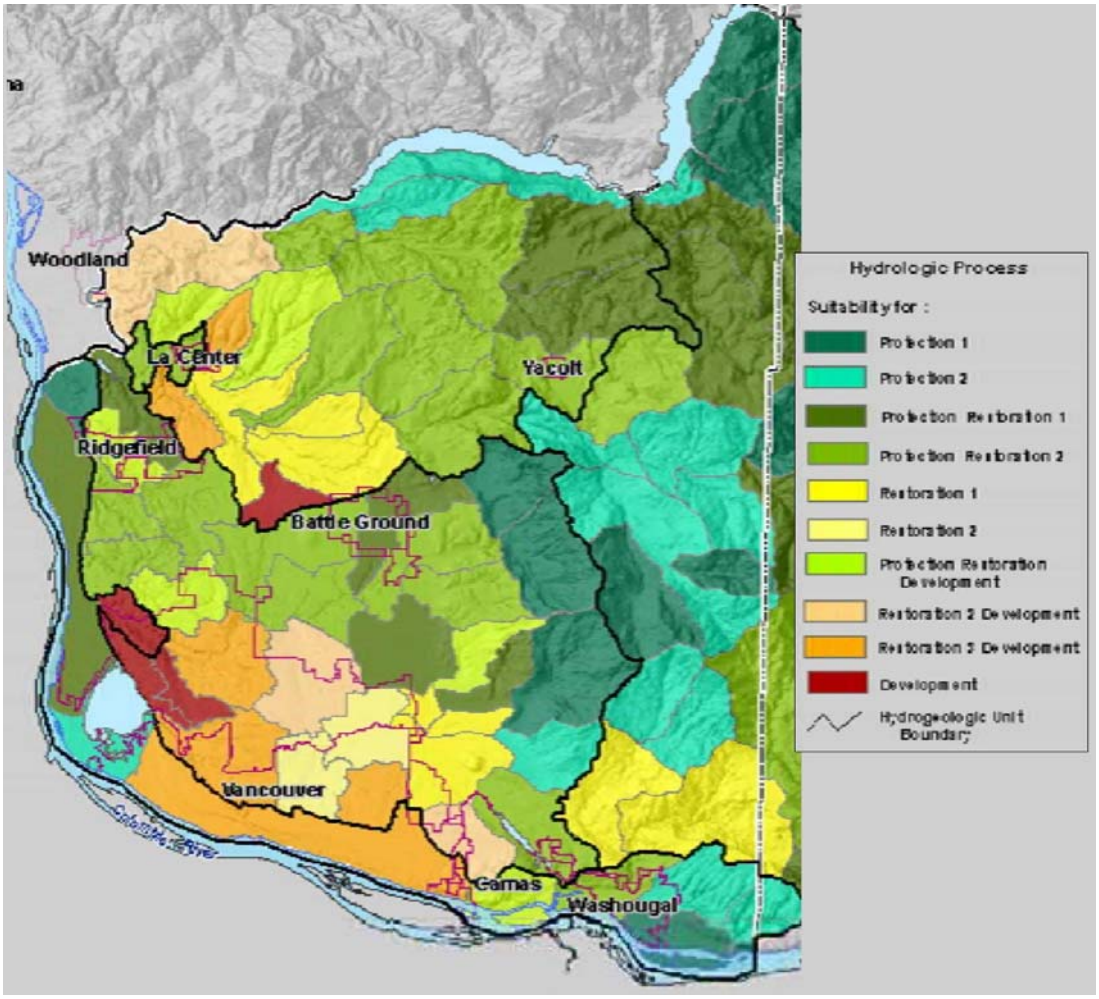

Figure 5: Priority areas for protection and restoration of hydrologic processes (from Watershed Characterization and Analysis of Clark County (Ecology, 2009))

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, 2009).

Protection and Restoration 2 (green) is the hydrologic process priority for the Flume Creek subwatershed.

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.

Flume Creek macroinvertebrate samples were collected by the CWP during August of 2008 at station FLU020 west of NW 234th Street.

Results

Station FLU020's one-year B-IBI score of 34 places it in the moderate biological integrity category.

Table 8 shows one low, six moderate, and three high scores among the results for individual metrics at station FLU020. The low metric score for the number of intolerant taxa metric suggests signs of degraded water and habitat quality since intolerant taxa are among the first organisms to disappear as human disturbances increase (Fore, 1999).

Table 8: Station FLU020 Annual Macroinvertebrate Community Metrics and Total Scores from 2008

B-IBI Metrics	FLU020 2008		
	Value	Score	Category

B-IBI Metrics	FLU020 2008		
	Value	Score	Category
Total number of taxa	49	5	high
Number of Mayfly taxa	5	3	moderate
Number of Stonefly taxa	5	3	moderate
Number of Caddisfly taxa	7	3	moderate
Number of long-lived taxa	4	3	moderate
Number of intolerant taxa	0	1	low
Percent tolerant taxa	35	3	moderate
Percent predator taxa	18.1	3	moderate
Number of clinger taxa	29	5	high
Percent dominance (3 taxa)	39	5	high
Summary of metric scores		34	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 Flume Creek 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 6 shows that the 2008 Station FLU020 B-IBI score is in the middle of the range of expected scores (estimated 2000 Total Impervious Area from Wierenga, 2005).

Given that Flume Creek's B-IBI score falls near the middle of those typically found for subwatersheds with 18 percent impervious area, there may be opportunities to improve biological integrity through habitat rehabilitation.

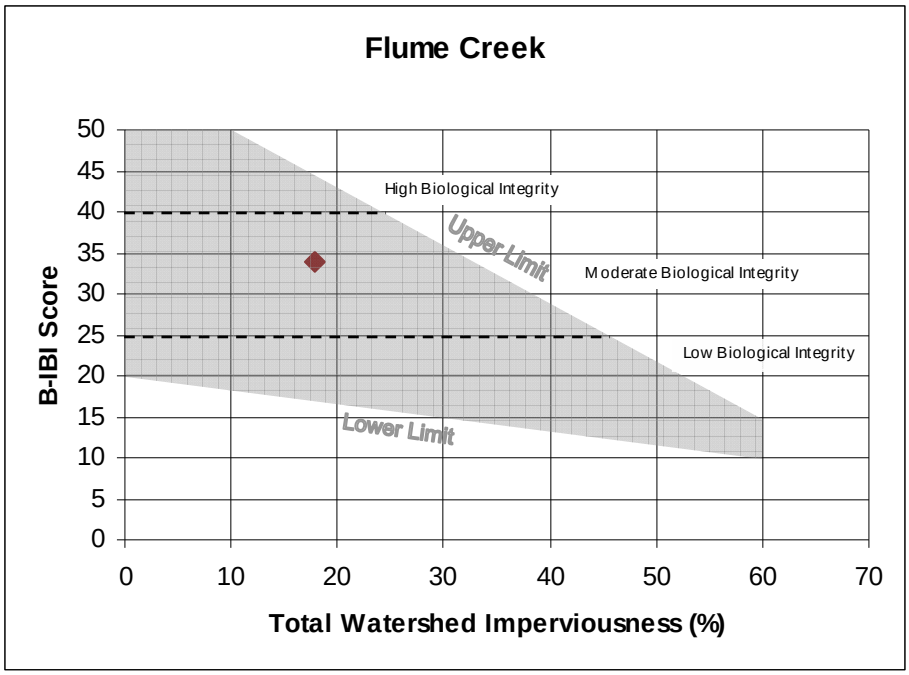

Figure 6: Approximate range of B-IBI in Puget Lowland watersheds, showing progressive decline with increasing imperviousness in the upstream watershed. Adapted from Booth et. al., 2004. Markers indicate Total B-IBI scores at Station FLU020 for 2008, versus estimated 2000 subwatersheds TIA.

Management Recommendations

The general character of the subwatershed suggests overall management strategies should be to limit further degradation and pursue targeted rehabilitation to maintain and potentially improve biological integrity. These strategies include protecting forested riparian areas and rehabilitating those that are impaired, promoting forestry best management practices, increasing overall forest cover, and minimizing sediment loading especially from near stream agricultural use and development runoff.

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 Flume Creek subwatershed 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 Flume Creek subwatershed includes the presumed presence of Coho salmon and winter steelhead (Figure 7 and Figure 8).

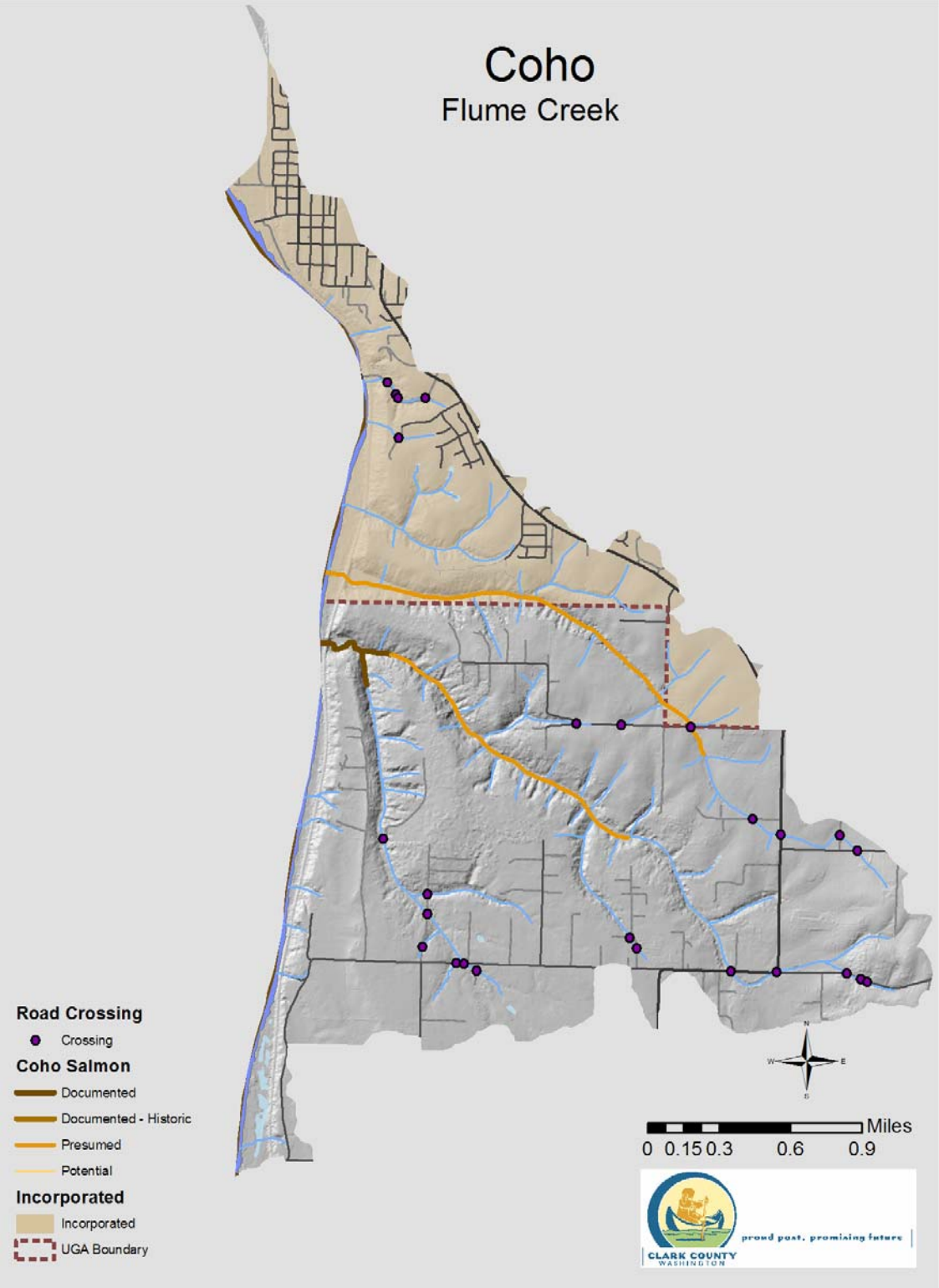

Figure 7: Flume Creek Fish Distribution and Barriers

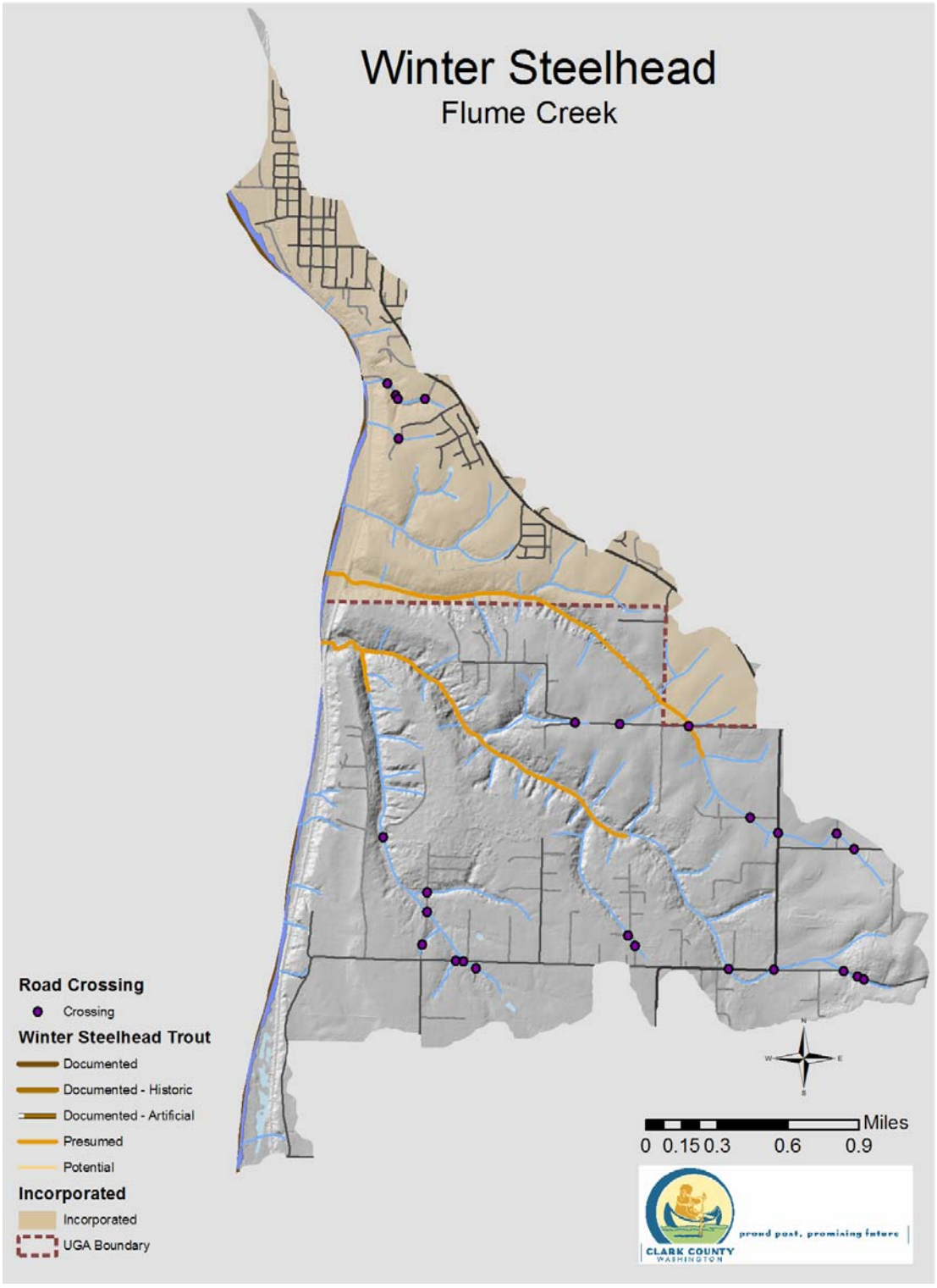

Figure 8: Flume Creek Fish Distribution and Barriers

Barriers

The WDFW barrier database provides the most complete assessment of barriers in the Flume Creek subwatershed (Figure 7 and Figure 8).

According to the WDFW barrier database, there are no known barriers within the Flume Creek subwatershed at this time.

Recommendations

No improvements to fish passage are necessary at this time.

Hydrologic and Hydraulic Models

A hydrologic and hydraulic model assessment 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 northern third of the assessment area lies within the rapidly growing City of Ridgefield where there are significant ongoing stormwater and water quality programs. As opportunities arise, the Clean Water Program coordinates with the City of Ridgefield for stormwater efforts.

Broad-Scale Characterization

The study area is highly urbanized within its northern quarter in the City of Ridgefield. The remainder consists mostly of rural residential areas along relatively flat hilltops and undeveloped forested areas within the steep valleys adjacent to Flume Creek and other unnamed streams draining to Lake River. Above the canyon areas that drop down to the Columbia River floodplain, the overall topography is low rolling hills typical of the relatively level floor of the Willamette Valley. Geology consists of sedimentary gravel and sandstone deposited by the ancestral Columbia River, overlain with more recent, easily erodible, fine-grained deposits. Stream hydrology is altered significantly from a natural forested condition. Stream channels are expected to be unstable based on relative subwatershed amounts of forest cover and impervious surface.

When compared to NOAA fisheries standard subwatershed scale metrics, the study area's percent forest, percent total impervious area, and road density suggest stream habitat that is not properly functioning, while stream crossing density and percent effective impervious area suggest marginally functioning habitat.

Water Quality Assessment
Ecology and CWP databases contain no records for Flume Creek water samples which could be used to evaluate water quality. Based on a simple land-use model utilized by the CWP for the 2004 Stream Health Report, Flume Creek's water quality is likely impaired in a consistent manner with that of similar subwatersheds by pollutants such as temperature, sediment, fecal coliform bacteria, nutrients, and flow extremes.

Drainage System Inventory and Condition
Significant updates to the drainage mapping database were completed in 2008 and 2009. Over 650 stormwater infrastructure features were added during this time period; a total of over 800 features are mapped in this study area, including six stormwater facilities of which none are publicly owned and operated. Capital project retrofit opportunities and maintenance evaluations were not completed since there are no public stormwater facilities in the study area. An off-site evaluation of the only high-priority outfall discharging to mapped critical areas in the study area found it was in compliance.

Source Control
A source control assessment was not conducted.

Illicit Discharge Screening
Illicit discharge detection and elimination screening was not conducted.

Stream Reconnaissance Feature Inventory
A stream reconnaissance feature inventory was not conducted.

Physical Habitat
A physical habitat assessment was not conducted.

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

Riparian Assessment
LWD recruitment potential and shade rating analyses were based on qualitative review of 2007 orthophotos and limited site visits by staff. Many of the streams in the study area flow through forested steep valley corridors with good opportunities for LWD production and relatively high levels of shade.

Wetland Assessment
The Flume Creek subwatershed has fringes of potential riverine and depressional wetlands along larger streams and the east bank of Lake River as well as areas of slope and depressional wetlands in some of the headwater areas.

Ecology's draft watershed characterization of Clark County places the study area in the category of Protection and Restoration 2. On a subwatershed scale, this category has a higher level of

importance for watershed hydrologic processes and limited alteration suggesting consideration for protection.

Macroinvertebrate Assessment
Based on samples collected in 2008, biological integrity is moderate. B-IBI scores are close to the middle of the typical range for areas with similar levels of total impervious area suggesting an opportunity to improve biological integrity through habitat rehabilitation.

Fish Use and Distribution
The available information suggests that anadromous fish use in the Flume Creek subwatershed includes the presumed presence of Coho salmon and winter steelhead. There are no known barriers within the Flume Creek subwatershed.

Recently Completed or Current Projects

As of December 2009, there are no stormwater projects listed for the Flume Creek subwatershed in the CWP capital planning database or major road projects listed in the 2010-2015 Public Works Transportation Improvement Plan.

Analysis Approach

Purpose
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.

Methods
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

No projects of this type were identified

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

Identifier	Issue	Project	Action
Flume Creek			
OS-198	Opportunity to enhance riparian area through reforestation adjacent to Lake River and on unnamed tributary on public property.	Potential replanting of herbaceous agricultural land with native riparian forest and native wetland vegetation to enhance habitat (Parcel # 190862-000 70 ac.)	Refer to CWP Capital Planning

Property Acquisition for Habitat Preservation
No projects of this type were identified.

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
No projects of this type were identified.

CWP Infrastructure Inventory
No projects of this type were identified

CWP Capital Planning
No projects of this type were identified.

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

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

No projects of this type were identified.

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 subwatershed, by NPDES permit component, include:

Storm Sewer Mapping and Inventory

- None

Coordination of Stormwater Activities

- Encourage coordination between Clark County and City of Ridgefield in this area particularly at stormwater connection points between the County and City systems.

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

- Focus continued effort on ensuring maintenance of energy dissipaters at outfalls

Education and Outreach to Reduce Behaviors that Contribute Stormwater Pollution

- Perform targeted technical assistance responding to results of field assessments

TMDL Compliance

- None

Monitoring Stormwater Program Effectiveness

- None

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