2007 Stormwater Needs Assessment Program

Mill Creek East Fork
Subwatershed Needs Assessment Report

Clark County Public Works Department
Clean Water Program

May 2008

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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
EIA	Effective Impervious Area
EDT	Ecosystem Diagnostic and Treatment model
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
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 Scores
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 Areas
UIC	Underground Injection Control
USFWS	U.S. Department Fish and Wildlife Services
VBLM	Vacant Buildable Lands Model
WAC	Washington Administrative Code
WRIA	Water Resource Inventory Area
WSDOT	Washington Department of Transportation

Executive Summary

Study Area

This Stormwater Needs Assessment report includes the Mill Creek tributary to the East Fork Lewis River, or Mill Creek East Fork. Assessment effort focused on the unincorporated areas.

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 than regional WRIA or ESA plans. Stormwater Needs Assessments are not comprehensive watershed plans or stormwater basin plans.

Findings

Watershed Conditions

The following table summarizes conditions in Mill Creek East Fork subwatershed, including water quality, biological health, habitat, hydrology, and the stormwater system.

Ongoing Projects and Involvement

Mill Creek East Fork is not well known outside the individuals and organizations that work to protect and restore fish habitat within the East Fork Lewis River watershed.

The Washington Department of Ecology is developing TMDLs for bacteria and temperature in the East Fork Lewis River watershed. Also, the Washington Department of Transportation is planning a major road widening project for SR 502 that should result in wetland and habitat restoration projects in the next several years.

Category	Status
Water Quality	
Overall	• Estimated as Fair to Poor
Fecal coliform bacteria	• TMDL required
Temperature	• Generally meets salmon habitat criteria
Sediment	• No data
Biological	
Benthic macroinvertebrates	• Moderate biological integrity
Anadramous fish	• Coho and winter steelhead use. High regional recovery priority
Habitat	
NOAA Fisheries criteria	• Forest cover, road density, and estimated total impervious area percentage fall into the Non-Functioning category. • Stream crossing density and estimated effective impervious area fall into the Properly Functioning category.
Riparian	• Forest cover largely limited to stream valleys. • Large woody debris moderate to high recruitment potential downstream of 239th Street and none above 239th Street.
Wetland	• Primarily limited to near-stream depressions
Hydrology/Geomorphology	
Overall hydrology	• No hydrologic data available; likely impacted, typical for an unforested rural watershed. • Stream reaches upstream of 239th Street are mainly excavated drainage ditches.
Future condition	• Projected impervious areas may increase rate of channel incision, bank failures, and accelerated channel migration in various areas unless adequate runoff controls are in place.
Stormwater (Unincorporated areas)	
System description	• Primarily field drains and road-side ditches, with limited piped infrastructure. • Two mapped public stormwater facilities
Inventory status	• Largely complete.
System adequacy	• Adequate treatment is probably provided by vegetation in ditches. • No flow control other than ditch infiltration
Condition	• Eighty-seven public outfalls exist and were inspected for illicit discharges; no suspected illicit discharges were detected. • Forty-eight public outfalls discharging to critical areas; none causing significant erosion.

Opportunities

Few projects were identified by the assessment due to the absence of public land to site them. The main project needs appeared to be for riparian and wetland habitat restoration and fish passage barrier removal. Stormwater management for westward expansion of Battle Ground is an important consideration for the future.

Examples of opportunities for stormwater-related watershed improvement, including the following:

- Focused stormwater outreach and education to streamside landowners in the headwaters areas.
- Coordination of potential habitat projects with WSDOT mitigation of SR 502 widening.
- Focused monitoring to determine if fecal coliform sources are present.
- Potential retrofits to roadside ditches for enhanced stormwater control or treatment.
- Removal of fish passage barriers in the lower reaches.
- Promotion of riparian enhancement projects, particularly in the upper watershed.

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. Management recommendations relevant to Mill Creek East Fork subwatershed include:

- Mill Creek East Fork is shared by Clark County and the City of Battle Ground. Basic stormwater management activities such as illicit discharge screening and infrastructure mapping may be coordinated in the future.
- The Lower Columbia Fish Recovery Board is planning a project to identify restoration projects in the East Fork Lewis River flood plain. While there is little of Mill Creek East Fork on the East Fork Lewis River flood plain, there may be opportunity to coordinate actions.
- TMDL development for bacteria and temperature coordination will include Clark County.
- In developing areas, emphasize stormwater management that focuses on reduction of runoff and diffuse infiltration close to the source rather than in centralized facilities. LID practices should be encouraged.
- Examine the use of small projects to improve stormwater retention and treatment in roadside ditches.
- While no specific wetland or habitat restoration projects are proposed by the SNAP due to the absence public land to place projects, restoring headwater wetlands should be a priority to improve hydrologic functions.

- Restoring access to fish habitat is a priority in Mill Creek East Fork. Consider fish barrier removal projects in the upper watershed as existing roads and culverts are upgraded or replaced.
- Develop a process to provide education about appropriate ditch maintenance practices to rural landowners.
- Problems caused by stormwater are common and most severe on small tributary streams. Future assessment may be most effective by focusing on smaller tributary streams.

Introduction

The Stormwater Needs Assessment for the Mill Creek East Fork subwatershed is part of an effort by the Clean Water Program (CWP) to gather and assemble 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 assessment 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 objectives and goals identified by the state GMA, ESA recovery plan implementation, TMDLs, WRIA planning, flood plain 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 initiating wetland banking systems, 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 Growth Management Act (GMA) and the federal Endangered Species Act (ESA).

Scope

This report largely summarizes and evaluates pre-existing information, but does include new information on stream geomorphology and hydrology. SNAP reports may also include basic summary information or incorporate, 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 the Public Works CWP and Stormwater Capital Improvement Program (SCIP), several programs within the Department of Community Development, and the county's ESA Program. Potential project or leveraging opportunities are also referred to local agencies, groups, and municipalities as appropriate.

Assessment Approach

Priorities for Needs Assessment in Mill Creek East Fork

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).

The Mill Creek East Fork subwatershed is a rural residential area largely outside of the UGA. Subwatersheds in this category typically include both city and county jurisdiction. The level of SNAP implementation depends to some extent on coordination between municipalities. Subwatersheds in this category are generally not heavily forested and generally a lower priority for basin planning due to the lack of urbanization.

However, Mill Creek East Fork may take on a higher priority for watershed management activities to protect and restore better quality stream habitat and promote salmon recovery priorities.

Assessment Tools Applied in Mill Creek East Fork

The SNAP utilizes a standardized set of tools for subwatershed assessment, including: desktop mapping analysis, modeling, outreach activities, and a variety of field data collection. 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 or analyses were conducted during the course of this needs assessment. The remaining tools were assessed based solely on pre-existing information or were not included in the assessment.

Table 1: Stormwater Needs Assessment Tools

Stakeholders *	Geomorphology And Hydrology Assessment*
Outreach and Involvement *	Riparian Assessment
Coordination with Other Programs *	Floodplain Assessment
Drainage System Inventory *	Wetland Assessment
Stormwater Facility Inspection *	Macroinvertebrate Assessment
Review of Existing Data *	Fish Use And Distribution
Illicit Discharge Screening *	Water Quality Assessment
Broad Scale GIS Characterization *	Hydrologic Modeling
Rapid Stream Reconnaissance	Hydraulic Modeling
Physical Habitat Assessment	

Assessment Actions

Outreach Activities

Outreach activities were limited and focused on raising awareness about the SNAP effort. The following activities were completed:

- July 2007 – press release to local media
- August 2007 – article in "Planning Stormwater Projects" flyer distributed at Clark County Fair and other public events.
- September 2007 – article in Clean Water Program E-Newsletter.
- Clean Water Program web pages updated to include the SNAP and SCIP.
- March 31 of each year, a description of the SNAP is included Clark County's stormwater management program plan submitted to Ecology.

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

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 plan projects and refine resource management options.

Methods

The CWP maintains a list of potential coordinating programs for each subwatershed area. The list was reviewed in early 2007 and general communications were planned. Coordination took the form of phone conversations, meetings, or electronic correspondence, and was 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 with departments and groups thought most likely to materially contribute to identifying potential projects and compiling information to complete the needs assessment.

Results

See the section describing potential projects (page 67) for an overall list and location of potential projects gathered during the needs assessment process. Projects identified through coordination with other agencies are included.

The following list includes departments, agencies, and groups contacted for potential coordination during the course of the Mill Creek East Fork needs assessment:

- Clark County Endangered Species Act Program
- Lower Columbia Fish Recovery Board
- Lower Columbia Fish Enhancement Program
- Fish First
- Clark County Transportation Improvement Program
- Clark County Legacy Lands Program
- Vancouver/Clark Parks and Recreation
- Washington Department of Ecology
- Washington Department of Transportation

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:

- LCFRB Habitat Assessments
- LCFRB Workplan
- CC LISP/SCMP/Project Data
- CC Volunteer Project Data
- Ecology 303D
- WRIA Limiting Factors Analysis
- CC Consproj GIS Layer (conservation projects)
- CC 6-year and 20-year TIP
- Ecology EIM Data
- CC Mitigation Opportunities Project
- CC 2007 Stormwater Needs Assessment Program
- CC 2005 Subwatershed Characterization and Classification
- CC 2004 Subwatershed Summary
- CC 2003 Stream Health Report

Broad-Scale GIS Characterization and Metrics

The broad-scale characterization is a GIS-based exercise providing an overview of the physical and biological 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 is generally used as a tool to complete the Needs Assessment report, 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.

Many of these characteristics are described in greater detail in later sections. For example, geology and soils form the cornerstone of the Geomorphology and Hydrology section (page 45).

The characterization includes three components:

- A set of three standard E-size paper maps.
- A summary table of selected subwatershed-scale metrics.
- A brief narrative including comparison of metrics to literature values, conclusions about general subwatershed condition and potential future changes, and potential mitigation or improvement site identification.

Map Products

Three standard SNAP map products are: 1) Stormwater Infrastructure and Hydrologic Soil Group, 2) Critical Areas information, and 3) Vacant Buildable Lands within UGAs. These maps are printed out for tabletop evaluations.

General Conditions and Subwatershed Metrics

General Geography

Mill Creek East Fork is a tributary of the East Fork of the Lewis River (Figure 1). It flows in a northerly direction to its confluence with the East Fork Lewis River. Mill Creek East Fork subwatershed covers 3.8 square miles, receiving on average 47 inches of precipitation annually. The upper portions of the subwatershed are relatively subtle terrain and have been converted from forest to a mix of agricultural, forest and residential uses. Average parcel size is five acres. Population density is 305 people per square mile. About 10 percent of the subwatershed is zoned for agricultural use. The majority of the subwatershed is located outside of the Urban Growth Area (UGA). A small amount of the easternmost portion of the subwatershed falls within the Battle Ground city limits. Dollars Corner, an unincorporated rural center, is located along the southern subwatershed boundary at the intersection of State Route 502 and 72nd Avenue.

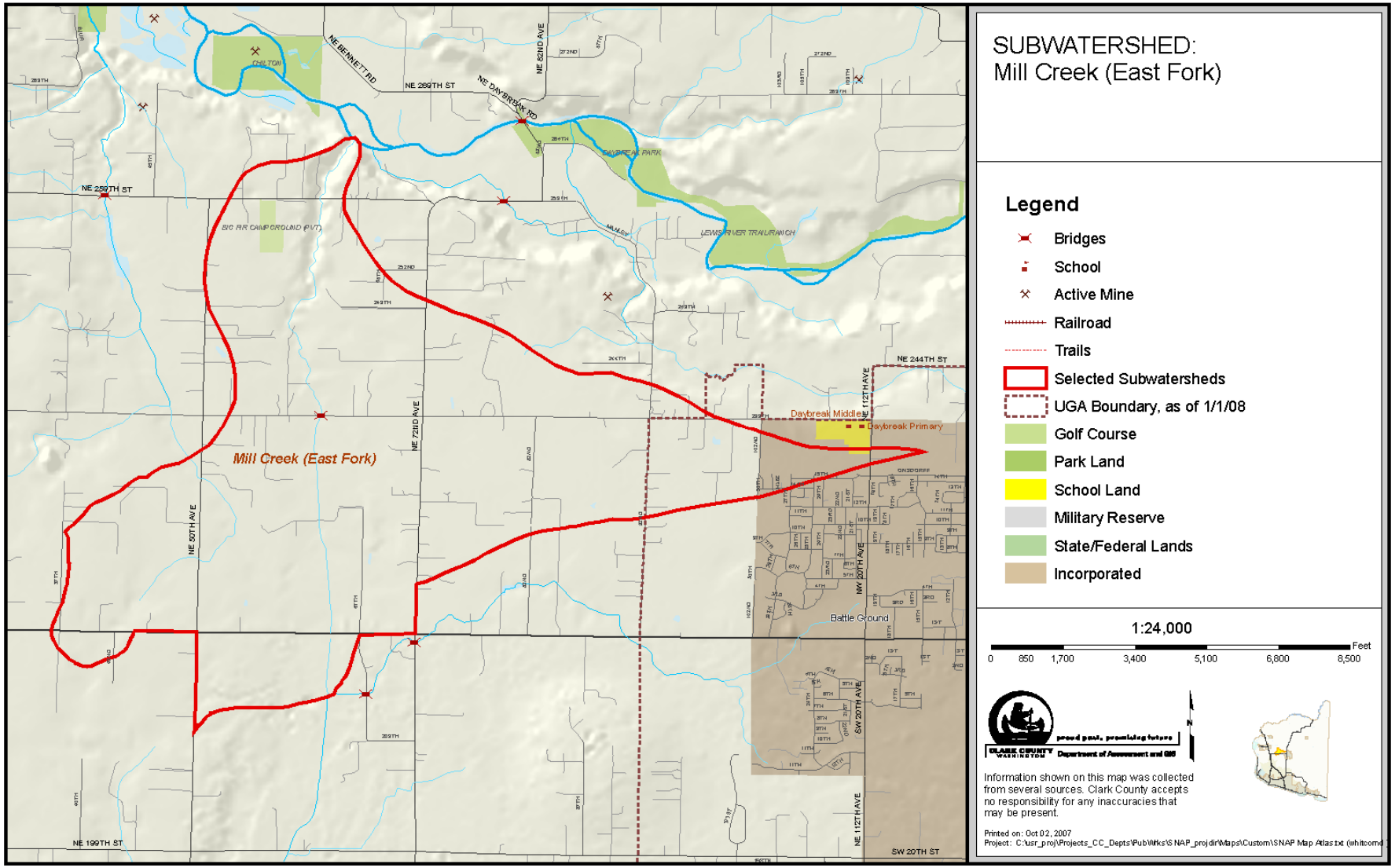


Figure 1: Mill Creek East Fork Subwatershed Area.

Topography

Mill Creek East Fork subwatershed has subtle terrain with an average subwatershed slope of 3.5 percent. Most of the subwatershed is a gently sloping to level surface above 200 feet elevation. The mainstem of Mill Creek East Fork cuts a canyon into this flat upland as it climbs from the East Fork Lewis River to about NE 239th Street. The majority of existing fish habitat is in the canyon that begins downstream of NE 239th Street.

Geology and Soils

Geology and soils influence stream channel type, the size and amount of sediment in the channel, wetland formation, and overall hydrologic framework. Mill Creek East Fork is underlain by two geologic units, older semi-consolidated sandy gravel commonly referred to as the Troutdale Formation or Troutdale gravels and sandy to silty Cataclysmic Ice Age Flood Deposits and alluvium. Geology is described in greater detail in the Geomorphology and Hydrology Section (page 45).

The Troutdale Formation is sandy gravel deposits from an ancestral Columbia River that at depth, underlie the entire Mill Creek East Fork subwatershed. Where streams have eroded into the Troutdale Formation, it forms steep valley walls and hard gravely substrate under stream channels. The upper surface of the Troutdale formation underlies the Ice Age Flood Deposits at about 190 to 200 feet elevation. The Troutdale Formation is much older than the Ice Age Cataclysmic Flood Deposits, resulting in the uppermost beds to be deeply weathered to clay and silt before being covered by the Cataclysmic Flood Deposits. This weathered surface provides a barrier to downward groundwater flow and may be a principal cause of wetlands in low-lying headwater areas.

The fine grained Ice Age Cataclysmic Flood Deposits mantle most of the study area, ranging in depth from a few feet to perhaps 70 feet thick at the east and west margins. These deposits are about 14,000 to 12,000 years old and were deposited by a succession of giant floods of the Columbia River caused by ice dam failures in the Missoula, Montana area. Mill Creek East Fork is part of a shallowly sloped, south to north drainageway formed by the floods as waters passed between the Orchards area and the East Fork Lewis River.

Soils formed on the Troutdale Formation and Cataclysmic Flood Deposits tend to be fairly clayey. Fine-grained Cataclysmic Flood Deposits tend to be easily eroded. The predominant soil types found in the Mill Creek East Fork subwatershed are Hydrologic Group C and D soils, which have relatively low permeability and are often associated with wetter areas.

Hydrology

Mill Creek East Fork hydrologic framework is determined by geology and topography. The flatter upland areas underlain cataclysmic flood deposits are cut by the mainstem channel eroding headword from the East Fork Lewis River

floodplain. Upstream of the NE 239th Street crossing, the Mill Creek East Fork subwatershed is flat, with drainage primarily by field ditches and roadside ditches. Wetlands form in several parts of the basin, notably along the ditched mainstem above 190 feet elevation. The Geomorphology and Hydrology Section describes hydrology in greater detail.

In the canyon downstream of 239th Street, groundwater seeping from the Troutdale Formation provides a steady flow during summer months, but the upper reaches tend to dry up.

No stream flow gauge data is available for Mill Creek East Fork.

Subwatershed Metrics

Subwatershed 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 conditions, are based on NOAA fisheries standards for salmon protection and restoration (1996 and 2003).

Overall, these metrics suggest that Mill Creek East Fork has relatively good stream habitat (Table 2). Future development in this area could have a significant impact because many of the metrics are near, or past the threshold of functioning to non-functioning.

Table 2: Mill Creek East Fork Metrics

Metric	Value	Functioning Criteria	Non-Functioning Criteria
Percent Forested (2000 Landsat)	29%	>65%	<50%
Percent TIA (2000 Landsat)	20%	<5%	>15%
Road Density 2007 Data (miles/mile 2)	8/mile	<2/mile	>3/mile
Stream Crossing Density (crossings per stream mile)	1.4/mile	<3.2/mile	>6.4
Percent EIA Estimated from the Comprehension Plan	9%	<10%	>10%

Forest Cover

The proportion of a watershed in forest 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 reduced riparian shade, less wood debris delivery to streams, increased stormwater runoff, and increased fine sediment

delivery due to mass wasting. The same research indicates that when forest cover drops below 50 percent, watershed forming processes are non-functioning.

The Mill Creek East Fork watershed has relatively little (29 percent) intact forest cover, and is categorized as "non-functioning". Most of the forest is found in the mainstem canyon and several scattered tracts of woods in upland areas. While the amount of forest cover is less than desirable, the large lot size and relatively low level of development suggest that forest restoration is a viable option.

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 area is 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 of less than five percent as fully functional and greater than 15 percent as non-functional habitat is a reasonable indicator of habitat quality. Mill Creek East Fork has 20 percent TIA. In some cases, the interpretation of the satellite images tends to overestimate the level of urbanization and the actual amount of TIA could be lower.

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, almost all of Clark County is non-functioning. Urban streams have road densities approaching 15 to 20 miles per square mile. Mill Creek East Fork has a road density of eight miles per square mile. This is typical for rural or mixed rural and urban areas and is indicative of non-functioning habitat under NOAA standards.

Stream Crossing Density
Stream crossing density is easily measured using available road and stream channel data. While the metric in Table 2 includes all road crossing, the salmon protection standard considers only larger fills over 60 feet wide, which would be approximately five to ten foot high road fill. According to NOAA Fisheries standards Mill Creek East Fork is functional for salmon habitat.

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 type and level of development, effective impervious area is about half of the TIA for lower intensity development, to almost equal to TIA for high intensity development.

The 2008 Comprehensive Plan guides development for the next few years and when used to estimate effective impervious area can provide a metric for expected hydrologic impacts due to development. Future effective impervious area estimated for Mill Creek East Fork under the 2008 Comprehensive Plan is estimated to be nine percent. This is below the defined standard of 10 percent for functioning habitat. It is anticipated that this area will encounter increased residential and commercial development as the City of Battle Ground continues its current growth patterns. The completion of the Salmon Creek interchange at Interstate 5 and proposed improvements to SR 502 will provide greater transportation access to this area, with the likely result of increased development.

Estimated Channel Stability Based on Forest and EIA

In a recent publication by Booth, Hartley, and Jackson (June 2003), a relationship between forest and percent EIA was presented as graphic (Figure 2). According to this figure, subwatershed scale conditions in Mill Creek East Fork indicate predominantly unstable channels under current conditions; however, factors such as low headwater channel gradients and many decades since forest clearing could lessen the impact of lost forest functions.

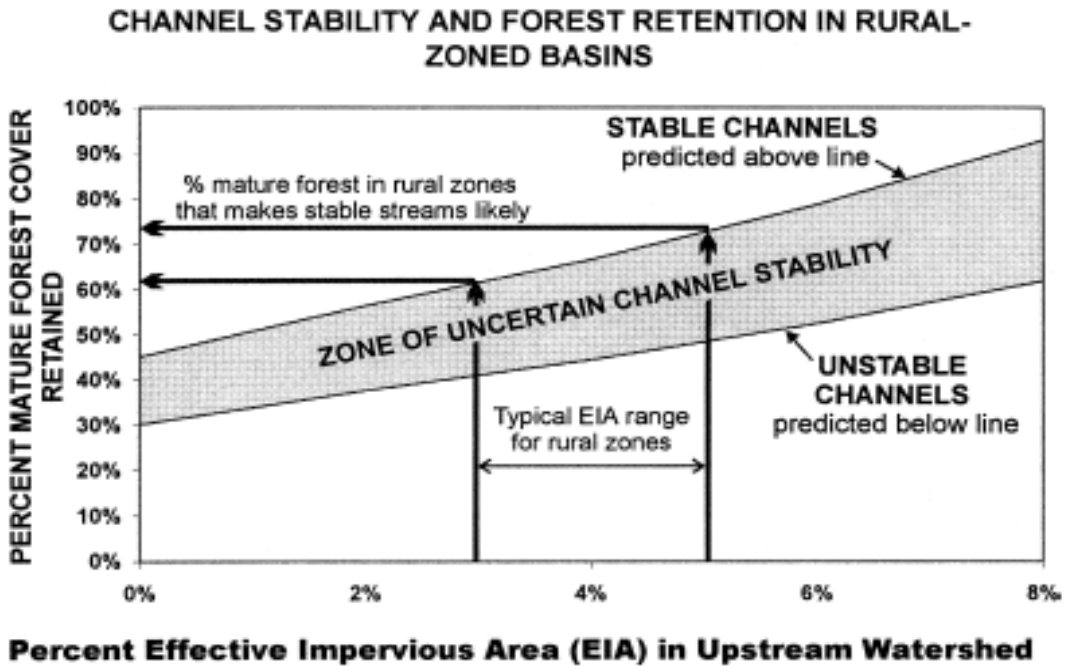


Figure 2: Channel Stability in Rural Areas (Booth, Hartley, and Jackson, June 2002)

Water Quality Assessment

The Water Quality Assessment summarizes and references available water quality data from the Mill Creek East Fork 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 state water quality standards, Mill Creek East Fork 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 and Table 602).

Table 3 summarizes currently applicable water quality criteria for Mill Creek East Fork.

Table 3: Applicable Water Quality Criteria for Mill Creek East Fork

Characteristic	Criteria
Temperature	≤ 16.0 °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 percent 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

Mill Creek East Fork is not listed on the 2002/2004 303(d) list. As a tributary to the East Fork Lewis River, Mill Creek East Fork is planned for fecal coliform and temperature TMDLs, which Ecology is developing.

Clark County Stream Health Report

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

No stream data were available for Mill Creek East Fork. The report utilized a simple predictive model to assess probable stream health in areas with no usable field data. Based on the amount of forested and developed area within the subwatershed, the probable health score for Mill Creek East Fork 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

Measured water quality data are virtually non-existent for Mill Creek East Fork. Data and information sources reviewed or summarized as part of this water quality characterization are listed in Table 4.

Table 4: Data and Information Sources

Source	Data and/or Report
Clark County Clean Water Program	Temperature data (Wierenga, November 2005)
Clark County Clean Water Program	2004 Stream Health Report and draft reports

Water Quality Summary

Little water quality data were located for the Mill Creek East Fork subwatershed. Ecology collected flow, velocity, depth, and wetted width on one occasion (7/19/05) from station 27NNE during data collection for the East Fork fecal coliform TMDL; however, Mill Creek East Fork was not included in fecal coliform monitoring efforts.

Clark County has one active monitoring station (MLN010) in the subwatershed; however, this station was only used for macroinvertebrate sampling and temperature monitoring during 2004 (see Macroinvertebrate section). Figure 3 shows the location of station MLN010.

Water Temperature

One summer of temperature logging in lower Mill Creek East Fork showed that the 7-Day Average Maximum was 61.4 degrees F, with values generally below 60 degrees. This suggests good conditions for salmonid use in the lower reaches of Mill Creek East Fork.

Temperature-related impacts to salmonids begin to occur at stream temperatures greater than approximately 64 degrees F (18 degrees C). Impacts include: decreased or lack of metabolic energy for feeding, growth or reproductive

behavior; increased exposure to pathogens; decreased food supply; and increased competition from warm-water tolerant species (ODEQ, 2004 draft).

The most complete predictor of current stream health in Mill Creek Fork may be 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 Mill Creek East Fork 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.

Implications for Stormwater Management

Table 5 lists general water quality concerns in Mill Creek East Fork 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.

Among the Clean Water Program activities most likely to have a positive impact on water quality are:

- effective stormwater system designs, retrofitting, and maintenance
- source detection and removal projects; and
- public education programs

Stormwater system design, retrofitting, and maintenance include a range of activities that can address specific pollutants of concern. Source detection and removal projects help eliminate specific contributions of pollutants. Education programs, though they rarely have a direct impact on water quality, are a critical element in modifying behavior and promoting better public stewardship of water resources.

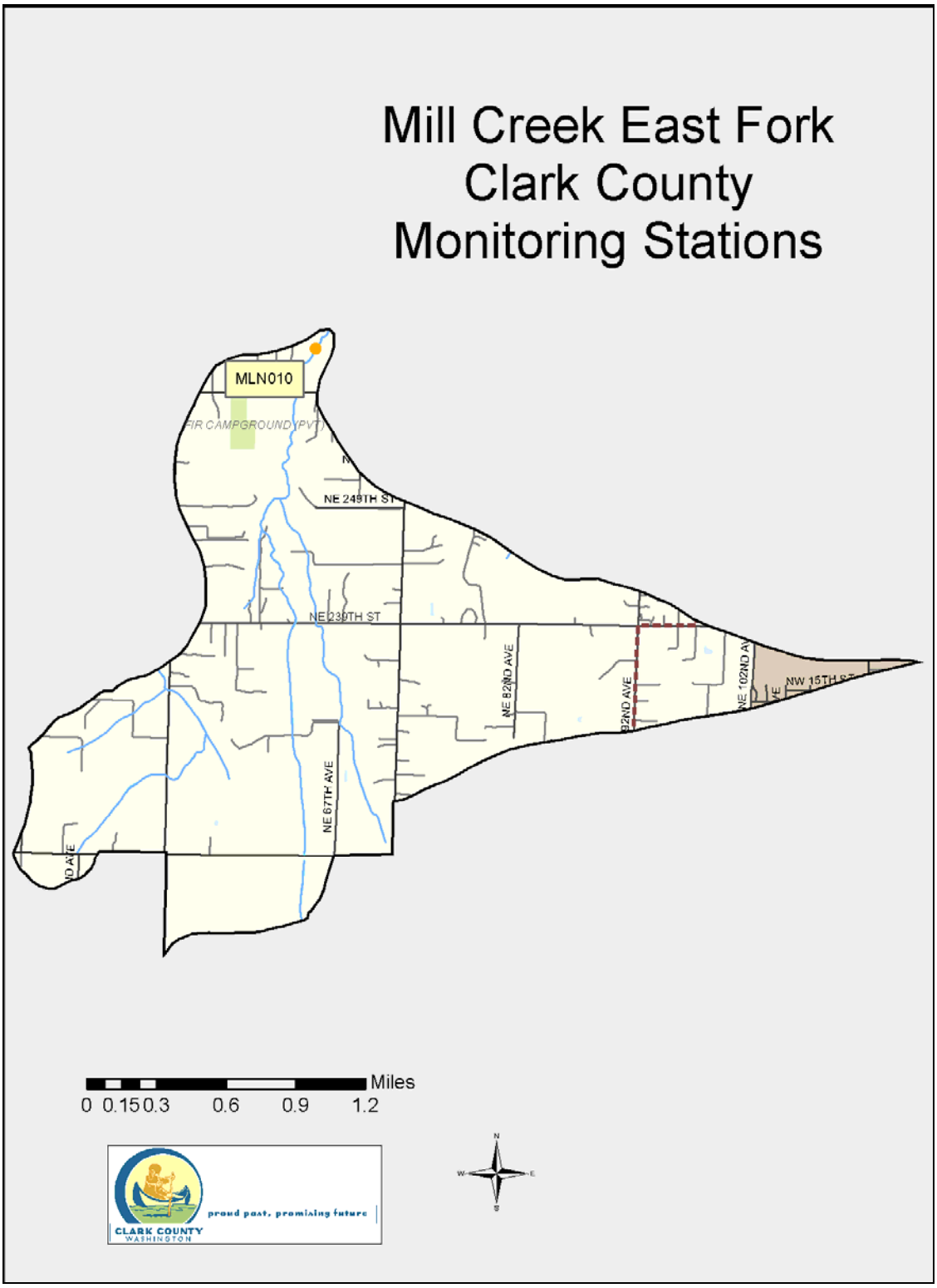


Figure 3: Clark County Monitoring Stations in Mill Creek East Fork Subwatershed

Table 5: Likely Water Quality Concerns, Sources, and Solutions for Mill Creek East Fork				
Characteristic	**Beneficial Use Affected**	**Potential Sources**	**Mechanism**	**Solutions (bold indicates direct Clean Water Program involvement)**
Fecal coliform bacteria	Primary contact recreation	failing septic systems	groundwater seeps	**Storm sewer screening for source identification and removal** **Education programs** Agricultural Best Management Practices Septic system inspection and maintenance
		livestock, wildlife, pets	overland runoff storm sewers/ditches direct access	
Water temperature	Core summer salmonid habitat (anadromous) Salmonid spawning and rearing (resident)	vegetation removal	direct solar radiation	**Stormwater infiltration to increase baseflow** **Streamside planting/vegetation enhancement/riparian preservation through acquisition** **Education programs**
		low summer flows	decreased resistance to thermal inputs	
Turbidity	Salmonid spawning rearing, and migration Aesthetic enjoyment	erosion *(development projects; land clearing; cropland; impervious surfaces; channel erosion)*	overland runoff storm sewers/ditches channel dynamics	Erosion control regulations **Storm water facility designs/retrofits to optimize settling and removal of suspended silt/clay** Agricultural Best Management Practices Stream bank stabilization/rehabilitation **Storm water outfall/facility retrofits to reduce flow-induced channel erosion**
Total phosphorus	Aesthetic enjoyment	natural groundwater	groundwater seeps	Erosion control regulations Septic system inspections and maintenance **Storm water facility designs/retrofits to optimize settling and removal of suspended silt/clay** Agricultural Best Management Practices
		erosion	(see turbidity)	
		livestock, wildlife	(see bacteria)	
		failing septic systems	(see bacteria)	

Drainage System 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 through the Digital Atlas located at:

http://gis.clark.wa.gov/imf/imf.jsp?site=digitalatlas&CFID=56651&CFTOKEN=98300052

The drainage system inventory is an ongoing CWP programmatic element focused on populating and updating the StormwaterClk database to include all existing stormwater drainage infrastructure.

Priority effort in Mill Creek East Fork during 2007 was directed toward identifying and mapping previously unmapped discharge points and stormwater facility polygons to support the Illicit Discharge Detection and Elimination Screening project (IDDE) and Public Facility Inspection project. Mill Creek East Fork was a high priority for mapping in support of both of these activities. Table 6 indicates the number of features previously inventoried in StormwaterClk prior to 2007 SNAP work, and the number of features added to the database as a result of 2007 SNAP implementation.

The drainage system inventory for the Mill Creek East Fork subwatershed is generally completed. Inventory is ongoing in 2008 and 2009 as part of a county-wide inventory update.

Table 6: Drainage System Inventory Results, Mill Creek East Fork

Database Feature Category	Previously Inventoried	Added to Database during 2007
Inlet	2	0
Discharge Point (outfall)	0	87
Flow Control	0	0
Storage/Treatment	4	0
Manhole	0	0
Filter System	0	0
Channel	38	93
Gravity Main	22	109
Facilities	0	7

Stormwater Facility Inspection

The Public Stormwater Facility Inspection project is designed to meet requirements of Clark County's 2007 NPDES permit requirement for an ongoing inspection program for county stormwater treatment and flow control facilities.

The facility inspection includes two components:

- A public stormwater facility inspection using standards meeting state requirements and county needs.
- An offsite inspection to check for problems such as bank erosion associated with stormwater outfalls.

Component 1: Public Stormwater Facility Inspection

Purpose

The purpose of the Public Stormwater Facility Inspection project is to verify that maintenance activities are implemented; facilities are properly functioning, and identify possible retrofit projects and major repairs.

Methods

The Public Stormwater Facility Inspection project is derived from 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 that may need repairs, the condition when repair or maintenance is needed, and the expected results. Individual components of a facility are referred to as "facility objects" and are listed in Table 9.

The public stormwater facility inspection process involves inspecting all facility objects to determine if all maintenance is in compliance with the standards. If any facility object does not meet the maintenance standards, the entire facility is not in compliance. Non-compliant stormwater facilities are referred to the appropriate public works departments for repairs or maintenance.

Results

Based on the county's StormwaterClk database, as of December 2007, there were two mapped public stormwater facilities in the Mill Creek East Fork subwatershed.

Figure 4 summarizes notable inspection activities including general facility location, compliant facilities and referrals of noncompliant facilities. As listed in Table 7, two public stormwater facilities in the Mill Creek East Fork subwatershed were inspected, including a total of six facility objects. All facility objects in compliance.

Maintenance Referrals

No referrals were generated as part of the inspection process.

Retrofit Opportunities

The public facility inspection process in the Mill Creek East Fork subwatershed did not generate any retrofit opportunities.

Management Recommendations

All public facilities inspected were found to be in compliance. Public stormwater facilities in the Mill Creek East Fork subwatershed were well maintained.

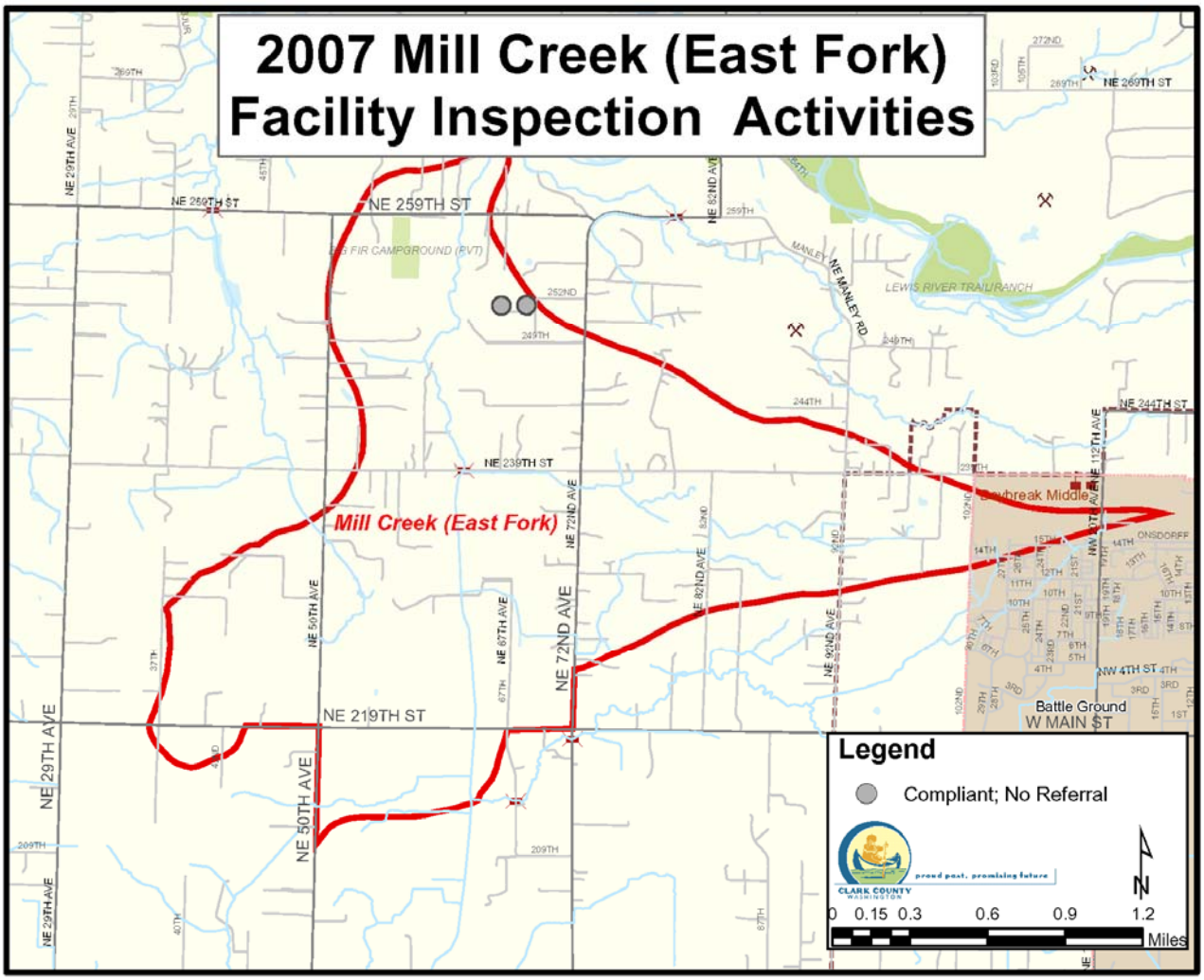


Figure 4: Summary of 2007 Public Stormwater Facility Inspection Activities in Mill Creek East Fork Subwatershed

Component 2: Offsite Assessment

Purpose

Stormwater outfalls can cause moderate to severe erosion as stormwater moves from the outfall, through the riparian zone, and to the receiving water. The erosion creates a source of mud to the stream due to incision and small slope failures. The Offsite Assessment is designed to detect possible offsite or downstream problems associated with the county's municipal separate storm sewer system (MS4), particularly from facility outfalls that discharge to critical areas.

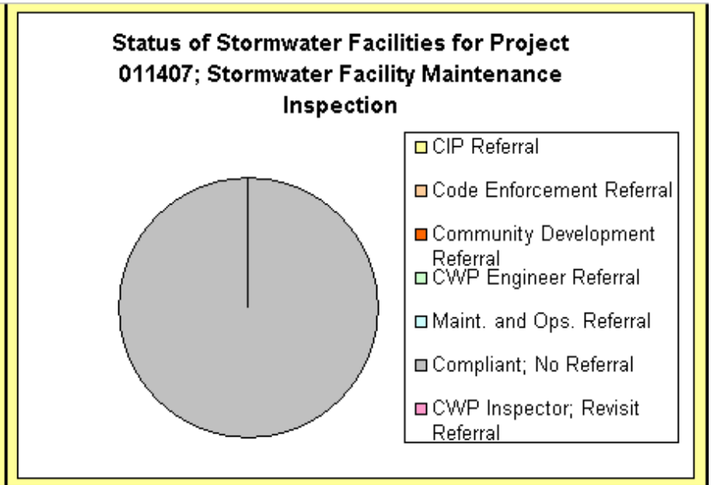
Table 7: 2007 Public Stormwater Facility Inspection Project Activity of the Mill Creek (East Fork) Watershed

SNAP Public Stormwater Facility Inspections (maintained by Public Works)

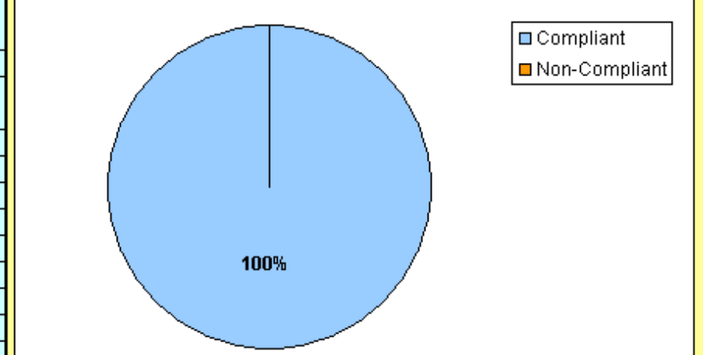
Subject: Mill Creek (East Fork) Subwatershed; Project 011407 Stormwater Facility Maintenance Inspection Initial Results

Total SNAP SWF Inspections	
Maintained by Public Works	2
Compliant	2
Non-Compliant	0
Not Visited (Under Construction)	0

Referrals of Non-Compliant SWF's as December 2007		**Referral Addressed and Facility Compliant as of December 2007**
CIP Referral	0	n/a
Code Enforcement Referral	0	n/a
Community Development Referral	0	n/a
CWP Engineer Referral	0	n/a
Maint. and Ops. Referral	0	n/a
Compliant; No Referral	2	n/a
CWP Inspector; Revisit Referral	0	n/a



Facility Objects Inspected	**Initial Inspections**		**Defect**	**Maintence Trigger**	**Facility Objects Repaired as of December 2007**
	Compliant	**Non-Compliant**			
Access Road or Easement	2	0	N/A	N/A	N/A
Catch Basin	0	0	N/A	N/A	N/A
Closed Detention System	0	0	N/A	N/A	N/A
CONTECH StormFilter	0	0	N/A	N/A	N/A
Control Structure / Flow Restrictor	0	0	N/A	N/A	N/A
Debris Barrier	0	0	N/A	N/A	N/A
Detention Pond	2	0	N/A	N/A	N/A
Drainage Trench	0	0	N/A	N/A	N/A
Drywell	0	0	N/A	N/A	N/A
Energy Dissipater	0	0	N/A	N/A	N/A
Fence, Gate or Water Quality Sign	0	0	N/A	N/A	N/A
Field Inlet	0	0	N/A	N/A	N/A
Infiltration Basin	0	0	N/A	N/A	N/A
Infiltration Trench	0	0	N/A	N/A	N/A
Inlet / outlet storm pipe	0	0	N/A	N/A	N/A
Sediment Trap	0	0	N/A	N/A	N/A
Typical Biofiltration Swale	2	0	N/A	N/A	N/A
Wet Biofiltration Swale	0	0	N/A	N/A	N/A
Wetland	0	0	N/A	N/A	N/A
Wetpond	0	0	N/A	N/A	N/A
Wetvaullt	0	0	N/A	N/A	N/A
Total SWF Objects	**6**	**0**			
Total Percentage	**100**	**0**			



Methods

County owned and operated stormwater outfalls meeting one or more of the following criteria were included in the offsite assessment:

- Within 200 feet of a critical area such as a stream channel or landslide hazard area.
- Within 300 feet of a headwater stream.
- Located on public land.
- Discharges stormwater from a public-dedicated facility that is currently under the two year private maintenance warranty bond.

The Offsite Assessment project is based on county and state standards equivalent to the maintenance standards specified in Chapter 4 of Volume V, of the 2005 *Stormwater Management Manual for Western Washington*. The standards list general design criteria and outfall features critical to reducing the chance of adverse impacts due to concentrated discharges from pipe systems and culverts, both onsite and downstream.

The offsite assessment process involved inspecting outfalls, as well as a 300 foot survey downstream of the outfall to look for any adverse impacts that may be caused by stormwater discharges.

If any outfall fails to meet the general outfall design criteria or is contributing to aggravation or creation of 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.

Results

Based on the county's StormwaterClk database, as of August 2007, there were 48 mapped outfalls in Mill Creek East Fork subwatershed that discharged into critical areas. Figure 5 and Table 8 summarize notable outfall assessment activities including critical areas and general outfall locations.

All 48 outfalls that discharged into critical areas or to headwater streams were assessed and all were found to be in compliance.

Potential Projects

No referrals were initiated for this outfall assessment project.

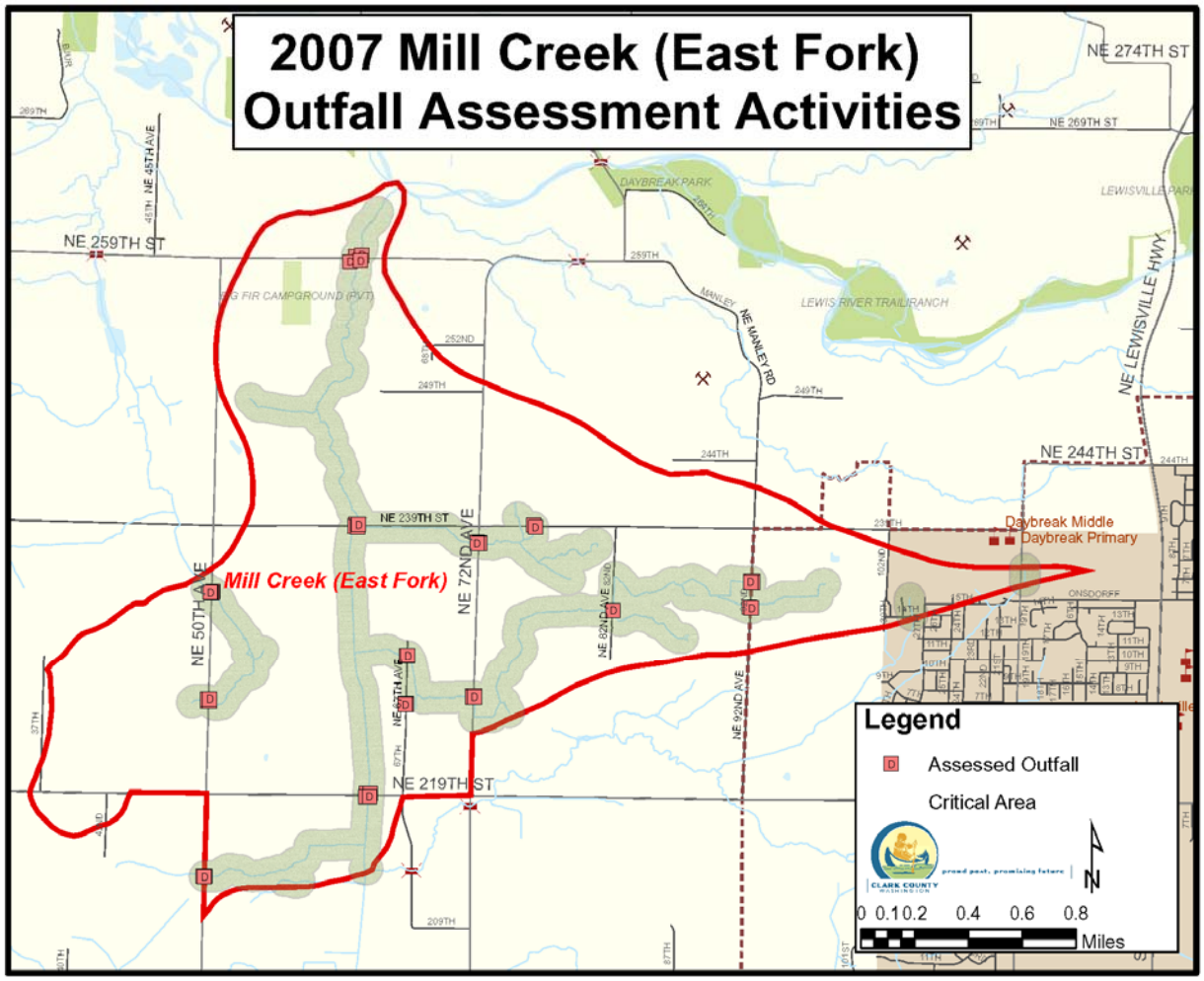


Figure 5: Summary of 2007 Outfall Assessment Activities in Mill Creek East Fork Subwatershed

Table 8: 2007 Outfall Assessment Project Activity Summary of Mill Creek East Fork Subwatershed	
Metric	Number
# of outfalls assessed	48
# of outfalls compliant	48
# of noncompliant outfalls	0
# of referrals initiated	0
# of referrals ongoing	0
# of outfalls fixed	0

Illicit Discharge Detection and Elimination (IDDE) Screening

Purpose

The purpose of the IDDE Screening project is to detect, isolate, and eliminate illicit connections and illicit discharges to Clark County's municipal separate storm sewer system (MS4).

The IDDE screening project is designed to meet the requirements of Clark County's 2007 NPDES permit which requires identifying and removing illicit connections to the county's MS4.

Methods

IDDE screening includes checking every stormwater outfall for potential illicit discharges, conducting follow-up investigations to track down suspected illicit discharges or connections, and referrals to the proper agencies for termination. Field work is primarily conducted during the dry summer season.

Results

IDDE Screening activities were completed in the Mill Creek East Fork subwatershed during 2007. Initial screening activities were completed from May through October 2007, and are summarized in this section.

Based on the county's StormwaterClk database, as of August 2007, there were 85 mapped stormwater outfalls in the Mill Creek East Fork subwatershed consisting primarily of roadside ditches.

Figure 6 summarizes notable screening activities, including: general outfall locations, outfalls where water samples were collected, follow-up investigations performed, referrals made, and sources removed.

As summarized in Table 9, 85 outfalls were screened. No flowing outfalls were discovered and accordingly, no samples were collected.

Table 9: IDDE Screening Project Activity Summary of Mill Creek East Fork Subwatershed as of December 2007

Metric	Number
# of outfalls screened	85
# of outfalls with sufficient flow to collect water samples	0
# of suspected illicit discharges	0
# of suspected illicit connections	0
# of investigations initiated	0
# of illicit discharge sources located	0
# of illicit connections identified	0
# of outfalls to be re-visited in 2008	0
# of referrals	0

Table 9: IDDE Screening Project Activity Summary of Mill Creek East Fork Subwatershed as of December 2007	
Metric	Number
# of illicit discharges removed	0
# of investigations and referrals ongoing	0
# of illicit connections terminated	0
# of cases closed without resolution	0

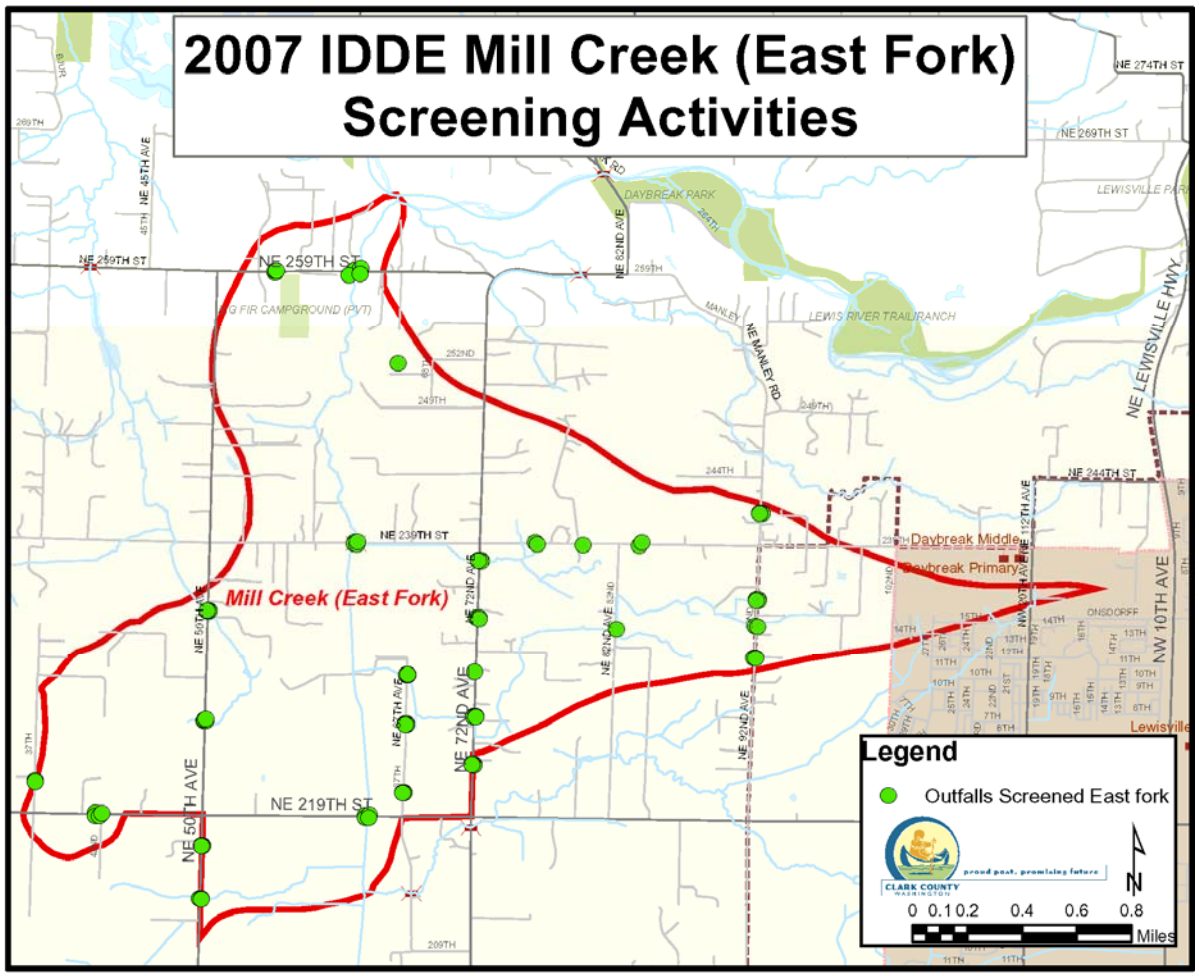


Figure 6: Summary of 2007 IDDE Screening Project Activities in Mill Creek East Fork Watershed

Stream Reconnaissance and Feature Inventory

A rapid stream reconnaissance and feature inventory was not conducted in Mason Creek during this assessment.

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 scale.

Methods

No physical habitat survey information is available for Mill Creek East Fork.

Results

No results are available for Mill Creek East Fork

Geomorphology and Hydrology Assessment

The geomorphology and hydrology assessment was completed as a stand-alone report after the bulk of this document was finalized. When available, this report will be attached as Appendix A.

Riparian Assessment

Purpose

The riparian assessment characterizes existing conditions based on available data, to identify general riparian needs and potential areas for rehabilitation projects.

The need for riparian rehabilitation tends to be widespread and exceeds the scope and resources of the Clean Water Program mission of stormwater management. Therefore, many potential riparian projects are referred to agencies such as LCFRB, Lower Columbia Fish Enhancement Group (LCFEG), Clark Public Utilities, and the Clark Conservation District for possible implementation.

This section focuses on opportunities likely to be considered by the Clean Water Program 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 2004 Watershed Characterization and Habitat Assessment reports prepared for the Lower Columbia Fish Recovery Board (R2, 2004 and SP Cramer, 2004). These reports apply primarily to salmon-bearing stream reaches and therefore, do not provide information for many smaller streams. These projects used aerial photo interpretation following Washington Forest Practices Board methods for LWD delivery and channel shade estimates.

In streams where no data exists from the 2004 LCFRB characterization, an examination of current orthophotographs is used to make a general assessment of riparian condition.

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 the respective sections and most are included on a final list for referral to outside agencies.

The 2004 LCFRB Habitat Assessment reports are also reviewed for site specific or general project recommendations within each subwatershed.

Results

The Mill Creek East Fork assessment uses results of the 2004 LCFRB Habitat Assessment. The full characterization reports are available on the Clark County website at:

http://www.clark.wa.gov/water-resources/documents.html#mon

Large Woody Debris Delivery
Figure 7 summarizes the LWD delivery potential for Mill Creek East Fork from the 2004 LCFRB assessment. LWD potential was estimated as 'none' in the upper portions of the subwatershed, south of the stream crossing at NE 239th Street, where the stream channel passes through cleared fields. The lower portion of the subwatershed, is forested from NE 239th Street to the confluence with the East Fork of the Lewis River.

Shade
Figure 8 illustrates shade conditions for Mill Creek East Fork from the 2004 LCFRB Habitat Assessment. It is estimated that the entire length of Mill Creek East Fork has a >90 percent shade rating, over its entire length. Although there are few trees upstream of 239th Street, shrubby vegetation covers the stream surface.

Potential Projects
No specific projects for the Mill Creek East Fork subwatershed are listed in the SP Cramer (2004) report.

Adding riparian vegetation to channels upstream of 239th Street should be pursued over the longer term.

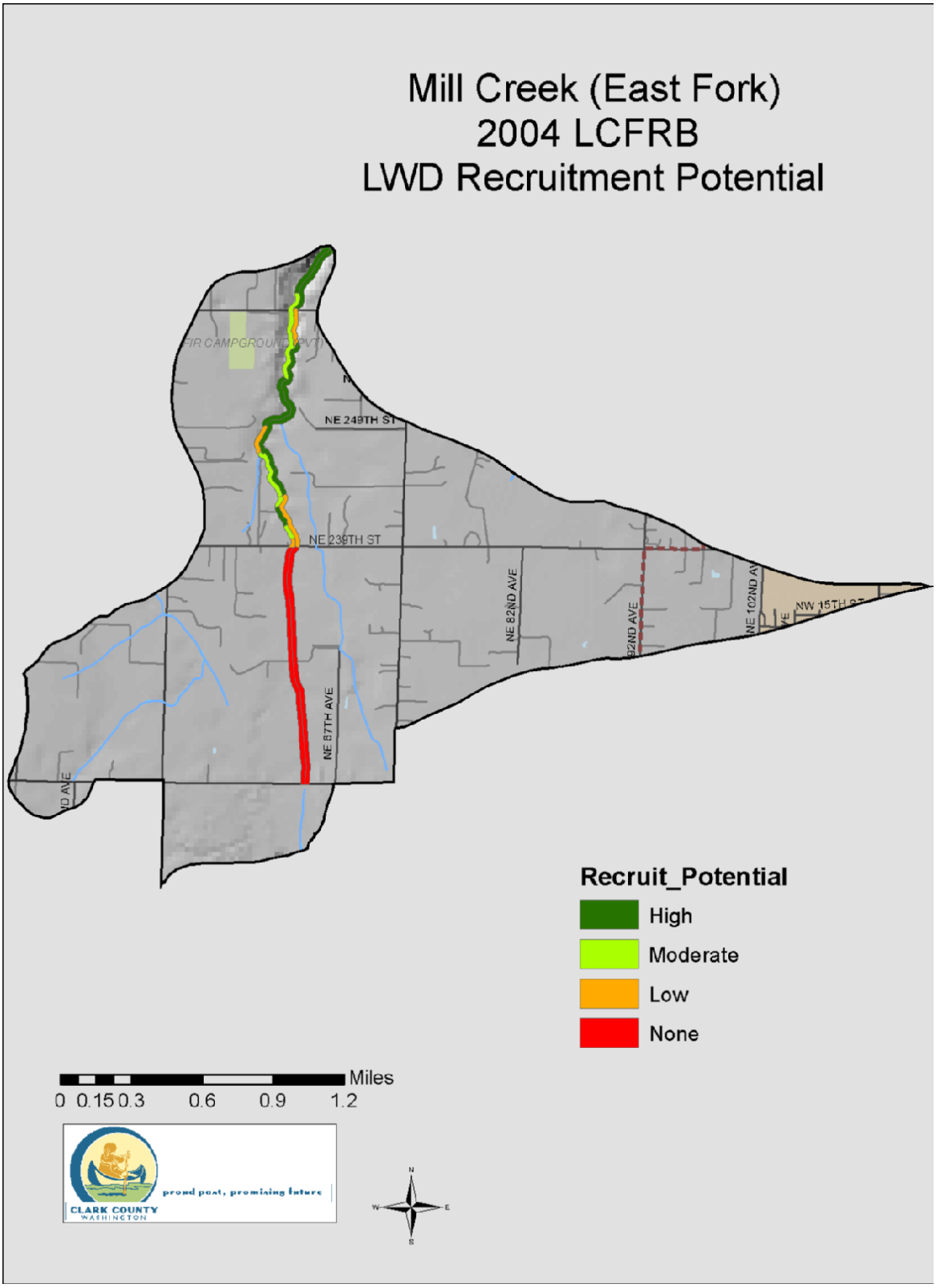


Figure 7: Mill Creek East Fork LWD Recruitment Potential (adapted from R2, 2004)

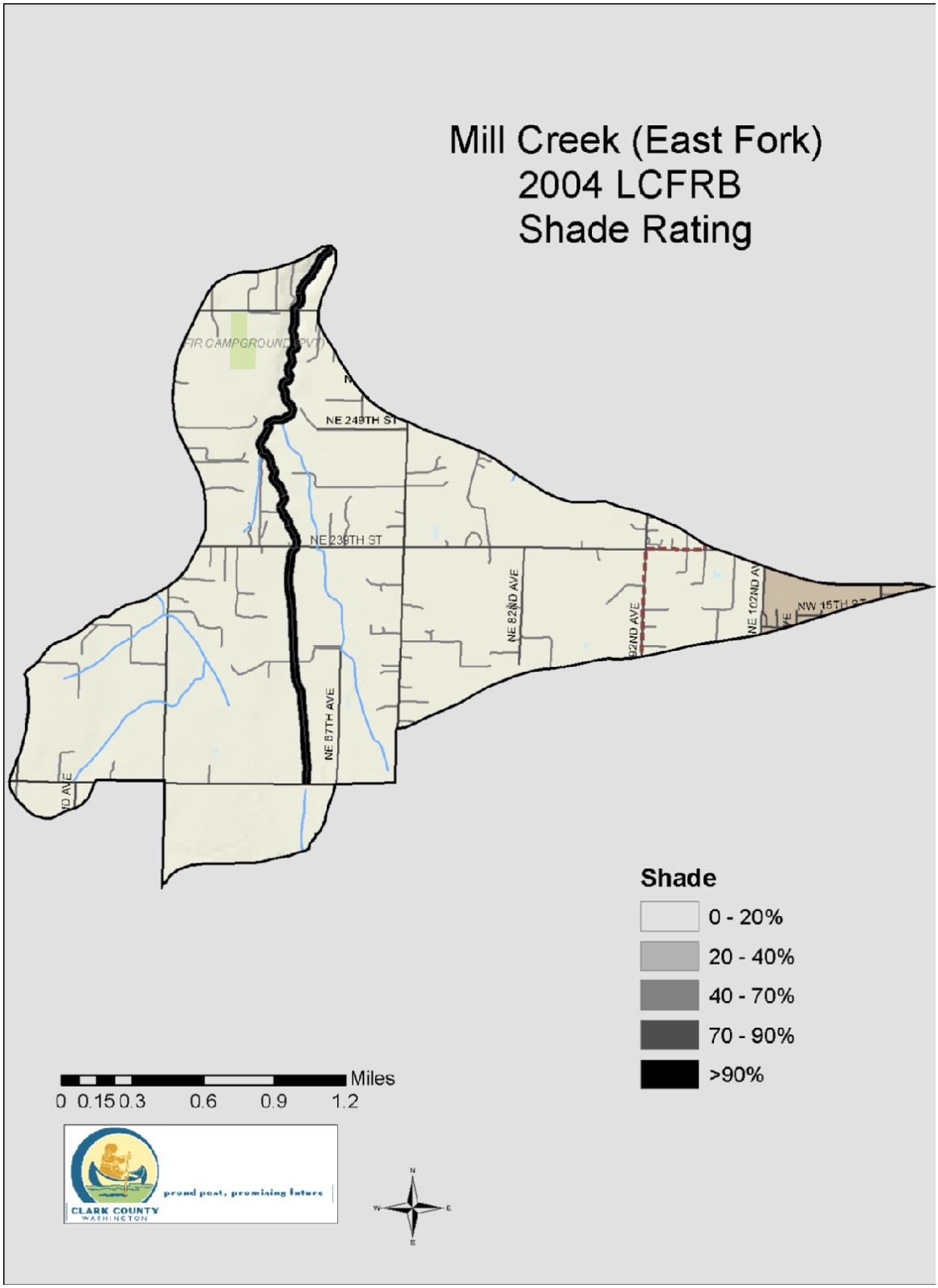


Figure 8: Mill Creek East Fork Shade Values (adapted from R2, 2004)

Floodplain Assessment

Mill Creek East Fork has almost no mapped flood plain. No flood plain assessment was completed for this report.

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; and
- make management recommendations for wetlands related to stormwater management.

The 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.

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. Detailed field evaluations and extensive review of existing data were not applied in the Mill Creek East Fork subwatershed.

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.

The Geomorphology and Hydrology section may also describe potential wetland-related project opportunities.

Results

Figure 9 shows potential wetland areas within the Mill Creek East Fork subwatershed based on data from the county wetlands atlas, including the Clark County wetland model, National Wetlands Inventory, and high-quality wetlands layer.

Potential wetlands within the Mill Creek East Fork subwatershed tend to be concentrated in near-stream areas within the upper watershed. A second area of potential wetland concentration is to the west of NE 50th Avenue.

Ecology's Clark County Regional Wetland Inventory and Strategy Study did not recommend any mitigation opportunities within Mill Creek East Fork, and the

only tax-exempt parcels within the subwatershed are a county-owned gravel facility with limited potential wetlands.

WSDOT work to mitigate for widening of SR502 is a potential source of future wetland enhancement projects.

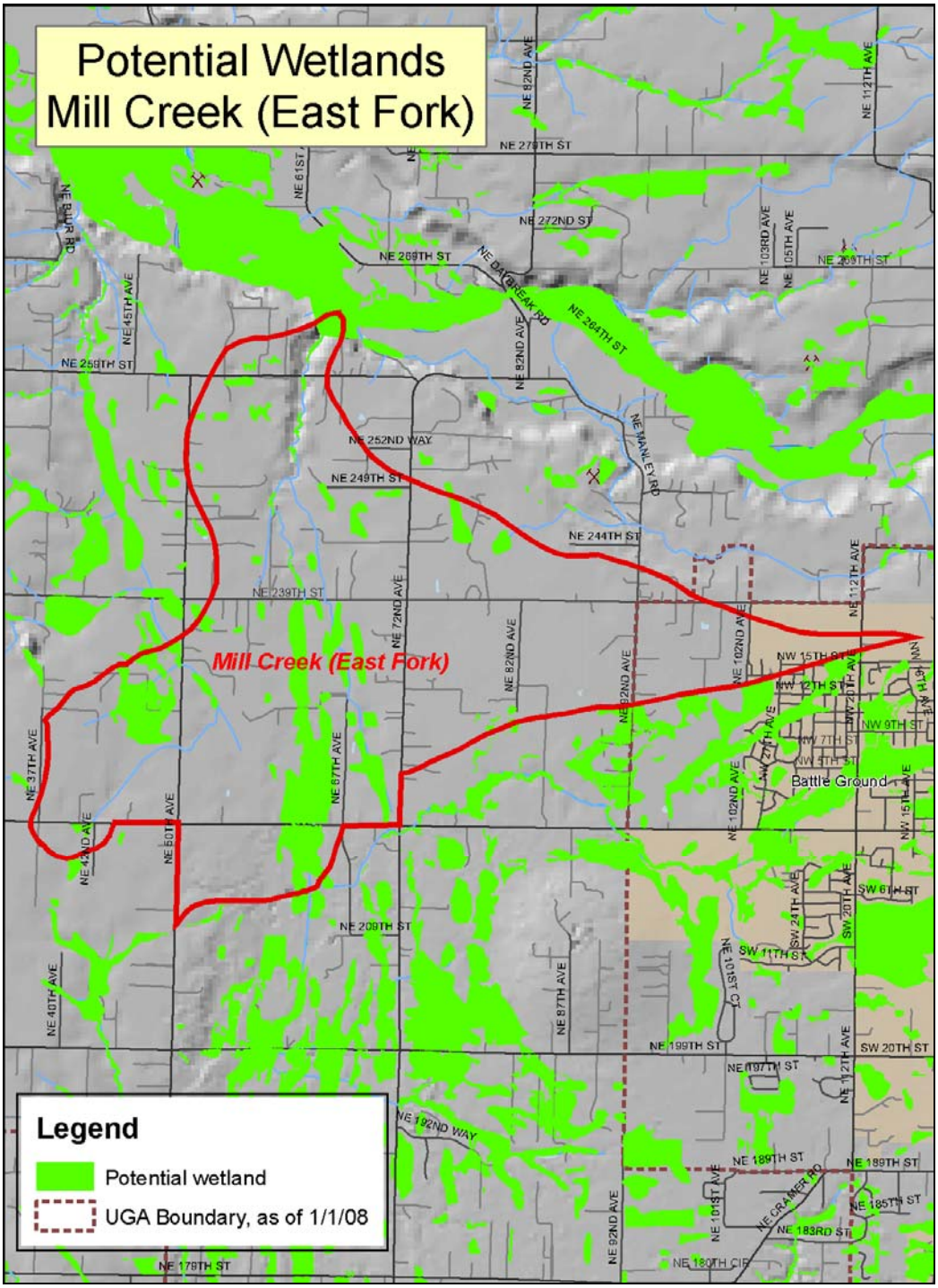


Figure 9: Potential Wetlands in Mill Creek East Fork Subwatershed

Draft Watershed Characterization (Ecology, 2007)
The Draft Watershed Characterization may be found on the Clark County website at http://www.clark.wa.gov/mitigation/watershed.html. Results pertaining to the Mill Creek East Fork subwatershed are summarized below.

Figure 10 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.

In general, green areas have higher levels of importance for watershed 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 to development areas, planning measures employing both restoration and appropriately sited development should be considered. (Ecology, 2007)

The Mill Creek East Fork subwatershed is defined as suitable for restoration due to its relatively high level of importance for watershed processes and relatively high level of alteration (Ecology, 2007).

Potential Projects
This assessment did not discover any high priority stormwater CIP projects to improve wetlands within the Mill Creek East Fork subwatershed.

Stormwater Management Recommendations
The Washington Department of Ecology recommends restoration of hydrologic processes in the Mill Creek East Fork subwatershed. Stormwater management actions taken by Clark County should focus on limiting degradation of hydrologic processes and identifying future opportunities for wetland enhancement.

Due to the lack of publicly owned land, these opportunities will likely arise primarily as part of mitigation and enhancement for future county and state road projects. Potential exists for partnering with WSDOT wetland mitigation projects associated with SR 502 widening.

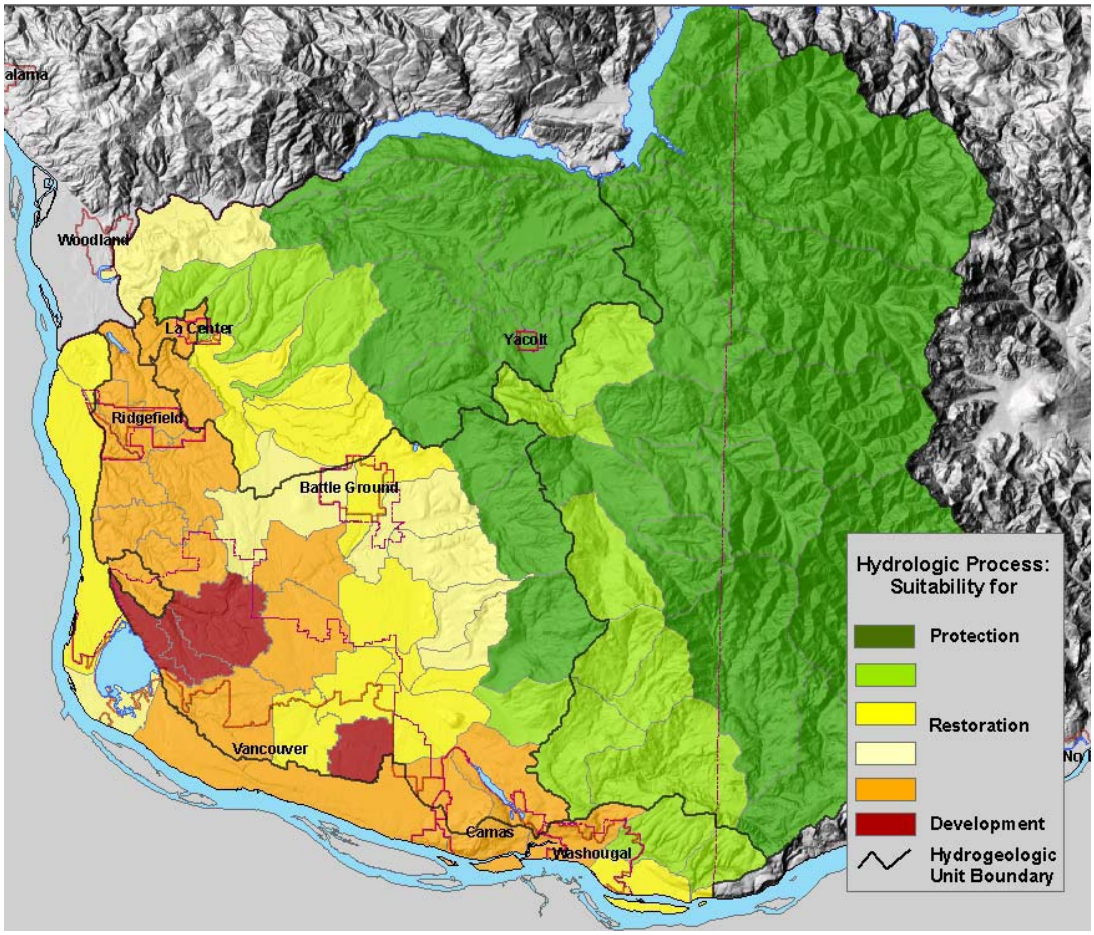


Figure 10: Priorities for suitability of areas for protection and restoration for the hydrologic process (Draft Watershed Characterization of Clark County, Ecology, 2007).

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 chronic and acute pollutant sources, modified stream hydrology, 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 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 Clark County's standardized protocols for macroinvertebrate sampling and analyses (Clark County Public Works Water Resources, June 2003). For example, to maximize the comparability of samples, macroinvertebrate collection is usually from multiple riffle habitats within a single reach. 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 a 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.

The Mill Creek East Fork macroinvertebrate sample was collected by Clark County in 2004 (Clark County, 2005) from station MLN010, located near where Mill Creek East Fork crosses under NE 259th Street, and approximately two miles northwest of Battle Ground (Figure 3 in the Water Quality Assessment section).

Results

Over this one year period, MLN010's B-IBI score was 28 (Table 10). This B-IBI score falls close to the lower end of the moderate category of biological integrity.

Table 10: MLN010 Annual Macroinvertebrate Community Metrics and Total Score From the Period 2004

B-IBI Metrics	MLN010 1-Year		
	Value	Score	Category
Total number of taxa	40	3	moderate
Number of Mayfly taxa	3	1	low
Number of Stonefly taxa	8	5	high
Number of Caddisfly taxa	6	3	moderate
Number of long-lived taxa	4	3	moderate
Number of intolerant taxa	1	1	low
Percent tolerant taxa	28	3	moderate
Percent predator taxa	12	3	moderate
Number of clinger taxa	11	3	moderate
Percent dominance (3 taxa)	54	3	moderate
Total B-IBI score		28	**moderate**

Examining Table 10 shows the ten individual annual metric results are classified as two low, seven moderate, and one high. In particular, the low scoring metric for intolerant taxa suggest signs of degraded water and habitat quality since they are among the first organisms to disappear as human disturbances increase (Fore, 1999). Also, the site's low score for Mayfly taxa could reflect the presence of toxins such as metals or pesticides.

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). Figure 11 shows that MLN010 station's 2004 B-IBI score falls in the middle of the range of expected scores (estimated 2000 Total Impervious Area from Wierenga, 2005).

By comparing Mill Creek East Fork to the likely range of conditions for watersheds with similar amounts of development, measured as impervious area, it is possible to make some general statements about the potential benefits from improving stream habitat. MLN010's B-IBI score falls in the middle of the expected range for its estimated 20 percent impervious area. This implies an opportunity to increase the level of biological integrity by improving habitat and stream conditions. Management strategies that limit further degradation and promote rehabilitation of this stream's health are important for at least maintaining its moderate biological integrity.

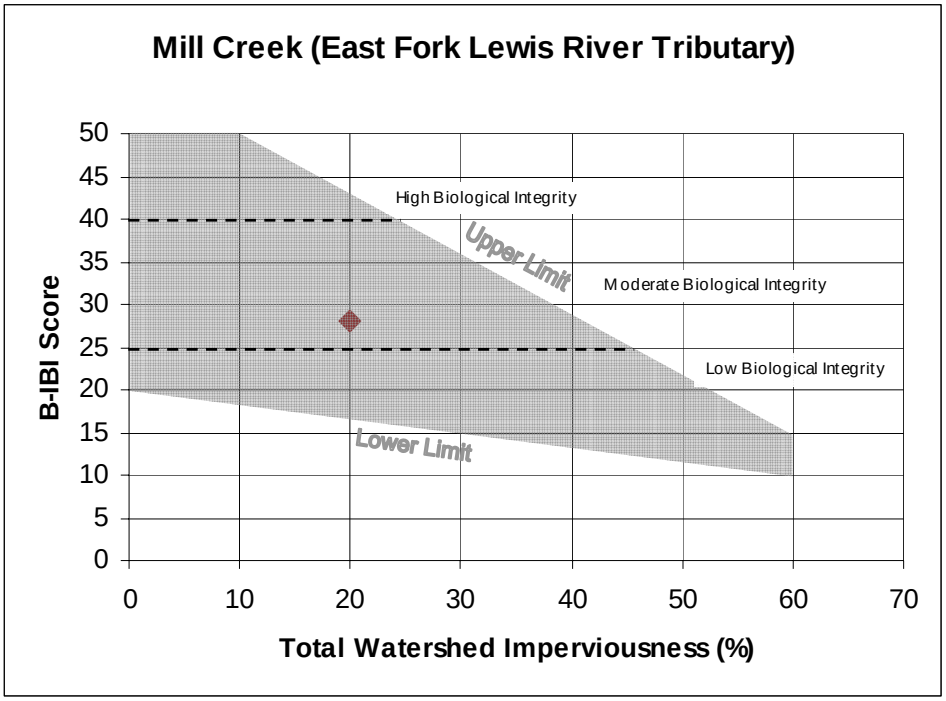


Figure 11: Approximate range of B-IBI in Puget Lowland watersheds, showing progressive decline with increasing imperviousness in the upstream watershed. Adapted from Booth et al., 2004. Markers indicate Total BIBI scores at MLN010 for particular years, vs. estimated 2000 subwatershed TIA.

Physical Habitat Factors

No stream habitat data are readily available for Mill Creek East Fork. Field observations suggest that habitat is fairly good in the sample reach with a gravel substrate and SP Cramer (2005) reported good shade cover.

Hydrology

No stream flow gauges exist on Mill Creek East Fork; however, based on watershed land cover, benthic macroinvertebrate populations probably are impacted by altered stream hydrology due to forest clearing.

Water Quality

Mill Creek East Fork lacks water quality data other than temperature data collected by the CWP in 2004. That study at MLN010 indicated that the stream met state standards (Clark County, 2005).

Management Recommendations for Mill Creek East Fork

One B-IBI sample may not be sufficient to make definitive statements about biological integrity due to annual variation; however, based on the moderate biological integrity, management efforts should focus on limiting further degradation and rehabilitation of degraded areas.

Considering that local habitat conditions appear good at MIL010, relatively low B-IBI scores may be associated with upstream conditions. Specific actions that

should be considered for Mill Creek East Fork are:

- Conduct dry weather screening to identify potential pollutant sources.
- Plan and build stormwater and wetland projects to reduce storm flows and improve summer base flow by restoring wetland functions in the upper parts of Mill Creek East Fork subwatershed.

Fish Use and Distribution

Purpose

Fish distribution refers to the geographic extent of 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 is mapped from existing Clark County GIS information, which reflect data collected and analyzed by the Northwest Indian Fisheries Commission (NWIFC). Fish distribution data for Clark County are available on the County's website.

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

- WDFW passage barrier database
- Salmon Scape (http://wdfw.wa.gov/mapping/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. Therefore, road crossings were mapped by overlaying the county road layer (roads.shp) with LiDAR-derived stream data from StrmCntr.shp.

Results/Summary

Distribution

All available evidence suggests that anadromous fish use of Mill Creek East Fork includes Coho and winter steelhead (Figure 12). The LCFRB identified Mill Creek East Fork as Tier 2 in its 2004 Salmon and Steelhead Recovery Plan. It is a Group A subwatershed because it includes one or more Tier 1 reaches. The recovery emphasis for this subwatershed is for restoration and preservation measures.

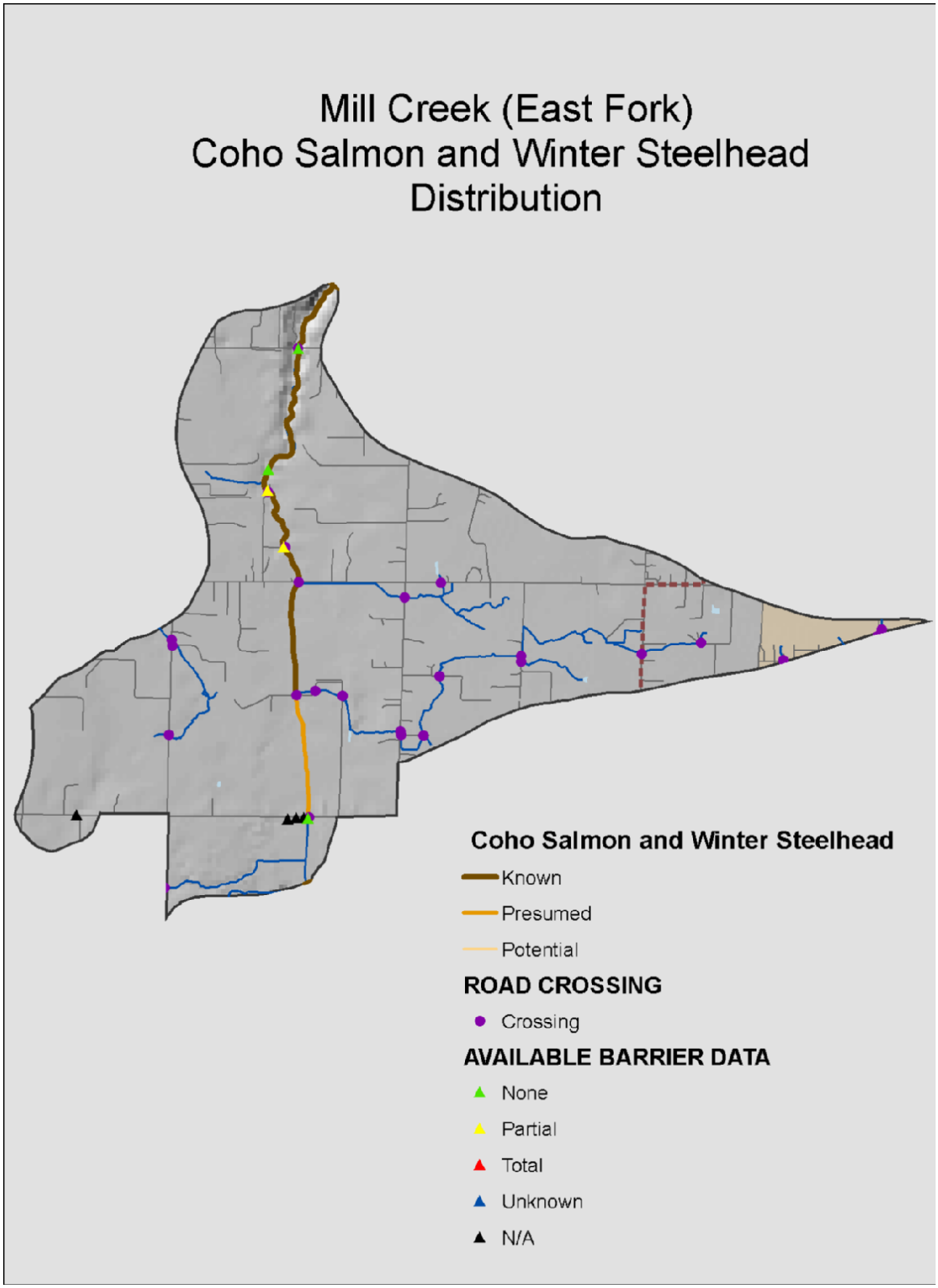


Figure 12: Fish Distribution and Barriers

Barriers

The WDFW barrier database and the 2007 LCFRB Regional Culvert Survey provide the most complete assessment of barriers in Mill Creek East Fork subwatershed (Figure 12). There are two partial blockages. One is located just north of NE 239th Street at river mile 1.34, and the other is located further north at river mile 1.06. The habitat between these two culverts is identified as a Tier 1 reach. The partial barrier at mile 1.06 is rated by LCFRB as a medium (14.49) priority index rating, the partial barrier at mile 1.34 has a low (6.42) priority index rating.

There are two other instream structures below the partial barrier at river mile 1.06. One is a fishway and the other is a culvert. Existing data suggest that there are no passage issues associated with these structures.

Recommendations

Because Mill Creek East Fork is a high priority for salmon recovery, priority should be given to projects to improve fish passage barriers and habitat-forming processes. While this study did not add to the knowledge about barriers, some recommendations are made.

Modifying the partial fish barriers in Mill Creek East Fork would allow fish better access to habitat in the upper portions of the subwatershed. The Tier 1 reach of Mill Creek East Fork is bounded by the partial barriers at river mile 1.06 on one end and the partial barrier at mile 1.34 at the other. Modifying the partial fish barrier at mile 1.06 would allow better access to the Tier 1 reach. The stream reaches above the partial barrier at river mile 1.34 are identified as Tier 4. Improving access to migratory fish alone may not provide a great deal of benefit. When improved access is combined with habitat improvement the benefits increase significantly. LCFRB indicates that this habitat has a high restoration potential.

Specific project recommendations include:

- Improve or remove the partial barrier at RM 1.06.
- Improve or remove the partial barrier at RM 1.34.
- The Wooldridge project is identified in the 2007 LCFRB Regional Culvert Inventory on page 10, Table 10. This culvert replacement project is located on private property at the intersection of NE 246th and 59th Street, which backs up when it rains. This project is currently unfunded and does not have a date for completion.

In addition, barriers should be removed over time as stream crossing infrastructure is replaced or upgraded.

Hydrologic and Hydraulic Modeling

At this time, no hydrologic or hydraulic modeling is completed for Mill Creek East Fork.

Analysis of Potential Projects

The analysis of potential projects includes a brief summary of stormwater 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, and lists recommended projects and activities for further evaluation. Projects or activities are placed in one of six categories.

Summary of Conditions, Problems, and Opportunities

Conditions and Problems

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

Coordination with Other Programs

Mill Creek East Fork is little known outside of the individuals and organizations that work to protect and restore fish habitat within the East Fork Lewis River watershed.

The Washington Department of Ecology is developing TMDLs for bacteria and temperature in the East Fork Lewis River watershed. Also, the Washington Department of Transportation is planning a major road widening project for SR 502 that should produce wetland and habitat restoration projects within the next several years.

Broad-scale Characterization

Mill Creek East Fork soils tend to be fine-grained and are easily eroded. Most of the watershed is level upland area that is cut by the Mill Creek Canyon. Once the stream enters this canyon, there is a wooded riparian zone and gravel substrate.

Standard metrics based on NOAA fisheries standards indicate significant human alteration and suggest Mill Creek East Fork habitat is significantly degraded but still meets some standards for properly functioning. These metrics include forest cover, TIA and EIA, road density, and stream crossing density.

Land cover, zoning, and subwatershed metrics suggest that a restore and protect approach is appropriate.

Water Quality Assessment

Mill Creek East Fork is not 303(d) listed, but is part of the East Fork Lewis River fecal coliform and temperature TMDL project.

Almost no water quality data is available for Mill Creek East Fork, except for a summer of water temperature data in 2004.

Drainage System Inventory
Drainage mapping is largely complete, with most ditch outfalls and channels mapped in 2007. Additional mapping will be completed in 2008 and 2009.

Stormwater Facility Inspection
As of December 2007, there were only two mapped public stormwater facilities in unincorporated areas of Mill Creek East Fork. The facilities were in compliance with standards in the 2005 SWMMWW Volume 5.

Off-site assessments conducted for 48 public stormwater outfalls discharging to critical areas identified no erosion problems caused by an outfall.

Illicit Discharge Screening
Screening conducted at 85 known stormwater outfalls, primarily from roadside ditches, identified no illicit connections or discharges.

Geomorphology and Hydrology
See Appendix A for results of these assessments.

Riparian Assessment
The most reliable riparian assessment data in Clark County is limited to the areas assessed during the 2004 LCFRB Habitat Assessment. Mill Creek East Fork was included in this assessment.

Generally, riparian conditions to support large woody debris recruitment are at good to acceptable levels downstream of 239th Street where the stream forms a wooded canyon. Above the canyon, forests are largely cleared and conditions are poor.

Riparian shade is good for the length of the mainstem; however, the reaches upstream of 239th Street are shaded by brush or tall grass. The need to maintain the function of the stream as a drainage ditch above 239th Street may inhibit efforts to restore riparian vegetation.

Public land is very limited within the watershed; therefore, riparian projects would typically be on private land and require landowner cooperation.

Wetland Assessment
Based on available wetlands data, potential wetlands are largely limited to low depressions along stream channels and ditch systems. Notable large areas of potential or current wetlands include the low areas along the mainstem between 239th Street and the subwatershed's southern boundary. Other smaller areas could be important for restoration projects.

Ecology's draft wetland characterization of Clark County characterizes Mill Creek East Fork as suitable for both development and wetland restoration due to

a higher relative level of alteration and lower relative importance to regional watershed processes.

No wetland projects are proposed at this time because there is no public land included in potential wetland areas.

Macroinvertebrate Assessment
Based on a single sample, Mill Creek East Fork has moderate biological integrity typical for a stream draining a deforested rural area. The range of B-IBI scores for comparable areas includes much higher and lower integrity. This and the relatively good condition of habitat at the sample site suggest that upstream conditions are probably lowering the score and it is probable that biological integrity could be increased through improvements to upstream water quality conditions.

Fish Use and Distribution
The LCFRB has identified Mill Creek East Fork as a relatively important stream for salmon recovery. There is known use by Coho and winter steelhead downstream of 239th Street.

At least two partial barriers are identified downstream of 239th Street and numerous unassessed culverts are upstream of the salmon bearing reaches. Mill Creek East Fork is a basin where the first priority should be to "restore access to habitat blocked by artificial barriers".

Recently Completed or Current Projects

There are no stormwater projects planned for Mill Creek East Fork in the 2007 through 2011 SCIP.

The Washington State Department of Transportation is planning a major project to widen SR 502 between I-5 and Battle Ground, converting a two-lane highway into a four-lane controlled access highway. This project will require sizable wetland mitigation, anticipated to include over 100 acres of enhanced wetlands and buffers, and construction of ten stormwater facilities.

At least one project is being planned by the Clark Conservation District to remove a private fish passage barrier downstream of 239th Street.

Analysis Approach

Purpose

The Analysis of Potential Projects narrows the initial list of possible projects to a manageable subset of higher priority opportunities. 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 IDDE 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

The review is qualitative and based on best professional judgment of CWP staff. 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 on the basis of problem severity, estimated cost and benefits, land availability, access, proximity and potential for grouping with other projects, and potential for leveraging resources.

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

Emergency or Immediate Actions

Limited field work in Mill Creek East Fork did not discover any situations that required immediate action.

Potential Stormwater Capital Projects

- None are identified at this point. Detailed evaluation of stormwater discharges from Battle Ground should be conducted before consideration of stormwater mitigation projects.

Stormwater Infrastructure Maintenance CIPs

- None were identified from SNAP field work.

Stormwater Class V Underground Injection Control Projects

- No county-owned Class V UIC wells are known in Mill Creek East Fork.

Habitat Rehabilitation/Enhancement Projects

- None are proposed due to the absence of public land.

Property Acquisition for Stormwater Facilities

- No stormwater facilities or land acquisitions for facilities are proposed, but should be considered to mitigate for development in Battle Ground.

Follow-up Activities for Referral within CWP

- Field inspections of stormwater facilities and outfalls identified no problems that warranted referral.

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

- Livestock have direct access at several points along Mill Creek East Fork. These sites should be referred to the Clark Conservation District.
- Fish passage barriers downstream of 239th Street are well known to resource management agencies and work is underway improve access.

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 Mill Creek East Fork subwatersheds, by permit component, include:

Storm Sewer Mapping and Inventory

- A complete drainage system inventory is critical for effective maintenance and inspection activities. Complete the stormwater inventory both in Mill Creek East Fork and countywide, including areas draining from the City of Battle Ground.

Coordination of Stormwater Activities

- Mill Creek East Fork is shared by Clark County and the City of Battle Ground. Basic stormwater management activities such as illicit discharge screening may be coordinated in the future.
- The Lower Columbia Fish Recovery Board is planning a project to identify restoration projects in the East Fork Lewis River flood plain. While there is little if any of Mill Creek East Fork on the mainstem flood plain, there may be some opportunity to coordinate with actions in Mill Creek East Fork.
- Clark County participates in Ecology's bacteria and temperature TMDL development.

Mechanisms for public involvement

- SNAP reports are published on the CWP web page.

Development Regulations for Stormwater and Erosion Control

- EIA is expected to increase to approximately 10 percent due to development in Battle Ground. At these levels, adverse changes to stream hydrology and stability can occur unless development standards effectively control the duration of erosive flows.
- In developing areas, emphasize stormwater management that focuses on reduction of runoff and diffuse infiltration close to the source rather than in centralized facilities. LID practices should be encouraged.
- Consider stormwater basin planning as a tool to better manage stormwater impacts due to future growth.

Stormwater Capital Improvements

- Examine the use of small projects to improve stormwater retention and treatment in roadside ditches.

- While no specific wetland or habitat restoration projects are proposed by the SNAP due to the absence public land to place projects, restoring headwater wetlands should be a priority to improve hydrologic functions.

Operation and Maintenance Actions

- Restoring access to fish habitat is a priority in Mill Creek East Fork. Fish barrier removal projects in the upper watershed should be considered as existing roads and culverts are upgraded or replaced.
- Confirm that county ditch maintenance practices minimize vegetation removal whenever possible.

Education and Outreach to reduce behaviors that contribute pollution

Areas where increased outreach could improve stream conditions include:

- Replace missing or deteriorated stream name signs.
- Develop a process to provide education about appropriate ditch maintenance practices to rural landowners.

TMDL Compliance

- Ecology is beginning to develop TMDLs for bacteria and temperature in the East Fork Lewis watershed. The county is participating in this process.
- Added monitoring for fecal coliform in Mill Creek East Fork may be warranted as part of the TMDL.

Monitoring Stormwater Program Effectiveness

- Problems caused by stormwater are common and most severe on small tributary streams. Future assessment may be most effective by focusing on smaller tributary reaches.

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Appendices

Appendix A — Geomorphology and Hydrology Assessment