# 2008 Stormwater Needs Assessment Program

## Lower Burnt Bridge Creek
## Subwatershed Needs Assessment Report

Clark County Public Works Clean Water Program

April 2009

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| Funding source: | Clark County Clean Water Fee |
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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 Lower Burnt Bridge Creek subwatershed in southern Clark County. The assessment area focused on unincorporated areas outside the city of Vancouver.

## 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 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 study area, including water quality, biological health, habitat, hydrology, and the stormwater system.

| Category | Status |
|---|---|
| **Water Quality** | |
| Overall | • Poor to very poor |
| Fecal coliform bacteria | • Fails state fecal coliform bacteria standard<br>• Included in Burnt Bridge Creek bacteria TMDL |
| Temperature | • Fails state temperature standard, except at the mouth of Cold Creek<br>• Included in Burnt Bridge Creek temperature TMDL |
| **Biological** | |
| Benthic macro-invertebrates | • Poor biological integrity. |
| Anadramous fish | • Known use by Coho salmon and Winter Steelhead; Presumed presence of Coho salmon within Cold Creek.<br>• No regional fish recovery priority ranking; assumed low |
| **Habitat** | |
| NOAA Fisheries criteria | • Percent forested, road density, and impervious area metrics suggest habitat is not properly functioning<br>• Stream crossing density suggests properly functioning condition |
| Riparian | • Lacking forest except for parks |
| Wetland | • Several mitigation opportunities, including east of St. Johns Road at NE 54th Street, and north of Minnehaha Street |
| **Hydrology and Geomorphology** | |
| Overall hydrology | • Peak discharges are much lower and of longer duration than a typical urban stream<br>• Nearly all of the runoff in southern part is routed to drywells<br>• Flat topography slows runoff rates through low gradient drainage systems |
| Future condition | • Impervious surface projected to be very high; impact is reduced because much runoff is sent to drywells |
| **Stormwater (Unincorp areas)** | |
| System description | • Primarily drywells and some piped infrastructure<br>West of I-5: mostly drywells and some pipes<br>Cold Creek: mostly pipes, some drywells<br>East of I-5: drywells and pipes |
| Inventory status | • Complete |
| System adequacy | • Likely inadequate treatment<br>• Much of area developed before treatment and flow control requirements existed |
| System condition | • 71% of facility components in compliance with county standards at time of inspection |

### Opportunities

Projects listed in the SNAP report represent only a small part of those needed to protect and restore Lower Burnt Bridge Creek. Potential project opportunities were identified based on current conditions and local program capabilities. Several opportunities exist for stormwater-related watershed improvement, including the following:

- Technical assistance visits to businesses with potential source control problems
- Coordination with other county departments and with local agencies such as Vancouver/Clark Parks & Recreation, Washington Department of Fish and Wildlife, Washington Department of Transportation, and City of Vancouver Water Resources Program to explore potential cooperative projects
- Inspection of publicly owned stormwater facilities and referral to appropriate county programs for corrective measures
- Potential capital improvement projects including drywell and bio-filtration swale retrofits
- Evaluation of potential wetland enhancement or advanced mitigation projects within tax-exempt parcels
- Promotion of riparian enhancement projects

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 the Lower Burnt Bridge Creek watershed include:

- Encourage the use of Low Impact Development techniques for new and re-development

## Introduction

This Stormwater Needs Assessment includes the Lower Burnt Bridge 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 and most cost effective mix of improvement actions to protect existing beneficial uses, and to improve or allow for the improvement of lost or impaired beneficial uses consistent with NPDES objectives and improvement goals identified by the state GMA, ESA recovery plan implementation, 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 protections and salmon recovery planning under the state Growth Management Act (GMA) and the federal Endangered Species Act (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 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 Lower Burnt Bridge 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).

The majority of the Lower Burnt Bridge Creek subwatershed is located within City of Vancouver urban growth area (UGA). The subwatershed is highly developed with residential, parks, commercial, and industrial development.

### Assessment Tools Applied in Lower Burnt Bridge Creek

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 marked with an asterisk (*) are those for which new data or analyses were conducted during the course of this needs assessment. The remainder of the tools and chapters were completed based on pre-existing information.

**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 primarily on raising awareness about the SNAP effort. The following activities were completed:

- August 2008 – press release to local media.
- March 2008 & December 2008 – articles in Clean Water Program E-Newsletter.
- April 2008 – SNAP information distributed with Clean Water Program information at Small Farm Expo: 69 participants.
- August 2008 – information on the SNAP program distributed at 10-day Clark County Fair.
- Clean Water Program web pages updated as needed on an on-going basis; 138 visitors to the SNAP Web page and 95 unique downloads of SNAP documents (note, these figures are under-reported as tracking software only records top 20 pages and documents monthly).
- A description of the SNAP is included in Clark County's annual stormwater management program plan submitted to Ecology.
- 229 source control technical assistance visits to businesses in SNAP watersheds, including more than 50 in this assessment area

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

Tools available to educate in response to identified problem areas include the following:

- Site visits by clean water technical assistance staff.
- Letters detailing specific issues to individual landowners.
- General educational mailings 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 improve 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 with departments and groups thought 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 gathered 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 Lower Burnt Bridge Creek needs assessment area:

- Lower Columbia Fish Recovery Board
- Clark County Legacy Lands Program
- Vancouver/Clark Parks and Recreation
- City of Vancouver Water Resources Program
- Washington Department of Fish and Wildlife
- Washington Department of Transporation
- Clark County Real Property Services

### 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 TMDL monitoring data
- CC 6-year TIP
- Clark County 2004 Stream Health Report

## 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 are 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.

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, conclusions about general subwatershed condition and potential future changes, and potential mitigation or improvement site identification.

### Map Products

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*

The Lower Burnt Bridge Creek subwatershed is adjacent to the Columbia River floodplain (Figure 1) and largely within the City of Vancouver. A small segment of Lower Burnt Bridge Creek and Lower Cold Creek are inside unincorporated Clark County and are the only natural stream channels outside the city. Land use is predominately urban with undeveloped open space on the Lower Burnt Bridge Creek floodplain and along steep canyon walls.

*Topography*

Lower Burnt Bridge Creek is a relatively flat lying area cut by canyons occupied by Lower Burnt Bridge Creek and it largest tributary, Cold Creek. North of Burnt Bridge Creek, the land surface is a relatively flat area with hills and closed depressions formed by late Ice Age cataclysmic floods of the Columbia River that range in elevation from 200 to 300 feet. South of Lower Burnt Bridge Creek, Mill Plain ridge forms a uniformly flat surface about 300 feet above sea level. The Lower Burnt Bridge Creek floodplain rises from near sea level at its mouth to about 50 feet where it is covered by Interstate 5.

*Geology and Soils*

Except for recent alluvium on floodplains, Lower Burnt Bridge Creek subwatershed is entirely underlain by Late Ice Age catastrophic flood deposits. Mill Plain Ridge is underlain by very coarse sand and gravel that is very well drained. North of Mill Plain Ridge, layered sand and silt deposits underlie the area. The differing ability of these geologic units to transmit groundwater greatly influences runoff and water table depth.

Soils formed on the coarse grained deposits under Mill Plain Ridge tend to be well drained. Soils north of Mill Plain Ridge are less permeable and tend to form wetlands in low lying areas.

*Hydrology*

Geology and topography play the main role in determining study area hydrologic framework. Human activities have also profoundly influenced the nature of Cold Creek and Lower Burnt Bridge Creek. The Lower Burnt Bridge Creek floodplain was filled to make an elevated grade for Interstate 5. Cold Creek enters a deeply buried culvert shortly upstream of Interstate 5 at Highway 99. Cold creek is also piped and buried through sections within BPA Ross Substation, Blossom wood Farm and High Meadow subdivisions, and Cold Creek Industrial Park.

There is historical stream gage data for Lower Burnt Bridge Creek, dating to the 1980s and early 1990s, collected by Burnt Bridge Creek Drainage Utility. Data has been collected intermittently by the US Geological Survey since then. Data suggests that Lower Burnt Bridge Creek is an unusual urban stream in that peak discharges are much lower and of longer duration than typical. The basin geology and topography explain this anomaly. Gravely geologic materials that underlie much of the upper and southern parts of the basin are ideal for stormwater infiltration, taking nearly all of the runoff in drywells and infiltration trenches. The basin's flat topography also influences runoff rates by providing slower flow to the channel through low gradient drainage systems.

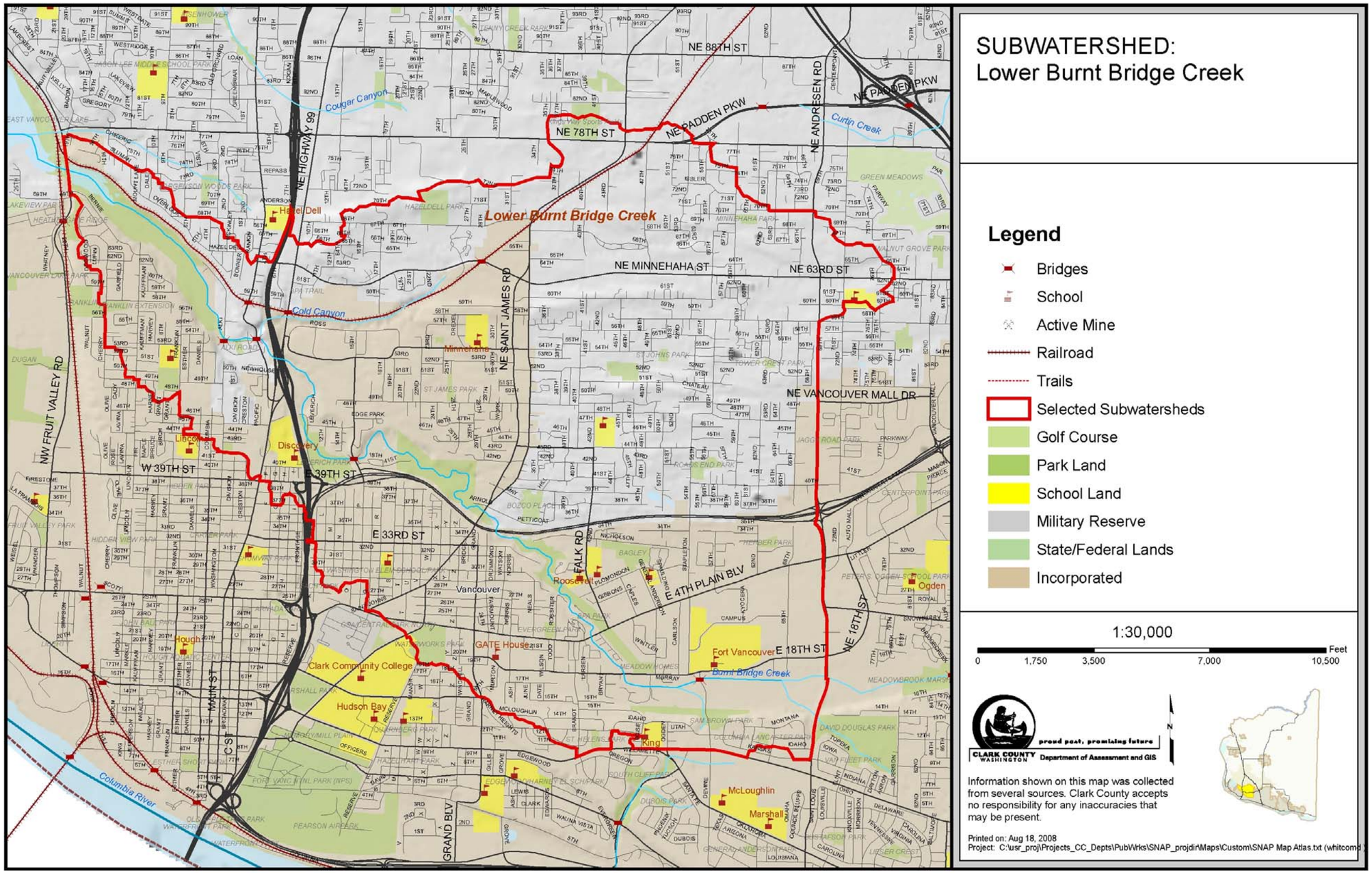



Figure 1: Lower Burnt Bridge Creek Subwatershed Area Map

*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 Lower Burnt Bridge Creek has non-functioning stream habitat (Table 2).

**Table 2: Watershed Scale Metrics**

| Metric | Value | Functioning | Non-functioning |
|---|---|---|---|
| Percent Forested (2000 Landsat) | 10 | > 65 % | < 50 % |
| Percent TIA (2000 Landsat) | 50 | < 5 % | > 15 % |
| Road Density 2007 data (miles/mile2) | 19 | < 2 | > 3 |
| Stream Crossing Density (crossings per stream mile) | 2.2 | < 3.2/mile | > 6.4/mile |
| Percent EIA estimated from the Comprehensive Plan | 41 | < 10 % | > 10 % |

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

The study area is largely urban, lacking forest except for parks, open space, and unbuildable slopes.

*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. Impervious area is about 50 percent, which is highly urbanized.

*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 at intense urban levels, well into the non-functioning (>3 road miles/$mi^2$) category.

*Stream Crossing Density*
Stream crossing densities are easily measured using available road and stream channel data. The salmon protection standard considers larger fills over 60 feet wide, which would be approximately five to ten foot high road fill. The study area subwatersheds all have stream crossing densities within the functioning category (<3.2 crossings/stream mile NOAA Fisheries criteria). However, BBC has unusually low amounts of natural stream channel due to soil type and the conversion of streams to stormwater conveyance.

*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. Estimated future effective impervious area is very high at 41 percent, but it is not an accurate estimate because much of the stormwater runoff is routed to infiltration devices such as drywells and infiltration trenches and not directly to the creek.

## Water Quality Assessment

The Water Quality Assessment summarizes and references available water quality data from the Lower Burnt Bridge 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 state water quality standards, Lower Burnt Bridge Creek is 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 and Table 602).

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

**Table 3: Applicable Water Quality Criteria**

| Characteristic | 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 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

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

Lower Burnt Bridge Creek is Category 5 listed (polluted waters that require a TMDL) for temperature, fecal coliform bacteria, dissolved oxygen, and pH on

the 2008 303(d) list. Overall, Lower Burnt Bridge Creek owns the distinction of having more 303(d) listed segments (25 Category 5 listings and 5 Category 2 listings (Waters of Concern) than any other water body in Clark County. Ecology is currently developing a multi-parameter TMDL for temperature, dissolved oxygen, and fecal coliform bacteria in the Lower Burnt Bridge Creek subwatershed. As of 2009, monitoring activities are ongoing.

Clark County Stream Health Report

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

Based on available datasets for general water quality, fecal coliform, and benthic macroinvertebrates, most of the Lower Burnt Bridge Creek subwatershed had very poor stream health. The lowermost reach of Cold Creek and the lowermost reach of Lower Burnt Bridge Creek were rated poor, notable because these were the healthiest reaches in the watershed.

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

Available Data

Lower Burnt Bridge Creek has been studied extensively since at least the early 1970s. A thorough summary of existing information is beyond the scope of this report. Without exception, monitoring reports for Lower Burnt Bridge Creek cite significant and ongoing water quality issues. For an overview and summary of historical data, see Ecology's Quality Assurance Project Plan: Burnt Bridge Creek Fecal Coliform Bacteria, Dissolved Oxygen, and Temperature Total Maximum Daily Load-Water Quality Study Design (2008) at: http://www.ecy.wa.gov/biblio/0803110.html .

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

**Table 4: Data and Information Sources**

| Source | Data and/or Report |
|---|---|
| Ecology | 2008 QAPP for TMDL Water Quality Study Design<br>Provisional TMDL technical data |
| Clark County Clean Water Program | 2004 Stream Health Report and draft reports |

Water Quality Summary

Clark County has no active monitoring stations in the assessment area.

Periodic monitoring conducted by the City of Vancouver between 1998 and 2006 indicate that fecal coliform, dissolved oxygen, and temperature violated state water quality criteria at most sampling stations throughout the watershed. The area within the Lower Burnt Bridge Creek subwatershed had consistent temperature and fecal coliform problems but violated dissolved oxygen criteria less often than the middle and upper watershed.

A microbial source tracking study in 1999 indicated humans, pets, migratory birds, urban wildlife, and livestock as the primary sources of bacterial pollution in Lower Burnt Bridge Creek.

Available data indicate dissolved oxygen, fecal coliform and temperature did not change significantly from 1972 through 2007.

TMDL data collection by Ecology is ongoing in 2008 and 2009 at 19 monitoring stations throughout the entire Lower Burnt Bridge Creek subwatershed. Provisional data for April through September 2008 are summarized below:

- All stations but one had fecal coliform concentrations greater than 200 CFU/100mL on at least one occasion.
- Fecal coliform met the state criterion at the mouth of Lower Burnt Bridge Creek.
- All 19 stations exceeded the state criterion for temperature, except at the mouth of Cold Creek.
- 14 of 19 stations failed the dissolved oxygen criterion on at least one occasion.
- 11 of 19 stations failed the pH criterion on at least one occasion.

Beneficial Use Impacts

Observed levels of fecal coliform bacteria, temperature, and dissolved oxygen are sufficient to have significant impacts on existing beneficial uses for Lower Burnt Bridge Creek.

In particular, fecal coliform bacteria clearly limit primary contact recreation, while both elevated temperatures and low dissolved oxygen pose serious concerns for salmonid spawning, rearing, and migration.

Implications for Stormwater Management

Table 5 lists general water quality concerns in Lower Burnt Bridge Creek and potential solutions for each. Solutions listed in bold indicate areas where CWP activities can have a positive impact.

It should be noted that very little of the Lower Burnt Bridge Creek subwatershed lies within unincorporated Clark County. CWP activities, though important, are not likely to achieve water quality improvement goals on their own. Other county departments, the City of Vancouver, 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 and identify areas where County stormwater outfalls connect to City of Vancouver stormwater drainage. 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.

| Table 5: Likely Water Quality Concerns, Sources, and Solutions for Lower Burnt Bridge Creek | | | | |
|---|---|---|---|---|
| **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**<br>**Education programs**<br>Agricultural Best Management Practices<br>Septic system inspection and maintenance |
| | | livestock, wildlife, pets | overland runoff<br>storm sewers/ditches<br>direct access | |
| Water temperature | Salmonid spawning, rearing, and migration | vegetation removal | direct solar radiation | **Stormwater infiltration (when feasible) to increase baseflow Streamside Planting/vegetation enhancement/ riparian preservation through acquisition**<br>**Education programs** |
| | | low summer flows | decreased resistance to thermal inputs | |
| | | in-line ponds | direct solar radiation | |
| Dissolved oxygen | Salmonid spawning rearing, and migration | elevated water temperature | see above | **Stormwater infiltration (when feasible) to increase baseflow**<br>**Streamside planting/vegetation enhancement/ riparian preservation through acquisition** |
| | | stagnant or low flow | dry climate cycles<br>water withdrawals<br>limited mixing (low gradient) | |
| | | excessive algal or plant growth | elevated nutrients (overland flow or groundwater)<br>respiration processes | |

## 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 viewable on the internet through the Digital Atlas located at: http://gis.clark.wa.gov/imf/imf.jsp?site=digitalatlas&CFID=56651&CFTOKEN=98300052

Drainage system inventory is an ongoing CWP work effort focused on updating the StormwaterClk database to include all existing stormwater drainage infrastructure.

The work effort during 2008 in the Lower Burnt Bridge Creek subwatershed focused on identifying and mapping previously unmapped discharge points and stormwater conveyance system. Table 6 indicates the number of features previously inventoried in StormwaterClk prior to 2008 SNAP work, and the number of features added to the database as a result of 2008 SNAP and mapping project implementation.

The drainage system inventory for Lower Burnt Bridge Creek is generally completed. Inventory is ongoing in 2009 as part of a county-wide inventory update.

**Table 6: Drainage System Inventory Results, Lower Burnt Bridge Creek**

| Database Feature Category | Previously Inventoried | Added to Database during 2008 |
|---|---|---|
| Inlet | 1751 | 327 |
| Discharge Point (outfall) | 43 | 2 |
| Flow Control | 62 | 17 |
| Storage/Treatment | 568 | 144 |
| Manhole | 746 | 184 |
| Filter System | 20 | 9 |
| Channel | 502 | 146 |
| Gravity Main | 2651 | 719 |
| Facilities | 150 | 41 |

## Stormwater Facility Inspection

The stormwater facility inspection process includes two components:

- A public stormwater facility inspection using state and county standards.
- An off-site inspection to check for problems such as downstream channel bank erosion.

### *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 7.

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. Noncompliant stormwater facilities are referred to the appropriate public works departments for repairs or maintenance.

Results

Based on the county's StormwaterClk database, as of October 2008, there were 66 public stormwater facilities in the Lower Burnt Bridge Creek subwatershed.

Figure 2 summarizes notable inspection activities including general facility location, compliant facilities, and referrals of noncompliant facilities.

As listed in Table 7, 66 out of the 66 public stormwater facilities were inspected. These facilities included a total of 467 facility objects or components that were inspected. Of the 467 facility objects inspected, 333 (71 percent) of the facility objects were in compliance.

The inspection process generated 49 referrals: three referrals were to the Capital Improvement Program (CIP) for a possible retrofit opportunity; two referrals were to the Clark County Public Works Code Enforcement; three referrals were to the Clark County Public Works Clean Water Program engineer; and 41 referrals were to Public Works Maintenance and Operations for needed maintenance activities.

No major defects or hazardous conditions were discovered; non-compliant issues included excess sediment depth, trash or debris, and vegetative management issues.

Maintenance Referrals

Referrals made to the public works maintenance and operations department have been either brought into compliance, or will be scheduled for repair or maintenance in 2009. As of December 2008, public works maintenance and operations have brought four of the 41 non-compliant facilities into compliance, including a total of 15 facility objects.

Once referrals are addressed, the CWP revisits facilities to conduct a second inspection to ensure compliance.

Retrofit Opportunities

The public facility inspection process in the Lower Burnt Bridge Creek subwatershed yielded three retrofit opportunities. These opportunities include retrofitting three bioswales or using low impact development projects to better treat stormwater runoff. See Table 8 for the list of retrofit opportunities.

Management Recommendations

The most common facility objects found out of compliance during the public stormwater facility inspection process were catch basins, field inlets, bioswales, and facility accessibility issues. Vegetative management issues were the most common non-compliant defects regarding bioswales. These defects included overgrown bioswales where grasses exceeded 10 inches in height with nuisance weeds and other vegetation starting to take over. Catch basin and field inlet defects included sediment and/or debris exceeding 60 percent of sump depth, and storm pipe damage preventing normal function. Facility accessibility issues included restriction of access road or easements by a private gate or lock.

Correcting facility accessibility issues and maintenance of catch basins, field inlets, bioswales, and will bring most facilities into compliance.


Figure 2: Summary of 2008 Public Stormwater Facility Inspection Activities in the Lower Burnt Bridge Creek Subwatershed.

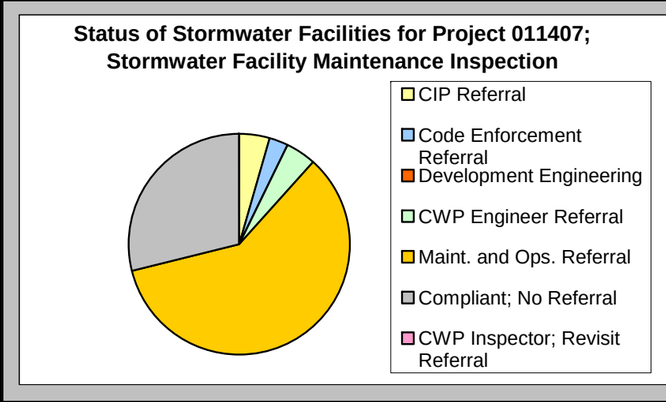
**Table 7: 2008 Public Stormwater Facility Inspection Project Activities of the Lower Burnt Bridge Creek**

**SNAP Public Stormwater Facility Inspections**

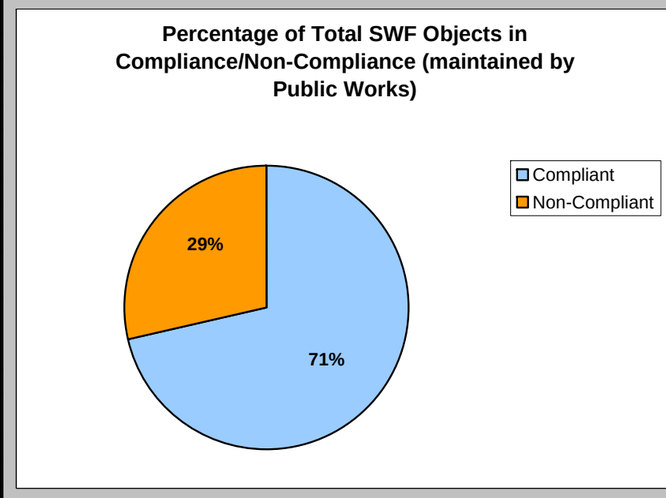
**Subject: Lower Burnt Bridge Creek Subwatershed; Project 011407 Stormwater Facility Inspection Results**

| | |
|---|---|
| **Total SNAP SWF Inspections** | **66** |
| **Maintained by Public Works** | **66** |
| **Compliant** | **20** |
| **Non-Compliant** | **46** |

| **Referrals of Non-Compliant SWF's as December 2008** | | **Referral Addressed and Facility Compliant as of December 2008** |
|---|---|---|
| CIP Referral | 3 | n/a |
| Code Enforcement Referral | 2 | n/a |
| Development Engineering | 0 | n/a |
| CWP Engineer Referral | 3 | n/a |
| Maint. and Ops. Referral | 41 | n/a |
| Compliant; No Referral | 20 | n/a |
| CWP Inspector; Revisit Referral | 0 | n/a |




| **Facility Objects Inspected** | **Initial Inspections** | | **Defect** | **Maintence Trigger** | **Facility Objects Repaired as of December 2008** |
|---|---|---|---|---|---|
| | **Compliant** | **Non-Compliant** | | | |
| Access Road or Easement | 54 | 12 | access restricted | access restricted by private gate or lock | N/A |
| Catch Basin | 13 | 12 | sediment & debris | sediment exceeds 60 percent of the sump depth | N/A |
| Closed Detention System | n/a | n/a | n/a | n/a | N/A |
| Stormwater StormFilter | 2 | 4 | sediment accumulation | sediment depth exceeds 6-inches in first chamber | N/A |
| Control Structure / Flow Restrictor | 26 | 2 | sediment & debris | material exceeds 25% of sump depth or 1 foot | N/A |
| Debris Barrier & Access Barrier | 5 | 5 | trash & debris / litter | Trash or debris that is plugging more than 20% of | N/A |
| Detention Pond | 27 | 3 | n/a | n/a | N/A |
| Facility Discharge Point | n/a | n/a | n/a | n/a | N/A |
| Oil Water Separator | n/a | n/a | n/a | n/a | |
| Drywell | 12 | 12 | standing water | standing water indicates the drywell is into the water table | N/A |
| Energy Dissipater | 32 | 8 | rock missing or moved | only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil at the energy dissipater | N/A |
| Fence, Gate or Water Quality Sign | 33 | 9 | gate or fence allows | openings in fence, missing gate, openings | N/A |
| Field Inlet | 21 | 12 | trash & debris | trash or debris (in the basin) that exceeds 60 percent of the sump depth | N/A |
| Infiltration Basin | 2 | 1 | standing water in basin | wetland vegetation present suggests water does | N/A |
| Sand Filter | n/a | n/a | n/a | n/a | N/A |
| Catch Basin Insert | n/a | n/a | n/a | n/a | N/A |
| Infiltration Trench | 10 | 0 | n/a | n/a | N/A |
| Filter Strip | n/a | n/a | n/a | n/a | N/A |
| Conveyance Stormwater Pipe | 62 | 15 | sediment & debris | sediment depth is greater than 20% of pipe | N/A |
| Sediment Trap | 11 | 3 | sediment | sediment (in the basin) that exceeds 60 percent of the sump depth. | N/A |
| Typical Biofiltration Swale | 17 | 35 | vegetation | grass is taller than 10 inches; nuisance weeds and | 15 |
| Wet Biofiltration Swale | 2 | 0 | n/a | n/a | N/A |
| Treatment Wetland | 3 | 0 | n/a | n/a | N/A |
| Wetpond | 1 | 1 | erosion | erosion of the pond's side slopes and/or scouring | N/A |
| Wetvaullt | n/a | n/a | n/a | n/a | N/A |
| **Total SWF Objects** | **333** | **134** | | | |
| **Total Percentage** | **71** | **29** | | | |



| Table 8: Description of Potential Retrofit Opportunities | | | |
|---|---|---|---|
| **Facility ID** | **Basis for Project** | **Project Description** | **Subwatershed** |
| 118 | Swale and detention pond area converted to backyard | Potential retrofit of bioswale or installation of LID practices | Lower Burnt Bridge Creek |
| 906 | Bioswale filled in with landscaping | Potential retrofit of bioswale or installation of LID practices | Lower Burnt Bridge Creek |
| 907 | Bioswale filled in with landscaping | Potential retrofit of bioswale or installation of LID practices | Lower Burnt Bridge Creek |

*Component 2: Offsite Assessment*

Purpose

Discharge 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 project detects possible 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 were included in the offsite assessment:

- Within 200 feet of a critical area such as a stream channel,
- 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 inspects all outfalls that discharge into critical areas, 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 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 June 2008 there were 17 mapped outfalls in unincorporated areas of Lower Burnt Bridge Creek subwatershed that discharged into critical areas. Twelve additional outfalls were assessed as part of the routine stormwater facility inspection process. Figure 3 summarizes notable outfall assessment activities including general outfall locations in the Lower Burnt Bridge Creek subwatershed.

Table 9 summarizes results for twenty-nine outfalls. All outfalls were found to be in compliance with county standards.

Potential Projects

No referrals were initiated for the outfall assessment project.

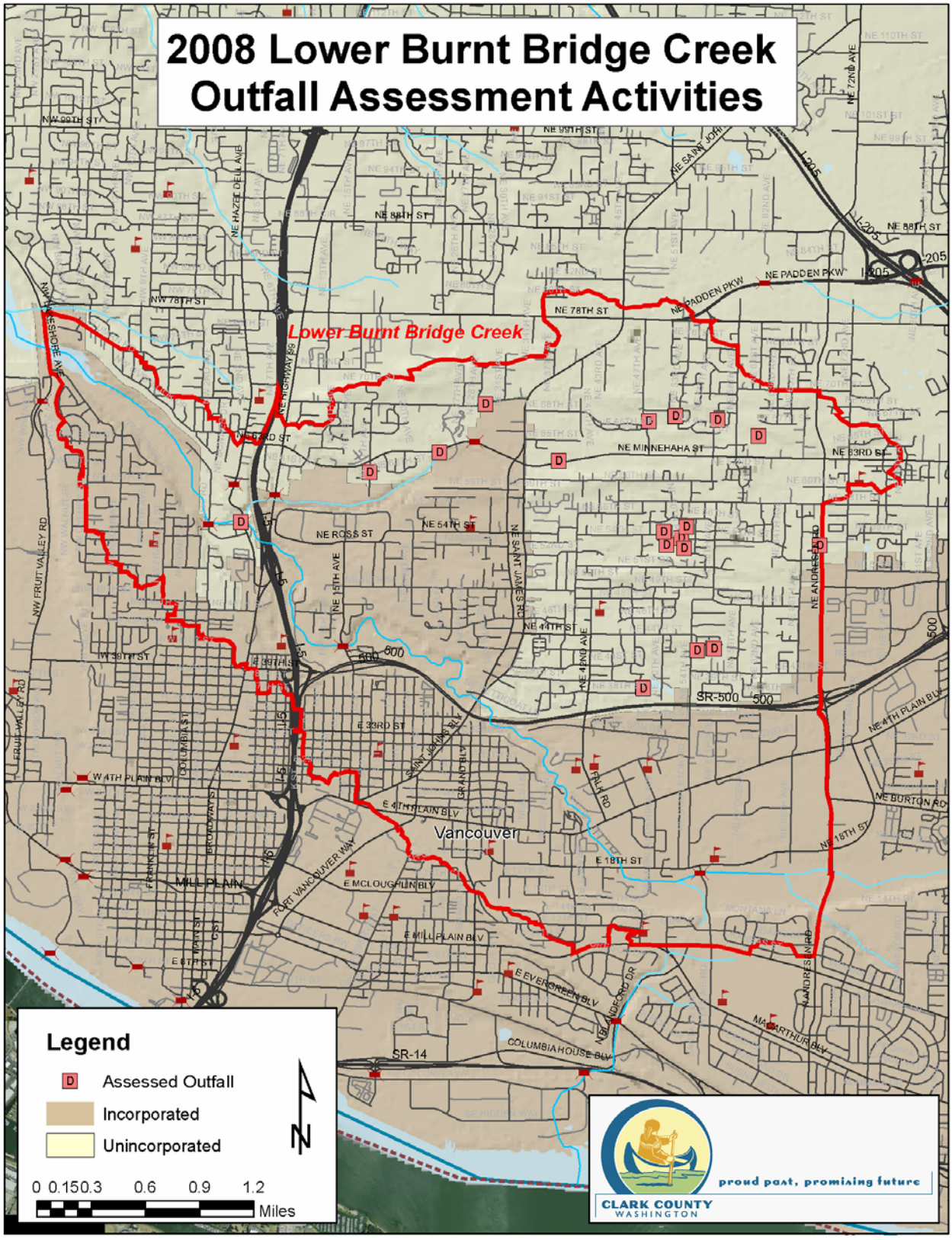



Figure 3: Summary of 2008 Public Stormwater Facility Inspection Activities in Lower Burnt Bridge Creek Subwatershed

| Table 9: 2007 Outfall Assessment Project Activity Summary of Lower Burnt Bridge Creek Subwatershed | |
|---|---|
| **Metric** | **Number** |
| # of outfalls assessed | 29 |
| # of outfalls compliant | 29 |
| # of noncompliant outfalls | 0 |
| # of referrals initiated | 0 |
| # of referrals ongoing | 0 |
| # of outfalls fixed | 0 |

## Illicit Discharge Detection and Elimination 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 discharges or connections, and referrals to the proper agencies for termination. Field work is primarily conducted during the dry summer season.

IDDE Screening activities were completed in the Lower Burnt Bridge subwatershed during 2008.

### Results

Based on the county's StormwaterClk database, as of March 2008, there were 46 mapped stormwater outfalls in the Lower Burnt Bridge subwatershed consisting primarily of pipe outfalls. Two previously unmapped outfalls were screened.

Figure 4 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 10, 45 outfalls were screened and samples were collected at seven outfalls. Two mapped outfalls were either not accessible or were mapped incorrectly. Two follow-up investigations were initiated based on laboratory results, and were conducted for two locations. In one investigation, the source area could not be adequately pinpointed, as sequential visits were dry. The other investigation confirmed the presence of an illicit discharge containing fecal coliform and was referred to County Code Enforcement.

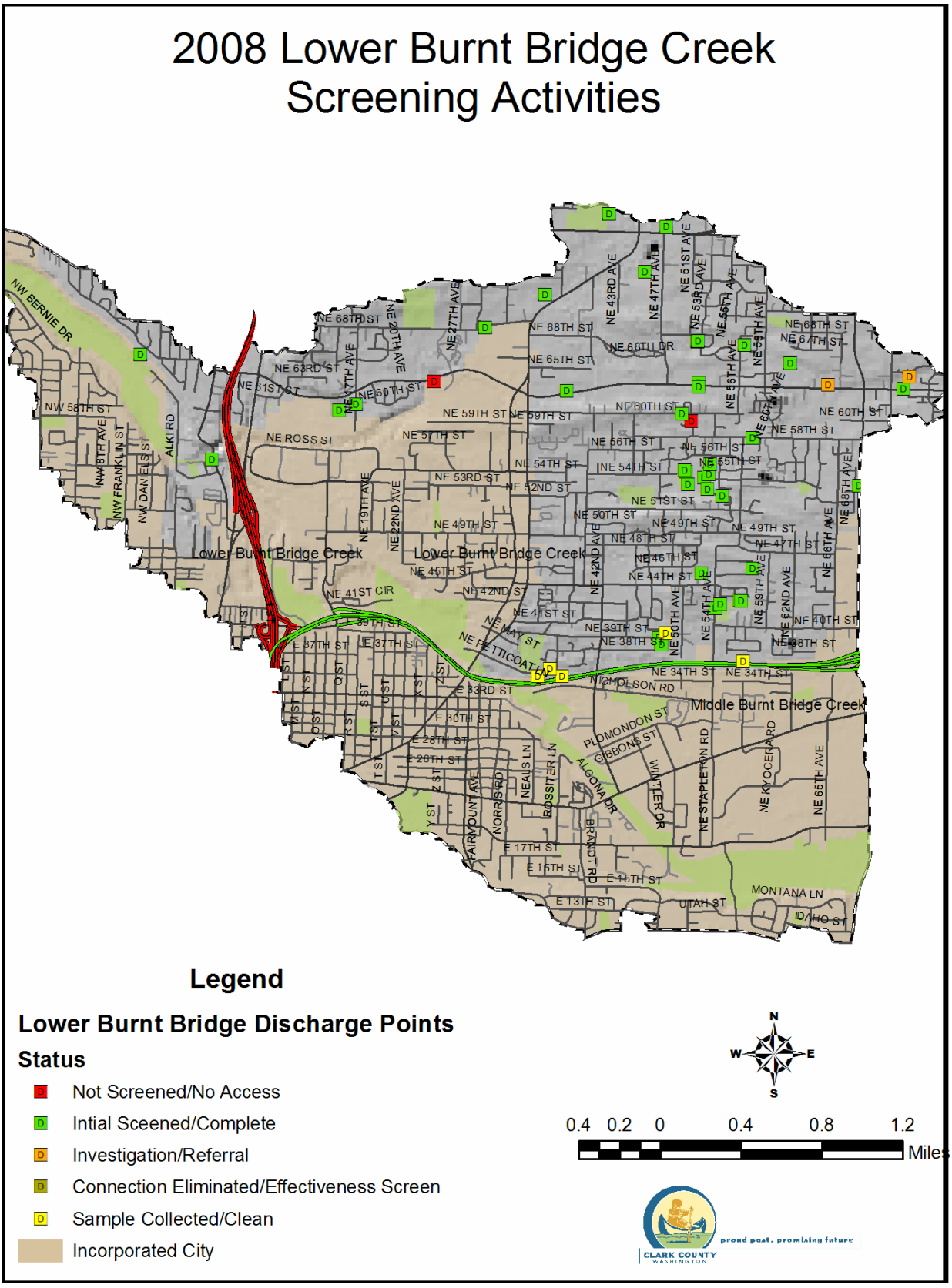



Figure 4: 2008 IDDE Screening Project in Lower Burnt Bridge Creek Subwatershed

| Table 10: IDDE Screening Project Activity Summary of Lower Burnt Bridge Creek Subwatershed as of December 2008 | |
|---|---|
| **Metric** | **Number** |
| # of outfalls screened | 45 |
| # of outfalls with sufficient flow to collect water samples | 7 |
| # of suspected illicit discharges | 2 |
| # of suspected illicit connections | 0 |
| # of investigations initiated | 2 |
| # of illicit discharge sources located | 0 |
| # of illicit connections identified | 0 |
| # of outfalls to be re-visited in 2009 | 2 |
| # of referrals | 0 |
| # of illicit discharges removed | 0 |
| # of investigations and referrals ongoing | 0 |
| # of illicit connections terminated | 0 |
| # of cases closed without resolution | 0 |

Samples were collected at seven flowing outfalls as part of the IDDE screening process. Laboratory analysis indicated suspected illicit discharges from two of the samples, which initiated two investigations: Investigation DP50 and Investigation GM29510.

Investigation DP50

Discharge point 050 was a suspected illicit discharge based on Ammonia/Potassium Ratio and Surfactants. The Ammonia/Potassium Ratio was 1.0 with a trigger ratio equal to or greater than 1.0. The Surfactants concentration was 0.23 mg/l with a trigger of greater than 0.0 mg/l. No referral was given as two laster visits found no evidence of flow and source could not be established. Outfall DP50 will be revisited in 2009 to attempt to isolate a potential source.

Investigation GM29510

A concerned neighbor called about water flowing into the stormwater facility adjoining their property. The water was flowing during an extended dry period.

The water was flowing from Gravity Main 29510 and flowing into Laurel Hills stormwater facility (Facility ID 1350). The water was soaking into the ground well before reaching the facility outfall. A fecal coliform water sample was taken. A suspected illicit discharge was established from lab results of 3200 CFU/100ml with a trigger of 500 CFU/100ml. The site was referred to code enforcement and an on-site investigation was coordinated with CWP section Waste Reduction Specialist, Natural Resources Specialist, and various property owners.

The investigation confirmed an illicit discharge from animal waste in the back yards of the adjoining properties which was mobilized by sprinkler water into backyard area drains leading to Gravity Main 29510. The discharge was determined to be isolated and of no threat as the stormwater facility was treating the water as designed. Two follow-up visits found no water flowing from the gravity main. Gravity Main 29510 will be revisited in 2009 to look for recurrences of flow. If flow is found in 2009, effectiveness monitoring will be conducted when and if the illicit discharge is removed.

### Stream Reconnaissance and Feature Inventory

A rapid stream reconnaissance and feature inventory was not conducted.

## Geomorphology and Hydrology 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 assessment focuses on areas of the Lower Burnt Bridge Creek subwatershed that are outside the City of Vancouver, in unincorporated Clark County.

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. In the absence of published studies on Lower Burnt Bridge Creek riparian conditions, the assessment used a review of orthophotography and general data obtained from the 2007 Burnt Bridge Creek Watershed Program report produced by the City of Vancouver. The orthophotograph review 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 the respective sections, and most are included on a final list for referral to outside agencies.

The Burnt Bridge Creek Watershed Program report (2007) was also reviewed for specific project opportunities within the subwatershed. Potential project sites have been reviewed and verified through field reconnaissance and are detailed in the results.

### Results

LWD recruitment potential and shade rating analyses were based on a qualitative review of 2007 orthophotography.

The LCFRB Recovery Plan (December 2004) rated all of Lower Burnt Bridge Creek as having impaired riparian conditions.

*Large Woody Debris (LWD) Delivery*
Mainstem Burnt Bridge Creek and its right bank tributary, Cold Creek have none to low LWD recruitment levels in unincorporated Clark County. The riparian areas consist primarily of deciduous species or emergent vegetation, which provide very limited LWD recruitment potential.

*Shade*
Within the incorporated areas, Lower Burnt Bridge Creek was estimated to have shade levels ranging from 0 to 40 percent, and Cold Creek had estimated shade levels of 0 to 20 percent. According to the 2007 Burnt Bridge Creek Watershed Program report, riparian areas were partly or fully cleared for agricultural and residential land uses.

Management Recommendations
Riparian reforestation and invasive species removal would be beneficial in the reaches of Burnt Bridge Creek and Cold Creek located within unincorporated Clark County. These areas are located east of Hazel Dell Avenue/west of Interstate 5, and east of Andresen Road/north of State Route 500.

Potential Projects
There are several potential project areas located on publicly owned land within unincorporated Clark County. These projects are identified and described in Table 11 and 12. These potential projects are adjacent to each other immediately west of Interstate 5 on Burnt Bridge Creek and near the mouth of its tributary, Cold Creek. The projects include reforestation and invasive species removal.

**Table 11: Tax Exempt Parcels Overlapping Potential Riparian Restoration Areas**

| ASSR_SN | ASSR_AC | OWNER | PT1DESC | Description |
|---|---|---|---|---|
| 101099-000 | 1.43 acres | Dept. of Transportation | Game and wildlife preserves | Potential reforestation restoration/invasive species removal area at the confluence of Lower Burnt Bridge Creek and Cold Creek |
| 101098-000 | 1.90 acres | State of Washington | Game and wildlife preserves | Potential reforestation restoration/invasive species removal area within riparian area of Lower Burnt Bridge Creek, west of Interstate-5 |

| Table 12: Description of Potential Project Opportunities | | |
|---|---|---|
| **ID** | **Basis for Project** | **Project Description** |
| IB1-BBC | Increasing native understory vegetation to reduce erosion and improve bank stabilization in the area downstream of GPS point. Remove widespread invasive species within riparian areas. Invasive species consists primarily of English ivy. | Improve native undergrowth vegetation within riparian area surrounding Lower Burnt Bridge Creek. Eradicate English Ivy within riparian areas. |
| IB2-BBC | Increasing native understory vegetation to reduce erosion and improve bank stabilization. Remove widespread invasive species and trash within riparian areas. Invasive species consists primarily of English ivy. | Improve native undergrowth vegetation within riparian area surrounding Cold Creek within property boundaries. Eradicate English Ivy within riparian areas and remove trash within creek and surrounding areas. |

## 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; and
- 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.

The assessment focuses on areas of the Lower Burnt Bridge Creek subwatershed that are outside the City of Vancouver, in unincorporated Clark County.

### 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.

Stream Reconnaissance and Geomorphology/Hydrology assessments may also discover potential wetland-related project opportunities. 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 county vacant buildable lands model (VBLM) information to identify possible wetland enhancement opportunities.

### Results

Figure 5 shows potential wetland areas within the Lower Burnt Bridge Creek subwatershed based on data from the county wetlands atlas, including the Clark County wetland model, National Wetlands Inventory, and high-quality wetlands layer.

The Lower Burnt Bridge Creek subwatershed has large expanses of potential wetland areas associated with the Burnt Bridge Creek riparian corridor and

floodplain areas, as well as pockets of potential wetland areas scattered throughout the subwatershed north of Burnt Bridge Creek and east of Cold Creek. Within the unincorporated areas in the subwatershed, the potential wetland areas are concentrated within the areas listed above.

Review of the wetland inventories and studies identified several mitigation opportunities within publicly held or tax-exempt lands within unincorporated Clark County. Both potential mitigation sites are owned by Clark County, and are located east of Saint Johns Road. One is located near NE 54th Street, and consists of multiple adjoining tax lots currently designated as park land (Saint Johns Park) and stormwater treatment areas. The second site is located directly north of Minnehaha Street, and consists of a degraded wetland area underneath power transmission lines.

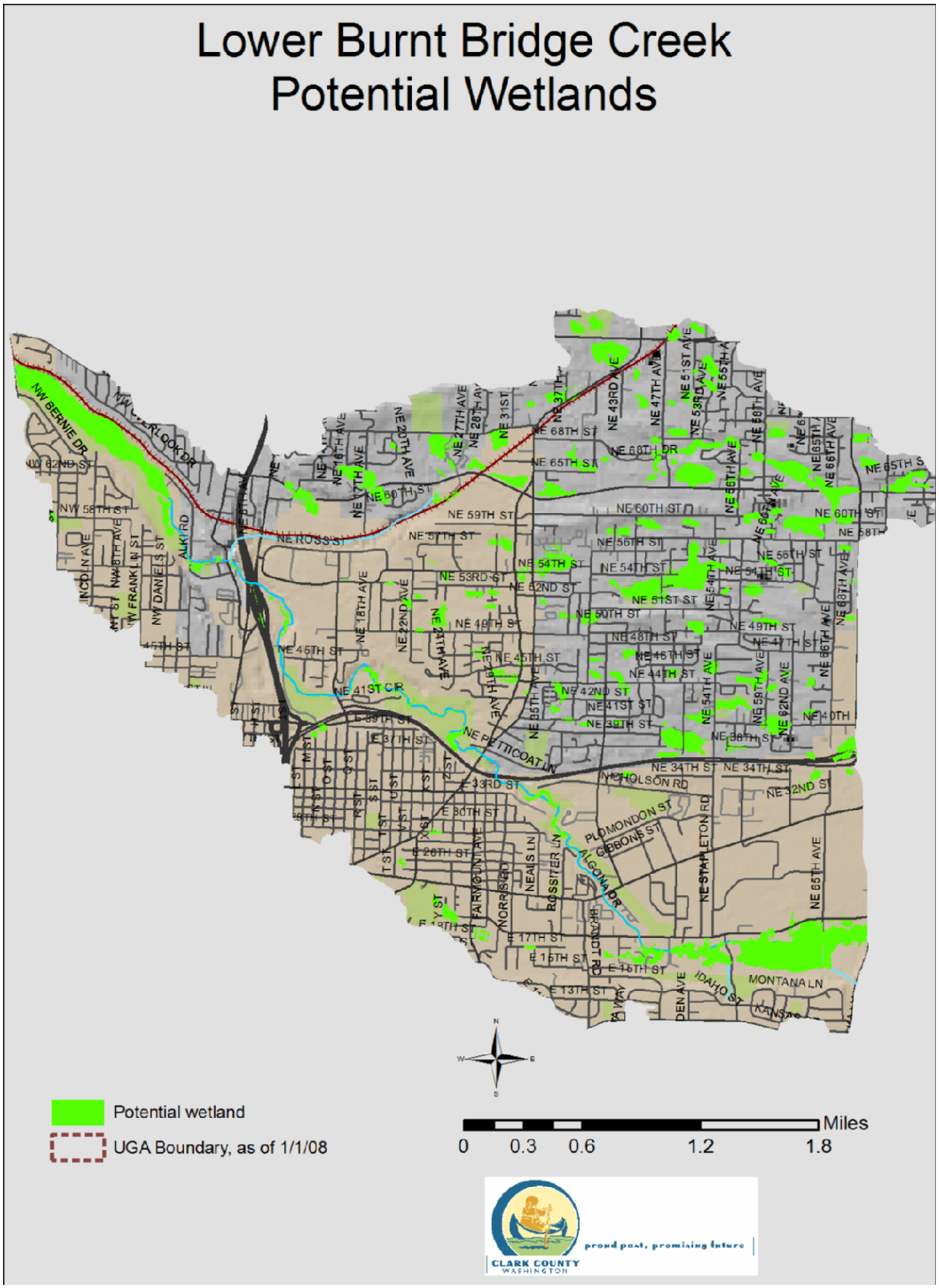



Figure 5: Lower Burnt Bridge Creek Potential Wetlands

*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 Draft Watershed Characterization (Washington Department of Ecology, 2007) may be found on the Clark County website at: http://www.clark.wa.gov/mitigation/watershed.html

Results pertaining to the Lower Burnt Bridge Creek subwatershed are summarized below.

The Lower Burnt Bridge Creek subwatershed is part of the Terrace hydrogeologic unit. This unit is dominated by rain; has a westward to southwestern trending groundwater flow pattern; 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, 2007).

Figure 6 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.

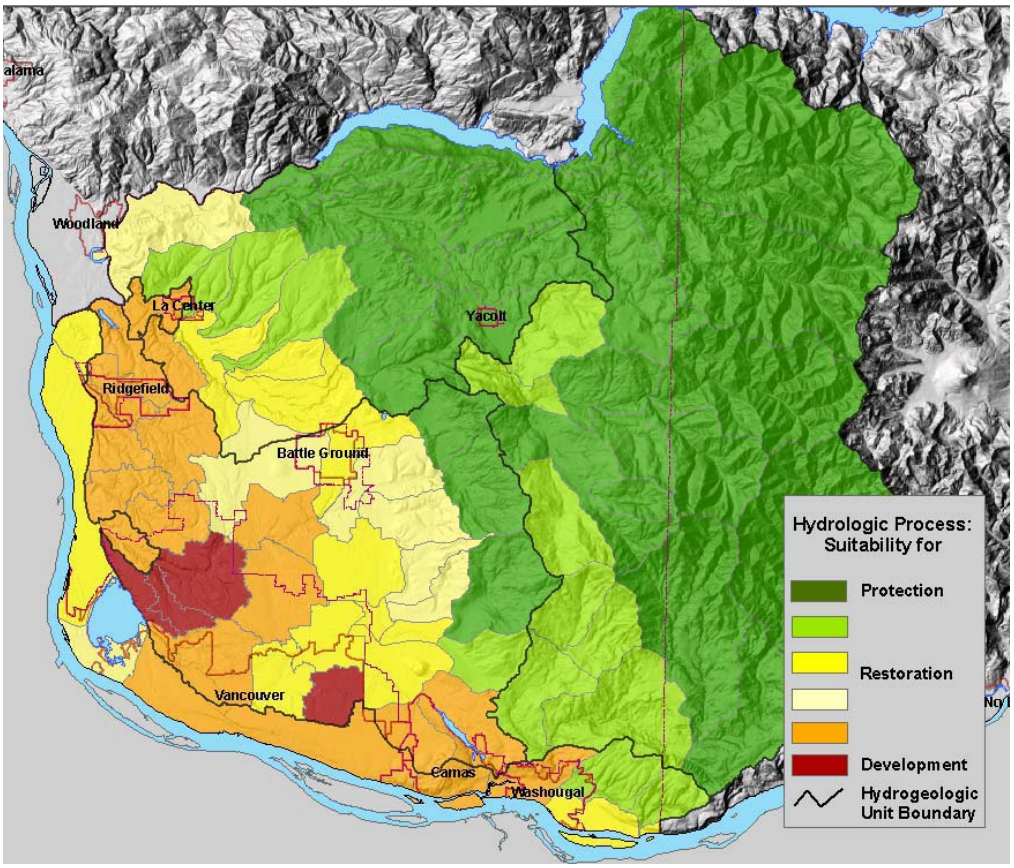



Figure 6: Priorities for suitability of areas for protection and restoration for the hydrologic process (from Draft Watershed Characterization of Clark County (Ecology, 2007)).

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

Potential Projects

Potential project locations for further exploration based on this wetland assessment include the following:

- Table 13 includes tax exempt parcels that overlap with potential wetlands from the Clark County wetlands model.
- Table 14 includes a brief description of potential projects identified after field survey.

**Table 13: Tax Exempt Parcels Overlapping Potential Wetlands**

| ASSR_SN | ASSR_AC | OWNER | PT1DESC | Description |
|---|---|---|---|---|
| 156965-001<br>156958-100<br>156948-048<br>108143-146 | 2.37 | Clark County | Unused or vacant land | Potential wetlands restoration area on County surplus land |
| 149283-000 | 1.94 | Clark County | Single family unit not sharing structure with other uses | Potential wetlands located under BPA power lines |

| Table 14: Description of Potential Project Opportunities | | |
|---|---|---|
| **ID** | **Basis for Project** | **Project Description** |
| IW1-BBC | Increasing native wetland vegetation and removing widespread invasive plant species within wetland areas immediately south of Cold Creek. Invasive species is predominantly reed canary grass and Himalayan blackberry. | Improve native undergrowth and canopy vegetation within wetland areas to shade out invasive plants, enhance wetland habitat and improve water quality of adjacent Cold Creek. Eradicate reed canary grass and Himalayan blackberry. |
| IW2-BBC | Increasing native wetland vegetation and removing widespread invasive plant species within wetland area north of St. Johns Park and west of GPS point. Invasive species consists primarily of reed canary grass. | Improve native undergrowth and canopy vegetation within wetland area to shade out invasive plants and enhance wetland habitat. Eradicate reed canary grass. |

## 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). For example, to maximize the comparability of samples, macroinvertebrate collection is from multiple riffles 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 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.

The Lower Burnt Bridge Creek macroinvertebrate samples were collected by a consultant for the City of Vancouver in the summer 2001 (City of Vancouver, 2002). Two sites were sampled in southwestern Vancouver's Lower Burnt Bridge Creek subwatershed: the downstream BBCDISC site in Discovery Park near the stream crossing of NW Alki Road and the upstream BBCLETT site adjacent to the lettuce fields near the south end of NE 65$^{th}$ Avenue.

Results

BBCDISC's and BBCLETT's single year B-IBI scores of 20 and 18, respectively, are both in the low biological integrity category. Even though the BBCDISC site is approximately four miles downstream from the BBCLETT site, only a two point difference separates the two sites' low scores.

Table 15 and 16 show the ten individual average annual metric results for the BBCDISC and BBCLETT. BBCDISC's metrics are classified as six low, three moderate, and one high. BBCLETT's metrics are classified as seven low, two moderate, and one high. The pattern in the categories of both sites' metrics is very similar with the following exceptions: long-lived taxa, percent tolerant taxa, and clinger taxa. In particular, common low scoring metrics for both sites suggest: the presence of pollutants such as heavy metals or pesticides affecting Mayflys; human caused impacts that affect temperature, sediment and food source sensitive Stoneflys; less varied stream habitat for Caddisflys; and signs of degraded water and habitat quality since intolerant taxa are among the first organisms to disappear as human disturbances increase (Fore, 1999). Additionally, low metric results for BBCDISC's percent tolerant taxa and BBCLETT's clinger and long-lived taxa suggests larger human disturbances to streams resulting in an increasingly large tolerant taxa percentage, fine sediments reducing habitat for Clinger taxa, and exposure to chronic or recurring water quality or habitat impacts for long-lived taxa.

**Table 15: BBCDISC Average Annual Macroinvertebrate Community Metrics and Total Score from Within the Period 2001**

| | BBCDISC 1-Year Averages | | |
|---|---|---|---|
| **B-IBI Metrics** | **Value** | **Score** | **Category** |
| Total number of taxa | n/a | 3 | Moderate |
| Number of Mayfly taxa | n/a | 1 | Low |
| Number of Stonefly taxa | n/a | 1 | Low |
| Number of Caddisfly taxa | n/a | 1 | Low |
| Number of long-lived taxa | n/a | 5 | High |
| Number of intolerant taxa | n/a | 1 | Low |
| Percent tolerant taxa | 80 | 1 | Low |
| Percent predator taxa | n/a | 1 | Low |
| Number of clinger taxa | 2 | 3 | Moderate |
| Percent dominance (3 taxa) | 69 | 3 | Moderate |
| **Total B-IBI score** | | 20 | **low** |

| Table 16: BBCLETT Average Annual Macroinvertebrate Community Metrics and Total Score from Within the Period 2001 | | | |
|---|---|---|---|
| B-IBI Metrics | BBCLETT 1-Year Averages | | |
| | Value | Score | Category |
| Total number of taxa | n/a | 3 | moderate |
| Number of Mayfly taxa | n/a | 1 | low |
| Number of Stonefly taxa | n/a | 1 | low |
| Number of Caddisfly taxa | n/a | 1 | low |
| Number of long-lived taxa | n/a | 1 | low |
| Number of intolerant taxa | n/a | 1 | low |
| Percent tolerant taxa | 16 | 5 | high |
| Percent predator taxa | n/a | 1 | low |
| Number of clinger taxa | n/a | 1 | low |
| Percent dominance (3 taxa) | 80 | 3 | moderate |
| **Total B-IBI score** | | 18 | **low** |

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 7 shows that both BBCDISC and BBCLETT stations' 2001 B-IBI scores fall in the upper range of expected scores for sites with 52 percent impervious area. By comparing Lower Burnt Bridge 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.

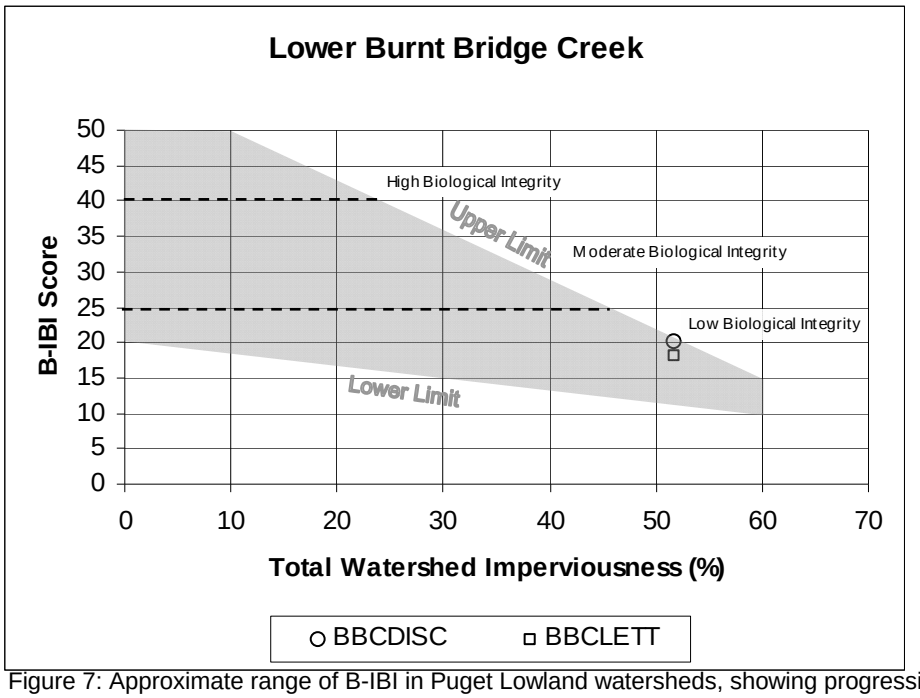



Figure 7: Approximate range of B-IBI in Puget Lowland watersheds, showing progressive decline with increasing imperviousness in the upstream watershed. Adapted from Booth et al., 2004. Markers indicate Total B-IBI scores at BBCDISC and BBCLETT for particular years, versus estimated 2000 subwatershed TIA.

Both of Lower Burnt Bridge Creek's B-IBI scores are at the higher end of those typically expected for sites with 52 percent total watershed impervious area (TIA). These conditions imply a limited ability to increase scores above the low range of biological integrity. Therefore management strategies should focus on stewardship to prevent further harm to such degraded streams.

Physical Habitat Factors

The City of Vancouver's study noted signs of physical, biological, and chemical degradation (City of Vancouver, 2002). Specific impacts included degradation of riparian resources, stream channel alteration and simplification, and altered natural stream flow regimes.

Management Recommendations for Lower Burnt Bridge Creek

Management strategies should focus on stewardship to prevent further harm to Burnt Bridge Creek. However, projects to improve degraded areas may also have significant benefits, as hydrologic conditions in Burnt Bridge Creek indicate an unusual opportunity to improve biological integrity outside of the predicted range.

## 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.

The assessment focuses on areas of Lower Burnt Bridge Creek subwatershed that are outside the City of Vancouver, in unincorporated Clark County.

Methods

Fish distribution for the Lower Burnt Bridge Creek subwatershed is mapped from existing Clark County GIS information, which reflects data collected and analyzed by the Northwest Indian Fisheries Commission (NWIFC). Fish distribution data for Clark County is available on the County's website.

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

- WDFW passage barrier database
- SalmonScape (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. 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 fish distribution mapped from Clark County GIS information (Figures E and F) varied slightly from fish distribution data originating from the SalmonScape database within the Lower Burnt Bridge Creek subwatershed. These differences are identified within the subwatershed discussion below. For the purposes of this report, when the fish distribution mapping figures differ from SalmonScape fish distribution data, it is assumed that the SalmonScape distribution is a more accurate representation of the fish populations within the listed watersheds.

The available evidence represented in the fish distribution mapping figures suggests that anadromous fish use within the Lower Burnt Bridge Creek subwatershed (Lower Burnt Bridge Creek) includes Coho salmon and winter

steelhead (Figures 8 and 9). The SalmonScape fish distribution data also identified the presumed presence of Coho salmon within Cold Creek, from its confluence with Lower Burnt Bridge Creek, upstream to the man-made falls/culvert crossing at Interstate-5.

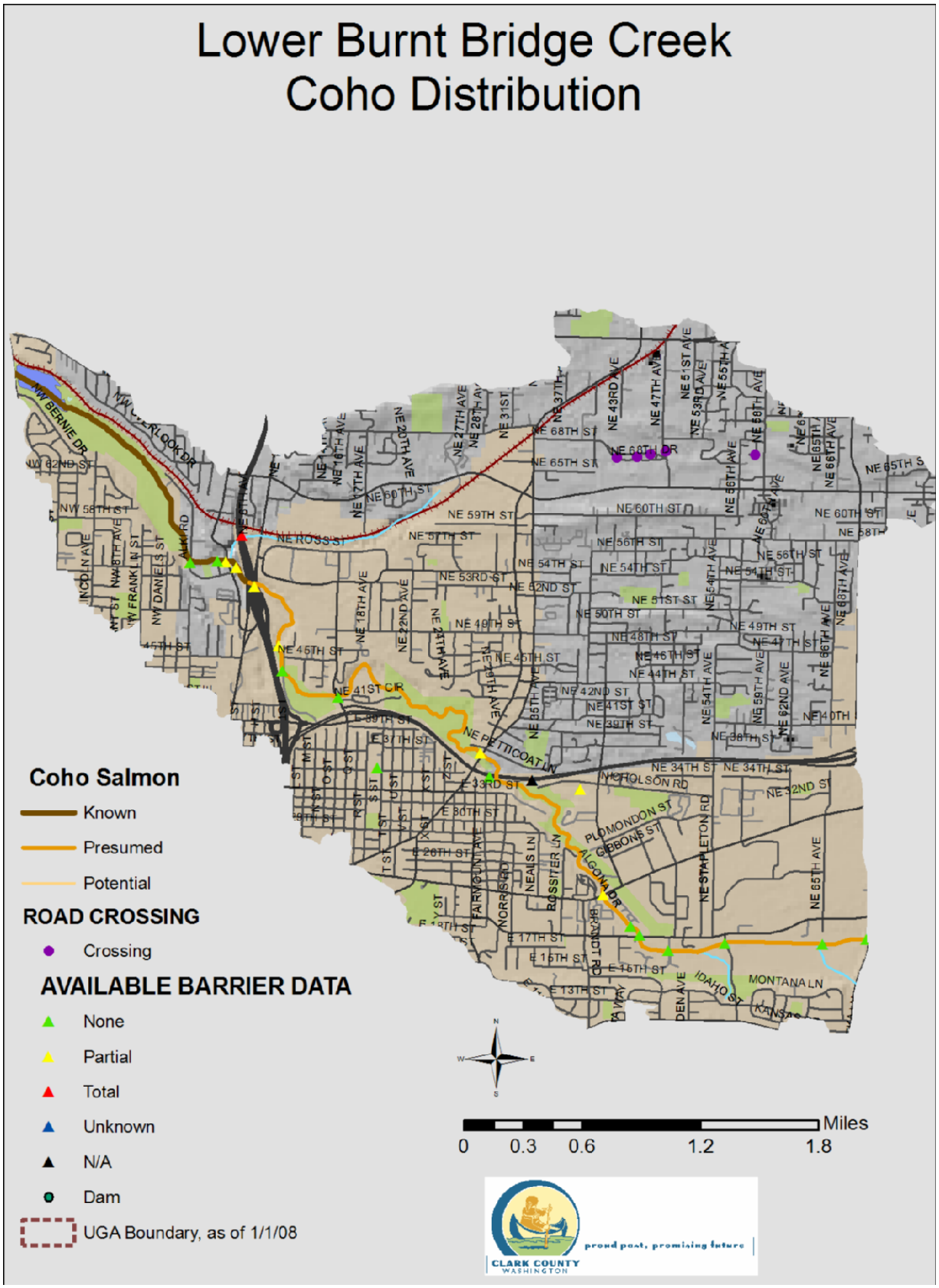



Figure 8: Lower Burnt Bridge Creek Fish Distribution and Barriers

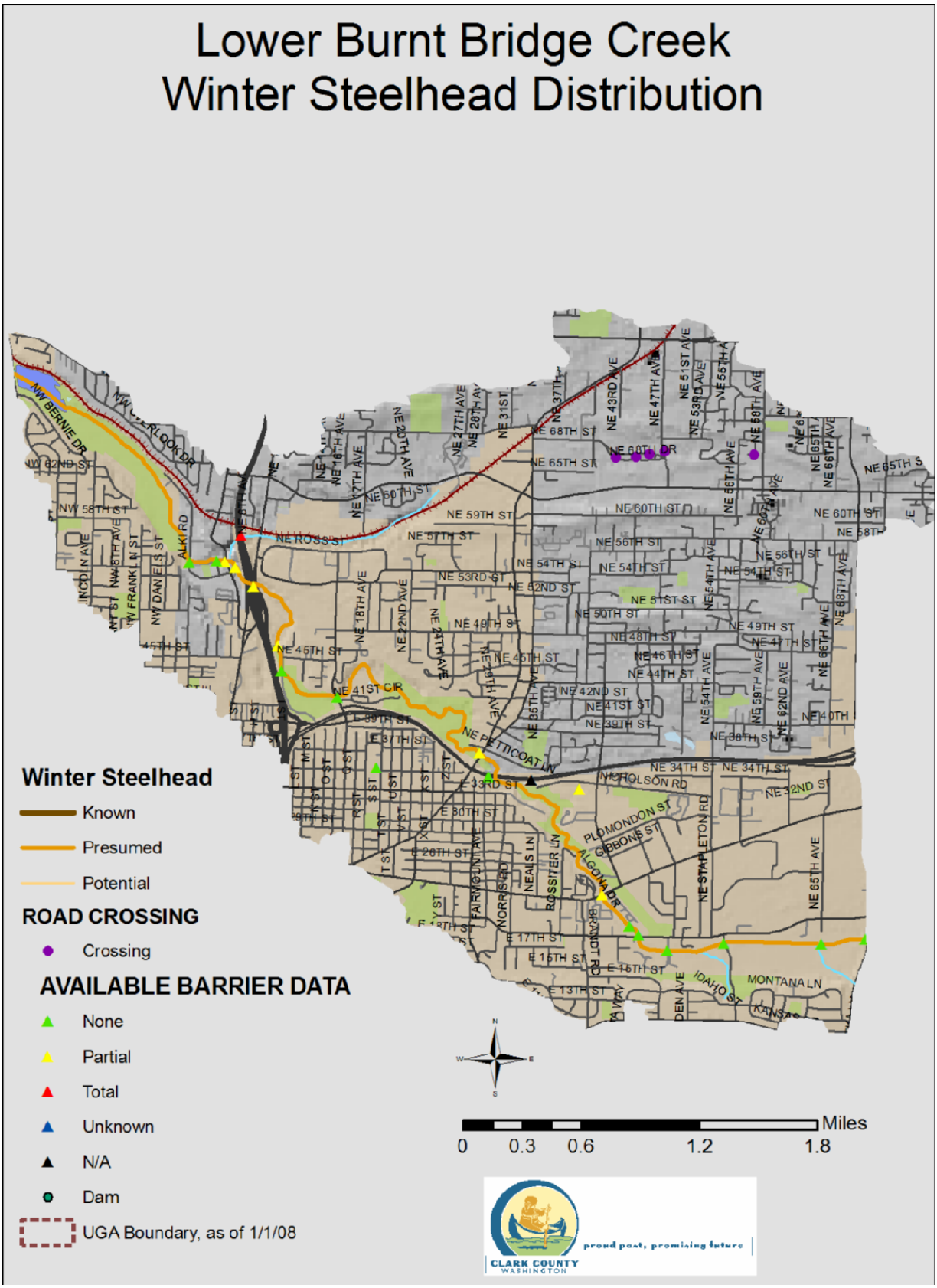



Figure 9: Lower Burnt Bridge Creek Fish Distribution and Barriers

Barriers

The WDFW barrier database provides the most complete assessment of barriers in the Lower Burnt Bridge Creek subwatershed (Figures C and D).

There are two partial barriers and a full barrier mapped within the Lower Burnt Bridge Creek subwatershed unincorporated areas. These barriers are located east of Hazel Dell Avenue and west of Interstate 5. The first is a partial barrier culvert crossing at Hazel Dell Avenue on Lower Burnt Bridge Creek, located just upstream of the confluence of Lower Burnt Bridge Creek and Cold Creek. Cold Creek has a partial barrier (man-made waterfall) and full barrier culvert located where Cold Creek crosses under Interstate 5. These barriers are blocking potential upstream distribution of Coho salmon, which (according to fish distribution data from SalmonScape) is presumed to be present downstream of the barriers.

Recommendations

Lower Burnt Bridge Creek and Cold Creek contain several full and partial fish barriers; however, improvement or replacement of these barriers is not recommended as a priority. The reasons are additional upstream barriers in Cold Creek, and poor water quality and stream habitat in both streams.

As a long-term strategy, barriers should be removed over time as stream crossing infrastructure is replaced or upgraded.

## Hydrologic and Hydraulic Models

No new modeling was performed for this assessment area.

Burnt Bridge Creek is a highly modified urban stream that flows some 12.6 miles from its agricultural origins near Northeast 162nd Avenue on the east, through the heart of Vancouver and the Greenway Project at its center, to its terminus at Vancouver Lake. The Burnt Bridge Creek Greenway Project was designed to re-establish the natural floodplain, provide wildlife feeding, resting and nesting habitat, slow down peak discharges, reduce soil erosion, and cool water temperature. West of NE 18th Street the channel flows along a natural path down a steep gradient and into a steep-sided ravine, then westerly to Interstate 5 and Vancouver Lake. The main tributary, Cold Creek, flows through unincorporated Clark County and joins Burnt Bridge Creek approximately two miles upstream of Vancouver Lake.

Burnt Bridge Creek – Looking Upstream from Andresen

Burnt Bridge Creek – Looking downstream from NE Hazel Dell Avenue

Cold Creek – Immediately upstream of Confluence with Burnt Bridge Creek

The Burnt Bridge Creek subwatershed is composed of a mix of commercial, industrial, residential, and parks. The majority of the area in unincorporated Lower Burnt Bridge Creek subwatershed is residential development.

Table 17 shows the estimated peak flows for the Intermediate Regional Flood and Standard Project Flood at selected locations along Burnt Bridge Creek. The discharges have been adjusted upward from the observed peak flow data to reflect increased rate of runoff as a result of urban expansion. Also, Figure 11 shows Burnt Bridge Creek Flood Areas Index Map.

**Table 17: Estimated Peak Flows along Burnt Bridge Creek**

| Location | Drainage Area (square mile) | Intermediate Regional Flood (cfs) | Standard Flood (cfs) |
|---|---|---|---|
| Mouth | 26.8 | 510 | 730 |
| R.M. 1.8 | 25.5 | 490 | 700 |
| R.M. 2.9 | 21.9 | 420 | 600 |
| R.M. 8.4 | 7.9 | 210 | 210 |

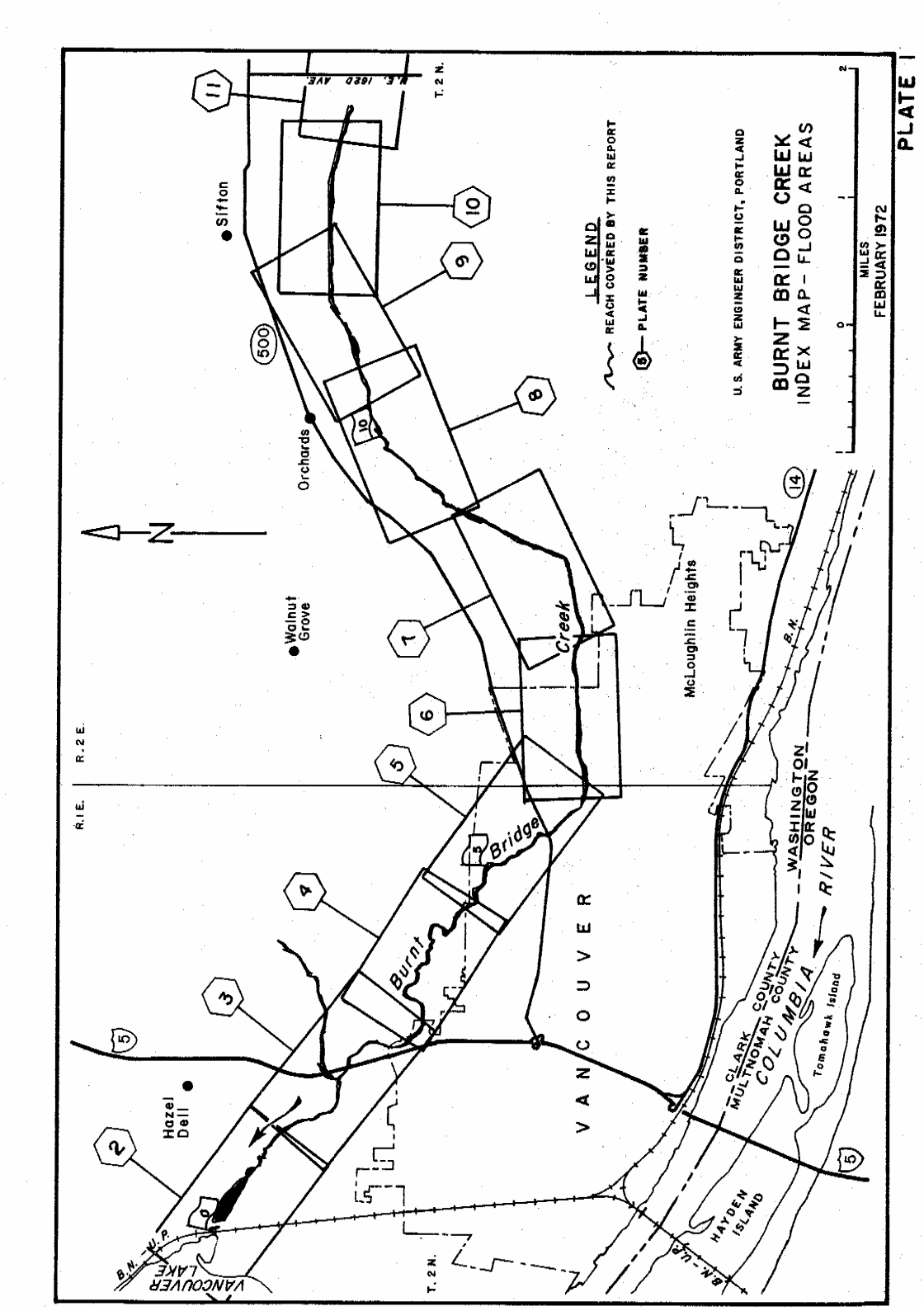



Figure 10: Burnt Bridge Creek Index Map – Flood Area

## 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.

### 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*

Phase II NPDES permit implementation by the City of Vancouver should provide opportunities for coordination and leveraging with Clark County.

*Broad-scale Characterization*

The Lower Burnt Bridge Creek subwatershed is adjacent to the Columbia River floodplain and largely within the City of Vancouver. A small segment of Lower Burnt Bridge Creek and Lower Cold Creek are inside unincorporated Clark County and are the only natural drainages outside the city. Land use is predominately urban with undeveloped open space on the Lower Burnt Bridge Creek floodplain and along steep canyon walls.

Lower Burnt Bridge Creek is a relatively flat lying area cut by canyons occupied by Lower Burnt Bridge Creek and it largest tributary, Cold Creek.

Except for recent alluvium on floodplains, Lower Burnt Bridge Creek subwatershed is entirely underlain by Late Ice Age catastrophic flood deposits. Mill Plain Ridge is underlain by very coarse sand and gravel that is very well drained. North of Mill Plain Ridge, layered sand and silt deposits underlie the area. The differing ability of these geologic units to transmit groundwater greatly influences runoff and water table depth. Soils formed on the coarse grained deposits under the Mill Plain Ridge tend to be well drained. Soils north of the Mill Plain Ridge tend to be less permeable and tend to form wetlands in low lying areas.

Burnt Bridge Creek is an unusual urban stream in that peak discharges are much lower and of longer duration than typical. The basin geology and topography explain this anomaly. Standard metrics based on NOAA fisheries standards indicate significant human alteration and suggest stream habitat is significantly degraded.

*Water Quality Assessment*
Lower Burnt Bridge Creek is Category 5 listed (polluted waters that require a TMDL) for temperature, fecal coliform bacteria, dissolved oxygen, and pH on the 2008 303(d) list. Overall, Lower Burnt Bridge Creek owns the distinction of having more 303(d) listed segments (25 Category 5 listings and 5 Category 2 listings (Waters of Concern)) than any other water body in Clark County. Ecology is currently developing a multi-parameter TMDL for temperature, dissolved oxygen, and fecal coliform bacteria in the Lower Burnt Bridge Creek subwatershed.

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

Based on available datasets for general water quality, fecal coliform, and benthic macroinvertebrates, most of the Lower Burnt Bridge Creek subwatershed had very poor stream health. The lowermost reach of Cold Creek and the lowermost reach of Burnt Bridge Creek were rated poor, notable because these were the healthiest reaches in the watershed.

*Drainage System Inventory*
The drainage system inventory for the Lower Burnt Bridge Creek subwatershed is largely completed. Inventory is ongoing in 2009 as part of a county-wide inventory update.

*Stormwater Facility Inspection*
Based on the county's StormwaterClk database, as of October 2008 there were 66 mapped public stormwater facilities in the Lower Burnt Bridge Creek subwatershed. All 66 public stormwater facilities were inspected. These facilities included a total of 467 facility objects or components that were inspected. Of the 467 facility objects inspected, 333 (71 percent) were in compliance.

The inspection process generated 49 referrals: three referrals were to the Capital Improvement Program (CIP) for a possible retrofit opportunity; two referrals were to the Clark County Public Works Code Enforcement; three referrals were to the Clark County Public Works Clean Water Program engineer; and 41 referrals were to Public Works Maintenance and Operations for maintenance.

*Illicit Discharge Screening*
IDDE Screening activities were completed in the Lower Burnt Bridge Creek subwatershed. There were 46 mapped stormwater outfalls, consisting primarily of pipe outfalls. Two previously unmapped outfalls were screened. One confirmed illicit discharge was referred to county Code Enforcement for removal.

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

*Riparian Assessment*
The assessment used a review of orthophotography and general data obtained from the 2007 Burnt Bridge Creek Watershed Program report produced by the City of Vancouver.

The LCFRB Recovery Plan (December 2004) rated all of Lower Burnt Bridge Creek as having impaired riparian conditions. Lower Burnt Bridge Creek was estimated to have shade levels ranging from 0 to 40 percent, and Cold Creek had estimated shade levels of 0 to 20 percent.

*Wetland Assessment*
The assessment includes review of existing GIS data for wetlands. Potential project sites have been reviewed and verified through field reconnaissance. Tax-exempt parcels often indicate the presence of publicly owned land, schools, or churches where large parcel sizes and opportunities for leveraging may exist.

The Lower Burnt Bridge Creek subwatershed has wetland areas associated with the Burnt Bridge Creek riparian corridor and floodplain areas, as well as pockets of potential wetland areas scattered throughout the subwatershed north of Burnt Bridge Creek and east of Cold Creek.

*Macroinvertebrate Assessment*
Based on samples from two sites, scores of 20 and 18 place BBC in the low biological integrity category. Burnt Bridge Creek's scores are at the higher end of those typically expected for sites with similar percent total watershed impervious area, suggesting limited opportunity for improvement. However, hydrologic conditions in BBC may present an unusual opportunity to improve biological integrity beyond the expected range.

*Fish Use and Distribution*
The available evidence suggests that anadromous fish use within the Lower Burnt Bridge Creek subwatershed includes Coho salmon and winter steelhead. The SalmonScape fish distribution data also identified the presumed presence of Coho salmon within Cold Creek, from its confluence with Lower Burnt Bridge Creek, upstream to the man-made falls/culvert crossing at Interstate 5.

There are two partial barriers and a full barrier mapped within the Lower Burnt Bridge Creek subwatershed unincorporated areas. Cold Creek has a partial barrier

(man-made waterfall) and a full barrier culvert located where Cold Creek crosses under Interstate 5.

### Recently Completed or Current Projects

There are no stormwater projects in Lower Burnt Bridge Creek under the 2009-2014 SCIP.

### 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

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 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. 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

None were found.

## Potential Stormwater Capital Projects

Stormwater Capital Facility Improvement Projects

| Project. No. | Issue | Project | Watershed | Action |
|---|---|---|---|---|
| OS-90 | Swale and detention pond area converted to backyard | Potential retrofit of bioswale or installation of LID practices (i.e., rain garden) | Lower Burnt Bridge Creek | Evaluate for implementation in 2009 |
| OS-91 | Bioswale filled in with landscaping | Potential retrofit of bioswale or installation of LID practices (i.e., rain garden) | Lower Burnt Bridge Creek | Evaluate for implementation in 2009 |
| OS-92 | Bioswale filled in with landscaping | Potential retrofit of bioswale or installation of LID practices (i.e., rain garden) | Lower Burnt Bridge Creek | Evaluate for implementation in 2009 |

Stormwater Infrastructure Maintenance CIPs

No projects found.

Stormwater Class V Underground Injection Control projects:

No potential projects found.

Habitat Rehabilitation/Enhancement Projects

None are recommended for SCIP.

Property Acquisition for Stormwater Mitigation

No specific acquisition sites were discovered.

## Follow-up Activities for Referral within Clean Water Program

Private Stormwater Facilities Maintenance

No problems documented.

Public Works stormwater infrastructure maintenance

The Public Facility Inspection section describes additional routine stormwater infrastructure maintenance needs referred to Public Works Operations during ongoing inspections.

## 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 Lower Burnt Bridge Creek subwatershed, by permit component, include:

Storm Sewer Mapping and Inventory

- None

Coordination of Stormwater Activities

- Coordinate with City of Vancouver to implement permit requirements and develop projects that would benefit the entire watershed
- Continue to participate in Ecology's TMDL development process for Burnt Bridge Creek

Mechanisms for public involvement

- Publish SNAP reports on CWP web page
- Consider stormwater basin planning as a tool to better manage stormwater impacts due to future growth in the entire Lower Brunt Bridge Creek watershed

Stormwater Source Control Program for Existing Development

- Encourage homeowners and business operators to adopt runoff reduction practices such as disconnecting downspouts

Operation and Maintenance Actions to Reduce Pollutants

- Focus additional effort on vegetation management in bioswales, catch basin and field inlet cleaning, and repair of damaged conveyances

TMDL Compliance

- There are no approved TMDLs in this assessment area

Monitoring Stormwater Program Effectiveness

- None

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