SNOQUALMIE WATERSHED
STREAM HABITAT RECONNAISSANCE REPORT

FINAL REPORT October 2004

King County
Department of Natural Resources and Parks
Water and Land Resources Division

Snoqualmie Watershed Stream Habitat Reconnaissance Report

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Snoqualmie Watershed Stream Habitat Reconnaissance Report

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ABBREVIATIONS AND ACRONYMS

APD	Agricultural Production District
C	Celsius
DNRP	Department of Natural Resources and Parks
ESA	Endangered Species Act
F	Fahrenheit
FPD	Forest Production District
LB	left bank
LWD	large woody debris
OHW	ordinary high water
RB	right bank
RM	river mile
WLRD	Water and Land Resources Division
WRIA	Water Resources Inventory Area

ACKNOWLEDGEMENTS

The stream habitat reconnaissance project was a partnership between the King County Department of Natural Resources and Parks, and the Tulalip Tribes. Dr. Fran Solomon was the Project Manager for King County and Anne Savery was the Project Manager for the Tulalip Tribes. Fran Solomon and Melissa Boles wrote this report. Tulalip Tribes field technicians Alan Cortez and Charles Shipp performed the streamwalks and recorded and photographed observations on aquatic habitat conditions. Dave Luzi and Richard Young of the Tulalip Tribes provided valuable input in developing the project scope and contract.

Many King County colleagues contributed to the success of the project and to the writing of this report. Gino Lucchetti and former colleague Karen Fevold provided valuable input in developing the project scope. Melissa Boles and Karen Fevold performed the Stossel Creek streamwalk. James Schroeder and Kerry Thrasher developed the contract with the Tulalip Tribes. Ken Rauscher produced the maps that were used for the field work, Constance Carlson and Todd Klinka produced the report maps, and Laurel Preston produced the report cover. Gino Lucchetti, Kate O'Laughlin, and James Schroeder reviewed the drafts of this report and Tom Ventur formatted the final report.

INTRODUCTION

This report summarizes and interprets information collected in the field in the summer of 2002 about habitat conditions for and presence/relative distribution of multiple species of salmonids and other aquatic biota in 14 rivers and streams in the Snoqualmie Watershed between the King-Snohomish County line and Snoqualmie Falls. This information was collected by King County Water and Land Resources Division (WLRD) staff and members of the Tulalip Tribes.

Until recently, there has been a paucity of information about habitat conditions in Snoqualmie Watershed rivers and streams. In the summers of 2000 and 2001, King County WLRD staff performed an inventory of riparian and in-stream habitat conditions in the Lower Snoqualmie River mainstem downstream of the Tokul Creek confluence (River Mile 38) to the King-Snohomish County line (River Mile 6). This work included the beginning of a qualitative habitat inventory on Griffin Creek and the Raging and Tolt Rivers. Parameters that were evaluated for the qualitative inventory included general habitat condition, bank condition, channel width and depth, maturity and type of riparian vegetation, density of large woody debris (LWD), dominant substrate type, presence of pools and riffles, observed species of fish and wildlife, composition of benthic community, and location of side channels, wetlands, channel modifications, culverts, bank hardening, discharge pipes, and anthropogenic debris. In the summer of 2002, this qualitative habitat inventory was continued in these three waterbodies as well as six others that are also direct tributaries to the mainstem Snoqualmie River and five tributaries to these tributaries. Adjacent land use, stream flow, stream gradient, and water temperature were evaluated in addition to the parameters that were evaluated in 2001.

Information from this report is intended to provide a qualitative overview of existing habitat conditions for fish and other aquatic biota in Snoqualmie Watershed rivers and streams and will be used to guide further, more quantitative surveys if necessary, as well as habitat and aquatic resources management decisions in the watershed. WLRD staff will evaluate relative habitat condition, existing or potential land use issues, and potential opportunities for aquatic habitat protection and restoration actions in the Snoqualmie Watershed. The information will be shared with members of the WRIA 7 Technical Committee and will be used to inform the WRIA 7 salmon conservation and recovery plan. Furthermore, the information will provide a baseline for evaluating general trends in habitat quality over time and for adaptive management and monitoring as habitat protection and restoration actions are implemented in the Snoqualmie Watershed.

METHODS

The following rivers and streams (Map 1) were inventoried from July 10 to September 26 of 2002. River miles were selected based on the presence of anadromous salmonids and on accessibility by foot. The total distance covered was 59.6 miles.

- Cherry Creek, River Mile (RM) 0.0-5.0
- Margaret Creek, RM 0.0-1.0
- Ames Lake Creek, RM 0.0-3.9
- Harris Creek, RM 0.0-6.6
- Tolt River, RM 0.0-5.9, 7.5-7.9
- Stossel Creek, RM 0.0-5.0
- Langlois Creek, RM 0.0-1.1
- Griffin Creek, RM 0.0-3.0
- Patterson Creek, RM 0.0-10.1
- Canyon Creek, RM 0.0-2.0
- Raging River, RM 0.0-11.0
- Deep Creek, RM 0.0-1.2
- Lake Creek, RM 0.0-2.0
- Tokul Creek, RM 0.0-1.4

Two-person field teams walked each river or stream in an upstream direction and took notes and photographs approximately every 0.1 mile. Before actual recording of written information began, the teams received training in King County field protocols, including a practice session in the field. This project was modeled after stream reconnaissance surveys conducted by King County in the mid 1980s in all King County watersheds and streamwalks conducted by King County in the early 1990s in the Cedar River Basin. The following habitat features and biota were evaluated qualitatively:

- Riparian vegetation – estimated width, maturity, and density, dominant type (trees, shrubs, grasses), and major species
- LWD – estimated density
- Substrate type – visual estimate of dominant and subdominant types (cobble, gravel, sand or silt)
- Bank hardening and erosion – presence, type (revetment, levee), and whether bank armoring leads to erosion issues directly downstream from or across the stream from armored bank
- Large pools – tally, association with LWD, quality (depth and cover), and the rough location of especially large, high quality pools
- Salmonids and other finfish – presence, major species, life history stages, relative abundance, location of partial and complete barriers to migration, whether each barrier is natural or human-caused;
- Wildlife (mammals, birds, reptiles, amphibians) – presence and major species
- Mussel beds – presence

- Benthic macroinvertebrates – presence, major species, and relative abundance
- Adjacent land use, e.g., forest, agricultural, rural residential, urban residential or commercial
- Stream flow estimate
- Stream width (wetted and bankfull) and stream depth
- Stream gradient changes
- Water temperature, cold water spring inputs
- Stream tributaries, side channels, back channels, springs, seeps, wetlands, and culverts – locations, whether these features are used/accessible by fish or if they could be reconnected to allow for use and what, if any, land use impacts are occurring.
- Presence of discharge pipes, anthropogenic debris, diversion pumps, weirs, and pilings

For each reach/segment of each waterbody, the field team wrote a general description of habitat condition and biological use/value (good, fair or poor), obvious habitat problems or concerns, and opportunity and/or need for a habitat protection or restoration project. Reaches were selected for consistency of adjacent land use and river morphology.

A reach was rated as "good" for habitat quality if a combination of the following habitat conditions was present, along with presence of salmon, other fish, and other aquatic species (mussels, crawfish, and benthic invertebrates such as caddisflies and mayflies that are associated with good water quality in rivers and streams).

- Mature and/or dense riparian vegetation.
- Mostly Pacific Northwest native species of trees and shrubs.
- Abundant LWD, i.e., 2–4 pieces per channel width greater than 20 m wide, >0.5 piece per channel width 10–20 m wide, and >0.3 piece per channel width <10 m wide (WDFW and Western Washington Treaty Tribes, 1997 and WFPB, 1997).
- Channel not confined by levees.
- Little or no bank hardening (revetments).
- Little or no bank erosion/little or no delivery of fine sediments to waterbody.
- Water temperature = 10°C–13.9°C which is the ideal range for salmon rearing (Bjornn and Reiser, 1991).
- Absence of fish passage problems.

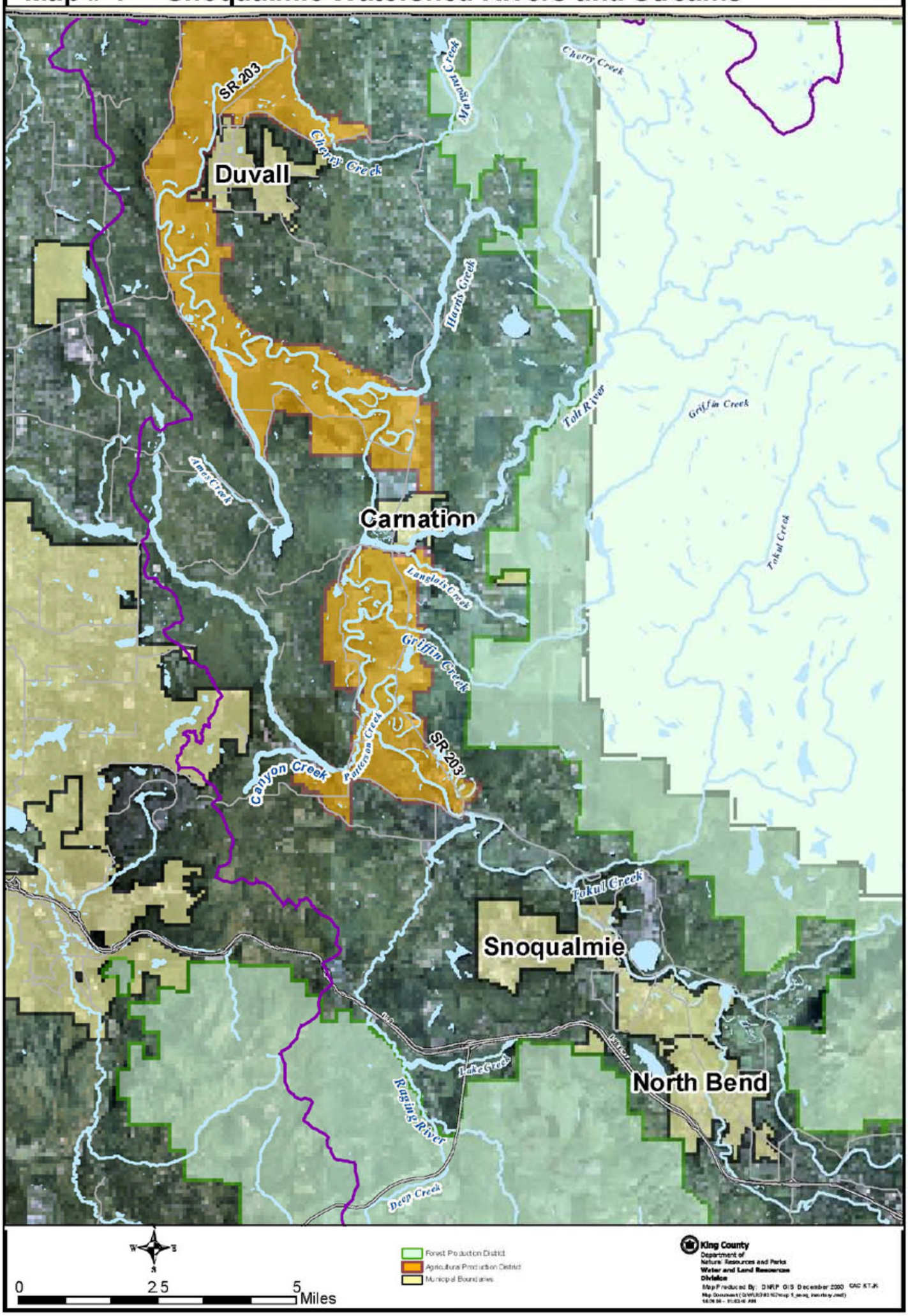
A reach was rated as "poor" for habitat quality if a combination of the inverse habitat conditions was present and there was a paucity of salmon and other aquatic species.

- Immature and/or sparse riparian vegetation.
- Mostly non-native species of trees and shrubs.
- Dearth of LWD.
- Channel confined by levees.
- Extensive bank hardening.
- Extensive bank erosion and fine sedimentation.
- Water temperature $\geq$14°C.

- Presence of fish passage problems.

Reaches that displayed some “good” and some “poor” habitat conditions were rated as “fair” for overall habitat quality. Field notes were then summarized and analyzed for this report.

Map # 1 Snoqualmie Watershed Rivers and Streams



RESULTS

Field observations are summarized and interpreted in the following subsections of this report. The rivers and streams that were included in the habitat inventory are listed and described from the most downstream to the most upstream. For each waterbody, there is an indication of the river miles that were walked and the date(s) on which the reconnaissance occurred. An overview of habitat conditions for the overall waterbody is followed by an overview of conditions at the reach level and site-specific observations, where available. LWD counts, pool counts, and photographs are included, where available. More detailed field notes (Cortez, 2002) can be obtained upon request from King County WLRD.

CHERRY CREEK (RIVER MILE [RM] 0.0-5.0), JULY 15—17, 2002

OVERVIEW

The headwaters of Cherry Creek (Map 2) are in an undeveloped Forest Production District. The creek then flows through a wooded reach of rural residential development, across a productive agricultural area, and into the Snoqualmie River at RM 6.7 of the Snoqualmie. Above the valley floor, Cherry Creek is very healthy and productive with coho salmon, trout, and freshwater mussels. However, fish habitat conditions are degraded in the lowest reach, i.e., Cherry Valley Floodplain.

RM 0.0—2.2, CHERRY VALLEY FLOODPLAIN REACH

Reach Overview:

LWD: data not available (N/A), pools N/A

This reach is a low gradient (0–0.5%) valley floodplain. Cherry Creek flows along the east edge of the valley. The stream is confined and entrenched in an agricultural ditch. The streambed morphology was riffle-glide, with very long and deep glides. The stream was very deep (up to 3 feet) throughout this reach, with high flow debris visible 5 feet above the July 17, 2002 water level. The substrate ranged from pebble/gravel as the stream entered the floodplain to sand and silt at the mouth. Both banks were armored in many locations throughout this reach.

The riparian vegetation included alder and cottonwood trees on the right bank (RB), alder, and big leaf maple trees on the left bank (LB), and reed canary grass and blackberry on both banks. There was no overhead canopy on either bank from RM 0.5 downstream to the mouth of the creek.

RM 2.2–3.0, LOW GRADIENT CHANNEL IN RURAL RESIDENTIAL DEVELOPMENT

Reach Overview:

LWD: 65 pieces, 7 pools

The streambed morphology of Cherry Creek was riffle/glide/pool through this reach with 0% gradient at RM 2.2, and gradient increases up to 30% at RM 3.0. The substrate was pebble/gravel with some patches of gravel/pebble and was embedded with fines. The wetted width in this reach was about 15 feet, with a 60 foot ordinary high water (OHW). Some coho were observed as well as a few rainbow trout fry. Benthic invertebrates were present but not abundant. Deer tracks were common. The riparian canopy was patchy and composed of alder, cottonwood, maple, and conifers. Native plants such as salmonberry dominated the riparian shrubs, but invasive species such as reed canary grass and blackberry became increasingly frequent in the lower half of this reach. There were homes scattered throughout this reach and approximately 10% of the streambanks were armored with riprap.

Site-Specific Observations:

A tributary on the RB at RM 2.5 had a large cobble delta at its confluence with Cherry Creek. Nearby on the RB, a side or remnant channel was located about 3 feet above the current channel behind a thin row of cottonwoods.

The water temperature at RM 2.8 was 17° Celsius (C) (62.6° Fahrenheit (F)) at 2:25 PM on July 17, 2002. At 9:00 AM that day, the water temperature was already 14°C (57.2°F) upstream. These temperatures exceed the optimal range of 10° to 13.9°C (50° to 57°F) for salmon rearing (Bjornn and Reiser, 1991).

A bridge at RM 2.9 constrained the creek through two riprapped supports on the banks. Upstream of the bridge, a large and long gravel bar had built up with about 50 pieces of LWD. The presence of this gravel bar indicated that high flows back up behind this bridge.

RM 3.0–4.4, HIGH GRADIENT CHANNEL IN RURAL RESIDENTIAL DEVELOPMENT

Reach Overview:

LWD: 313 pieces, 31 pools

Cherry Creek had a consistent gradient of 2–3% through this reach. Both banks were steep, ranging between 30% and as much as 100% in places on the LB. Only a few juvenile coho were observed in this reach. Several old redds were noted. Homes were scattered along the banks through this reach, some as close as 15 feet from the edge of the creek. On undeveloped properties, the riparian vegetation was dense and comprised of native species such as salmonberry, sword ferns, and vine maples. However, the vegetation on the home lots was mowed to the stream bank and often dominated by non-native, invasive species such as reed canary grass and blackberry. Some of the homeowners had hardened the banks in front of their property; approximately 5% of the banks were armored through this reach. The canopy was composed of alder, cottonwood, and about 40% conifers. Bedrock and glacial outwash were exposed on the banks throughout this reach, with the overlying substrate generally pebble, and gravel with embedded fines. Large boulders were found in the channel frequently.

Site–Specific Observations:

A side channel flowed along the RB at RM 3.1 for about 0.1 mile. Power lines crossed the creek at RM 3.3; all riparian vegetation underneath the power lines was mowed for 0.1 mile of creek. Just below the power lines, there was a logjam with at least 100 pieces that had forced the channel to split around a large gravel bar. There were a few small pools associated with this logjam and the streambed indicated that further habitat would be available during winter high flows.

Three large erosion features were observed along the steep LB between RM 3.4 and 3.8. A slide at RM 3.4 was 400 feet long and about 35 feet high with water seepage. Downstream of this slide were three old growth cedars in the creek. A slide at RM 3.5 went up the hillside for about 700 feet and appeared to be very old. Another slide at RM 3.8 was 150 feet tall and 300 feet long, and had created a logjam in the creek. A water withdrawal pump led from the creek to a home at RM 4.0.

RM 4.4–5.0, UNDEVELOPED TIMBER PROPERTY

Reach Overview:

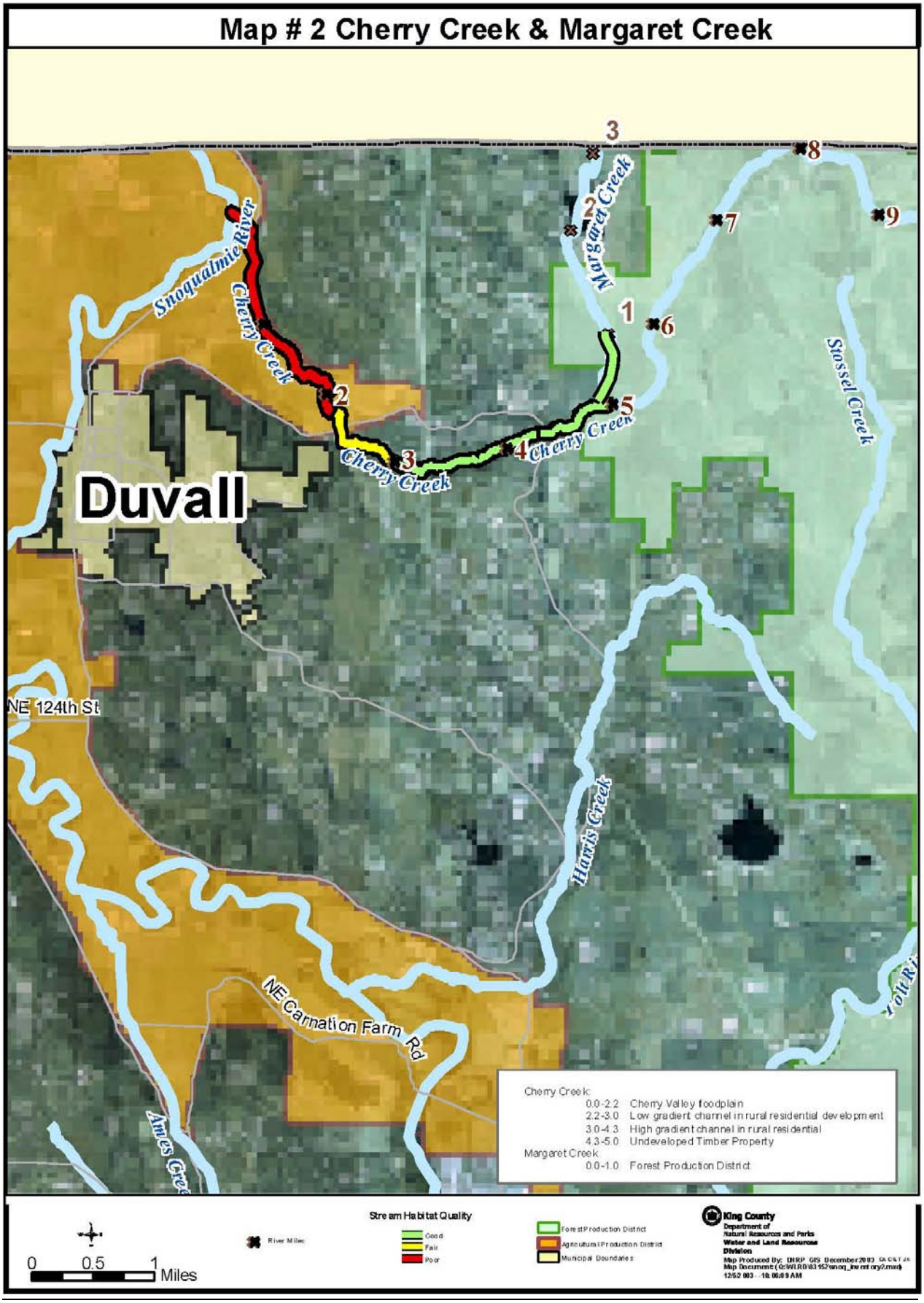
LWD: 149 pieces, 31 pools

Above RM 4.4, Cherry Creek was low gradient with wetland habitat. This reach was very productive with the highest density and largest coho fry observed in Cherry Creek, as well as abundant benthic invertebrates and freshwater mussels. The substrate was pebble and gravel with a wetted width of 10 feet and an OHW of 75 feet. The streambed morphology was riffle/glide/pool. Several piles of mussel shells on the LB indicated that wildlife come to the creek to feast. The canopy was offset by the wide wetland area, and was composed of alder, maple, and conifers. The shrubs were all native, mostly salmonberry and Pacific ninebark.

Site-Specific Observations:

NE Kelly Road crosses Cherry Creek on a bridge at RM 4.4. A 100-foot long boulder cascade runs down from under the bridge. Water temperature at the bridge was 14°C (57.2°F) on July 17, 2002.

There was a large cedar piling on both sides of the creek at RM 4.9, presumably left behind by an old logging operation. The reach between RM 4.9–5.0 had accumulated 114 pieces of LWD and some associated scour pools that were up to 6 feet deep.


Map # 2 Cherry Creek & Margaret Creek
Snoqualmie River
Cherry Creek
Margaret Creek
Stossel Creek
Harris Creek
Duvall
NE 124th St
NE Carnation Farm Rd
Ames Cree
Cherry Creek:
0.0-2.2 Cherry Valley floodplain
2.2-3.0 Low gradient channel in rural residential development
3.0-4.3 High gradient channel in rural residential
4.3-5.0 Undeveloped Timber Property
Margaret Creek
0.0-1.0 Forest Production District
Stream Habitat Quality
Good
Fair
Poor
River Miles
Forest Production District
Agricultural Production District
Municipal Boundaries
0 0.5 1 Miles
King County
Department of Natural Resources and Parks
Water and Land Resources Division

MARGARET CREEK (RM 0.0–1.0), JULY 15, 2002

RM 0.0–1.0, FOREST PRODUCTION DISTRICT REACH

Margaret Creek flows out of Lake Margaret through Forest Production District land and enters Cherry Creek at Cherry RM 4.5. Margaret Creek is a coho-bearing stream from its mouth to RM 0.7 (Snohomish River Basin Work Group, 1998).

OVERVIEW:

Reach Overview:

LWD: N/A, pools N.A

The gradient of Margaret Creek ranged from 6.5% upstream to 4 % as the creek neared its confluence with Cherry Creek. The wetted width ranged from 8 to 15 feet and the OHW ranged from 12 to 18 feet in an upstream to downstream direction as well. Water seeped from the hillside on the RB.

The channel morphology was mostly riffle/glide with very few pools. The substrate was mostly boulder (some rocks were five feet long and three feet wide) and gravel, suggesting good spawning habitat for coho salmon. Some clay hardpan was observed on the RB.

The riparian canopy shaded the stream and was composed mainly of Pacific Northwest trees and shrubs: alder, big leaf maple, large cottonwood (four to five feet in diameter), salmonberry, and devils club. Some reed canary grass was found as well. There was some LWD in Margaret Creek, including a logjam that appeared to have caused the formation of a gravel bar on the LB near the confluence with Cherry Creek.

LWD provides rearing and refuge habitat for juvenile salmonids (WFPB, 1997). Many coho fry were visible in Margaret Creek, along with two of their food sources – mayflies and caddisflies. Freshwater mussel shells were ubiquitous at the mouth of the creek.

AMES LAKE CREEK (RM 0.0–3.9), JULY 30, 2002

OVERVIEW:

Ames Lake Creek (Map 3) flows out of Ames Lake, which is surrounded by residential suburban development. Downstream of Ames Lake, the creek flows through rural residential development to the Snoqualmie River floodplain, where the water in the creek is used to irrigate farmlands. Excessive sedimentation of the floodplain ditches has been a problem for farmers in recent years. Clearing, straightening and dredging in the lower agricultural reaches of Ames Lake Creek have degraded fish habitat by reducing habitat complexity. The lack of native riparian vegetation also contributes to degraded habitat conditions.

RM 0.0–2.0, SNOQUALMIE RIVER FLOODPLAIN, AGRICULTURAL PRODUCTION DISTRICT

Reach Overview:

LWD: 0 pieces, 0 pools (data incomplete as this reach was not wholly accessible)

From its mouth to RM 2.0, Ames Lake Creek flows through agricultural ditches with a wetted width of 6 to 8 feet. The substrate was primarily silts and sands, with some small patches of gravel. The riparian vegetation was exclusively reed canary grass and blackberry, with no trees. Although a few coho fry were observed in this reach, overall habitat conditions for salmonids were poor. The stream was exposed and had little to no cover or refuge habitat. Landowners expressed that there is a need for habitat restoration, and that the culverts needed to be cleared to improve drainage. The culverts were blocked and appeared to be hindering fish passage.

Site-Specific Observations:

Five beaver dams were found where Ames Lake Creek entered the Snoqualmie River floodplain. The field technicians were not able to get close enough to evaluate the habitat formed by this beaver activity.

RM 2.0–3.6, RURAL RESIDENTIAL DEVELOPMENT

Reach Overview:

LWD: 146 pieces, 9 pools (pool data incomplete due to subsurface flow)

The Ames Lake Creek subbasin was developed with homes from RM 2.0 upstream to Ames Lake. Streambed morphology was not described because the flow was subsurface for much of this reach. The substrate was consistently gravel and pebble through this reach. Coho fry were generally observed wherever adequate water existed, but benthic invertebrates were scarce.

Site-Specific Observations:

From RM 2.0 to 2.1, there was a sparse canopy of young alder and maples and a high density of shrubs, mostly blackberry, salmonberry, and Pacific ninebark. Immediately upstream, from RM 2.1 to 2.4, there was no canopy. The streambed morphology was riffle-glide, with three pools between RM 2.0 and 2.4. One of these pools was at the base of a slightly perched culvert at RM 2.3. Occasional red ribbons in the shrubs noted the locations of coho redds from fall, 2001.

At RM 2.6, there was an alder canopy, but it was set back 20 feet from the stream. The creek meandered slightly and there were about a dozen ribbons noting the locations of old coho redds. The substrate was gravel and pebble. The riparian vegetation was salmonberry with abundant devils club. Eight pieces of LWD were found in this 0.1 mile.

The streambed morphology was riffle/glide at RM 2.7, with no pools and a wetted width of 3 to 6 feet, and an OHW of 10 feet. A tributary on the LB had a wetted width of 2.5 feet. There was another tributary on the RB at RM 2.8. Between these two tributaries, Ames Lake Creek had a bar made of gravel and cobbles that was one foot higher than the streambed, indicating some high water events during the wet season.

At RM 2.9, the gradient dropped and the stream displayed some wetland characteristics. The low gradient wetland habitat occurred through RM 3.1, with dense vegetation on both banks composed of salmonberry, vine maple and devils club. At RM 3.2, the shrubs were entirely devils club and nettle. The canopy of alders was only 10 feet from the edge of the stream and was as dense as the shrubs, providing good recruitment potential for instream LWD.

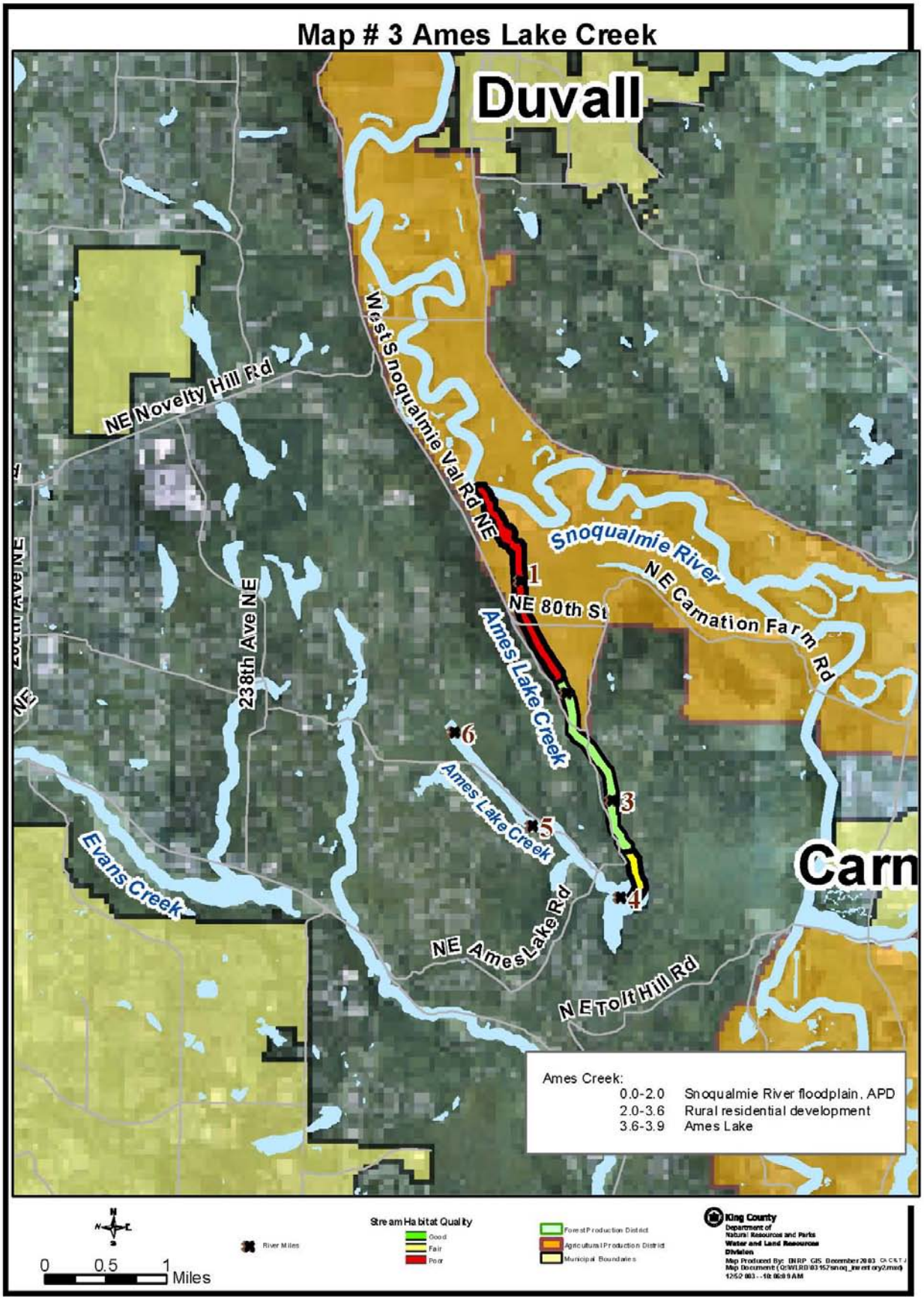
The flow was subsurface from RM 3.2 to Ames Lake with the streambed morphology appearing to be riffle/glide. The gradient was 2–3% with a pebble and gravel substrate. The creek flowed through culverts at RM 3.3 and 3.4 at 47th Place and an old logging road.

RM 3.6–3.9, AMES LAKE

Reach Overview:

LWD: 0 pieces, 0 pools

Ames Lake was heavily developed with homes on the entire shoreline. There was very little natural shoreline remaining; many lawns and gardens bordered the lake. Although there were still some tall conifers around the lake, their density was too low to provide adequate shading for fish in the lake.


Map # 3 Ames Lake Creek
Duvall
Carn
West Snoqualmie Val Rd NE
NE Novelty Hill Rd
Snoqualmie River
NE Carnation Farm Rd
NE 80th St
Ames Lake Creek
238th Ave NE
Evans Creek
NE Ames Lake Rd
NE Tolt Hill Rd
1
3
4
5
6
Ames Creek:
0.0-2.0 Snoqualmie River floodplain, APD
2.0-3.6 Rural residential development
3.6-3.9 Ames Lake
0 0.5 1 Miles
River Miles
Stream Habitat Quality
Good
Fair
Poor
Forest Production District
Agricultural Production District
Municipal Boundaries
King County
Department of Natural Resources and Parks
Water and Land Resources Division

HARRIS CREEK (RM 0.0–6.6), AUGUST 1, AND AUGUST 5–7, 2002

OVERVIEW

The headwaters of Harris Creek (Map 4) and most of its watershed are surrounded by rural residential development. Wildlife and signs of wildlife were observed, e.g., deer, cougar, beaver, and ducks. There are many wetlands associated with the headwaters; habitat problems occur where road crossings are frequent and invasive plants are persistent. At its mouth, Harris Creek flows through a wildlife preserve and into the Snoqualmie River at RM 20.7.

RM 0.0–1.7, SNOQUALMIE RIVER FLOODPLAIN

Reach Overview:

LWD: N/A, pools: N/A

From RM 0–1.1, Harris Creek flows through an abandoned channel cut by the Snoqualmie River. This channel was wide and filled with aquatic macrophytes; large cottonwoods formed a discontinuous line along the edges of the channel. This reach was very low gradient with fine substrate, and was connected to two distinct oxbow ponds.

Site-Specific Observations:

The Snoqualmie Valley Trail crosses Harris Creek at RM 1.1. Above the trail, there were three beaver ponds on the RB. The ponds were over 4.9 feet deep. The LB of the creek was planted at RM 1.3 with conifers and native shrubs. The substrate was sands and silts and the creek was up to 4 feet deep. Above the beaver ponds, between RM 1.4–1.7, Harris Creek flows along agricultural property on the RB.

RM 1.7–2.8, UNDEVELOPED FORESTED AREA

Reach Overview:

LWD: 252 pieces, 28 pools

The riparian trees at RM 1.7 were cottonwood, alder, and vine maple and were set back approximately 50 feet from the creek. Shrubs were vine maple, salmonberry, and Pacific ninebark. Harris Creek began to widen here as it entered the Snoqualmie River floodplain; the OHW was greater than 40 feet wide.

There was a big gravel bar just upstream of the SR 203 Bridge over Harris Creek, indicating that the bridge may back up the creek at higher flows (Photo HA1). Coho fry were abundant in this area.

Site-Specific Observations:

The water temperature at RM 2.0 was 12°C (53.6 °F) on August 7, 2002. Cougar tracks were observed on the LB at RM 2.0. Crawfish, a 6-inch trout, and coho fry were also present in the creek. At RM 2.1, the

gradient increased to 3.5%. The substrate was gravel and pebble and the stream split around gravel bars through this reach. Some large huckleberries were found at RM 2.1 near an old-growth cedar stump.

At RM 2.2, the substrate increased in size to gravel and boulder (Photo HA2), with the gradient up to 9%. The dominant riparian shrub was salmonberry. The canopy was still about 40 feet back from the stream, and was composed of alder, maple, and conifers. There was a logjam at RM 2.3 that was 40 feet wide with approximately 60 pieces of wood. Some small caddisflies were present. Many boulders were present at RM 2.3. The wetted width of the channel was 15 to 20 feet and the OHW was 40 feet at this location. Complex habitat with adequate shading and LWD were found at RM 2.5–2.6 (Photos HA3–4).

An old, failed bridge at RM 2.6 had backed up a sizeable logjam (Photo HA5). Another logjam was only a few feet upstream of it. Between RM 2.6 and 2.8, the stream was pristine–looking with a healthy riparian canopy. Caddisflies and mayflies were present. These species of macroinvertebrates are associated with good water quality.

RM 2.8–3.6, RURAL RESIDENTIAL

Reach Overview:

LWD: 63 pieces, 13 pools

The riparian vegetation in this reach was all native plants, but was sparse on the LB. Predominant shrub species were Pacific ninebark, salmonberry, and skunk cabbage; the latter is indicative of wetland conditions.

The substrate was gravel and pebble, mixed with silts from the wetland. The gradient was 1–2% and the channel morphology was pool/riffle, with some large and deep pools filled with coho salmon. Coho were observed throughout this reach, especially just downstream of the wetland.

Site-Specific Observations:

The first house on Harris Creek appeared on the RB at RM 2.9. Exposed clay hardpan was observed on the LB at this location. Freshwater mussels were found at RM 3.0 (Photo HA6), with gravel and pebble substrate. Caddisflies and mayflies were not observed at this location.

RM 3.6–4.6, WETLAND

Reach Overview:

LWD: 12 pieces, 0 pools

This reach was too swampy and deep to walk, so the field technicians conducted the reconnaissance from nearby roads. The riparian plants were mostly reed canary grass with native wetland shrubs; scattered alders lined the wetland. The wetted width was approximately 7 feet, and the OHW was 50 feet. A resident at RM 3.7 said that the OHW was very high in the winter.

Site-Specific Observations:

A LB tributary at RM 4.3 was dry. NE Kelly Road crosses Harris Creek at the downstream end of the wetland over two large, grated culverts (Photo HA7).

RM 4.6–6.6, RURAL RESIDENTIAL WITH SMALL WETLANDS

Reach Overview:

LWD: 52 pieces, 13 pools

There were not many homes along Harris Creek through this reach, but there were frequent road crossings. NE Stossel Creek Way crosses Harris Creek via culverts at RMs 5.6, 5.9, 6.0, 6.1, and 6.6. The stream also flowed through culverts and under bridges at several small streets and driveways (Photos HA8–11).

The stream gradient fluctuated between 0–1% and the substrate was gravel and pebble with isolated reaches of silts and sands. The riparian canopy in this reach was broken up by the homes along the RB, but the LB had a consistent canopy of alder, cottonwood, and a few conifers. The riparian shrubs were Pacific Northwest natives, mostly salmonberry, cascara, vine maple, and Pacific ninebark (Photo HA12). Small caddisflies were observed and coho fry were abundant. The substrate was pebble and gravel and was considered to be typical coho spawning habitat. In this reach, all of the tributaries to Harris Creek were dry.

Site-Specific Observations:

The streambed morphology was riffle/glide between RM 4.6 and 5.1. At RM 5.2, Harris Creek flowed through a culvert that had a fish ladder built into the downstream end (Photo HA13). Above the culvert, between RM 5.2–5.6, the stream was low gradient and the canopy was offset from the stream, indicating that Harris Creek flowed through a broad wetland here. Reed canary grass covered both banks, and alder trees lined the valley. The substrate was silts, and the streambed morphology varied from riffle/glide to low gradient glide with deep, murky water. Another culvert at the NE Stossel Creek Road crossing at RM 5.6 had a fish ladder built into the downstream end.

From RM 5.8 – 6.2, the gradient increased to 2.5%. The canopy closed in on this reach and was comprised of alder and maple, but was thin on the LB where it was broken up by homes. The riparian shrubs were dense and all native, including salmonberry, Pacific ninebark, and vine maple. There were frequent road crossings through this reach.

Between RM 6.3 and 6.6, Harris Creek did not flow far from NE Stossel Creek Road, and crossed under it several times. The riparian vegetation in this reach was almost entirely reed canary grass, with some patches of salmonberry. There was no canopy noted in this reach, but there may be a canopy that is set back from the creek. A large wetland was connected to the creek on the RB from at least RM 6.3 – RM 6.5. The channel through this reach was entrenched and the flow was subsurface at times, with a wetted width of 1.5 feet and an OHW of only 6 feet.

An old pickup truck and two washing machines were also found in the creek at RM 6.5. A logging road ran alongside the creek at RM 6.5 and the shrubs there were covered in dirt, suggesting that the logging activity was contributing fine sediments to the creek at this location.

The gradient was approximately 0.5% and the substrate was pebble and gravel with fines. It may be possible for spawning to occur here. Coho fry were observed here, but not in dense numbers. The water temperature at RM 6.6 was 13°C (55.4°F) on August 5, 2002.

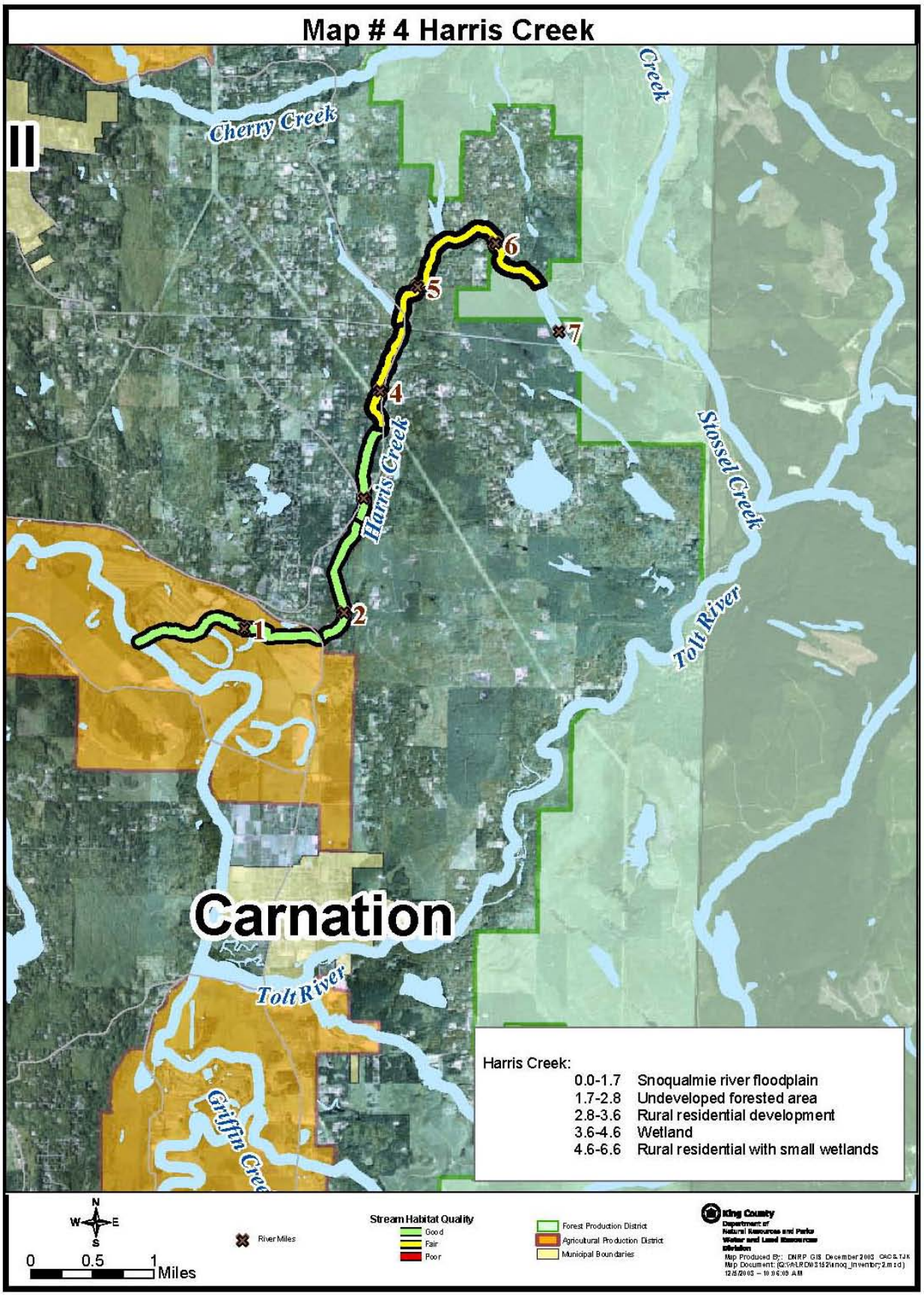

Map # 4 Harris Creek
Cherry Creek
Harris Creek
Stossel Creek
Tolt River
Carnation
Griffin Cree
1
2
4
5
6
7
Harris Creek:
0.0-1.7 Snoqualmie river floodplain
1.7-2.8 Undeveloped forested area
2.8-3.6 Rural residential development
3.6-4.6 Wetland
4.6-6.6 Rural residential with small wetlands
N
W
E
S
0 0.5 1 Miles
River Miles
Stream Habitat Quality
Good
Fair
Poor
Forest Production District
Agricultural Production District
Municipal Boundaries
King County
Department of Natural Resources and Parks
Water and Land Resources Division

Photo HA1. Harris Creek. Gravel bar upstream of SR 203 Bridge

Photo HA2. Harris Creek. RM 2.2

Photo HA3. Harris Creek. RM 2.5

Photo HA4. Harris Creek. RM 2.6

Photo HA5. Harris Creek. LWD jam at RM 2.6

Photo HA6. Freshwater mussel

Photo HA7. NE Kelly Road crossing at RM 4.6

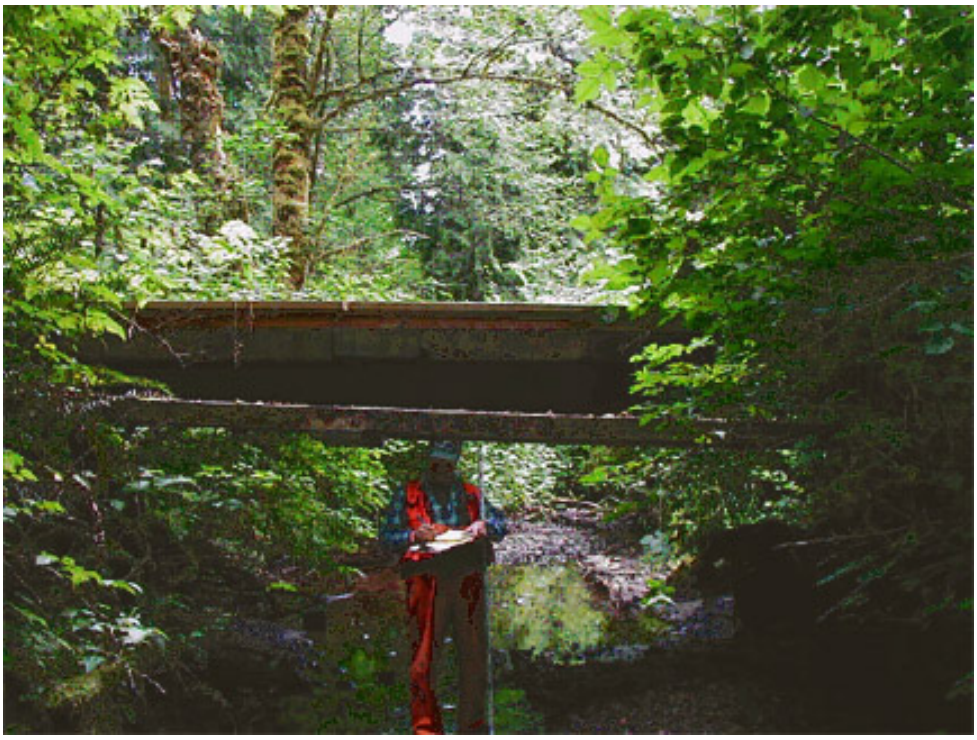


Photo HA8. Driveway over Harris Creek at RM 5.7.

Photo HA9. RM 6.0.

Photo HA10. RM 6.1.

Photo HA11. RM 6.3.

Photo HA12. Riparian vegetation, RM 5.1.

Photo HA13. Fish ladder at RM 5.2.

TOLT RIVER (RM 0.0–5.9, 7.5–7.9), SEPTEMBER 4, 2002

OVERVIEW:

The Tolt River (Map 5) is the largest tributary to the Snoqualmie River, entering the mainstem Snoqualmie at Snoqualmie RM 24.1 (Photo Tolt1). The North and South Forks of the Tolt River are similar in size and meet at Tolt RM 8.2. Seattle Public Utilities operates a water supply dam on the South Fork Tolt River, which alters the hydrology downstream. Aside from RM 0.0–2.0, the Tolt River drains forested lands and has mostly healthy riparian and healthy instream habitat.

RM 0.0–2.0, TOLT RIVER DELTA

Reach Overview:

LWD: 12 pieces, 0 pools

In this lowest reach, the Tolt River was confined between containment levees that protect the City of Carnation; consequently, gravel movement to the Snoqualmie River is disrupted. The substrate in the Tolt River is unsorted gravels embedded with fines. Tall gravel bars have built up within the levees, often confining the river to narrow and fast channels. The channel morphology is mainly riffle/glide with very little available habitat for juvenile fish (Photo Tolt2).

There were tall, mature, mostly deciduous trees lining the Tolt River on both banks throughout this reach, but the trees were all behind the levees and therefore cannot be recruited as LWD to the river. Juvenile fish were not observed in this reach. Adult salmon redds were noted in the gravel in places; chinook, coho, chum and pink salmon are known to spawn in this reach (WDFW and Western Washington Treaty Indian Tribes, 1994).

Site-Specific Observations:

The Snoqualmie Valley Trail crosses the Tolt River on an old railroad bridge at RM 1.6. The opening under the bridge was inadequate for Tolt River flows, so a gravel bar had backed up for 0.2 mile upstream of the bridge, with a sharp drop-off under the bridge. At high flows, water under this bridge will likely reach velocities that are too swift for fish.

RM 2.0–5.9, RURAL RESIDENTIAL DEVELOPMENT

Reach Overview:

LWD 120 pieces, 12 pools

There was consistent but infrequent and well-spaced residential land development on the LB of the Tolt River in this reach. Where houses were present, there was bank hardening and an absence of trees and shrubs (Photo Tolt3).

On the LB, where there are no homes, and throughout the RB the riparian vegetation was generally healthy with mature trees and dense shrubs. The trees were cottonwoods and conifers. The native shrubs were salmonberry, vine maple, ninebark, and cascara. Invasive plants, particularly budlea and blackberries, occurred infrequently except on developed properties where they were dense.

The channel substrate was cobble and gravel with localized reaches of cobble and boulder. Fines embedded the gravels throughout the reach. LWD was prevalent, and there were a few logjams with some excellent salmon habitat (Photo Tolt4).

Pink and chinook salmon were spawning throughout this reach when it was walked on October 2, 2001 (Solomon and Boles, 2002). At that time, both species were observed spawning in the same pool tailout at RM 3.3. Caddisflies, mayflies and stoneflies were abundant. When this reach was walked in 2001, deer and a great blue heron were observed as well.

Site-Specific Observations:

A King County facility to protect the Tolt River Road at RM 2.8 is constructed of large riprap with some placed LWD. There was a vertical bulkhead on the RB at RM 5.8.

RM 3.3 offered some very complex habitat where the Tolt River split to multiple channels as it flowed around a tight bend. Several woody debris complexes occurred around this bend, with pools, off-channel habitat and high gradient riffles providing a variety of habitat types. A similar complex of habitats occurred at RM 4.5 where an LWD jam forced the river to split into two channels. A boulder with a cedar growing on it at RM 4.0 had scoured out a long, deep pool (Photo Tolt5). An LWD jam at RM 5.8 created a large, deep pool with abundant cover. Instream habitat was generally excellent, with over-wintering habitat, off-channel habitat, and deep pools occurring regularly.

Channel avulsions were evident at RM 2.8, 3.7 and 5.7. These locations had remnant channels that were dry in the summer of 2002 but likely contained water at higher flows.

RM 7.5–7.9, UNDEVELOPED FORESTED AREA

Reach Overview:

LWD: 37 pieces, 19 pools

The riparian trees were mature and dense in this reach, but the river was so wide that the trees did not form a complete canopy (Photo Tolt6). The trees were cottonwood, big leaf maple, and conifers. The shrubs were dense and primarily native species, although budlea continued to occur throughout this reach.

The river had a 100 foot wetted width and a 125-foot OHW. The flow was deep and swift with back eddies, making the stream walk a challenge.

Juvenile coho were observed in this reach, using the slower water along the edges of the channel. Adult chinook spawners were actively building redds when this reach was walked in September 2002.

Site-Specific Observations:

The channel morphology was 2 to 5% gradient riffle at RM 7.5, and then increased to 10% gradient with a step-pool morphology (Photo Tolt7). At RM 7.6, the banks steepened, confining the river in a canyon

for the remainder of the reach. At RM 7.9, the combination of rocky banks and swift, deep water made it impossible to continue walking upstream (Photo Tolt8).

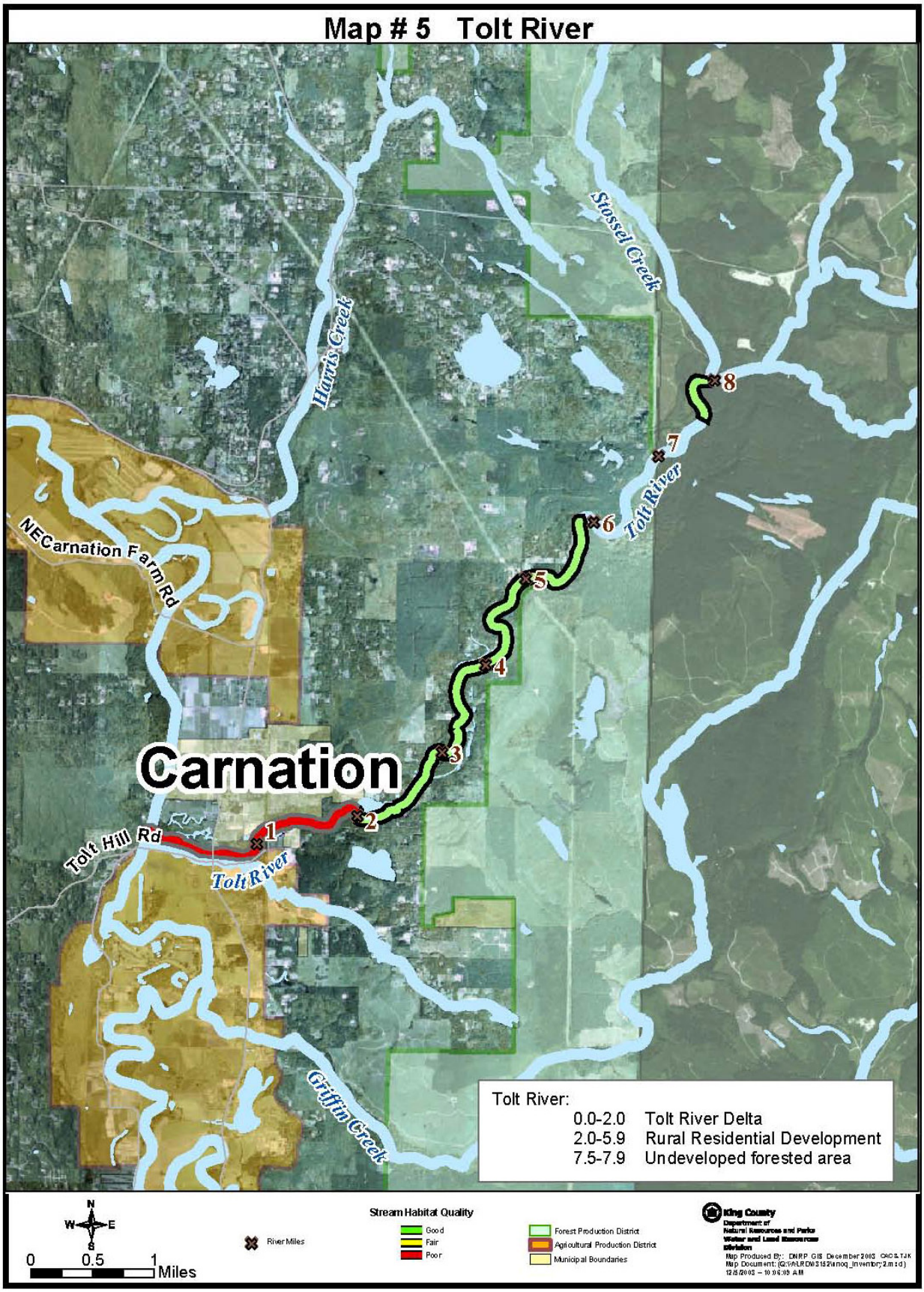

Map # 5 Tolt River
Stossel Creek
Harris Creek
Tolt River
NE Carnation Farm Rd
Carnation
Tolt Hill Rd
Tolt River
Griffin Creek
1
2
3
4
5
6
7
8
Tolt River:
0.0-2.0 Tolt River Delta
2.0-5.9 Rural Residential Development
7.5-7.9 Undeveloped forested area
N
W
E
S
0 0.5 1 Miles
River Miles
Stream Habitat Quality
Good
Fair
Poor
Forest Production District
Agricultural Production District
Municipal Boundaries
King County
Department of Natural Resources and Parks
Water and Land Resources Division

Photo Tolt1. Confluence of Tolt River (foreground) and Snoqualmie River (back left)

Photo Tolt2. Narrow channel between containment levees, RM 0.2

Photo Tolt3. Residential property with cleared riparian vegetation.

Photo Tolt4. LWD scoured pool at RM 3.2.

Photo Tolt5. Pool scoured by boulder at RM 4.0

Photo Tolt6. Riparian vegetation, RM 6.9

Photo Tolt7. High gradient channel at RM 7.5.

Photo Tolt8. Step-pool channel with boulder substrate, RM 7.7.

STOSSEL CREEK (RM 0–5.0), JULY 24, 30–31, AUGUST 28, AND SEPTEMBER 11, 2002

OVERVIEW:

Stossel Creek (Map 6) is a tributary to the North Fork Tolt River and flows alternately through broad wetlands and slightly steeper wooded reaches. Overall, Stossel Creek is a very productive system rich with several species of fish, invertebrates, birds, and wildlife. The wetland reaches are characterized by slow water in broad channels, with frequent beaver dams. Freshwater mussels are so abundant in the wooded reaches of Stossel Creek that the stream bottom appears in places to be paved with them (see reach descriptions for more details). Trees lining the banks of Stossel Creek are predominantly hemlock, cedar, big leaf maple, and alder.

The wooded reaches of Stossel Creek contained freshwater mussel (*Margeratifera falcata)* populations that covered the wetted width of the creek, prohibiting continuous access of the creek by foot. The wetland sections of Stossel Creek contained thick brush that also prohibited continuous access of the creek by foot. Therefore, the LWD and pool data collected was incomplete. Habitat and overall stream quality data were collected by spot checks of the creek where access was possible.

RM 0.0–0.8, HIGH GRADIENT FORESTED REACH

Reach Overview:

LWD: 7 pieces (partial count), pools N/A

This most downstream reach of Stossel Creek is confined in a wooded valley with a bankfull width of about 30 feet (Photo ST1). The water temperature was 11°C (51.8°F) at 2:00 PM on September 11, 2002. The gradient fluctuated between 3 to 15%, with a few boulder cascades and a bedrock falls where a fish ladder had been built into the LB. Sediment in this reach was gravel and cobble with embedded fines. LWD was abundant, as were freshwater mussels and coho. Crawfish, sculpins, and at least two species of frogs (one species was rusty gold with black bands coming down from its eyes, and the other species was spotted with light green stripes) were observed, as well as evidence of deer and otter use. The riparian tree canopy was composed of alder, big leaf maple, cedar, and hemlock. The riparian shrubs included Pacific ninebark, salmonberry, fern, vine maple, devils club, twinberry, horsetail, red huckleberry, blueberry, and rush. Reed canary grass and Himalayan blackberry occurred in isolated patches in this reach.

Site-Specific Observations:

A fish ladder was built into the LB around a steep boulder reach at RM 0.3. It was unclear how old this fish ladder was, who installed it, or if it worked (Photo ST2). Mussels were found in especially high densities at RM 0.7.

RM 0.8–1.9, WETLAND COMPLEX

Reach Overview:

LWD: 6 pieces (partial count), pools N/A

A large wetland complex existed between RM 0.8–1.9. This wetland had the most pronounced assemblage of invasive plants in Stossel Creek, with some patches of nightshade, Himalayan and evergreen blackberry, and a lot of reed canary grass. Below the Swan Loop Road crossing at RM 1.2, the creek was 6 to 8 feet wide and dark with dissolved organic carbons (Photo ST3). There was evidence of beaver activity. Freshwater mussels and many fish were present including coho fry and other fish that were 30–60 mm in length with deeply forked tails and big bellies. These fish may have been redside shiners.

Site-Specific Observations:

The Swan Loop Road crossing had two culverts across the Stossel Creek valley. The larger of the two was gated and resembled the snow plow on a train. Freshwater sponges were observed below these culverts. The valley upstream of the Swan Loop Road crossing was characterized as a "sea of spirea" turning into a "sea of cattails." The LB riparian vegetation along the edge of this valley was excellent with dense 40- to 50-year-old conifers, and alder, big leaf maple and willow. The RB riparian vegetation was sparse, but mature.

A large lake between RM 1.5 and 1.8 had been dammed by an abandoned logging road that stretches north-south along the base of the lake (Photos ST4-5). The current outlet of the lake was located in a bedrock outcrop on the RB side of the valley. An enormous logjam was built up at the outlet of the lake. Mussels, crawfish, and green freshwater sponges were observed near the outlet. The lake appeared to be very productive with ducks, jumping fish (unidentified species), and many midges, dragonflies and damselflies. There was a lot of wood in the lake, including submerged old growth stumps. All of the wood was debris from logging operations, and appeared to be very old.

A thin wedge of wetland valley above the lake at RM 1.85 was overgrown with reed canary grass (Photo ST6). This was the upper extent of Himalayan blackberry in Stossel Creek.

RM 1.9–2.0, FORESTED REACH

Reach Overview:

LWD: 17 pieces (partial count), pools N/A

This was a steep wooded reach below a culvert and road crossing at RM 2.0 (Photo ST7). Mussels were present here, but were less abundant than in the reach from RM 2.5–3 (see description below). For 100 feet below the road crossing, the stream tumbled down a boulder cascade overgrown with salmonberry, willow, Pacific ninebark, and dogwood. Below the cascade, the riparian shrubs were cascara, fern, nettle, Pacific ninebark, and rush. Wetted width was 8–12 feet.

RM 2.0–2.5, NARROW WETLAND VALLEY

Reach Overview:

LWD: 34 pieces (partial count), pools N/A

Between RM 2.0 and 2.5, Stossel Creek flowed through a sparsely vegetated, 100–foot wide wetland valley that did not have standing water throughout. Many coho salmon were observed, as well as a few mussels. Deer tracks were frequent and beaver modifications were abundant. Otter tracks were observed near a pile of crawfish remains, and some unidentified paw prints were photographed (Photo ST8). Valley plants were mostly rush, cattails and grasses, with some spirea, willow, alder, cascara, vernacular buttercup, salmonberry, and an invasive-looking daisy. Two large bedrock outcrops occurred between RM 2.2–2.3.

RM 2.5–3.0, MUSSEL HOT BED

Reach Overview:

LWD: 30 pieces (partial count), pools N/A

This is a non-wetland, wooded reach of Stossel Creek that was described as a “mussel hot bed” because there was a ubiquitous and dense population of mussels (Photos ST9–10). Some of the mussels were located in riffles.

The riparian canopy was comprised of 30-year-old conifers on both banks. The shrubs were mostly native with small patches of reed canary grass, Himalayan blackberry, and evergreen blackberries. Songbirds, red-tailed hawk, beaver activity, and many fish (coho salmon, threespine stickleback, and possibly whitefish and dace) were observed. The channel wetted width was 3–4 meters, and the bankfull width was 25–30 meters.

RM 3.0–4.1, NARROW WETLAND VALLEY

Reach Overview:

LWD: 29 pieces (partial count), pools N/A

In this reach, Stossel Creek flowed through a narrow wetland valley with standing water. The valley was 200–500 feet wide with dense growth of spirea (Photo ST11). Localized swampy regions had skunk cabbage, fern, and rush (Photo ST12). The riparian vegetation on both banks was sparse but mature. Several valley-spanning beaver dams had created large pools. Coho and trout were observed in these pools. One blown-out beaver dam had bear tracks that appeared to belong to an adult and a juvenile (Photo ST13), and other tracks that may have belonged to a cougar.

Site-Specific Observations:

A huge rock in the creek at RM 3.5 might be a glacial erratic (Photo ST14). The stream wrapped around it and was not very deep, indicating that the stream had little scour power at this location. Otter scat on top of the rock was composed almost entirely of crawfish shells.

RM 4.1–4.7, FORESTED REACH

Reach Overview:

LWD: N/A, pools N/A

This was a densely wooded area with a gradient of 1–3%. Otter scat and deer tracks were observed throughout this reach, and coho were observed near the road crossing at RM 4.4 (Photo ST15). Riparian trees were dense and mature. The shrubs were all native, with only a few patches of reed canary grass and nightshade near the road crossing. The dominant shrubs were salmonberry, twinberry, devils club, and salal. Mussels were not observed in this wooded area.

RM 4.7–5.0, WETLAND COMPLEX WITH BOG

Reach Overview:

LWD: N/A, pools N/A

This reach was a broad wetland, about 350 feet wide, with a lake that was approximately 500 feet long and 200 feet wide. The valley had ankle deep water throughout. Bog laurel and labrador tea grew densely at the edges of the valley. Grasses and spirea grew in this valley. The channel was approximately 4 feet deep with very steep banks and meanders. Some duckweed grew in the channel. Songbirds, kingfishers, and midges were present, and there was evidence of otter and deer use of this valley.

The riparian vegetation was dense and mature, composed of hemlock, cedar, vine maple, and alder, with about 40% conifers. There were two large beaver dams at the southern extent of the valley.

A bog at the north end of the lake consisted of labrador tea with mosses. Cattails grew all around the lake, and yellow pond lilies grew on the south and east ends of the lake. The lake bottom was at least 4 feet deep. Small fish, likely redside shiners, were very abundant in the lake. They swim in very high densities in the shallow waters.

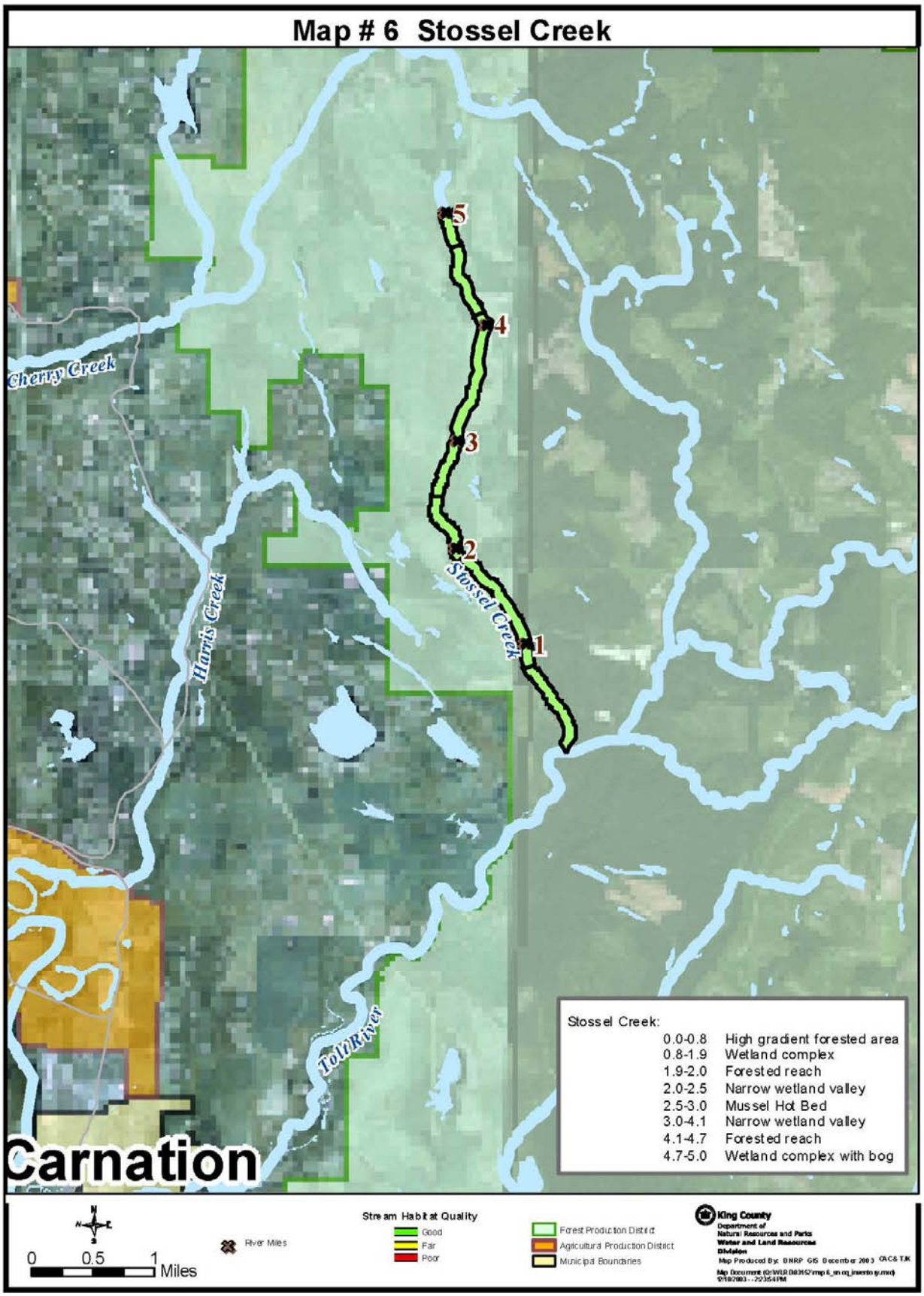

Map # 6 Stossel Creek
5
4
3
2
1
Cherry Creek
Harris Creek
Stossel Creek
Tolt River
Carnation
Stossel Creek:
0.0-0.8 High gradient forested area
0.8-1.9 Wetland complex
1.9-2.0 Forested reach
2.0-2.5 Narrow wetland valley
2.5-3.0 Mussel Hot Bed
3.0-4.1 Narrow wetland valley
4.1-4.7 Forested reach
4.7-5.0 Wetland complex with bog
N
0 0.5 1 Miles
River Miles
Stream Habitat Quality
Good
Fair
Poor
Forest Production District
Agricultural Production District
Municipal Boundaries
King County
Department of Natural Resources and Parks
Water and Land Resources Division
Map Produced By: DNRP GIS December 2003 CAC & TJK

Photo ST1. RM 0.5.

Photo ST2. Fish ladder at RM .03.

Photo ST3. Swan Lake Road crossing, RM 1.2.

Photo ST4. Lake at RM 1.6, looking downstream.

Photo ST5. Lake at RM 1.6, looking upstream.

Photo ST6. Wetland valley with reed canary grass.

Photo ST7. Culvert at RM 2.0

Photo ST8. Unidentified paw prints.

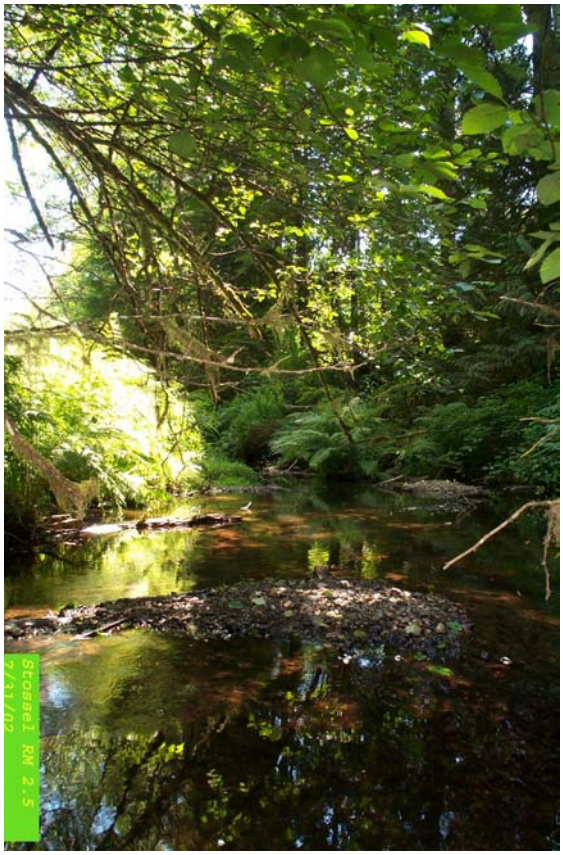


Photo ST9. Wooded reach with dense freshwater mussels

Photo ST10. Freshwater mussels

Photo ST11. Wetland valley with Spirea

Photo ST12. Freshwater mussel and wetland vegetation

Photo ST13. Bear tracks at RM 3.6

Photo ST14. Boulder in channel, RM 3.5

Photo ST15. Road crossing at RM 4.4

LANGLOIS CREEK (RM 0.0–2.2), AUGUST 12, 2002

OVERVIEW:

Langlois Creek (Map 7) drains a small area between the Tolt River and Griffin Creek, entering the Snoqualmie River at Snoqualmie RM 25.6. Langlois Creek might have drained directly into the Tolt River at one time, but is now cut off by levees along the lower Tolt. The creek flows through some rural residential land in its headwaters and mostly agricultural production district land downstream of RM 2.0. In general, the creek has a dearth of riparian vegetation and an excess of fine sediments.

Stream flow is ephemeral and partially subsurface during the summer. Wetlands located at RM 2.2 appeared stagnant and no fish were observed. There was no flowing water between these wetlands and the creek at RM 1.1. Therefore, the only reach of Langlois Creek that could be walked was the Snoqualmie River floodplain reach between the mouth of the creek and RM 1.1.

RM 0.0–1.1, SNOQUALMIE RIVER FLOODPLAIN

Reach Overview:

LWD: N/A, pools N/A

Langlois Creek had a very low gradient as it flowed across the Snoqualmie River floodplain. The substrate was composed of sand and fine silt, and the wetted width varied between 1.5 feet and 50 feet in places where the stream flowed across small wetlands. The riparian vegetation for the lowest 100 feet of the creek, where the creek flowed through the Snoqualmie River's riparian zone, was composed of reed canary grass with a canopy of alder, maple, and cottonwood. Aside from some evidence of beaver activity (see details in Site-Specific Observations), neither wildlife nor salmonid use were observed.

Upstream of the Snoqualmie River riparian zone, the riparian vegetation for Langlois Creek was mostly reed canary grass with very sparse trees. Upstream of SR 203, Langlois Creek entered a broad and deep wetland area that may have been a remnant channel of another river (Photo LA2).

From RM 0.7–1.0, there was some riparian canopy composed of maple, alder, and cottonwood, but the riparian vegetation remained predominantly reed canary grass and blackberry. Native plant re-vegetation of the streambanks throughout the reach could contribute to better winter rearing habitat for salmonids.

Site-Specific Observations:

A beaver dam was photographed at RM 0.1 (Photo LA1), and another collection of debris at RM 0.4 may have been created by beavers as well.

A small road crosses Langlois Creek at RM 0.4; SR 203 crosses at RM 0.6 where the blackberry and reed canary grass are particularly dense. There are two driveway crossings at RM 0.7. At RM 0.9, NE 24th Street crosses Langlois Creek but the culvert was not located. A deep, ponded area (Photo LA3) upstream of this road crossing was filled with threespine stickleback. A broad wetland continued upstream of this pond (Photo LA4).

At RM 1.1, Langlois Creek's flow became subsurface and therefore could not be followed any further (Photo LA5). Across this farm field, there was a dry streambed with 20-foot-tall blackberry bushes.

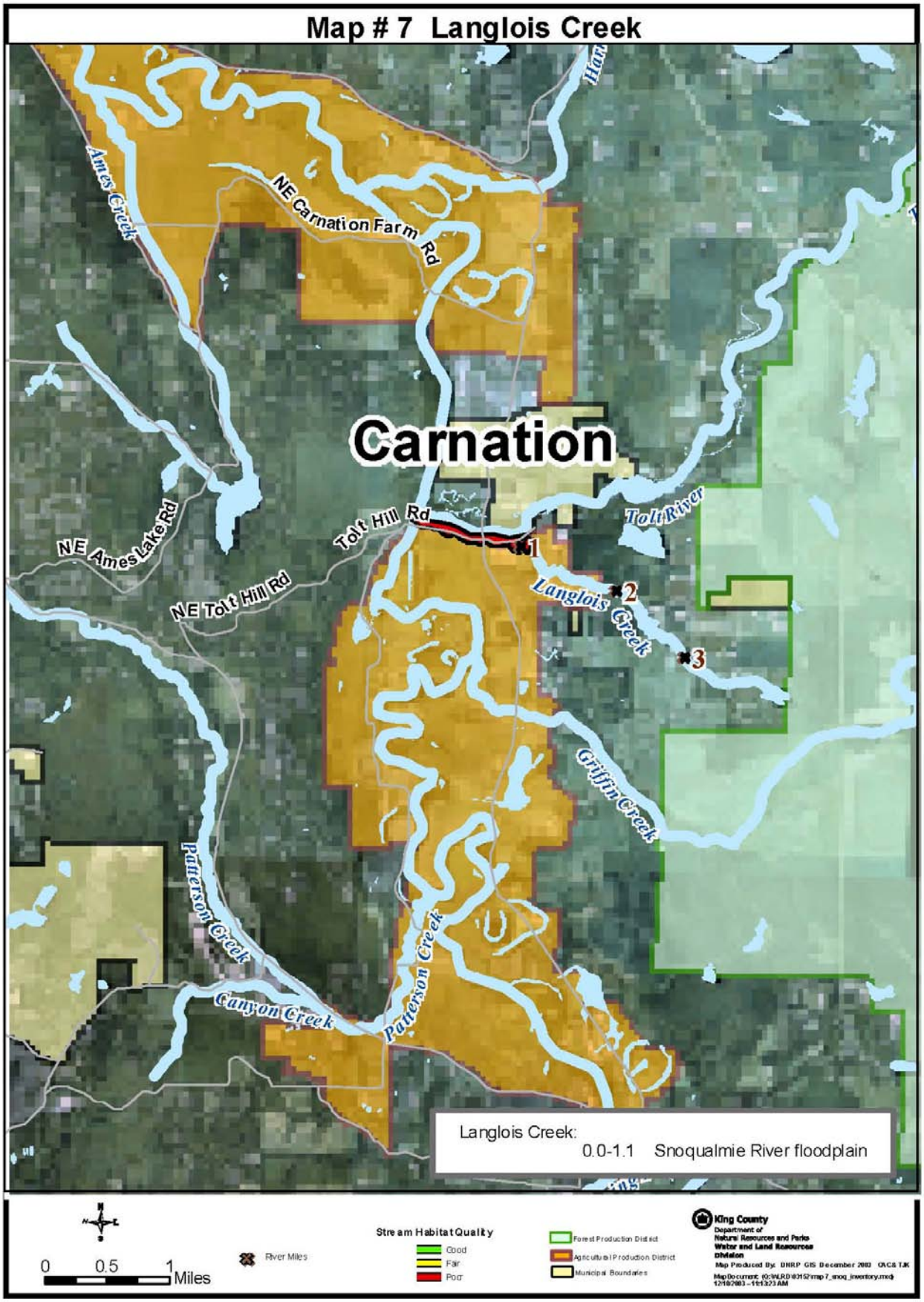

Map # 7 Langlois Creek
Carnation
Ames Creek
NE Carnation Farm Rd
NE Ames Lake Rd
Tolt Hill Rd
NE Tolt Hill Rd
Tolt River
Langlois Creek
Griffin Creek
Patterson Creek
Canyon Creek
1
2
3
Langlois Creek:
0.0-1.1 Snoqualmie River floodplain
0 0.5 1 Miles
River Miles
Stream Habitat Quality
Good
Fair
Poor
Forest Production District
Agricultural Production District
Municipal Boundaries
King County
Department of
Natural Resources and Parks
Water and Land Resources
Division

Photo LA1. Beaver dam near mouth of Langlois Creek.

Photo LA2. Wetland area at RM 0.6.

Photo LA3. Deep section with reed canary grass.

Photo LA4. Wetland area at RM 0.9.

Photo LA5. Where's the creek? RM 1.0

GRIFFIN CREEK (RM 0.0–3.0), JULY 10 AND SEPTEMBER 23–24, 2002

OVERVIEW:

Griffin Creek (Map 8) is a tributary to the Snoqualmie River, flowing into the Snoqualmie at RM 26.5. The headwaters of Griffin Creek and most of its watershed are in the Forest Production District. There are many wetlands associated with the headwaters, which may account for the creek's having the largest escapement of coho salmon of all tributary watersheds in WRIA 7. Some rural residential development in the lower few river miles, coupled with agricultural practices near the mouth, create the primary detriments to habitat in Griffin Creek. Logging practices in the headwaters result in a dearth of LWD and an overabundance of fine sediments, while sparse riparian buffers may not be adequately shading the creek in the forested areas.

RM 0.0–0.7, SNOQUALMIE RIVER FLOODPLAIN

Reach Overview:

LWD: 6 pieces, 4 pools

A 500 square foot pond was backed up behind the Snoqualmie River's natural levee at the mouth of Griffin Creek. This pond offered rearing habitat and refuge from high flows in the Snoqualmie River, and was filled with juvenile coho salmon and other undetermined species of fish. Although there were some rushes growing around this ponded area, the riparian vegetation was grazed to the soil by horses that had full access to the pond.

Between the pond and the SR 203 crossing (RM 0.7), Griffin Creek meandered across the floodplain. The riparian vegetation consisted of blackberries and an occasional mature tree. The wetted width was about 8 feet with a 20- to 30-foot OHW. The gradient was about 0.5%, and the substrate was pebble and gravel with a lot of fines. The streambed morphology was riffle/glide for most of this reach with only a few pools. Juvenile coho were observed throughout this reach.

Site-Specific Observations:

A small beaver dam was found at RM 0.3. A large pool was found at RM 0.5. Some LWD that was placed in a King County project at RM 0.6 had been washed downstream to several other locations. That project site included the planting of many immature native shrubs and trees.

RM 0.7–3.0, RURAL RESIDENTIAL DEVELOPMENT

Reach Overview:

LWD: 125 pieces, 24 pools

The stream gradient was 1% at the SR 203 crossing, then increased to 2% with occasional boulder runs up to 8%. The wetted width was 15 feet with a 30 foot OHW.

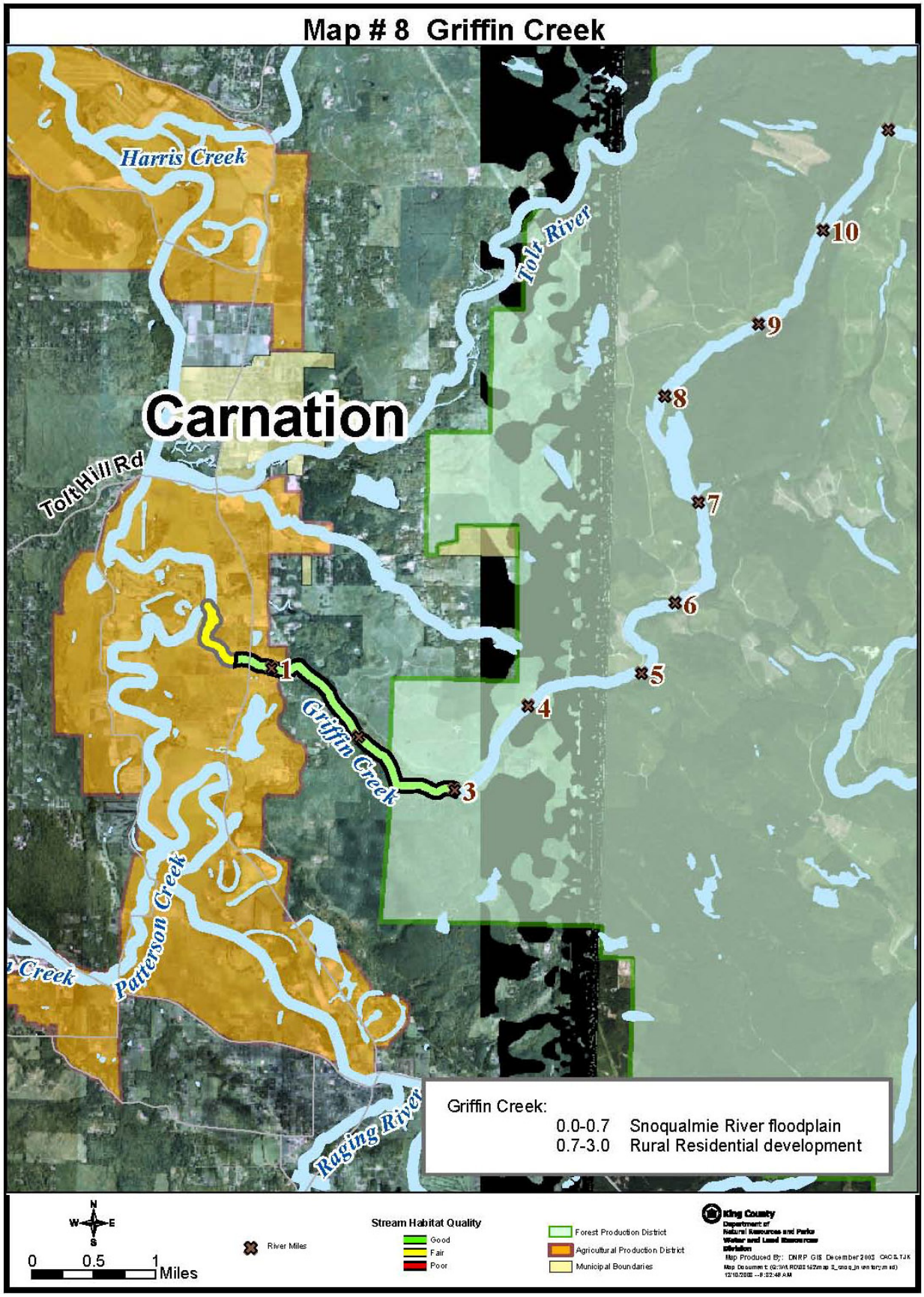
The substrate was gravel and pebble for half of this reach, and gravel and boulder for the other half (Photo GR1) with embedded fine sediments throughout. Additionally, the substrate was covered in algae for most of this reach. The channel morphology was riffle/glide with many pools, some of which were forced by LWD (Photo GR2). It appeared that several LWD placement projects had been implemented in this reach (Photo GR3); the wood in these projects comprised almost all of the LWD that was found

The riparian canopy was moderately dense from RM 0.7–1.5 and dense from RM 1.5–3.0. The canopy was composed of 70% alders and 30% conifers. The shrubs were mostly salmonberry and vine maple, with about 15% of the banks either mowed to the stream edge for a lawn or covered in blackberry, knotweed, or butterfly bush.

Juvenile coho were observed throughout this reach, along with occasional sculpin and crawfish. Caddisflies were abundant throughout, and mayflies were seen in many locations. Deer tracks were observed in several locations. Residents of the area said that they have seen cougar and bear in Griffin Creek.

Site-Specific Observations:

Although there were homes along Griffin Creek through this whole reach, the banks were hardened with riprap along only RM 0.8 – 0.9. The water temperature of 15°C (59°F) at RM 0.8 on July 10, 2002 exceeded the optimal range for salmonid rearing (Bjornn and Reiser, 1991)


Map # 8 Griffin Creek
Harris Creek
Tolt River
Carnation
Tolt Hill Rd
Griffin Creek
Patterson Creek
Raging River
1
3
4
5
6
7
8
9
10
Griffin Creek:
0.0-0.7 Snoqualmie River floodplain
0.7-3.0 Rural Residential development
N
W
E
S
0 0.5 1 Miles
River Miles
Stream Habitat Quality
Good
Fair
Poor
Forest Production District
Agricultural Production District
Municipal Boundaries
King County
Department of Natural Resources and Parks
Water and Land Resources Division

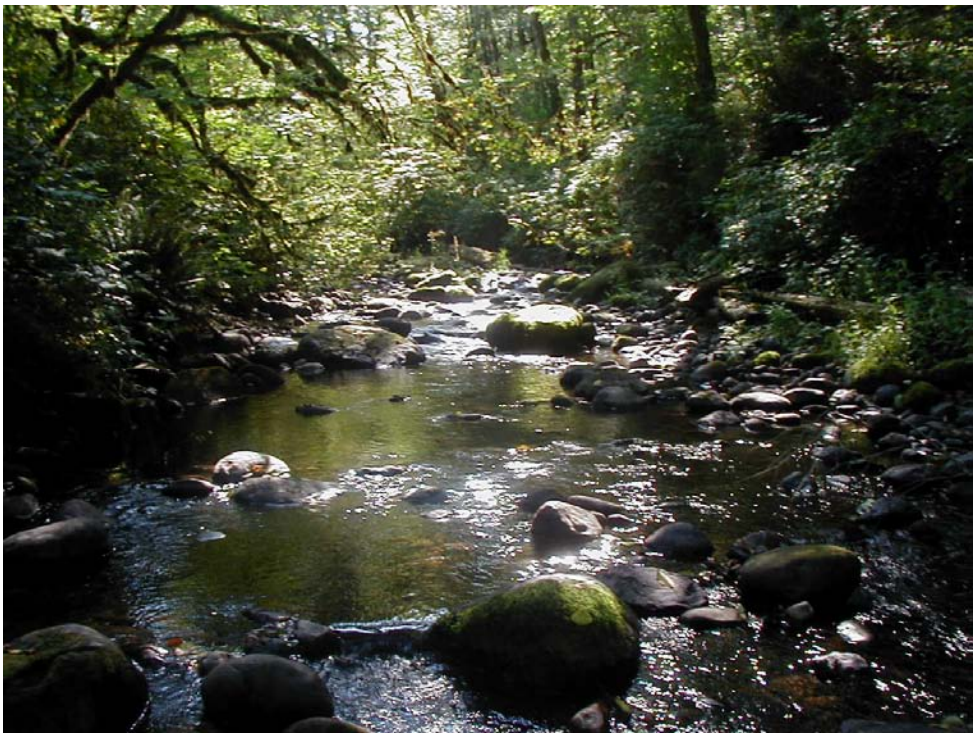


Photo GR1. Wooded reach with boulder substrate, RM 2.2.

Photo GR2. Pool at RM 2.4.

Photo GR3. Engineered LWD jam at RM 2.7.

PATTERSON CREEK (RM 0.0–10.1), AUGUST 14–15, AUGUST 19–21, AND AUGUST 27, 2002

OVERVIEW:

Patterson Creek (Map 9) is a low gradient tributary to the Snoqualmie River that flows into the Snoqualmie at RM 30. Patterson Creek is prone to flooding, and has endured decades of dredging to control flooding and to drain the valley floor for development and agriculture. The watershed of Patterson Creek is currently experiencing a tremendous amount of development, particularly in the headwaters.

RM 0.0–1.9, SNOQUALMIE RIVER FLOODPLAIN

Reach Overview:

LWD: 12 pieces, 0 pools

Patterson Creek flows across the Snoqualmie River floodplain at its mouth and under SR 202 at RM 1.9. The creek was entrenched into a narrow and deep channel through this reach. The substrate was silty. The riparian vegetation was primarily reed canary grass and some invasive shrubs such as blackberry. Some localized reaches of the stream had a canopy of alder and willow. LWD was sparse.

RM 1.9–3.0, PATTERSON CREEK FLOODPLAIN

Reach Overview:

LWD: 0 pieces, 0 pools

Patterson Creek followed SR 202, flowing within 100 feet of the roadway throughout this reach. The creek was straight and deeply entrenched (Photo PA1). The substrate was predominantly silt with patches of gravel and pebble. The shallowest water was only 2.9 feet in depth; in other locations the water was too deep to measure. At RM 2.9 the flow was subsurface. The wetted width was approximately 10 feet, and the OHW was 24 feet wide.

There was a thin line of immature trees on the LB of this reach between the creek and SR 202, in some places as much as 20 feet away from the bank. These trees were 90% alder and 10% maple. Shrubs were reed canary grass and blackberry. In several places, the stream appeared to be choked by reed canary grass.

Water temperature was 12°C (53.6°F) on August 20, 2002. This temperature is within the range that is optimal for salmonid rearing (Bjornn and Reiser, 1991). Coho fry were observed at RM 2.3.

Site-Specific Observations:

There are road crossings at RM 2.2, 2.5, and 2.9 (Photo PA2). A culvert on the RB at the Duthie Hill Road crossing (RM 2.5) had water that was noted as "very cold, aches to walk in." This was likely groundwater seeping into Patterson Creek.

RM 3.0–8.3, WETLAND VALLEY

Reach Overview:

LWD: 1 piece, 1 pool

Patterson Creek flowed through a low gradient valley wetland in this reach. Agriculture was predominant in this valley, but residential development pressure was intense in the upland areas.

The wetted width of the creek was 4–6 feet. The water depth varied from 6 inches to as much as 5 feet (Photo PA3). Silt dominated the substrate.

Invasive plants, especially reed canary grass and yellow iris (Photos PA4–PA5), were very dense in this reach of Patterson Creek. Some willows were observed, but very few native plants existed. LWD was absent. Nevertheless, coho fry were observed throughout the reach.

Site-Specific Observations:

Standing water was observed in the valley at RM 5.2. Homeowners on 276th Avenue NE informed the field technicians that the street floods frequently, and has been covered with as much as 14 feet of water.

There were six road crossings in this reach, at RM 4.2, 4.6, 5.0, 5.8 (Photo PA6), 6.5, and 6.9.

Beaver activity was noted at RM 5.2 and 8.2.

RM 8.3–10.1, RESIDENTIAL

Reach Overview:

LWD: 108 pieces, 1 pool

In this upper reach, Patterson Creek flowed through residential land with a gradient of 2–5%. Flow was subsurface at times (Photo PA7). Land development in this area had forced the creek through several culverts, some of them perched, as roads crossed the creek.

Coho fry were abundant in pockets of water at RM 8.9 and observed all the way upstream to RM 10.1. A few 4–5 inch trout were observed in deeper pockets of water. Raccoon and deer tracks, a large red-headed woodpecker, and crawfish were observed in this reach. Caddisflies observed here were very small; they may have been *Glossosoma* species or may have been early instar stages from larger species.

With the exception of occasional blocked culverts and some water withdrawal pumps, this reach was described as looking "very healthy and natural" (Photo PA8). LWD was abundant.

Channel width was 8–12 feet wide, and the substrate was gravel dominant and pebble subdominant. The creek was shaded with a canopy of maple, alder, and conifer. Shrubs were native, mostly salmonberry. The stream was somewhat entrenched, with bank slopes of 100% in places.

Site-Specific Observations:

Residents at a house at RM 8.6 explained that their driveway over Patterson Creek was washed out recently when the culvert underneath it plugged up. They had installed a temporary bridge and were waiting for the permits to install a permanent bridge (Photo PA9). A 60-foot-long blown-out culvert was resting in the creek at RM 9 (Photo PA10); the original location of this culvert was unclear. A perched culvert at RM 9.7 was a barrier to coho fry migration. A plunge pool at the downstream end of this culvert was 15 feet long and 9 feet wide. This was the only pool observed in this uppermost reach of Patterson Creek.

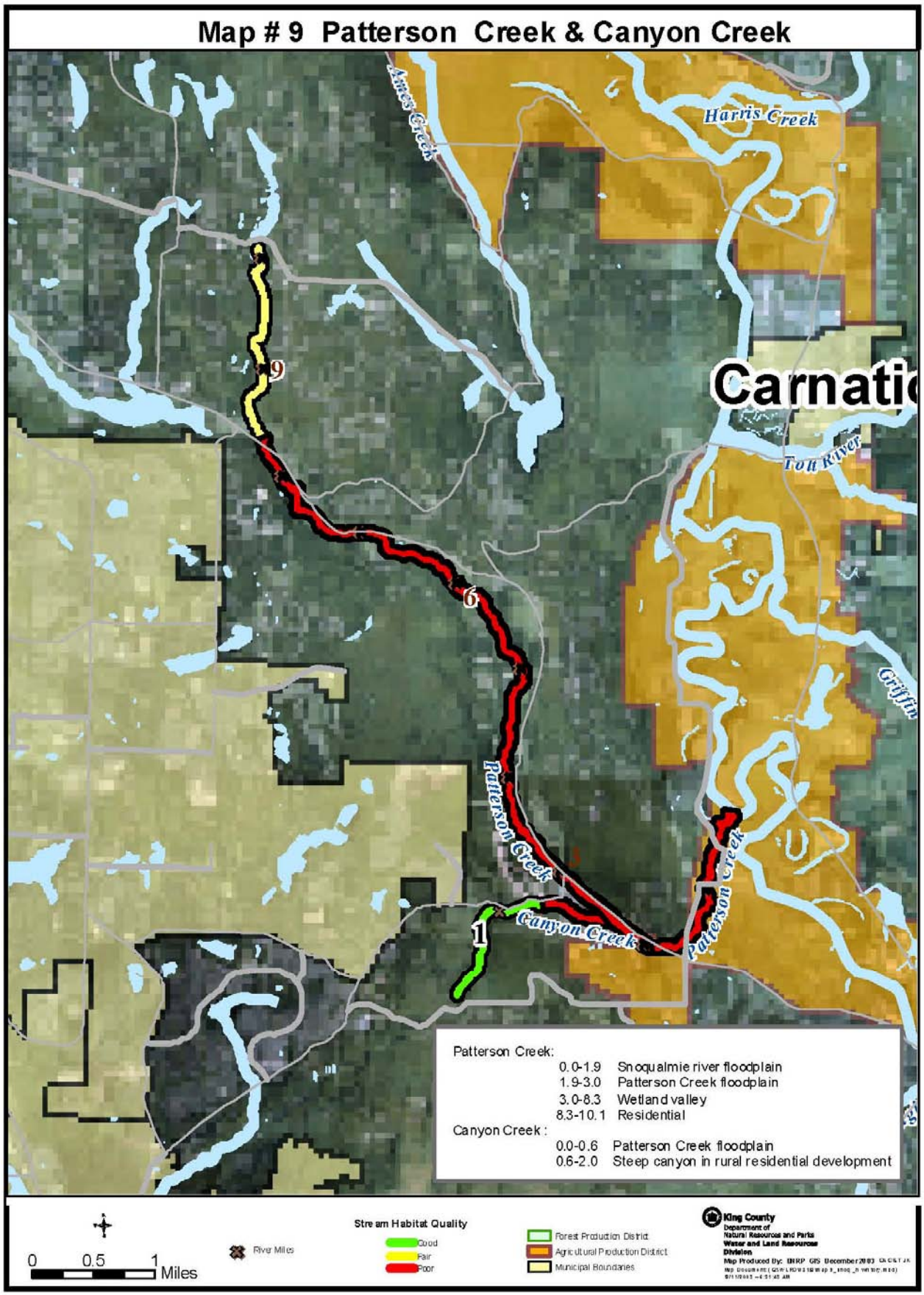

Map # 9 Patterson Creek & Canyon Creek
Ames Creek
Harris Creek
Carnati
Tolt River
Griffin
Patterson Creek
Canyon Creek
Patterson Creek
9
6
3
1
Patterson Creek:
0.0-1.9 Snoqualmie river floodplain
1.9-3.0 Patterson Creek floodplain
3.0-8.3 Wetland valley
8.3-10.1 Residential
Canyon Creek:
0.0-0.6 Patterson Creek floodplain
0.6-2.0 Steep canyon in rural residential development
0 0.5 1 Miles
River Miles
Stream Habitat Quality
Good
Fair
Poor
Forest Production District
Agricultural Production District
Municipal Boundaries
King County
Department of Natural Resources and Parks
Water and Land Resources Division
Map Produced By: DNRP GIS December 2003

Photo PA1. Patterson Creek floodplain.

Photo PA2. Road crossing at RM 2.9.

Photo PA3. Reed canary grass dominates the Patterson Creek floodplain, RM 6.9.

Photo PA4. Invasive plants choke Patterson Creek at RM 6.9.

Photo PA5. Deep pool at RM 5.0.

Photo PA6. Road crossing at RM 5.8.

Photo PA7. Sub-surface flow at RM 8.9

Photo PA8. Healthy riparian vegetation at RM 9.4.

Photo PA9. Temporary bridge over driveway at RM 8.6.

Photo PA10. Old culvert rotting in the creek, RM 9.4.

CANYON CREEK (RM 0.0–2.0), AUGUST 20–21, 2002

OVERVIEW:

Canyon Creek (Map 9) is a tributary to Patterson Creek, flowing into it from the Issaquah Plateau at Patterson's RM 2.4. Historically, coho salmon have spawned and reared in Canyon Creek. Many coho fry were observed during the stream walk. However, current development pressure in the watershed may be impacting Canyon Creek, especially in the lower reach.

RM 0.0–0.6, PATTERSON CREEK FLOODPLAIN

Reach Overview:

LWD: 1 piece, 2 pools

The streambed morphology in this lower reach was riffle/glide and the wetted width was 8–10 feet with a 24-foot OHW. Two deep pools were observed in this reach. The substrate was pebble and gravel of good quality for coho spawning (Photo CA1).

However, Patterson Creek's invasive weeds inundated Canyon Creek (Photo CA2). The riparian vegetation was exclusively reed canary grass and blackberry, except for some restoration plantings at RM 0.1. Because of the degraded riparian vegetation, the overall habitat quality was rated as poor (see Table 1 in the Conclusions Section).

Site-Specific Observations:

Canyon Creek flowed through a golf course between RM 0.2–0.6. A LB tributary that flows through the golf course at RM 0.2 was dry; an old redd was noted at RM 0.2. Bridges for golf carts crossed the stream at RM 0.2 and 0.3, and twice at RM 0.4. Fish ladders were observed at RM 0.4 and 0.5 (Photo PA3).

RM 0.6–2.0, STEEP CANYON IN RURAL RESIDENTIAL DEVELOPMENT

Reach Overview:

LWD: 182 pieces, 24 pools

Canyon Creek flowed through a steep canyon with abundant wildlife, coho fry, and trout. Reed canary grass was observed up to RM 0.7, but only in sparse quantities. The riparian shrubs through this reach were salmonberry, vine maple and devils club. The canopy was closed throughout this reach and was mostly alder with some maples. Overall, the riparian vegetation in this reach was excellent (Photo CA4).

Many old coho redds were observed. Cutthroat trout were observed in a couple of pools, and caddisflies were noted as occurring everywhere. Deer tracks were also ubiquitous.

The substrate was gravel dominated. The gradient through this reach was about 2%, with small reaches up to 5%. In the steeper reaches, the substrate included large boulders.

Site-Specific Observations:

Riprap along the LB at RM 0.8 was protecting an old logging road (Photo CA5). Bear tracks were observed on the RB at RM 1.3. The presence of a silt fence along the LB at RM 1.3 indicated that land development and/or logging activity were occurring in the basin (Photo CA6). Just upstream of the silt fence was a wooden footbridge (Photo CA7). Some stream braiding at RM 1.4 had built up gravel bars.

Some clay hardpan was noted in the RB at RM 1.5 and 1.7, indicating stream scour during high flow events. At RM 2.0, Canyon Creek flows under SE Issaquah-Fall City Road (Photo CA8). Many coho fry were observed in the pool under this culvert.

Photo CA1. Spawning gravel, RM 0.1.

Photo CA2. Reed canary grass in Canyon Creek, RM 0.1.

Photo CA3. Fish ladder at RM 0.4.

Photo CA4. Healthy riparian vegetation at RM 1.5.

Photo CA5. Rip rap at RM 0.8.

Photo CA6. Silt fence, RM 1.3.

Photo CA7. Foot bridge, RM 1.3.

Photo CA8. Culvert under SE Issaquah-Fall City Rd, RM 2.0.

RAGING RIVER (RM 0.0–11.0), SEPTEMBER 11–13, 2002

OVERVIEW

The Raging River (Map 10) flows out of forested timberlands, through rural residential properties and the towns of Preston and Fall City; and then joins the Snoqualmie River at Snoqualmie RM 34.9. Most of the Raging River has a steep gradient with cobble substrate that is coated with a slippery algae. The bedload appeared to be dynamic with scouring and depositing of sediments evident everywhere. This may be a natural condition, the result of over-sedimentation from logging practices in the headwaters, or altered hydrology from the development in the basin.

RM 0.0–1.3, URBAN DEVELOPMENT AND CONTAINMENT LEVEES

Reach Overview:

LWD: 4 pieces, 0 pools

The Raging River is confined in a narrow channel between containment levees for the lowest 1.3 river miles before its confluence with the mainstem Snoqualmie River. The levees are approximately 60 feet apart, and the wetted width ranged from 10 to 60 feet

Accumulation of sediment in this reach has resulted in aggradation of the riverbed so that the channel is several feet higher in elevation than the surrounding land. The substrate in the channel was cobble and gravel embedded with fines, and gravel bars were built up as much as five feet above the channel.

Although the habitat reconnaissance was conducted during summer low flow conditions, the river flow was too swift as the wetted stream navigated around the tall gravel bars to provide much rearing habitat for fish. Riparian vegetation throughout this reach was very poor and was dominated by invasive shrubs; however tall, mature cottonwoods aligned the RB and provided some shade. There was very little LWD or other types of cover in this reach.

Site-Specific Observations:

At RM 0.2, there was a terrace with cobbles as large as 10 inches in diameter. Juvenile coho and trout fry were observed in a long glide at RM 0.3.

The Preston-Fall City Road crosses the Raging River over a bridge at RM 0.4. Sediment under one span of the bridge had accumulated up to 10 feet below the bridge, indicating that there is inadequate space under the bridge for high flow events.

There was evidence of beaver activity between RM 0.4–0.8. A small woody debris jam at RM 0.6 was created by a beaver and included one small channel-spanning piece of wood (Photo RA1). A property owner on the LB expressed some concerns about the woody debris but the field technicians assured him that any high flow would knock out the jam.

At RM 1.1, the LB levee was 8–10 feet in height and very steep, spilling riprap into the channel. Logs with rootwads were chained into this portion of the levee.

RM 1.3–8.0, RURAL RESIDENTIAL

Reach Overview:

LWD: 321 pieces, 15 pools

Three roads run alongside or near the Raging River in this reach: Preston-Fall City Road (RM 1.3–4.7), Interstate 90 (RM 4.7–6.1), and Upper Preston Road (RM 4.0–7.9). Road crossings are frequent. The proximity of these roads suggests a potential ongoing source of stormwater runoff that could transport sediment, nutrients, and other pollutants to the river, thereby impairing water quality.

Between RM 1.3 and 2.0, the riparian vegetation was of better quality than in the most downstream reach (RM 0.0–1.3) (Photo RA2). There were mature conifers, deciduous trees, and dense shrubs on both banks, although invasive shrubs such as English ivy and Japanese knotweed were still frequent. Upstream of RM 2.0, the riparian vegetation was patchy, with predominantly immature or sparse trees due to the frequency of homes and road crossings. The riparian shrubs were dense where there were no homes and cleared for yards where houses were present. The shrubs were mixed invasives and some natives such as salmonberry and vine maple. The upstream extent of budlea (butterfly bush) invasion was at RM 5.0 and the farthest upstream sighting of Japanese knotweed was at RM 7.4.

Homes along the river were very close to the banks (Photo RA3); some homeowners have built revetments to protect their properties from flooding and erosion. Riparian vegetation was completely cleared from some yards (Photo RA4). Others had lawns that were contained to small areas; therefore, mature trees and native shrubs were still present.

The occasional exposure of hardpan along the banks throughout this reach is evidence of the occurrence of high scour events. LWD was not abundant; it might have been cleared by residents or moved downstream during high flows.

A resident near a bridge crossing at RM 7.5 informed the field technicians that the Washington Department of Fish and Wildlife releases steelhead smolts into the Raging River at that bridge. Juvenile coho and old redds were observed throughout this reach. The juvenile fish preferred glide habitat to the infrequent pools. Sculpin, suckerfish, dace, and trout were also observed in this reach, as were caddisflies, mayflies, and stoneflies. Deer and beaver were abundant.

Site-Specific Observations:

A water withdrawal pipe led to a house on the RB at RM 1.6. At RM 1.6, there was a large deposit of sorted gravel that looked like good spawning habitat.

Riprap was patchy from RM 1.4 – 1.6, but was then continuous to RM 2.0. At RM 1.8, very steep riprap was protecting a road on the RB and dumping rocks into the river.

A bridge crossing at RM 2.0 has a very narrow base of approximately 30 feet from toe to toe, which is inadequate space to provide suitable fish passage at higher flows. A long delta of 8–10 inch rocks had built up about 100 feet upstream of the bridge, indicating that the bridge backs up water at high flows.

Between RM 2.0 and 2.3, the Raging River flows through a narrow box canyon with rock walls that are 30 feet high on each side. The gradient was moderately steep through the canyon. There were no homes in this reach. The riparian vegetation was composed of dense, mature trees and native shrubs; the shrubs were sparse because the banks are predominantly bedrock. Two large pools were found in the box canyon; one of the pools was at least four feet deep. Summer rearing conditions for salmonids were

excellent, but flows through the narrow canyon might be too swift for over-wintering habitat. An abandoned footing from an old railroad bridge at RM 2.3 had scoured a deep and long pool at the base of the pilings. The channel was split around a gravel bar upstream of the pilings. The box canyon was naturally constraining the channel, and the bridge footings constrained it even more. The resulting gravel bar was six feet high with an accumulation of wood on the upstream side. There were many juvenile coho salmon in the smaller of the channels around the gravel bar. The bigger channel was very steep with a swift flow.

Immediately upstream of the gravel bar at RM 2.4, a long glide with a wetted width of 35 feet appeared to provide good fish habitat. Smaller side channels at RM 2.4 and RM 3.6 were being used by juvenile coho. Large caddisflies, some chironomids, and mayflies were observed along with raccoon prints at RM 3.4. Redds were observed at RM 3.5.

Several dead dace had been observed in the Raging River when it was walked on August 28, 2001 (Solomon and Boles, 2002). From RM 3.4–4.4, the river smelled increasingly of diesel fuel. The frequency of dead fish increased with the intensity of the diesel odor until RM 4.4 when both the diesel odor and the dead dace sightings stopped. Diesel fuel may be seeping into the river from the old Preston Mill.

In the summer of 2002, a large slide on the RB at RM 3.7 was estimated to be 8–10 years old by the approximate age of the alders growing on the slide deposit. This slide is located near the mouth of Icy Creek, which was contributing a lot of fine sediments to the Raging River. Upstream of the slide, the gravels were embedded with noticeably fewer fines. Overall, the substrate was gravel with fines downstream of this slide (Photo RA5), and gravel and boulder upstream of this slide. At RM 3.9, the river appeared to be cutting through a terrace, which may have been deposited by sediment from landslides.

Water was leaking from a pipe that bridged the river at RM 6.0; the pipe appeared to have a lot of flow through it. The source of the water may have been a small tributary on the RB.

At RM 6.2, the channel appeared to have been dredged and was cut down to bedrock.

At RM 7.5, riprap that was five feet tall was found on both banks and restricted the channel to a 45-foot-wide OHW. This channel geometry creates dangerously swift water for fish during high water events.

A logjam at RM 7.8 accounted for almost all of the observed LWD in this reach of the Raging River. The logjam was nearly 0.1 mile long, and was the result of a major failure on the LB. Several excellent pools were associated with the LWD in this reach; this was the best fish habitat observed in the Raging River.

RM 8.0–11.0, UNDEVELOPED TIMBER PROPERTY

Reach Overview:

LWD: 310 pieces, 67 pools

Native riparian vegetation was found throughout this reach, except for some reed canary grass at RM 10.2. Shrubs were mostly salmonberry and vine maple, with alder, maple, and conifer trees. The trees were dense and tall on the RB from RM 8.0–9.9 except for 0.1 mile between RM 9.2–9.3, and on the LB from RM 8.0–8.7 and 9.7–9.9. Between RM 8.7–9.7, trees had been cleared up to the river’s edge.

Above RM 9.9, the riparian vegetation was patchy due to logging activity right up to the streambanks in some places. Either the trees had been totally cleared or immature trees had been planted in place of the mature trees that were harvested.

The wetted width of the channel was mostly 20–30 feet, with OHW at 40–60 feet except at RM 10.6 and 11.0 where the OHW was constrained to approximately 25 feet. The morphology changed from riffle-glide in the lower gradient portions, to high gradient riffle and step-pool. The gradient ranged from 4% up to 15%. The substrate was mostly boulder, with some reaches of gravel in the riffle-glide habitats.

The water temperature was 12°C (53.6°F) when this forested reach was surveyed on September 13, 2002. Juvenile coho and old redds were observed throughout the length of the reach. Some of the redds were found in substrate that was larger than optimal for coho spawning. Trout and benthic invertebrates were also abundant. Beaver activity was observed in several locations, but there were not any other signs of wildlife. Overall this upper reach had healthy aquatic habitat and was biologically productive.

Site-Specific Observations:

LWD jams with associated pools were noted at RM 8.5, 9.5, 9.9, 10.5, and 10.8. The logjam at RM 8.5 included a piece of old growth timber. The channel was split around gravel bars at RM 8.7, 8.8, 9.5, and 9.9. These gravel bars created smaller channels that offer good high flow refuge. At RM 11.0, the stream entered a canyon with steep rock walls on each side. The gradient was very high through the canyon.

Old railroad tracks and logging cable were abandoned in the river at RM 9.6. It was not clear where the railroad used to be.

Some hardpan exposed at RM 9.9 indicated that this upper reach was also prone to high scour events.

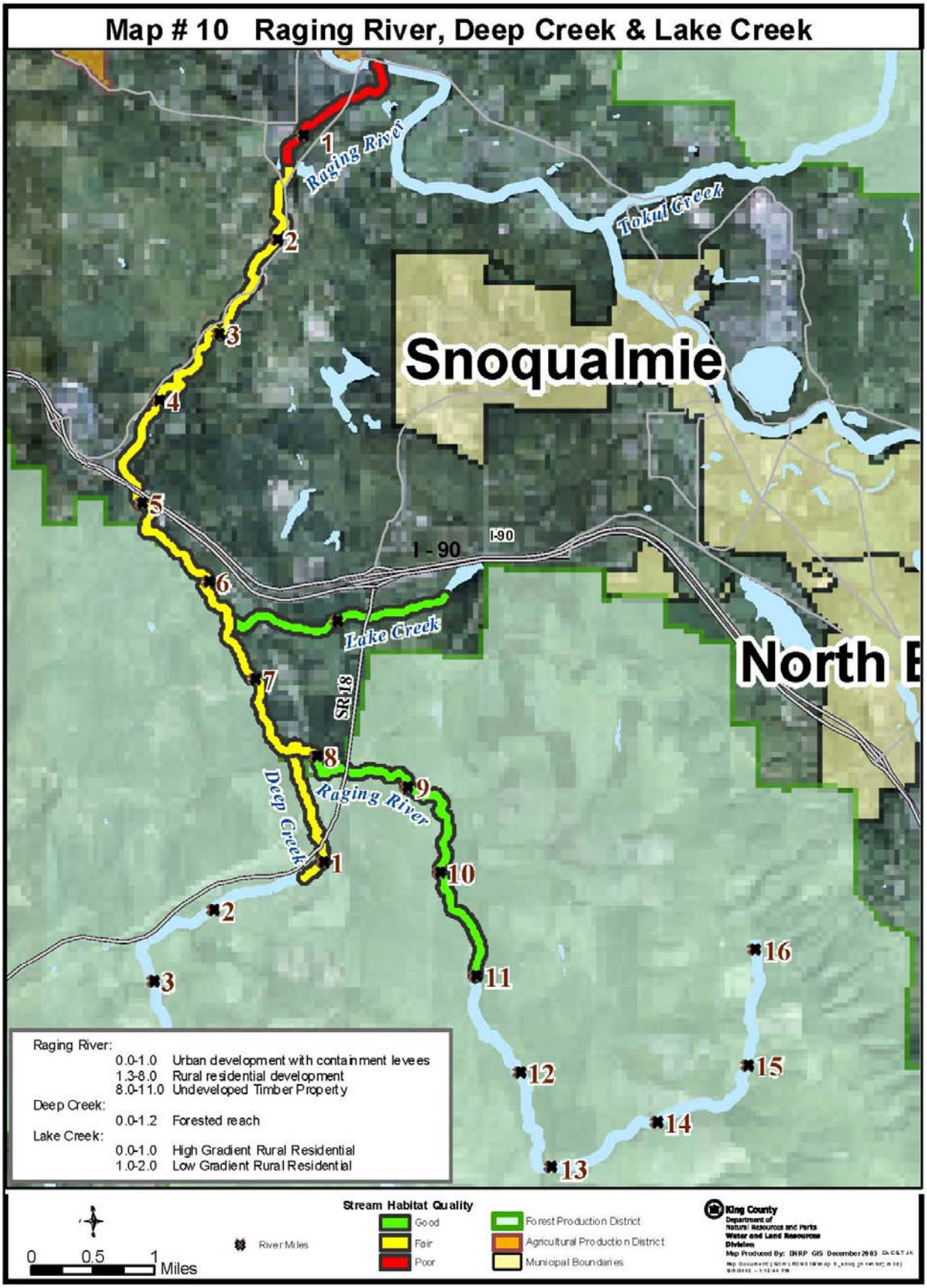

Map # 10 Raging River, Deep Creek & Lake Creek
Raging River
Tokul Creek
Snoqualmie
I - 90
I-90
Lake Creek
North B
SR 18
Deep Creek
Raging River
Raging River:
0.0-1.0 Urban development with containment levees
1.3-8.0 Rural residential development
8.0-11.0 Undeveloped Timber Property
Deep Creek:
0.0-1.2 Forested reach
Lake Creek:
0.0-1.0 High Gradient Rural Residential
1.0-2.0 Low Gradient Rural Residential
0 0.5 1 Miles
River Miles
Stream Habitat Quality
Good
Fair
Poor
Forest Production District
Agricultural Production District
Municipal Boundaries
King County
Department of Natural Resources and Parks
Water and Land Resources Division
Map Produced By: DNRP GIS December 2003

Photo RA1. Log felled by beaver at RM 0.6.

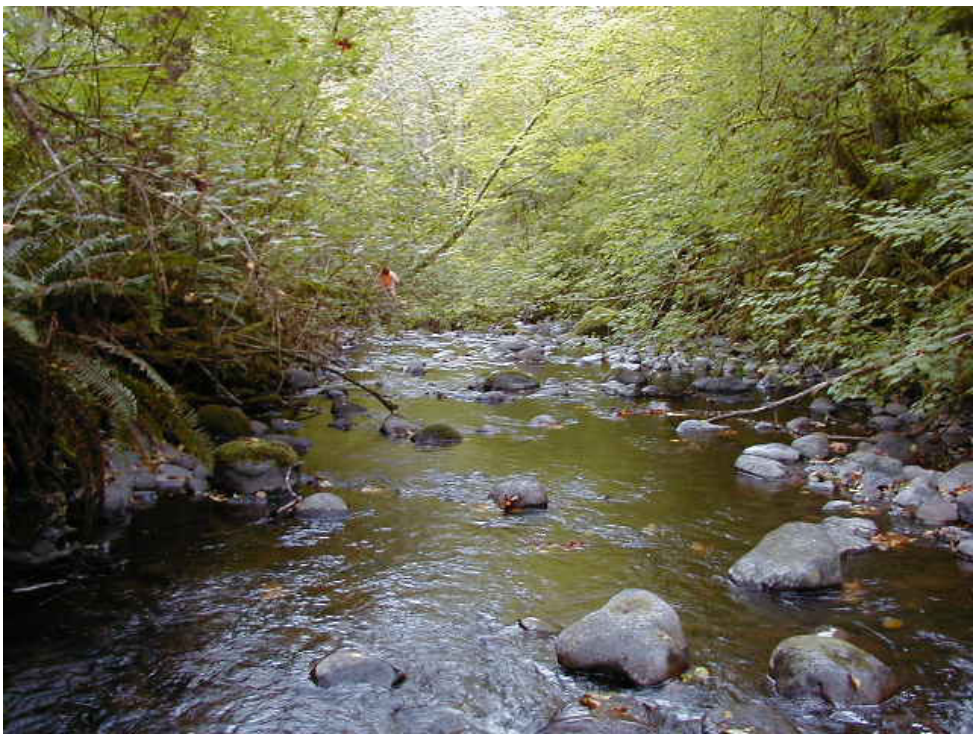


Photo RA2. Healthy riparian vegetation.

Photo RA3. Home perched on left bank.

Photo RA4. Home with cleared riparian vegetation.

Photo RA5. Unsorted gravels.

DEEP CREEK (RM 0.0–1.2), SEPTEMBER 11, 2002

RM 0.0–1.2, FORESTED REACH

Reach Overview:

LWD: 209+ pieces, 38 pools

Deep Creek (Map 10) flows north from Tiger Mountain through forested lands until its confluence with the Raging River at Raging RM 7.7. From the mouth of Deep Creek to RM 1.2, the gradient ranged between 3–5%. The channel morphology was high gradient riffle and pool, with a gravel and pebble substrate and some exposed hardpan and boulders at RM 0.1. The wetted width near the mouth of the creek was 20 feet with a 40 foot OHW. Upstream of RM 0.2, the wetted width was 8–10 feet with a 16-foot OHW.

The riparian canopy was complete through most of the reach and was composed of alder and conifers. The riparian shrubs were all native; salmonberry, vine maple, and devils club were the predominant species. The stream was well shaded by the canopy. The shading likely contributed to the water temperature of 11°C (51.8°F). Additionally, the water was clear.

LWD was abundant and several functioning logjams were observed with large pools associated with them. Two high quality logjams were observed at RM 0.4 and another one was observed at RM 0.8. At RM 1.0, there was more LWD than could be counted. Some of the LWD at this location was comprised of old growth timber.

Coho fry were observed throughout the reach, along with sculpin and trout. In particular, fish were associated with the LWD-scoured pools and a pool under the Highway 18 culvert. Caddisflies were abundant throughout the reach. Deer, cougar, and raccoon tracks were observed as well.

Site-Specific Observations:

There are three homes along Deep Creek between RM 0.0 and 0.1. The two homes on the RB were pumping water from the creek. A bridge just upstream of the mouth provides access to the house on the LB.

Power lines cross Deep Creek at RM 0.5. A horse trail crosses the creek at this location and the banks were mowed to the edges of the creek for fully 0.1 mile. Eagle feathers and a partial carcass were found under the power lines. At RM 0.9, the creek was logged to the banks and some trees that had been retained as a riparian buffer were blown down. Deep Creek flows through a perched culvert under Highway 18. Based on the height that this culvert was perched, the field technicians estimated that this culvert is a barrier to juvenile salmonids, but probably not a barrier to adult coho migration. The culvert had internal weirs to slow water flow and assist fish passage. A pool formed under the culvert was very deep and surrounded with cement bags to protect the banks from scour. More than 30 trout at least 8 inches long and many juvenile coho were observed in the pool.

LAKE CREEK (RM 0.0–2.0), AUGUST 27, 2002

OVERVIEW:

Lake Creek (Map 10) is two miles long and flows west from Echo Lake into the Raging River at Raging RM 6.2. Interstate 90 is located less than 0.5 mile north of the whole length of Lake Creek. There is rural residential development throughout most of Lake Creek's watershed. The riparian shrubs and trees that were observed in the summer of 2002 were mature, and predominantly composed of native species. Many juvenile coho and adult coho carcasses and many crawfish were observed throughout this creek. The water was very clear. Overall stream habitat conditions were very healthy.

RM 0.0–1.0, HIGH GRADIENT RURAL RESIDENTIAL

Reach Overview:

LWD: 379 pieces, 65 pools

This reach of Lake Creek was canyon-like in appearance. The channel morphology was riffle-glide-pool. The gradient ranged from 1–3%, and the substrate in the lower half of the reach was gravel and pebble with many boulders. The wetted width was 6–8 feet, with a 12–15 foot OHW. The upper half of this reach had a wetted width of 4–8 feet, with a 10-25-foot OHW. The substrate was mostly gravel and cobble, with some boulders.

Although there are homes throughout the lower mile of Lake Creek, the riparian vegetation was healthy with complete canopy composed of alder, maple, cottonwood, conifers, and native shrubs. Between RM 0.4 and 0.5, the shrubs included salmonberry, vine maple, devils club and some blueberries. Many coho smolts and crawfish were observed.

Site-Specific Observations:

There was a tributary on the LB at RM 0.2, and a house on the RB opposite the tributary. Upper Preston Road SE crosses Lake Creek at RM 0.3. There were two houses on the LB at RM 0.4.

A cougar track was found at RM 0.6. The gradient between RM 0.6–0.8 ranged from 2–3%. The substrate at RM 0.9–1.0 contained large boulders. Here the wetted width was 7 feet and the OHW was 20 feet.

RM 1.0–2.0, LOW GRADIENT RURAL RESIDENTIAL

Reach Overview:

LWD: 29 pieces, 6 pools

Lake Creek was not walked between RM 1.4–1.7 because a landowner complained that the field technicians were trespassing and asked them to leave his property. For the 0.7 mile that was walked, the

substrate was predominantly gravel and pebble, with a gradient of 0.5–1.0%. Alder was the most frequently occurring deciduous tree.

Site-Specific Observations:

An old bridge, possibly a logging bridge, crosses Lake Creek at RM 1.1. The riparian canopy began to open up at this location. There was a long, deep glide at RM 1.2 that had coho fry and a 6–inch trout.

Highway 18 crosses Lake Creek over two culverts at RM 1.3. Downstream of the culverts was a knee-deep pool with coho fry, crawfish, and an 8-inch trout.

At RM 1.7, a culvert under 348th Avenue SE was perched two inches on its lower end. There was a large pool at the base of the perched culvert. The riparian vegetation was very brushy with some skunk cabbage. Many coho fry were observed in the creek.

Between RM 1.8 and 2.0, the riparian canopy was composed of 95% conifers and 5% deciduous trees, most of which were alder. The riparian shrubs were vine maple and salmonberry. The stream flow was very low and the gradient was 2%. Coho fry were observed all the way up to Echo Lake. The substrate was predominantly silt, with some pebbles. The wetted width was 3 feet and the OHW was 10–12 feet.

There were houses on the RB at RM 1.8 and RM 2.0. There was a broken pipe of undetermined purpose at RM 1.9 on the RB; no visible discharge was observed. There are two bridge crossings in this area: an 8-foot wide bridge at 350th Avenue SE at RM 1.9 and a wooden bridge at RM 2.0.

TOKUL CREEK (RM 0.0–1.4), SEPTEMBER 24–25, 2002

RM 0.0–1.4, ANADROMOUS FISH-BEARING REACH

Reach Overview:

LWD N/A, pools N/A

Tokul Creek (Map 11) is a direct tributary to the Snoqualmie River that enters the Snoqualmie at Snoqualmie RM 38. Except for the lowest 0.5 RM, Tokul Creek flows through undeveloped Forest Production District. A natural barrier at river mile 1.4 excludes most of this watershed to anadromous fish migration. Within this 1.4-mile reach, there are several ongoing hillslope failures on the LB; the most significant failure occurs at RM 0.3. A revetment along the RB from RM 0.5 to the mouth has deflected the flow against the LB, undermining the stability of that bank. This revetment protects a Washington Department of Fish and Wildlife (WDFW) fish hatchery. The landslide at RM 0.3 adversely affects habitat quality and fish access to Tokul Creek. Another major slide in this reach occurred at RM 0.5 and was caused by a previous bridge crossing of SR 202 that is just downstream of the current SR 202 crossing.

Access to Tokul Creek from the mouth to just upstream of the slide at RM 0.3 was not possible because the area was too dangerous to walk. Some photos of the slide area that were shot from the fish hatchery illustrate a substantial construction effort to contain the slide area (Photos Tokul1-2).

Upstream of RM 0.3, the wetted width was 36 feet with a 50-foot OHW. The canopy was composed of immature conifers, alder, and maple (Photo Tokul3). The water was very turbid; visibility was only 1.5 meters on September 24 and 1.4 meters on September 25.

Site-Specific Observations:

A pair of chinook spawners was observed near the SR 202 crossing. An adult chinook carcass was observed washed against a fish weir for the hatchery intake near the live fish (Photo Tokul4).

A photo of the landslide at RM 0.5 shows some immature vegetation beginning to stabilize the slide area (Photo Tokul5). At this location, residents of the area advised the field technicians to leave Tokul Creek because of safety concerns around a gun range at RM 0.8.

The approximately 70 foot high waterfall at RM 1.4 is a certain barrier for all salmonids except possibly steelhead (Photo Tokul6). A resident downstream of the waterfall told the field technicians that salmonids are not able to migrate past the SR 203 bridge, and that any salmonids upstream of the bridge have been transported by the hatchery.

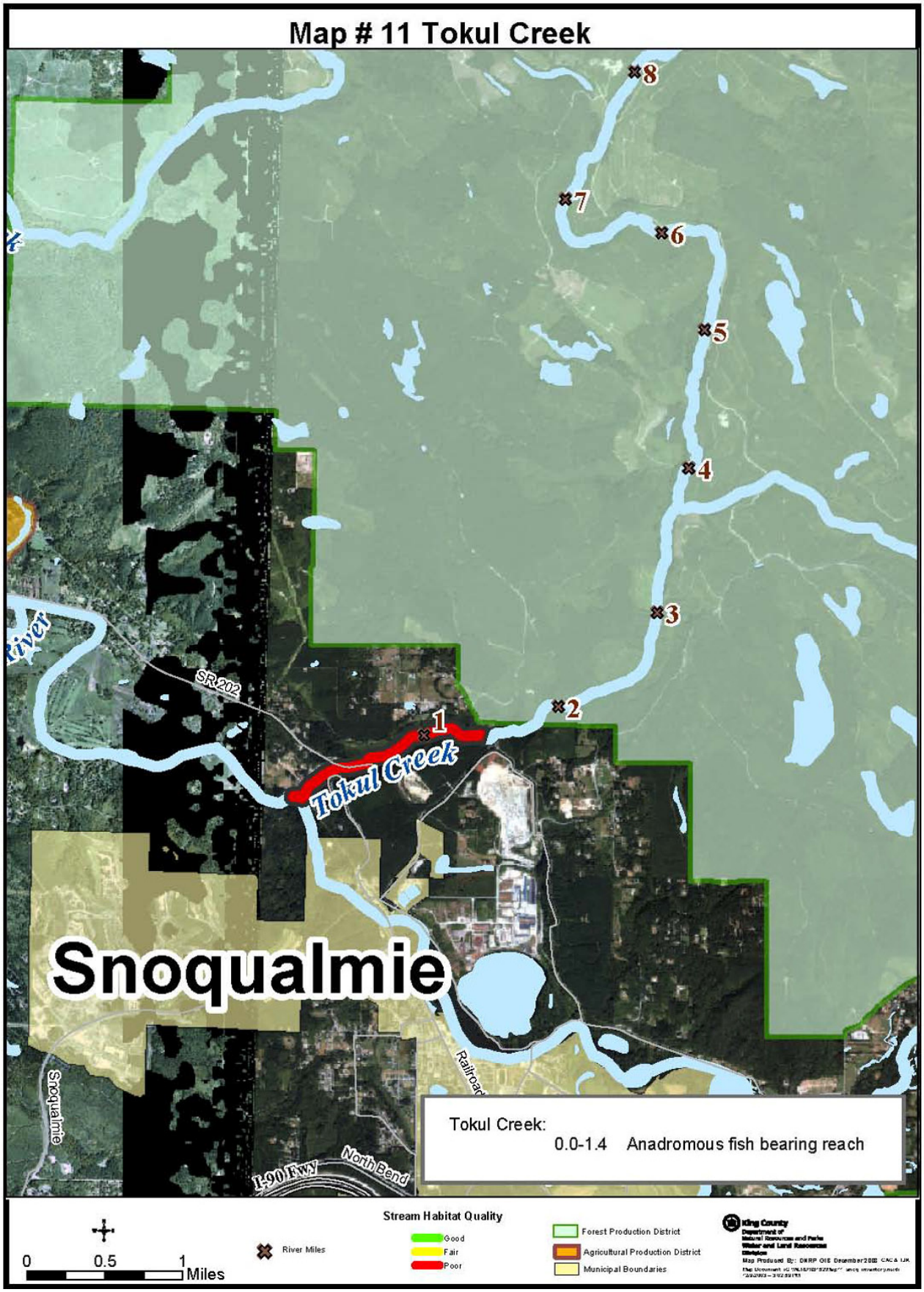

Map # 11 Tokul Creek
8
7
6
5
4
3
2
1
SR 202
Tokul Creek
Snoqualmie
Railroad
Snoqualmie
I-90 Fwy
North Bend
Tokul Creek:
0.0-1.4 Anadromous fish bearing reach
0 0.5 1 Miles
River Miles
Stream Habitat Quality
Good
Fair
Poor
Forest Production District
Agricultural Production District
Municipal Boundaries
King County
Department of Natural Resources and Parks
Water and Land Resources Division

Photo Tokul1. Construction on landslide at RM 0.3

Photo Tokul2. Efforts to contain sediments at RM 0.3

Photo Tokul3. Looking upstream from SR 202 bridge.

Photo Tokul4. Chinook mortality at hatchery intake.

Photo Tokul5. Old landslide caused by previous SR 202 bridge.

Photo Tokul6. Fish passage barrier at RM 1.4.

SUMMARY AND CONCLUSIONS

The results of the habitat reconnaissance that was conducted on 14 Snoqualmie Watershed rivers and streams corroborate previous findings that the Snoqualmie Watershed has some healthy aquatic habitat, but there are impaired habitat conditions at many locations. Table 1 describes the reaches of the rivers and streams that were walked in 2002, rates the habitat quality of each as good, fair or poor (based on criteria cited in the Methods section of this report), and summarizes the major habitat issues that were observed.

"Good" habitat quality was found for 23.6 river miles (39.6% of the total 59.6 miles in the habitat reconnaissance) and "poor" habitat quality was found for 18.9 river miles (31.7% of the total). "Fair" habitat quality was found for the remaining 17.1 river miles (28.7% of the total). Overall, aquatic habitat conditions were better in tributaries to the mainstem Snoqualmie River than in the mainstem, where only 13% of the river miles that were inventoried in the summer of 2000 exhibited good habitat conditions for all habitat features (Solomon and Boles, 2002).

Margaret Creek, Stossel Creek, and Lake Creek were the waterbodies in the summer, 2002 stream reconnaissance survey that had "good" habitat quality in all walked reaches. Tokul Creek was observed to have "poor" habitat quality in the reach that was walked (RM 0.0–1.4). The Margaret Creek subwatershed is mostly forested. The Stossel Creek subwatershed is comprised of undeveloped forest and wetland. Although there is rural residential development in Lake Creek, the dense, mature, Pacific Northwest native riparian vegetation is largely intact. On the other hand, the lower reach of Tokul Creek is largely forested but residential development upstream and a RB revetment from RM 0.5 to the mouth of the creek have impacted habitat quality by contributing to hillslope failures and excessive delivery of fine sediments to the creek. The other 10 inventoried waterbodies displayed a mixture of "good," "fair," and/or "poor" habitat quality.

The results of this stream reconnaissance survey highlight five of the nine most important chinook salmon habitat problems that were identified by the WRIA 7 Technical Committee (Snohomish Basin Salmonid Recovery Technical Committee, 1999). These were loss of channel area and complexity resulting from bank protection, disconnecting the channel from its floodplain; dearth of LWD; increased sediment input to rivers and streams as a result of unnaturally high rates of erosion; poor quality riparian forests; and urbanization (road construction, residential construction; additional bank hardening) that further reduces chinook salmon viability in the basin.

The results of the 2002 reconnaissance surveys for the Tolt River, Griffin Creek, and the Raging River were compared with the results of the reconnaissance surveys that were begun in the summer of 2001 (Solomon and Boles, 2002). For both years, habitat quality was better in the less developed headwaters than further downstream where there were more human impacts such as confinement levees, other bank hardening, and residential land uses. The upstream reaches generally displayed dense native riparian vegetation that recruited a high frequency of LWD to the waterbody, cobble, and gravel substrate, which is ideal for salmon spawning, and pools for juvenile salmon rearing.

The reaches with "good" habitat conditions in these and the other waterbodies that were inventoried in the summer of 2002 should be targeted for habitat protection actions in the Snoqualmie Watershed portion of the WRIA 7 salmon conservation plan. The qualitative information obtained from this stream habitat reconnaissance survey also suggests potential opportunities for habitat restoration. The information needs to be overlain with other information from several forthcoming reports (Snoqualmie Valley Floor Habitat Reconnaissance Report, Snoqualmie Watershed Geology Report, and the WRIA 7 Ecological Analysis for Salmonid Conservation) to prioritize projects for greatest ecological gains.

The 2002 streamwalks provided qualitative information about baseline habitat conditions in 14 rivers and streams in the Snoqualmie Watershed. Because of its qualitative nature, this is not considered a final or comprehensive picture of habitat conditions in these waterbodies. Before definitive conclusions can be drawn, more in-depth and quantitative research and habitat inventories need to be conducted. Some remaining high priority information needs for the Snoqualmie Watershed include:

- Quantitative surveys of habitat conditions in specific reaches of rivers and streams.
- Temperature stratification assessments in large pools of the mainstem Snoqualmie River.
- Wetland assessments, including location, functions, and values.
- Juvenile salmonid distribution mapping.
- Hydrologic mapping and modeling of stormwater catchment and subcatchment basins.

Information that is obtained from the above investigations and from monitoring habitat quality trends over time will also be applied to making habitat and aquatic resource management decisions in King County.

Table 1. Summary of Habitat Conditions in Snoqualmie Watershed Rivers and Streams

Stream	River Miles	Reach	Quality of Habitat	Major Issues
Cherry Creek	0.0–2.2	Cherry Valley Floodplain	Poor	Lack of riparian vegetation and LWD. Channel is confined and entrenched.
	2.2–3.0	Low Gradient Channel in Rural Residential Development	Fair	Some bank armoring and riparian vegetation clearing near homes. Sediment backed up behind bridge.
	3.0–4.3	High Gradient Channel in Rural Residential Development.	Good	
	4.3–5.0	Undeveloped Timber Property	Good	
Margaret Creek	0.0–1.0	Forest Production District	Good	
Ames Lake Creek	0.0–2.0	Snoqualmie River floodplain, APD	Poor	Creek is ditched, no riparian vegetation.
	2.0–3.6	Rural Residential Development	Good	
	3.6–3.9	Ames Lake	Fair	Overdeveloped with little riparian vegetation.
Harris Creek	0.0–1.7	Snoqualmie River Floodplain	Good	
	1.7–2.8	Undeveloped Forested Area	Good	
	2.8–3.6	Rural Residential Development	Good	
	3.6–4.6	Wetland	Fair	Riparian vegetation dominated by invasive plants.
	4.6–6.6	Rural Residential with Small Wetlands	Fair	Frequent road crossings, riparian vegetation dominated by invasive shrubs, and some garbage in the creek.
Tolt River	0.0–2.0	Tolt River Delta	Poor	River confined between narrow levees, poor instream habitat, invasive riparian shrubs.
	2.0–5.9	Rural Residential Development	Good	
	7.5–7.9	Undeveloped Forested Area	Good	
Stossel Creek	0.0–0.8	High Gradient Forested Reach	Good	
	0.8–1.9	Wetland Complex	Good	
	1.9–2.0	Forested Reach	Good	
	2.0–2.5	Narrow Wetland Valley	Good	

Stream	River Miles	Reach	Quality of Habitat	Major Issues
	2.5–3.0	Mussel Hot Bed	Good	
	3.0–4.1	Narrow Wetland Valley	Good	
	4.1–4.7	Forested Reach	Good	
	4.7–5.0	Wetland Complex with Bog	Good	
Langlois Creek	0.0–2.2	Snoqualmie River Floodplain	Poor	Lack of riparian vegetation and LWD.
Griffin Creek	0.0–0.7	Snoqualmie River Floodplain	Fair	Lack of riparian vegetation and LWD.
	0.7–3.0	Rural Residential Development	Good	
Patterson Creek	0.0–1.9	Snoqualmie River Floodplain	Poor	Lack of riparian vegetation and LWD. Channel is confined and entrenched.
	1.9–3.0	Patterson Creek Floodplain	Poor	Lack of riparian vegetation and LWD. Channel is confined and entrenched.
	3.0–8.3	Wetland Valley	Poor	Lack of riparian vegetation and LWD.
	8.3–10.1	Residential	Fair	Frequent road crossings and some perched culverts.
Canyon Creek	0.0–0.6	Patterson Creek Floodplain	Poor	Riparian vegetation composed of invasive weeds.
	0.6–2.0	Steep Canyon in Rural Residential Development	Good	
Raging River	0.0–1.3	Urban Development with Containment Levees	Poor	Lack of LWD, channel is confined, entrenched and prone to high scour events.
	1.3–8.0	Rural Residential Development	Fair	Frequent road crossings and invasive shrubs.
	8.0–11.0	Undeveloped Timber Property	Good	
Deep Creek	0.0–1.2	Forested Reach	Fair	Fish passage problems.
Lake Creek	0.0–1.0	High Gradient Rural Residential	Good	
	1.0–2.0	Low Gradient Rural Residential	Good	
Tokul Creek	0.0–1.4	Anadromous Fish-Bearing Reach	Poor	Oversedimentation and fish passage issues.

REFERENCES

Berman, Cara. 1998. *Oregon Temperature Standard Review*. U.S. Environmental Protection Agency, Region 10, Seattle, WA.

Bjornn, T.C. and D.W. Reiser. 1991. "Habitat Requirements of Salmonids in Streams." *American Fisheries Society Special Publication* 19: 83-138.

Cortez, Alan. 2002. *Field Notes on Snoqualmie Watershed Streamwalks* (unpublished data). Tulalip Tribes, Marysville, WA.

Snohomish Basin Salmonid Recovery Technical Committee. 1999. *Initial Snohomish River Basin Chinook Salmon Conservation/Recovery Technical Work Plan*. Snohomish County Surface Water Management Division, Everett, WA.

Snohomish River Basin Work Group. 1998. *Anadromous Fish Distribution Maps in the Snohomish River Basin.* Snohomish County Surface Water Management Division, Everett, WA.

Solomon, Fran and Melissa Boles. 2002. *Snoqualmie Watershed Aquatic Habitat Conditions Report: Summary of 1999–2001 Data*. King County Department of Natural Resources and Parks, Water and Land Resources Division. Seattle, WA.

Washington Department of Fish and Wildlife (WDFW) and Western Washington Treaty Indian Tribes. 1994. *1992 Washington State Salmon and Steelhead Stock Inventory. Appendix One: Puget Sound Stocks North Puget Sound Volume.* Olympia, WA.

Washington Department of Fish and Wildlife and Western Washington Treaty Indian Tribes. 1997. *Wild Salmonid Policy*. Olympia, WA.

Washington Forest Practices Board (WFPB). 1997. *Watershed Analysis Manual, v 4*. Olympia, WA.