LOWER SNOQUALMIE RIVER MAINSTEM

The mission of King County WLRD includes sustaining healthy watersheds and protecting and restoring habitats (King County WLRD, 2002c). In order to accomplish this part of the mission for the Snoqualmie Watershed, it is useful to know the habitat conditions that historically existed as well as the habitat conditions that exist at present.

Historic Habitat Conditions

Under contract to King County, University of Washington geomorphologists researched and analyzed physical habitat conditions for salmonids in the lower Snoqualmie River mainstem (downstream of Snoqualmie Falls to the confluence with the Skykomish River) and valley floor prior to Euro-American settlement (Collins and Sheikh, 2002). The historical (approximately 1870) landscape was reconstructed from archival materials including maps and field notes from General Land Office (GLO) surveys from 1871-1873 and aerial photographs from 1936. These materials were entered into a Geographic Information System (GIS) and in combination with a Digital Elevation Model (DEM) constructed from Light Detection and Ranging (LIDAR) imagery, were used to map the location of the river channel, wetlands, oxbows, and types and sizes of riparian trees and shrubs. LWD removal and recruitment were also analyzed. To evaluate subsequent change, conditions were also mapped from 1936 and 2000 aerial photos. Following is a summary of the findings. The full Collins and Sheikh report, titled *Mapping Historical Conditions in the Snoqualmie River Valley (RM 0—RM 40),* is available on the King County website (http://dnr.metrokc.gov/wlr/waterres/streams/snoqhist.htm).

The lower Snoqualmie River can be subdivided into several morphologically distinct reaches. Throughout most of the study area, Holocene (post-glacial) deposition by the river has built up the river and its meander belt as much as 6 meters above the valley floor. From RM 2-12, the channel is relatively straight with little or no meander belt. Nearly the entire valley is several meters lower in elevation than the riverbanks. Upstream, the meander belt is approximately one kilometer in width, with valley-marginal lowlands narrower than in the downstream reach. Exceptions to this morphology are where the alluvial fans of the Tolt River (RM 23-27), Raging River, and Tokul Creek (RM 35.5-38.5 combined) narrow the meander belt (Collins and Sheikh, 2002).

Historically, wetlands occupied low areas at the margins of the meander belt. Seasonal flooding and tributaries replenished such valley wetlands. Historic records indicate that vegetation in a large wetland complex between about RM 4 and RM 11 was primarily shrubs and small deciduous trees with scattered small spruce trees. Ponds and wetlands also occupied many oxbows created by historic channel avulsions (Collins and Sheikh, 2002).

The riparian forest that existed prior to Euro-American settlement was numerically dominated by hardwoods, including red alder (*Alnus rubra*), willow (*Salix spp.*), vine maple (*Acer circinatum*), big leaf maple (*Acer macrophyllum*), black cottonwood (*Populus balsamifera*), and Pacific crabapple (*Pyrus fusca*). The largest hardwoods were big leaf maple and black cottonwood with an average diameter of 54 centimeters (21 inches), together comprising 33% of the total forest biomass. Numerically, conifers were only 7% of the riparian trees, but comprised 43% of the total forest biomass. Western red cedar (*Thuja plicata*) and Sitka spruce (*Picea stchensis*) were the largest conifers and largest trees overall, with an average diameter of 97 centimeters (38 inches) and 91 centimeters (36 inches) respectively.

Combining LIDAR and georeferenced GLO field data in a GIS layer shows that tree species grew in distinct elevation ranges relative to the riverbank, with spruce, willow, and alder being most tolerant of flooded conditions, growing 1-4 meters below the riverbank elevation. Forest composition varied with distance from the river; alder and willow were more dominant in areas immediately adjacent to stream channels (Collins and Sheikh, 2002).

Cedar, spruce, maple, and cottonwood would have been the most common tree species that historically contributed LWD to the Snoqualmie River because they were the largest tree species in the riparian forest. It was common for the U.S. Army Corps of Engineers (ACOE) to remove LWD from Puget Sound rivers in the late nineteenth and early twentieth centuries. However, there was no mention of LWD in the first ACOE report on the Snoqualmie River in 1880. LWD may not have been abundant enough to impede navigation on the river or may have been removed by settlers prior to 1880. Later ACOE reports indicate that the ACOE removed wood from the Snoqualmie River at irregular intervals between 1887 and 1908. The ACOE did not record the specific locations of this wood in the river prior to removing the wood (Collins and Sheikh, 2002).

Over 40 oxbow features were historically present in the Snoqualmie River valley. Since approximately 1870, only nine additional oxbows have formed on the valley floor. This fact suggests that the migration rate of the Snoqualmie River is generally low. Most oxbows that now exist were created prior to the earliest mapping in around 1870. On the other hand, the total area occupied by valley floor wetlands has decreased substantially over the past 130 years. In 2000, it was only 19% of the presettlement wetland area. Forest cover in 2000 along the Snoqualmie River and in the valley floor was only 16% of its mapped presettlement extent. Between 1870 and 2000, there was a concomitant large increase in agricultural/cleared land and urban areas (Collins and Sheikh, 2002).

King County will use the historical habitat conditions information to help identify and prioritize salmonid habitat protection and restoration projects for the Snoqualmie Watershed portion of WRIA 7. Such projects could include: (1) acquiring land with existing good habitat; (2) planting native vegetation along the riverbanks, oxbow ponds, and wetlands; (3) hydraulically reconnecting the main channel of the river to oxbows and wetlands where such connections have been lost; (4) restoring ditched floodplain tributary creeks; and (5) restoring valley wetlands.

Habitat Conditions Inventories in 2000 and 2001

In the summers of 2000 and 2001, King County WLRD staff performed an inventory of salmonid habitat conditions in the lower Snoqualmie River mainstem from the mouth of Tokul Creek (RM 38) to the King-Snohomish County line (RM 6). Different habitat characteristics were analyzed each year. Figure 5 shows the study area. Washington Trout, a nonprofit salmonid habitat protection and restoration organization located in Duvall, partnered with King County in 2000. The data obtained from these inventories will be used to guide the WRIA 7 strategic assessment, develop the Snoqualmie Watershed portion of the long-term salmonid conservation plan for WRIA 7, identify and prioritize protection and restoration actions in the Snoqualmie River mainstem, and provide baseline data for adaptive management and monitoring.

Figure 5.

SNOQUALMIE RIVER SURVEY: Base Map

Map 1 of 1

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21 River Miles

Minor Roads

Major Roads

DNRP Basin Boundary

Incorporated Areas

0 .3 .6 1.2 1.8 2.4 Miles

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

DATA SOURCE NOTES:
Large Woody Debris: KC DNRP & Washington Trout survey, 2000
Waterbodies: KC DNRP & WA DOE Hydrography Project, 1997
River Miles: Generated from waterbody routes in waterbody layer
Basin Boundaries: KC DNRP Basin Planning, 1997

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Methods

The habitat conditions inventories addressed the following questions:

- What is the current condition of the riverbanks with respect to location and type of bank hardening?
- Where are the riverbanks undergoing significant erosion?
- Where can the river be accessed by cattle, people, and vehicles?
- Where are the back channels and tributaries that are still connected to the main channel?
- Where are artificial floodplain and channel modifications located? What types of modifications are present?
- What is the composition, density, and size of the riparian vegetation?
- Where is LWD found in the river at present and what is the type, size, and quality?
- Where are discharge pipes and anthropogenic debris found?
- Where are major pools located and what is their depth?
- Is the temperature of the Snoqualmie River low enough to provide good rearing and prespawning holding habitat for salmon during summer and early fall low flow conditions?

Other questions related to salmonid distribution (species use and relative abundance) in the main channel and habitat conditions in the valley floor (100-year floodplain) will be addressed in fieldwork to be performed in 2003 by King County WLRD and Tulalip Tribes staff.

The habitat conditions inventory in the summer of 2000 focused on physical habitat conditions (bank hardening and erosion, floodplain features, channel modifications, and LWD), riparian vegetation, river access, and dumping and discharge points. Prior to beginning the fieldwork, recent (1996) aerial photos were reviewed to obtain a watershed scale view of King County flood control facilities, other hydromodifications, LWD locations, riparian canopy (presence, amount of cover, types of vegetation), and side channels and oxbows. A data dictionary was developed, listing the features and attributes to be examined in the field (see Appendix A).

Next, King County WLRD and Washington Trout staff received training in the operation of two Trimble Global Positioning System (GPS) Pro XR and TSC1 data collectors. The field team performed a "rehearsal" in order to become familiar with the operation of the GPS equipment in the field and to standardize GPS data collection techniques. For consistency in data collection, the same personnel operated the GPS units throughout the study period. Actual data collection began on August 9, 2000 and continued for two to three days weekly until completion of the habitat conditions inventory on September 12, 2000. King County WLRD provided a raft and Washington Trout provided a canoe. On days when both the raft and canoe were available, the raft crew inventoried habitat conditions on one bank of the river while the canoe crew inventoried habitat conditions on the opposite bank. On days when only one boat was available, the crew inventoried habitat conditions on one bank, then repeated the reach on the other bank another day. Field crew who were not operating the GPS equipment assisted in identifying the start and end points of each habitat feature, recorded supplementary descriptive notes in a field notebook, and photographed key features. Data were downloaded into a computer at the end of each day.

After the conclusion of the summer 2000 habitat inventory, the GPS data were imported to a GIS and map layers were produced for each category of habitat features (bank hardening and erosion, access points, floodplain features, channel modifications, riparian shrubs, riparian trees, LWD, and dumping and discharge points). Summary maps are included and described in subsequent sections of this report. The full set of maps is available in hard copy (King County WLRD, 2002b) and compact disk.

The inventory in the summer of 2001 focused on assessing large pools in the entire lower Snoqualmie River mainstem from the mouth of Tokul Creek (RM 38) to the confluence of the Snoqualmie and Skykomish rivers (RM 0) by canoe. Large pools were defined as pools with a length greater than one channel width. During the month of August, King County WLRD ecologists mapped the location of each pool on laminated Snoqualmie Watershed aerial photos in the field and measured the maximum and residual pool depths using Hondex depth sounders. Digital photos were taken. Pool data were imported into a GIS and map layers were produced.

Water temperature was assessed during both summers. Five temperature loggers were installed in holding pools in the Snoqualmie River mainstem on July 14, 2000. The loggers were tied to rocks and sunk to the bottom of the river in deep pools. The locations of the loggers were:

1. just upstream of the Raging River confluence at RM 35.7.
2. the Neal Road boat launch at RM 32.6.
3. just upstream of the Tolt River confluence at RM 24.8.
4. immediately downstream of "Chinook Bend," King County open space land near NE Carnation Farms Road at RM 21.1.
5. downstream of the City of Duvall at RM 8.8.

The temperature loggers recorded water temperature every hour from July 14 to September 28, 2000. Four of the loggers were removed on that date (the logger at the "Chinook Bend" location was not recovered) and the data were downloaded. The four temperature loggers were reinstalled in the same locations on June 26, 2001 in order to obtain additional temperature data during the hottest months of the year. Three of these loggers were removed (the logger at RM 24.8 was not recovered) and the data were downloaded on October 19, 2001.

Results and Discussion

For each category of salmonid habitat conditions, the findings and reasons for or implications of these observations are discussed in the following subsections of this report.

Bank Hardening and Erosion

The locations and types of armoring along the toe and top of the banks of the Snoqualmie River are mapped in Figures 6 to 11 and graphed in Figures 12 to 15. The maps include recognized King County flood control facilities as well as other locations. A revetment is a hardened bankline where the top of the bank is at approximately the same elevation as the adjacent land. Riprap is armoring material with a diameter of at least 256 millimeters (mm). Rubble is armoring material with a diameter of less than 256 mm. The locations of levees (structures that are composed of raised fill that is higher than the area landward) were not recorded because the habitat conditions inventory was conducted from the river and field staff did not climb up on the banks.