Appendix H: Biological Criteria Discussion

BACKGROUND

Streams in the Tualatin River Sub-Basin have been altered considerably since the arrival of settlers in the mid-1800s. Early changes in the basin consisted primarily of harvesting timber and converting land use to agriculture. Changes in landscape because of agricultural practices significantly affected hydrology in the basin. More recently, dramatic increases in population have resulted in urbanization of the watershed. Parts of the Tualatin River and many tributaries now flow through or under housing developments, shopping centers and industrial complexes. These changes in habitat have undoubtedly contributed to changes in fish assemblages throughout the basin (ODFW, 1995).

Historic information on fish populations and habitat in the Tualatin River Sub-Basin is scarce. In 1993, the Oregon Department of Fish and Wildlife (ODFW) and Unified Sewerage Agency (USA) began a cooperative study to:

- Describe the status and characteristics of fish populations in streams within the urban growth boundary of the Tualatin River Sub-Basin;
- Describe status of aquatic habitat in these streams; and
- Examine the relationship between fish assemblages and aquatic habitat to identify stream reaches that would most likely benefit from habitat enhancement.

Streams of high quality habitat where protection from habitat degradation should be of priority and streams where fish populations may not benefit from habitat enhancement because of water quality or other problems were also identified.

This work was summarized in a report entitled *“Distribution of Fish and Crayfish and Measurement of Available Habitat in the Tualatin River Sub-Basin – Final Report of Research.”* The report concluded:

- **Fish assemblages in streams of the Tualatin River Sub-Basin are undoubtedly different from those that historically evolved in the system** – finding 25 species and 10 families of fish with 12 species from five families being exotic to Oregon and introduced species comprising 6% of the total catch;

- **Fish assemblages varied widely among streams and among reaches within streams** – generally with the upper reaches containing the largest numbers of trout, native minnows and sculpins and the lower reaches containing more of the introduced species;

- **In general, aquatic habitat throughout the Tualatin River Sub-Basin has been influenced by human development in the basin** – streams were found to be channelized and isolated from their natural floodplains; glides, characterized by even flow and depth with no turbulence, were the most common habitat type; sand, silt and organic material were the most common substrate; the majority of stream banks were actively eroding; and the amount of overhead cover, the percentage of banks that were undercut, and the amount of woody debris were all generally low.

- **Only 5 of 38 reaches surveyed met most of the general habitat requirements of native species intolerant of habitat degradation and pollution** – these upper reaches of streams generally contained swift water, a variety of substrates, a high amount of shade and relatively complex habitat.

- **Biotic integrity varied throughout the basin, but was generally low** – 34 stream reaches were surveyed in summer 1994 and were rated as follows based on a modified Index of Biotic Integrity (IBI):
  - 0 - excellent
  - 1 - good
  - 13 - fair
  - 20 - poor or very poor

- **16 reaches where improvements to habitat would likely result in increased biotic integrity and an additional seven reaches that should be protected from habitat degradation and be high priority sites for habitat enhancement were identified**.

The report grouped stream reaches into three major categories to help prioritize stream restoration efforts that could be carried out in sub-basin plans. Habitat improvements, such as increases in the amount of instream cover (trees and vegetation to increase canopy cover, undercut banks, rocks, woody debris or increased depth or turbulence), were recommended to increase the number of native intolerant species such as cutthroat trout.

BENEFICIAL USES

Oregon Administrative Rules (OAR Chapter 340, Division 41, Table 6) lists the "Beneficial Uses" occurring within the Tualatin River Sub-Basin (**Table 1**). Numeric and narrative water quality standards are designed to protect the most sensitive beneficial uses. The Biological Criteria was developed to protect Resident Fish and Aquatic Life.

Table 1. Beneficial uses occurring in the Tualatin River Sub-Basin
(OAR 340 – 41 – 442)
Beneficial uses protected by the Biological Criteria are marked in gray

Beneficial Use	***Occurring***	***Beneficial Use***	***Occurring***
Public Domestic Water Supply	✓	Salmonid Fish Spawning (Trout)	✓
Private Domestic Water Supply	✓	Salmonid Fish Rearing (Trout)	✓
Industrial Water Supply	✓	Resident Fish and Aquatic Life	✓
Irrigation	✓	Anadromous Fish Passage	✓
Livestock Watering	✓	Wildlife and Hunting	✓
Boating	✓	Fishing	✓
Hydro Power	✓	Water Contact Recreation	✓
Aesthetic Quality	✓	Commercial Navigation & Transportation	

WATER QUALITY CRITERIA

OAR 340-41-027 is a Biological Criteria that is applicable to all waters of the state and reads as follows:

Waters of the state shall be of sufficient quality to support aquatic species without detrimental changes in the residential biological communities.

- *"Aquatic species" means any plants or animals which live at least part of their life cycle in waters of the State.*
- *"Biological Criteria" means numerical values or narrative expressions that describe the biological integrity of aquatic communities inhabiting waters of a given designated aquatic life use.*
- *"Resident Biological Community" means aquatic life expected to exist in a particular habitat where water quality standards for a specific ecoregion, basin, or water are met. This shall be established by accepted biomonitoring techniques.*
- *"Without Detrimental Changes in the Resident Biological Community" means no loss of ecological integrity when compared to natural conditions at an appropriate reference site or region.*
- *"Ecological Integrity" means the summation of chemical, physical and biological integrity capable of supporting and maintaining a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of the natural habitat of the region.*
- *"Appropriate Reference Site or Region" means a site on the same water body, or within the same basin or ecoregion that has similar habitat conditions, and represents the water quality and biological community attainable within the area of concern.*

303(d) Listed Stream Segments

ODFW (1995) used a modified index of biotic integrity (IBI) to assess fish assemblages at sampling sites within the basin. The IBI comprises metrics that reflect structural and functional characteristics of fish communities. Ten metrics were used to assign IBI scores. These included: number of native species, number of native benthic species, number of native pelagic species, number of intolerant species, number of individuals, percent tolerant individuals, percent top carnivores, percent native insectivores other than cottids, percent introduced, and percent with anomalies. Scores were assigned to each of these metrics (either a 1, 3 or 5). Because no historic information was available for fish assemblages in the Tualatin Basin and because all streams surveyed had experienced some form of alteration, it was impossible to estimate expected IBI scores for "excellent" fish assemblages similar to those undisturbed by humans. Scoring criteria were categorized in a range of observed scores as follows: 0-19 = very poor; 20-29 = poor; 30-39 = fair; 40-45 = good; 46-50 = excellent.

Part of the criteria used for listing streams in the 1998 303(d) listing included *"where monitoring methods determined a Biotic Condition Index, Index of Biotic Integrity or similar metric rating of poor or a significant departure from reference conditions utilizing a suggested EPA biomonitoring protocol or other technique acceptable to DEQ."* Based on this listing criteria, streams that received a poor or very poor rating were identified on the 303(d) list[1]. Where multiple reaches were sampled on a stream, IBI values were averaged and, if the IBI average was in the poor or very poor category, the stream was listed. These listed streams as shown in Table 2.

[1] Oregon's 1998 303(d) list can be publicly accessed via the Internet at http://www.deq/state.or.us/

Table 2: Tualatin Basin Streams Listed for Biological Criteria

Tualatin Sub-Basin Streams listed for Biological Criteria	Other Parameters listed
Ash Creek	Bacteria, Dissolved Oxygen, Temperature
Beaverton Creek	Bacteria, Dissolved Oxygen, Temperature
Bronson Creek	Bacteria, Chlorophyll a, Dissolved Oxygen, Temperature
Butternut Creek	Bacteria, Dissolved Oxygen, Temperature
Cedar Mill Creek	Bacteria, Temperature
Hedges Creek	Bacteria, Dissolved Oxygen, Temperature
Johnson Creek (Beaverton Creek Drainage)	Bacteria, Dissolved Oxygen, Temperature
Rock Creek	Bacteria, Chlorophyll a, Dissolved Oxygen, Temperature
South Rock Creek	
Summer Creek	Bacteria, Dissolved Oxygen, Temperature

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DISCUSSION

The 303(d) List is intended to identify all waters not meeting water quality standards. EPA has interpreted that Total Maximum Daily Loads (TMDLs) are to be established only where a waterbody is water quality limited by a "pollutant[2]." In the case of the listings such as for Habitat Modification and Flow Modification which are not pollutants[3], TMDLs would not need to be established and other approaches to address these concerns, such as through Management Plans, could be used to address these impairments. In the case of a Biological Criteria listing which could be due to either to a pollutant (e.g. excessive temperature, low dissolved oxygen or sedimentation) or some form of pollution (flow or habitat modification), the likely cause for the Biological Criteria exceedence needs to be determined. If pollutants were the likely cause, a TMDL would need to be established. If some other form of pollution was involved, other appropriate measures could be used.

ODFW (95) explored the relationship between the IBI scores and habitat variables that they measured. A plot of IBI scores against habitat scores revealed three major groups of reaches based on the relationship between IBI and habitat. Seven reaches (Lower Beaverton, Lower Bronson, Upper Cedar, Middle Chicken, Lower and Upper Dawson, and Middle Fanno) had IBI scores higher than expected for the available habitat, which indicated that they should be protected from further habitat degradation and would be high priority for habitat enhancement. Sixteen reaches (Lower and Middle Ash, Middle Bronson, Middle and Upper Butternut, Middle Cedar, Middle Cedar Mill, Lower Chicken, Middle and Upper Dairy, Lower Fanno, Middle and Upper South Rock, Lower and Middle Rock, and Lower Summer) had IBI scores similar to that expected by the habitat score and would likely benefit from habitat enhancement. Eleven reaches (Upper Ash, Middle Beaverton, Lower Butternut, Upper Cedar Mill, Upper Chicken, Upper Fanno, Middle and Upper Hedges, Upper Johnson, Middle and Upper Summer) had IBI scores lower than expected, and are probably limited by factors other than, or in addition to, physical habitat.

[2] Section 303(d)(1)(C) states that "each State shall establish for the waters identified in paragraph (1)(A) of this subsection, and in accordance with the priority ranking, the total maximum daily load, for those pollutants which the Administrator identifies under section 304(a)(2) as suitable for such calculation.

[3] The term pollutant is defined in section 502(6) of the CWA and in the proposed 40 CFR 130.2(d) as follows: "The term "pollutant" means dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water."

Habitat improvements designed to increase the number of native intolerant species such as cutthroat throat and torrent sculpin were identified as likely resulting in the largest increases in IBI scores. The ODFW report cited literature that indicated the biomass of cutthroat trout in streams would increase with the amount of cover present. Instream cover can be provided by undercut banks, rocks, woody debris or increased water depth and turbulence. Placement of boulders and logs in streams provides direct cover and may also increase cover indirectly by causing increased depth and turbulence.

Restoration of canopy cover will not only be a benefit for habitat but will also address temperature concerns. In addition, trees and vegetation associated with stream canopy will also serve to decrease erosion, thereby decreasing the amount of soil substrate. The amount of shade and the amount of soil substrate were found to be negatively correlated in the Tualatin River basin. Cutthroat trout prefer cooler temperatures and coarser sediment. For example, Bell (1973) reported that cutthroat trout preferred temperatures of 9 to 12°C whereas Heath (1963) reported 15°C as the optimal temperature for juvenile cutthroat trout. Survival of cutthroat trout embryos increase as the percentage of fine sediments decreases (Irving and Bjornn, 1984). Juvenile and adult cutthroat trout are usually associated with gravel or cobble up to 30 cm (Hanson, 1977) and cutthroat trout have been observed spawning in gravel of 0.2 to 5.0 cm (Hooper, 1973; Hunter, 1973)

While habitat improvements will go a long way toward improving these streams, it should also be noted that most of these streams are listed for temperature and dissolved oxygen standard violations. The only two exceptions out of the 10 streams listed for Biological Criteria exceedences, South Rock Creek (listed only for Biological Criteria) and Cedar Mill Creek (list for temperature and Biological Criteria), did not have sufficient temperature and dissolved oxygen or dissolved oxygen data respectively to determine if they should be listed. TMDLs for temperature and dissolved oxygen are being developed for all of these streams as a sub-basin approach of setting TMDLs is being used.

SUMMARY

In summary, based on the ODFW 1995 Report, physical habitat and water quality affect fish assemblages in the Tualatin Sub-Basin and would need to be addressed to show improvements in native fish populations. No TMDLs are being developed for biocriteria. However, TMDLs are being developed for temperature and dissolved oxygen throughout the basin which should address the pollutants of concern and improve the water quality for the fish assemblages. Other factors such as habitat and flow improvements, for which a TMDL will not be developed, will also need to be addressed in management plans in order to have substantial improvements in the fish assemblages.

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