SALMONID HABITAT LIMITING FACTORS

FINAL REPORT

WATER RESOURCE INVENTORY AREA 30

KLICKITAT WATERSHED

WASHINGTON STATE

CONSERVATION COMMISSION

Limiting Habitat Factors Analysis
WRIA 30 (Klickitat)

Executive Summary

Introduction

This limiting habitat factors analysis is conducted pursuant to RCW 75.46 (Salmon Recovery). The purpose of this analysis is "to identify the limiting factors for salmonids" where limiting factors are defined as "conditions that limit the ability of habitat to fully sustain populations of salmon." It is intended that the findings of this analysis be used by a locally-based habitat project selection committee to prioritize appropriate projects for funding under the state salmon recovery program; the analysis may also be used by local organizations and individuals interested in habitat restoration to identify such projects.

This first version of the LHFA is limited in its consideration to anadramous fish in the Klickitat Watershed only. The next version (anticipated completion early fall, 1999) will extend the analysis to fish-bearing streams in WRIA 31 (Rock/Glade), include consideration of bull trout (*Salvelinus confluentus*), and will incorporate new information on habitat, water quality, and forest practices that is anticipated to be released shortly.

Setting

WRIA 30 (Klickitat) consists of the Klickitat River watershed plus a number of small tributaries draining to the Columbia between the Klickitat watershed and the Rock Creek watershed to the east. These small tributaries are not known to be utilized by anadramous fish, and are excluded from this analysis.

The Klickitat River watershed encompasses an area of 1350 square miles. The landscape consists primarily of a plateau of volcanic origin dissected by canyons carved by the watershed's network of streams and rivers. The Klicklitat River arises at about 5000 feet elevation and flows just over 95 miles to the Columbia River at Lyle. Major tributaries include Swale Creek, Little Klickitat River, Outlet Creek, Big Muddy Creek, W. Fk Klickitat River, and Diamond Fork.

Climate can be characterized as a hybrid of that found on the east and west sides of the Cascades, owing to the watershed's position at the head of the Columbia Gorge. A climatic gradient exists from the northwest (cooler, wetter) to the southeast (warmer, drier), portions of the watershed. Summers are typically hot and dry (avg. temp. 55°F - 70°F) and winters are cold and wet (avg. temp. 25°F - 37°F). Precipitation ranges from 140 inches on Mount Adams to 15 inches on the southeastern plateau with 75-85%

falling between November and May; a persistent snowpack contributes runoff to some tributaries and the mainstem far into the drier portion of the year.

The watershed is approximately equally divided between Klickitat and Yakima counties. The Yakima Indian Nation reservation occupies the northern 56% of the watershed. Approximately 90% of the non-reservation land is privately held. Approximately 75% of the land is forested, and is mostly managed for commercial timber production and grazing. Most of the remaining 25% is agricultural land (orchards, hay, and pasture); of this, about 25% is irrigated. Total population in the watershed is 16000; urban development is limited to the city of Goldendale (pop. 3500) and the unincorporated towns of Lyle, Klickitat, and Glenwood and, combined with rural residential use, occupies less than one-half of one percent of the watershed.

Species and Stock Description

Six stocks comprising three species of anadramous salmon utilize the Klickitat watershed. All stocks, except possibly winter steelhead, have been supplemented or even sustained by the Klickitat Hatchery, operated since 1952 by the Washington Department of Fish and Wildlife:

Spring chinook are known to have existed historically in the watershed. The stock is of mixed (native and non-native) origin, and is sustained by both hatchery and wild production. The stock is identified as depressed in the WDF/WDW Salmon and Steelhead Stock Inventory (SASSI), due to chronically low adult returns. This stock spawns almost exclusively in the mainstem; rearing is assumed to occur in all the areas where spawning occurs and near the mouths of the larger tributaries.

Early run (tule) fall chinook were not found in the watershed prior to 1946, due to the impassability of Lyle Falls at the time the adults returned to spawn. Passage improvements in the early fifties and hatchery production from 1952-1986 have resulted in establishment of a naturally spawning population. The stock is of mixed (native and non-native) origin, and is sustained by both hatchery and natural production. The stock is identified as healthy in the WDF/WDW Salmon and Steelhead Stock Inventory (SASSI). This stock spawns almost exclusively in the mainstem; rearing is assumed to occur in all the areas where spawning occurs.

Late run (upriver bright) fall chinook were discovered in the watershed in 1989. The stock is of non-native origin, and is sustained by entirely by natural production of hatchery strays. The stock is identified as healthy in the WDF/WDW Salmon and Steelhead Stock Inventory (SASSI). This stock spawns almost exclusively in the mainstem; rearing is assumed to occur in all the areas where spawning occurs.

Coho are not believed to be native to most of the Klickitat watershed, due to the impassability of Lyle Falls at the time the adults returned to spawn. The stock is of non-native origin, and is sustained by entirely by hatchery production. The stock is identified

as depressed in the WDF/WDW Salmon and Steelhead Stock Inventory (SASSI), due to chronically low adult returns. Limited information on spawning distribution is available; spawning has been observed in the mainstem as far as the hatchery, as well as the lower reaches of a number of tributaries; rearing is assumed to occur in all the areas where spawning occurs.

Summer steelhead are known to have existed historically in the watershed. The stock is of native origin, and is sustained by natural production. The stock status is unknown in the WDF/WDW Salmon and Steelhead Stock Inventory (SASSI), due to limited information. This stock is also part of the Mid-Columbia Evolutionarily Significant Unit (ESU), which has been listed as "threatened" under the Endangered Species Act.
This stock is spawns throughout the mainstem, as well as in the lower reaches of most tributaries; rearing is assumed to occur in all the areas where spawning occurs.

Winter steelhead are suspected to occur in the watershed, based on observations of bright steelhead observed in late winter and early spring catches. The stock is of native origin, and is sustained by natural production. The stock status is unknown in the Salmon and Steelhead Stock Inventory (SASSI), due to limited information. This stock is also part of the Mid-Columbia Evolutionarily Significant Unit (ESU), which has been listed as "threatened" under the Endangered Species Act. No information on spawning distribution is available; it is believed that this stock spawns in the lower mainstem, perhaps as far as Castile Falls (RM 64.2). Rearing is assumed to occur in all the areas where spawning occurs.

Access

Lack of access to potential habitat due to the presence of natural barriers to migration has been identified in previous reports as a major limitation of the production potential of the watershed. Over most of its length, the Klickitat River has carved deep, steep-walled canyons into Columbia River basalt flows, resulting in impassable or marginally passable falls and cascades where the river encounters more resistant bedrock, and restricted access to suitable habitat in many tributaries, where impassably high gradients occur close to the tributary confluence with the mainstem.

Key limiting habitat factors include:

* poor design and operation of the fishway/tunnel complex at Castile Falls;
* difficult passage at Lyle Falls;
* difficult passage at Little Klickitat Falls;
* restoration of Lower Snyder Creek;

* inaccessible or partially accessible habitat due to numerous road culvert barriers throughout the watershed.

Information needs include:

* a comprehensive culvert inventory and survey of inaccessible habitat.

Floodplains/Wetlands/Riparian Areas

Development of floodplains and wetlands is naturally limited over a large portion of the watershed; deeply incised canyons with narrow valley floors comprise most of the mainstem, as well as substantial portion of most fish bearing tributaries. On the plateau, unrestrained channels are able to develop natural meander patterns and create floodplains and wetlands.

No evaluation of wetlands is available at this time. Wetlands development appears to be constrained by topography in some portions of the watershed and climate (i.e. low rainfall) in other portions.

Riparian condition is influenced by geology and topography. In the canyon reaches described above, riparian areas appear to be more or less intact; on the plateau reaches where agricultural and urban land uses occur, the riparian forest has been almost entirely removed, or is in a condition such that only minimal amounts of necessary ecological functions can be provided.

Key limiting habitat factors include:

* degraded riparian habitat along the Little Klickitat River (above RM 12);

* degraded riparian habitat along Swale Creek (RM 0 to RM 14);

* degraded meadow and riparian habitat along the mainstem Klickitat River above Castile Falls (RM 77 to RM 85).

Information needs include:

* Assessment of floodplain connectivity and riparian condition, with a focus on plateau reaches.

Sediment

Sedimentation and turbidity in the watershed are viewed as a significant factor limiting habitat productivity in the watershed. The primary source of this sediment is naturally generated glacial silt from the eastern flanks of Mount Adams, which is delivered to the mainstem Klickitat by snowmelt runoff via Big Muddy and Little Muddy Creeks. Other sources of excess sediment, both natural and anthropogenic, are likely to be miniscule at the watershed scale compared to this source, though they may have adverse effects on fish and fish habitat at the local scale.

No systematic, watershed evaluation of sediment sources and impacts has been conducted in the watershed. Generally speaking, land-use related sediment sources in this watershed occur as a result of forest practices (e.g. harvesting, skidding, and road building across or adjacent to a stream), agricultural practices (e.g. rill irrigation, streamside grazing), or residential or commercial construction (land clearing and excavation in the vicinity of a stream). Problem areas identified include damaged meadows and riparian areas along the mainstem above Castile Falls and eroded/compacted streambanks and riparian areas along portions of the Little Klickitat River (above RM 12) and Swale Creek (RM 0 to RM 14).

Key limiting habitat factors include:

* naturally-generated glacial sediments entering the Klickitat River at RM 53.8 and RM 63.1;

* damaged meadows and eroded/compacted streambanks along the Klickitat River (RM 77 to RM 85);

* eroded/compacted streambanks along the Little Klickitat River (above RM 12);

* eroded/compacted streambanks along Swale Creek (RM 0 to RM 14);

* chronic erosion from stream-adjacent logging roads (various locations in the watershed).

Information needs include:

* a watershed-scale evaluation on sediment sources and sinks, including relative magnitudes and habitat impacts.

Water Quantity/Quality

No flow regulation occurs within the watershed; all flows in the watershed occur within a natural flow regimen, with the exception of portions of Outlet Creek, Hellroaring

Creek, Swale Creek, and the Little Klickitat River, where diversions for water supply and irrigation occur. An instream flow study conducted in 1991 identified Swale Creek and the Little Klickitat River and a number if its tributaries as having insufficient flows to support fish populations (anadramous and resident); these streams have been placed on the state "water quality impaired" (303d) list for instream flows. It is not known to what extent insufficient flows are land use related.

Identified water quality problems include high temperature in Butler Creek, Swale Creek, and the Little Klickitat River; these streams have been placed on the state "water quality impaired" (303d) list for temperature. Temperatures exceeding state water quality standards have been recorded in these streams primarily during low flow periods during the summer months; it is presumed that these exceedences are attributable to lack of stream shading due to degraded or non-existant riparian areas and low summer flows.

Key limiting habitat factors include:

* lack of riparian shading along Swale Creek from RM 0 to RM 14;

* lack of riparian shading along the Little Klickitat River above RM 12.

Key information needs include:

* in streams identified as "water quality impaired" for instream flows: an evaluation of the relative contribution of natural and land use factors (particularly water withdrawals) on low flows;

* in streams identified as "water quality impaired" for temperature: coordination of stream temperature data collection and riparian inventory to identify reaches which are most responsive to riparian zone planting and restoration.

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A. INTRODUCTION

In 1998, the Washington state legislature passed, and the governor signed, Engrossed Senate and House Bill 2496. The resulting law, codified in Revised Code of Washington Chapter 75.46 (see Appendix B), was enacted to "develop a structure that allows for the coordinated delivery of federal, state, and local assistance to communities for habitat projects that will assist in the recovery and enhancement of salmon stocks." The law encourages development of a strong, locally-based effort to restore salmon habitat, and defines a process (the *"critical pathways methodology")* that:

(a) identifies the key factors limiting the productivity of salmon habitat,

(b) gives projects that effectively redress these factors highest priority for state salmon recovery funds, and

(c) requires development of an adaptive management strategy to integrate monitoring and evaluation of implemented projects with habitat restoration planning.

To accomplish items (a) and (c) above, the law requires the Washington Conservation Commission (represented by the Regional Technical Coordinator) to convene a *Technical Advisory Group (TAG)*, consisting of "private, federal, state, tribal, and local government personnel with appropriate expertise", whose primary responsibility is to conduct a *limiting factors analysis* of salmonid habitat. The purpose of this analysis is to identify conditions within the watershed that limit the ability of habitat to fully sustain populations of salmonids, and is intended to provide a scientifically credible and clearly documented basis for identifying and prioritizing appropriate habitat restoration projects. In compiling this analysis, the technical advisory group should strive to meet the following four objectives:

- use existing reports and data to the greatest extent possible;
- provide information that is accessible and understandable by non-fish professionals and an interested public;
- identify limiting factors at all appropriate scales;
- identify knowledge and information gaps.

Other activities to be undertaken by the TAG include:

- working with the project evaluation committee to develop project prioritization criteria and an adaptive management strategy for local/regional habitat restoration

programs (including standards and guidance for monitoring and evaluation of individual projects);

- providing technical support and guidance for priority projects.

In February of 1999, the Technical Advisory Group (TAG) for Water Resource Inventory Area (WRIA) 30 convened and initiated the development of a Limiting Habitat Factors Analysis for the Klickitat Watershed. The WRIA 30 TAG includes the following participants:

Kevin Lautz, Regional Technical Coordinator, Washington Conservation Commission

Bill Weiler, Regional Volunteer Coordinator, Washington Department of Fish and Wildlife

Lori Zoller, Watershed Coordinator, Klickitat County

Carl Dugger, Area Habitat Biologist, Washington Department of Fish and Wildlife

David Clayton, District Manager, Eastern and Central Klickitat Conservation Districts

Steve Stampfli, District Manager, Underwood Conservation District

David Kreft, District Conservationist, Natural Resources Conservation Service

Tom Tasto, Soil Conservation Technician, Natural Resources Conservation Service

Bill Sharp, Habitat Biologist, Yakama Nation

Mike Blakely, District Conservationist, Natural Resources Conservation Service

Richard Visser, Habitat Biologist, Yakama Nation

Larry Bellamy, City Planner, City of Goldendale

This first version of the LHFA is limited in its consideration to anadramous fish in the Klickitat Watershed only. The next version (anticipated completion early fall, 1999) will extend the analysis to fish-bearing streams in the adjoining WRIA 31 (Rock/Glade), include consideration of bull trout (*Salvelinus confluentus*), and will incorporate new information on habitat, water quality, and forest practices that is anticipated to be made shortly.

B. SETTING

Landscape

The Klickitat **W**ater **R**esources **I**nventory **A**rea (WRIA 30) encompasses the Klickitat River watershed, plus numerous small tributaries draining into the Columbia River between the mouth of the Klickitat River and the mouth of Rock Creek to the east (Map B1). These small tributaries are not known have any significant fish use, and were excluded from this analysis.

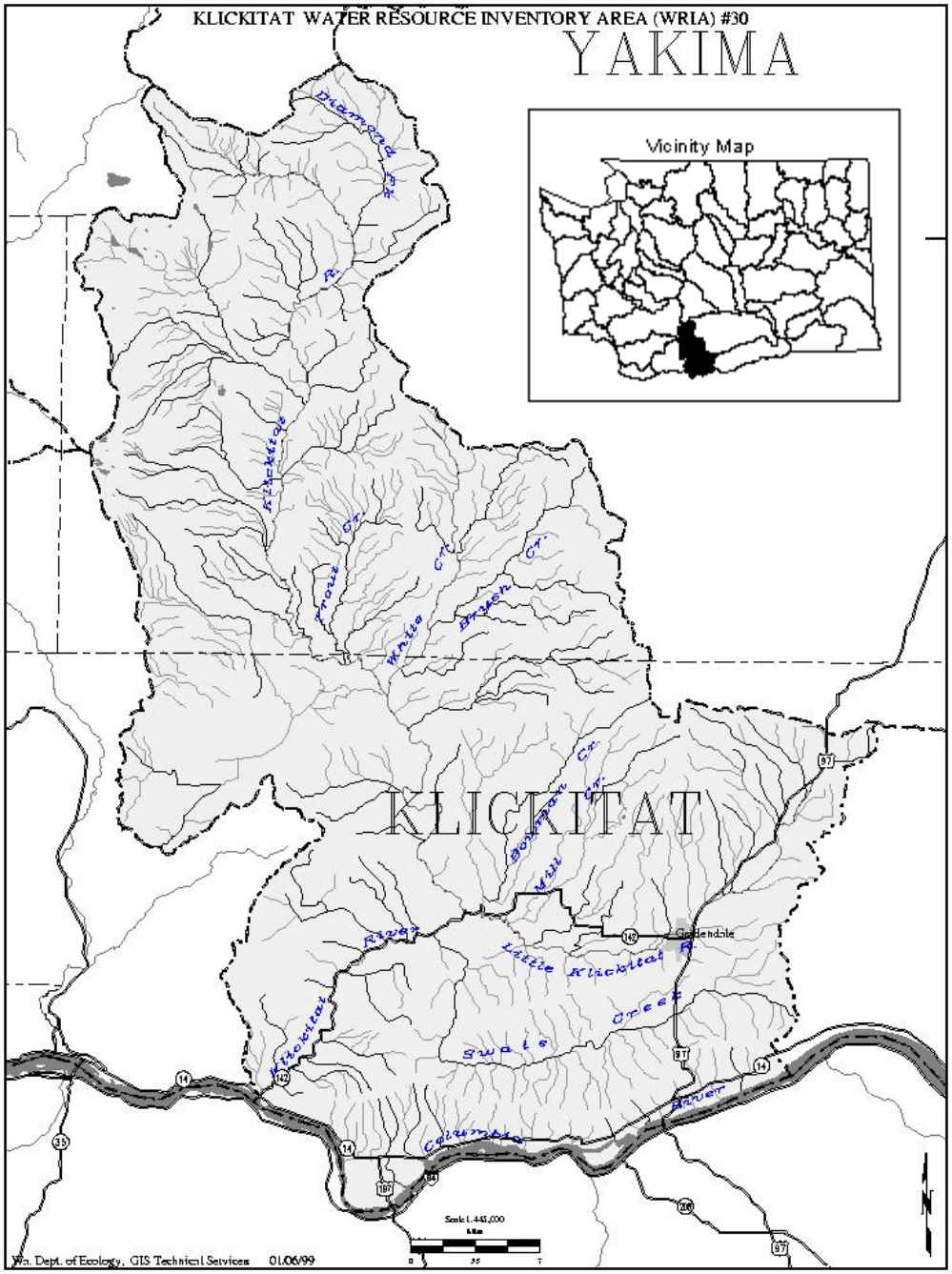
The Klickitat River watershed has a drainage area of 1350 square miles and is located along the eastern slope of the Cascade Range, immediately north of the Columbia River. The landscape consists primarily of a plateau of volcanic origin dissected by canyons carved by the watershed's network of rivers and streams; this plateau descends steeply to the Columbia River on its southern margin, and is bounded by the Cascade range to the north and west and the Simcoe Mountains to the northeast. Elevations range from 74 feet at the Columbia River to over 12000 feet at the summit of Mount Adams; most of the basin occurs between 1500 and 5000 feet elevation.

The geology of the watershed is dominated by extensive basalt flows having a total thickness of several thousand feet (Cline 1976). The erosion-resistant nature of these flows has resulted in the creation of deep (700 to 1500 feet), steep-walled canyons and has severely constrained alluvial floodplain development over most of the watershed. Local variations in erosion resistance of these flows have resulted in the formation of cascades and waterfalls along the mainstem and in many of the tributaries.

The mainstem Klickitat River arises from the Cascades at approximately 5000 feet elevation below Cispus Pass and flows for approximately 95 miles to the Bonneville Pool (elevation 74 feet) at river mile (RM) 180.4 on the Columbia River. Channel gradients vary from 0.4 to 0.8 percent downstream of the hatchery (RM 42.4), between 1 and 2 percent above the hatchery to just beyond Diamond Fork (RM 78), and to 0.5 percent or less to the upper extent of McCormick Meadow (RM 85). Above McCormick Meadow, channel gradient abruptly increases to 8 percent or greater to the headwaters. Two notable gradient "discontinuities" on the mainstem are Lyle Falls (RM 2.2), which is a series of five falls ranging from 4 to 12 feet in height, and Castile Falls (RM 64.0 to 64.5), which is a series of 11 falls having a total elevation change of approximately 80 feet.

Major tributaries to the mainstem include Swale Creek (RM 17.2), Little Klickitat River (RM 19.8), Outlet Creek (RM 39.7), Big Muddy Creek (RM 53.8), W. Fk. Klickitat River (RM 63.1), and Diamond Fork (RM 76.8). Below Castile Falls, most tributaries have short (less than 100 feet) to medium-length (several miles) low gradient reaches along the valley floor, followed by a falls and/or a moderate- to high gradient (greater than 4%) reach that continues until the tributary attains the plateau, where gradients typically decrease to less than 0.5%.

Map B1. Klickitat Water Resources Inventory Area (WRIA 30).



Climate

Climate over the entire watershed can be characterized as a hybrid of those typically found on either side of the Cascade Range; while the watershed lies on the east side of the Cascades and is subject to the continental climate which typically occurs in that area, its position at the head of the Columbia River gorge insures a stronger marine influence than would be found further to the east. This, combined with the effects of variations in elevation over the watershed, results in a noticeable climatic gradient as one moves from the north and west (cooler, wetter) of the watershed to the south and east (hotter, drier).

Summers are typically hot and dry throughout the watershed; winters are typically cold and wet. Average temperatures in the summer range from 55°F in the far north and west portions of the watershed to 70°F in the southeast. Average winter temperatures range from 25°F in the north and west to 37°F in the south. Annual precipitation ranges from 140 inches on Mount Adams, to 90 inches at lower elevations to the north and west, to 35 inches in the Simcoe Mountains, down to as little as 15 inches in the southeast plateau. Generally, about 75-85% of the precipitation falls between November and May; at higher elevations, much of this occurs as snow, forming a persistent snowpack which can provide runoff to some of the tributaries and the mainstem far into the drier portion of the year.

Land Use

The Klickitat watershed is approximately equally divided between Klickitat and Yakima counties. The Yakama Nation Reservation occupies the northern part of the watershed, encompassing 56% of the total watershed area, including the entire portion within Yakima County. Outside of the reservation, approximately 90% of the land is privately held, 10% of the land is state-owned (Department of Natural Resources, Department of Fish and Wildlife), and less than 1% is federally owned (Bureau of Land Management).

Land use is well correlated with climate, vegetation, and topography. Approximately 75% of the watershed is forested; these areas are generally characterized by steep topography considered unsuitable for agriculture. Most of this forestland is managed for commercial timber production; major landowners include the Yakama Nation, Washington Department of Natural Resources, Champion International, and Boise Cascade. These forest lands are also considered suitable for grazing, and most currently have active grazing allotments.

Most of the rest of the watershed is agricultural land, dedicated primarily to orchards, hay, and pasture. Agricultural use is concentrated in the Glenwood/Camas Prairie area in the western part of the watershed, and on the southeastern plateau, where climatic conditions do not support establishment and growth of commercial timber species outside of riparian areas. Approximately 25% of the arable land is irrigated, primarily in the Glenwood/Camas Prairie area (Outlet Creek drainage), along the Little Klickitat River near Goldendale, and in the upper Swale Creek drainage.

Total human population within the watershed is approximately 16,000. Urban development is limited to the city of Goldendale (population 3500) and unincorporated towns of Klickitat, Lyle, and Glenwood. Rural residential use is found primarily along the main thoroughfares (SR 142 and US 97). In total, these areas constitute less than one-half of one percent of the total watershed area.

C. DESCRIPTION OF SPECIES AND STOCKS

Background

The Klickitat River watershed supports two of the five species of Pacific salmon (chinook, coho) in addition to steelhead (the anadramous form of rainbow trout). These include three chinook stocks (spring, tule, upriver bright), one coho stock, and two steelhead stocks (summer, winter).

Spring chinook and summer steelhead are known to have existed historically in the watershed; winter steelhead ("discovered" in the early 80's) are presumed to have existed historically. Tule fall chinook and coho were introduced in the late 1940's and early 1950's, with the Washington Department of Fisheries Hatchery (1950), and construction of the fishway at Lyle Falls (1952). Upriver bright fall chinook were "discovered" in 1989, and are also considered an introduced stock.

Hatchery production dominates natural production for chinook and coho, and has resulted in some hybridization of the native spring chinook stock. Escapements for these species have been managed to provide for hatchery requirements, with no allowance for natural production (Hymer, et al. 1992).

Chinook *(Onchorynchus tshawytscha)*

Spring Chinook

General. Spring chinook are known to have existed historically in the Klickitat watershed. Bryant (1949) cited reports of large runs of spring chinook and a significant Indian fishery at Lyle Falls (RM 2.2) prior to about 1920; he also cited reports that spring chinook once spawned in the West Fork of the Klickitat River (RM 63.1).

This stock is considered to be of mixed origin and is sustained by both hatchery and natural production. Hatchery production began in 1950 with the release of 11,900 yearlings of unknown origin. Most of the brood stock has been of native origin, though some hybridization with Carson, Willamette, and Cowlitz hatchery stocks has occurred. Genetic stock identification indicates that this stock is most closely related to Yakima spring chinook stocks (WDF and WDW 1993). A remnant native, naturally-spawning sub-population is believed to exist above the hatchery (Howell et al. 1985); however, most of the natural spawners in the watershed are considered to be hatchery strays.

Currently, total smolt production is dominated by the hatchery component; current production goals are 750,000 smolts, while estimated natural production is on the order of 15,000 smolts (NWPPC, 1990). While some outplanting of excess fry and

parr have occurred in the watershed, most artificial production is of smolts released at the hatchery.

Phenology (see Figure C1). Adults enter the Columbia in March and April, passing through Bonneville Dam from mid-April to mid-May. They enter the watershed shortly after that, with migration past Lyle Falls peaking in May and June. The adults hold in the mainstem until mid to late August, when spawning begins. Spawning peaks in late August and early September, and will continue until mid- to late October.

There is no information on juvenile life histories specific to this watershed. Based on juvenile development in the hatchery, fry are believed to emerge in late November through early December, and will rear through the following winter. Smoltification and out-migration are believed to occur from late March through April.

Stock Status. Spring chinook are identified as a depressed stock in the 1993 SASSI report (WDF and WDW 1993), due to chronically low adult returns. For the period 1977-1997, estimated natural escapement (based on spawning ground surveys) has ranged from 63 (1980, 1983) to 1108 (1988) adults, with a mean of 244 adults (Figure C2).

Spawning distribution (see Map C1). Spring chinook spawn almost exclusively in the mainstem of the Klickitat River. The main spawning area extends from Parott's Bridge (RM 49) to Castile Falls (RM 64.0), which is recognized as the historical upper limit of anadramous distribution. Other identified spawning areas include the mainstem from Castile Falls to McCormick Meadows (RM 84.0) and the W. Fork of the Klickitat River up to an impassable falls at RM 4.6. Spawning above Castile Falls was made possible by construction of tunnels and fishways, but utilization is extremely limited due to the continued difficult passage (see Access section).

Rearing distribution (see Map C1). Spring chinook juveniles rear in all the areas where spawning occurs. In addition, some rearing near the mouths of larger tributaries is assumed to occur; for example, juvenile spring chinook have been found near the mouths of the Little Klickitat River, Summit Creek, White Creek, and Trout Creek (B. Sharp, pers. comm.). The assumed upper extent for rearing within the mainstem is at RM 87.5, where the gradient decreases from 8.0 % to 0.5%.

Figure C1. Phenology chart for Klickitat River spring chinook.

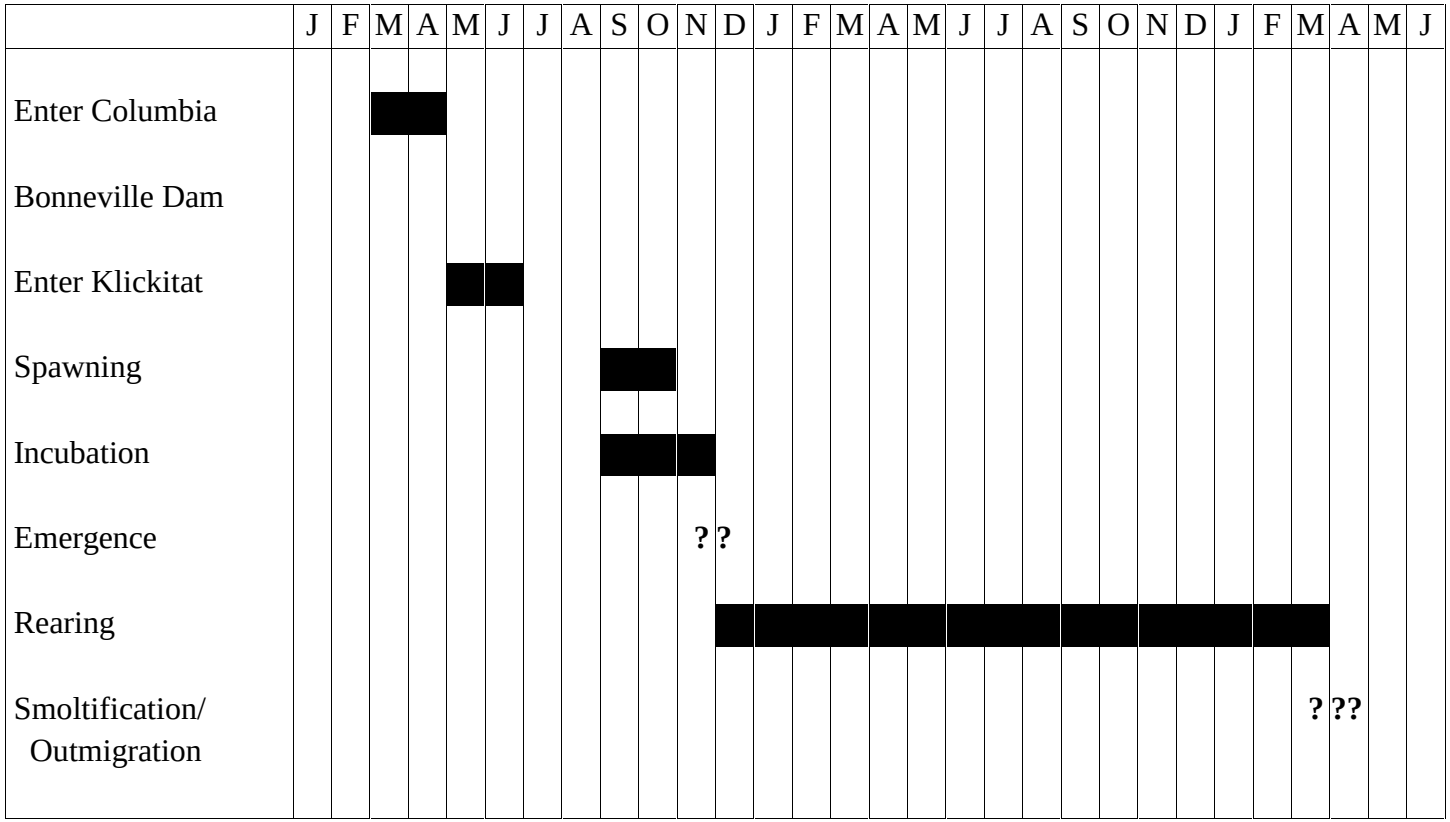
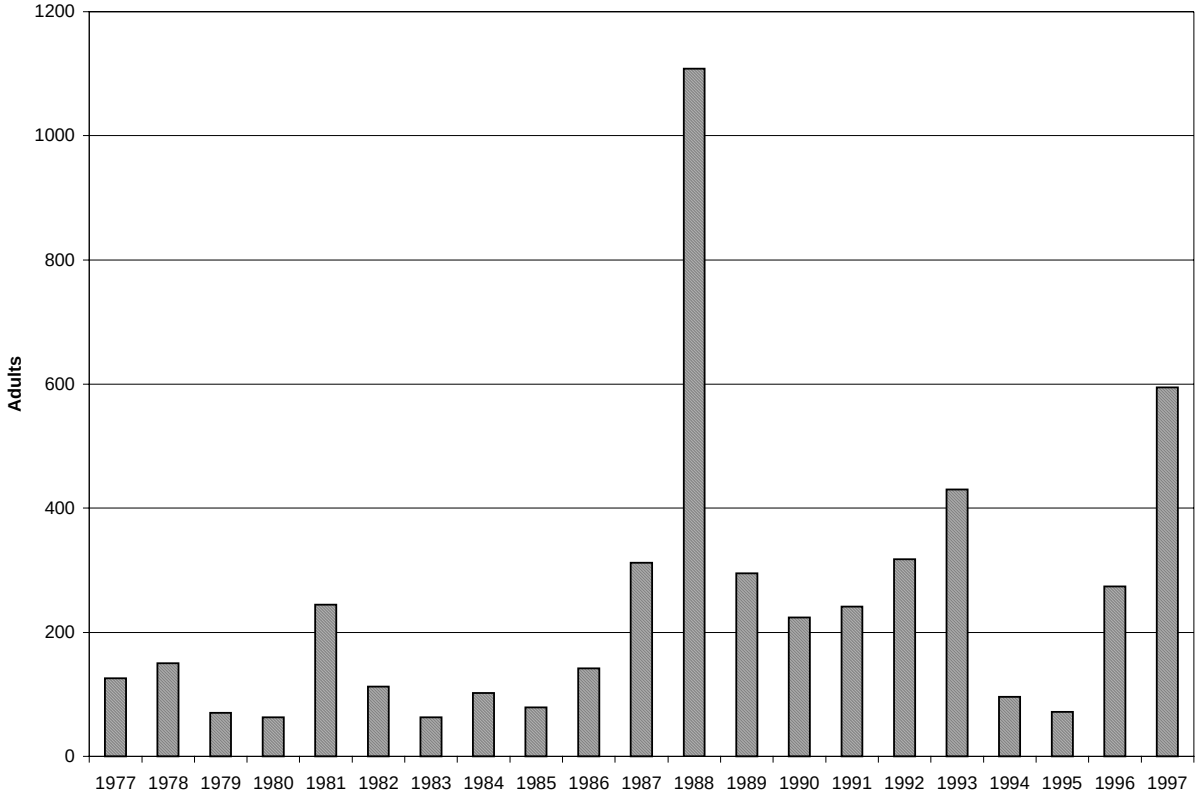
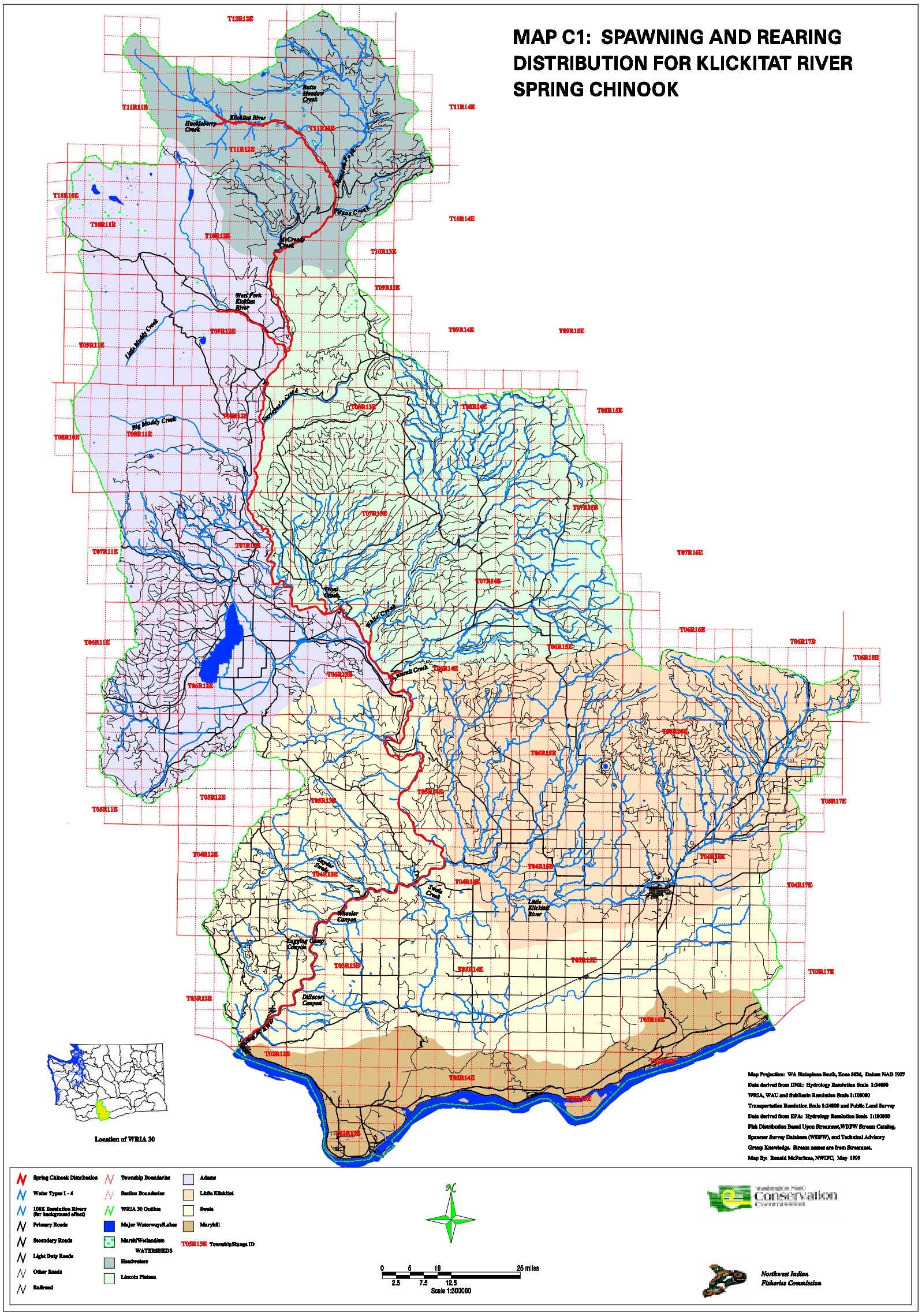


Figure C2. Estimated natural escapement of spring chinook to Klickitat River, 1977 – 1997.




MAP C1: SPAWNING AND REARING DISTRIBUTION FOR KLICKITAT RIVER SPRING CHINOOK
Klickitat River
Huckleberry Creek
Butts Meadow Creek
Pitcher Creek
McCready Creek
West Fork Klickitat River
Little Muddy Creek
Big Muddy Creek
Swartwood Creek
Trout Creek
White Creek
Spring Creek
Swale Creek
Little Klickitat River
Wheeler Canyon
Jagging Gang Canyon
Dillacort Canyon
Location of WRIA 30
Map Projection: WA State Plane South, Zone 5626, Datum NAD 1927
Data derived from DNR: Hydrology Resolution Scale 1:24000
WRIA, WAU and SubBasin Resolution Scale 1:100000
Transportation Resolution Scale 1:24000 and Public Land Survey
Data derived from EPA: Hydrology Resolution Scale 1:100000
Fish Distribution Based Upon Streamnet, WDFW Stream Catalog, Spawner Survey Database (WDFW), and Technical Advisory Group Knowledge. Stream names are from Streamnet.
Map By: Ronald McFarlane, NWIFC, May 1999
Spring Chinook Distribution
Water Types 1 - 4
100K Resolution Rivers (for background effect)
Primary Roads
Secondary Roads
Light Duty Roads
Other Roads
Railroad
Township Boundaries
Section Boundaries
WRIA 30 Outline
Major Waterways/Lakes
Marsh/Wetlands/etc
WATERSHEDS
Headwaters
Lincoln Plateau
Adams
Little Klickitat
Swale
Maryhill
T05R13E Township/Range ID
0 5 10 25 miles
2.5 7.5 12.5
Scale 1:300000
Conservation Commission
Northwest Indian Fisheries Commission

Fall Chinook - Early Run (Tule)

General. Prior to 1946, this stock was not found in the Klickitat Watershed; Lyle Falls (RM 2.2) was impassable to chinook at the time the adults arrived in the late summer and early fall. Passage improvements and hatchery production have resulted in establishment of a naturally spawning population in the lower part of the mainstem.

This stock is considered to be of mixed origin and is sustained by both hatchery and natural production. Hatchery plants from outside the watershed first occurred in 1946; releases from the Klickitat hatchery began in 1952 and continued until 1986. Releases have included stocks from Cowlitz, Toutle, Kalama, Washougal, Bonneville, Cascade, and Ringold hatcheries. Since 1986, production has been entirely natural, though probably comprised primarily of hatchery strays. There are no plans to supplement the stock in this watershed.

Phenology (see Figure C3). Tule fall chinook enter the Columbia River from mid-August through September and migrate into the Klickitat watershed during September and October. Spawning occurs shortly after arrival at the spawning grounds.

There is no information on juvenile life histories specific to this watershed.

Stock status. Tule fall chinook are identified as a healthy stock by SASSI (WDF and WDW 1993). For the period 1964 to 1997, estimated natural escapement (based on spawning ground surveys) has ranged from 53 (1985) to 14,934 (1964) adults, with a mean of 2617 adults (Figure C4).

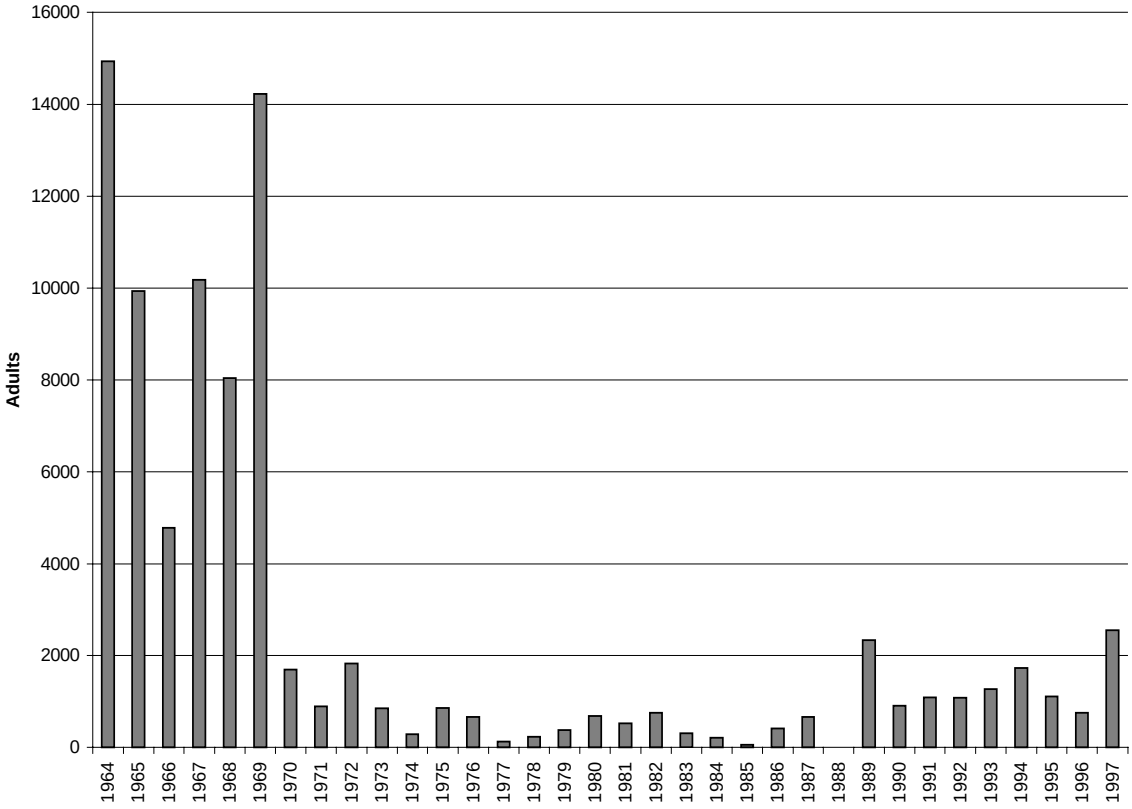
Spawning distribution (see Map C2). Tule fall chinook spawn almost exclusively in the mainstem of the Klickitat River. The main spawning area extends from Maddock Springs (RM 16.8 - also know as Twin Bridges) to the hatchery (RM 42.4). Additional spawning has been observed from Maddock Springs (RM 16.8 - also known as Twin Bridges) to the mouth.

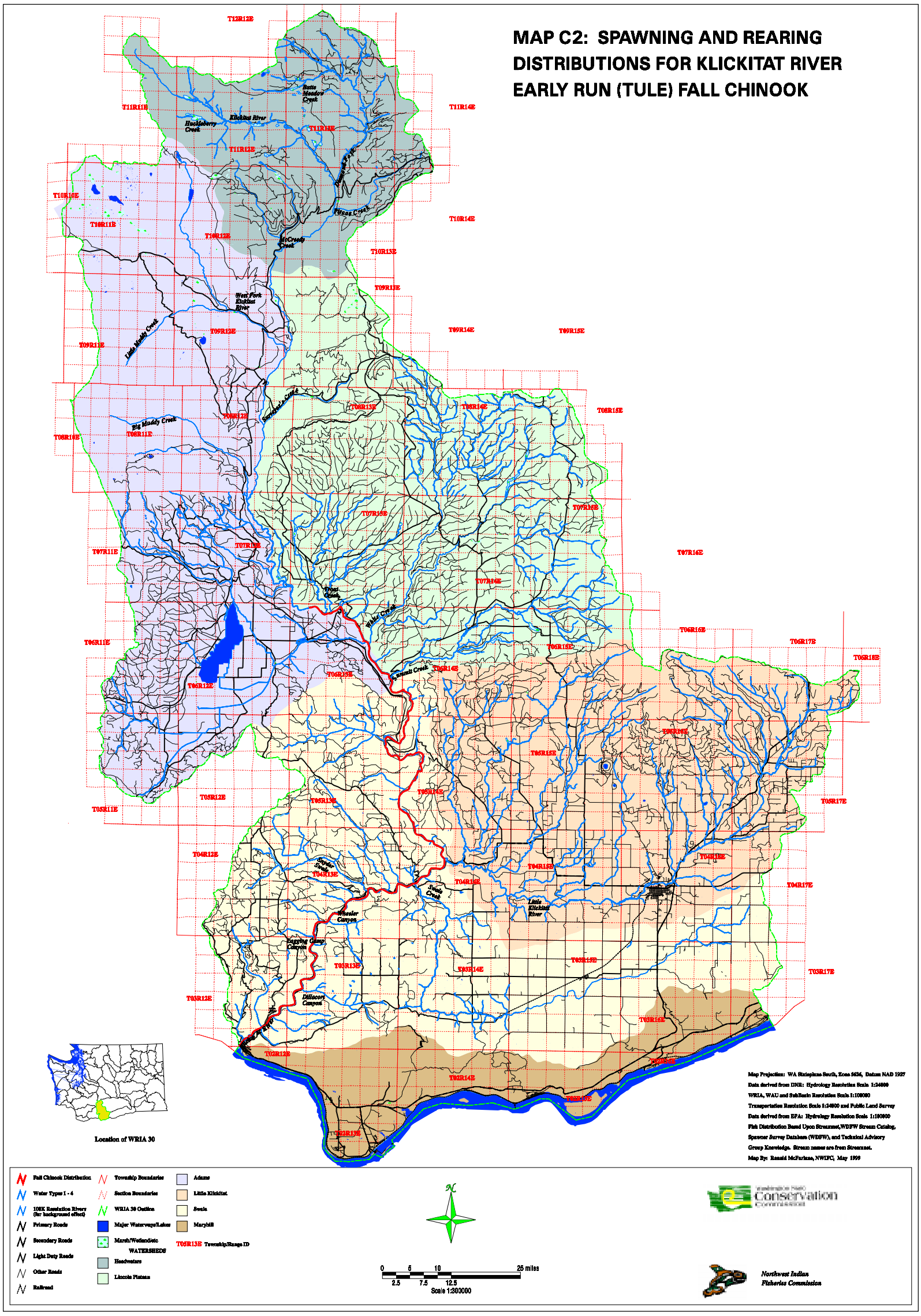
Rearing distribution (see Map C2). Fall chinook juveniles rear in all areas where spawning occurs.

Figure C3. Phenology chart for Klickitat River Early Run Fall Chinook (Tule)

	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
Enter Columbia																														
Bonneville Dam																														
Enter Klickitat									■	■																				
Spawning									■	■																				
Incubation							N	O		I	N	F	O	R	M	A	T	I	O	N		A	V	A	I	L	A	B	L	E
Emergence							N	O		I	N	F	O	R	M	A	T	I	O	N		A	V	A	I	L	A	B	L	E
Rearing							N	O		I	N	F	O	R	M	A	T	I	O	N		A	V	A	I	L	A	B	L	E
Smoltification/ Outmigration							N	O		I	N	F	O	R	M	A	T	I	O	N		A	V	A	I	L	A	B	L	E

Figure C4. Estimated natural escapement of early run (tule) fall chinook to Klickitat River, 1964 – 1997.




MAP C2: SPAWNING AND REARING DISTRIBUTIONS FOR KLICKITAT RIVER EARLY RUN (TULE) FALL CHINOOK
Location of WRIA 30
Map Projection: WA State Plane South, Zone 5626, Datum NAD 1927
Data derived from DNR: Hydrology Resolution Scale 1:24000
WRIA, WAU and SubBasin Resolution Scale 1:100000
Transportation Resolution Scale 1:24000 and Public Land Survey
Data derived from EPA: Hydrology Resolution Scale 1:100000
Fish Distribution Based Upon Streamnet, WDFW Stream Catalog,
Spawner Survey Database (WDFW), and Technical Advisory
Group Knowledge. Stream names are from Streamnet.
Map By: Ronald McFarlane, NWIFC, May 1999
Fall Chinook Distribution
Water Types 1 - 4
100K Resolution Rivers (for background effect)
Primary Roads
Secondary Roads
Light Duty Roads
Other Roads
Railroad
Township Boundaries
Section Boundaries
WRIA 30 Outline
Major Waterways/Lakes
Marsh/Wetland/etc
WATERSHEDS
Headwaters
Lincoln Plateau
Adams
Little Klickitat
Swale
Marybill
T05R13E Township/Range ID
0 5 10 25 miles
2.5 7.5 12.5
Scale 1:300000
Conservation Commission
Northwest Indian Fisheries Commission

Fall Chinook - Late Run (Upriver Bright)

General. Naturally spawning upriver bright fall chinook were discovered in the Klickitat Watershed in 1989. Natural production is likely from hatchery strays.

This stock is of non-native origin and is sustained by hatchery production. Hatchery releases commenced in 1987, using eggs from Priest Rapids and Bonneville upriver bright stocks. Very few adults from these releases have returned to the hatchery, preferring instead to spawn in the lower river.

Phenology (see Figure C5). Adults migrate into the Klickitat watershed from mid-August to mid-October, and will hold in the mainstem until ready to spawn in October and November.

There is no information on juvenile life histories specific to this watershed.

Stock status. Upriver bright fall chinook are identified as a healthy stock in the SASSI report (WDF and WDW 1993). For the period 1989 to 1997, estimated natural production (based on spawning ground surveys) has ranged from 253 (1989) to 5,699 (1997) adults, with a mean of 2636 adults (Figure C6).

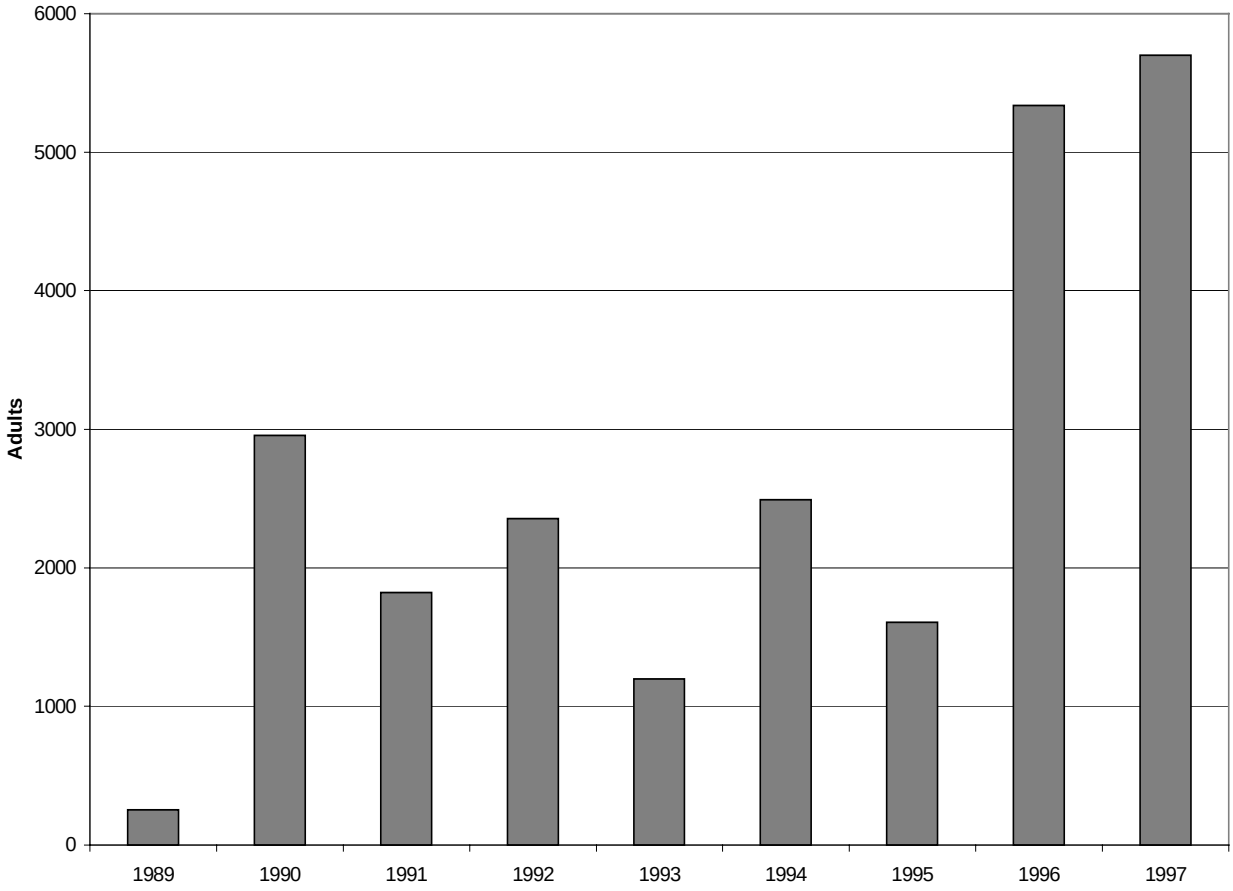
Spawning distribution (see Map C3). Fall chinook spawn almost exclusively in the mainstem of the Klickitat River. The main spawning area extends from Maddock Springs (RM 16.8 - also know as Twin Bridges) to the hatchery (RM 42.4). Additional spawning has been observed from Maddock Springs to the mouth.

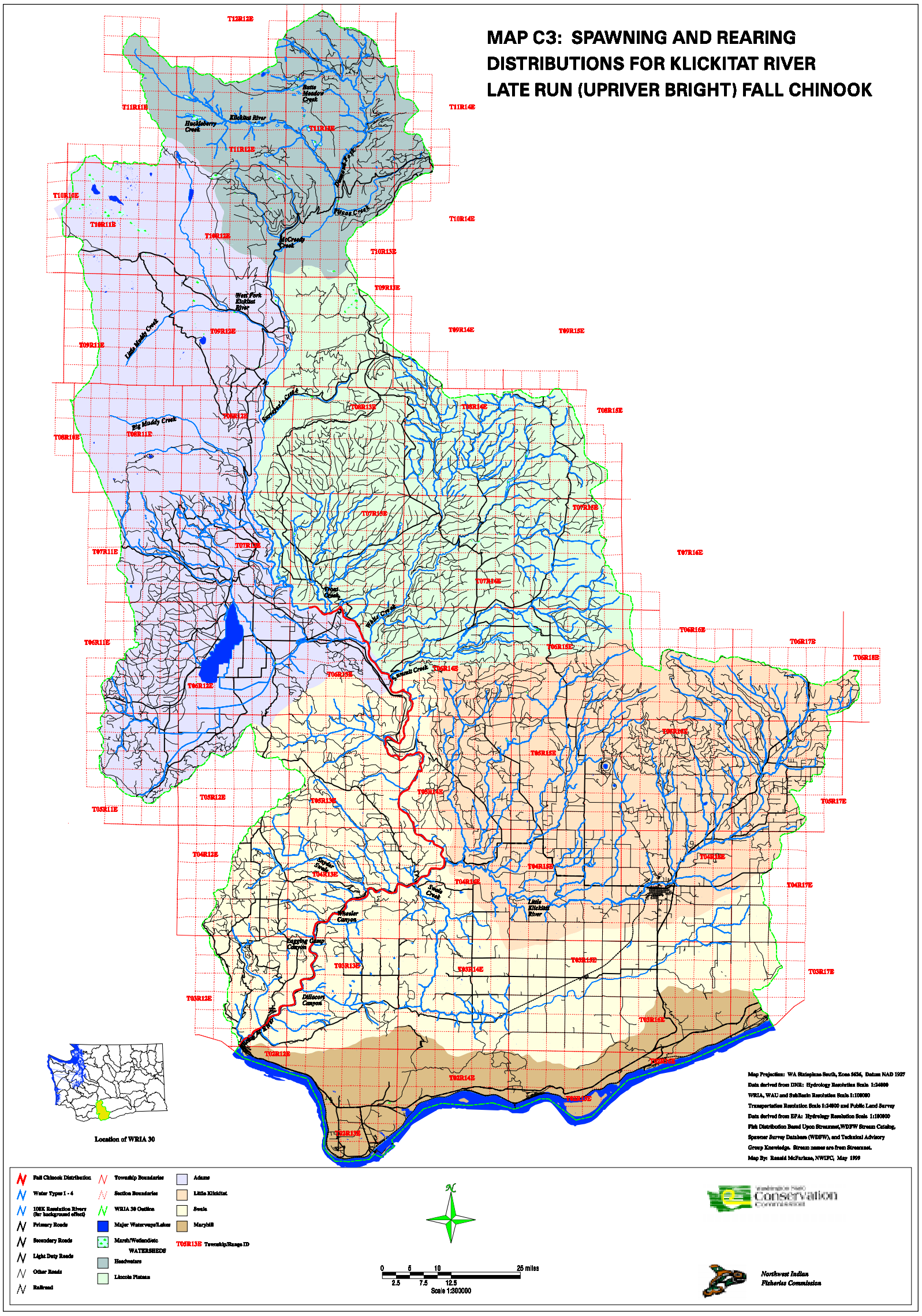
Rearing distribution (see Map C3). Fall chinook juveniles rear in all the areas where spawning occurs.

Figure C5. Phenology chart for Klickitat River Late Run (Upriver Bright) Fall Chinook .

	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
Enter Columbia									■																					
Bonneville Dam																														
Enter Klickitat									■																					
Spawning										■	■																			
Incubation							N	O		I	N	F	O	R	M	A	T	I	O	N		A	V	A	I	L	A	B	L	E
Emergence							N	O		I	N	F	O	R	M	A	T	I	O	N		A	V	A	I	L	A	B	L	E
Rearing							N	O		I	N	F	O	R	M	A	T	I	O	N		A	V	A	I	L	A	B	L	E
Smoltification/ Outmigration							N	O		I	N	F	O	R	M	A	T	I	O	N		A	V	A	I	L	A	B	L	E

Figure C6. Estimated natural escapement of late run (upriver bright) fall chinook to Klickitat River, 1989 – 1997.




MAP C3: SPAWNING AND REARING DISTRIBUTIONS FOR KLICKITAT RIVER LATE RUN (UPRIVER BRIGHT) FALL CHINOOK
Location of WRIA 30
Map Projection: WA State Plane South, Zone 5626, Datum NAD 1927
Data derived from DNR: Hydrology Resolution Scale 1:24000
WRIA, WAU and SubBasin Resolution Scale 1:100000
Transportation Resolution Scale 1:24000 and Public Land Survey
Data derived from EPA: Hydrology Resolution Scale 1:100000
Fish Distribution Based Upon Streamnet, WDFW Stream Catalog,
Spawner Survey Database (WDFW), and Technical Advisory
Group Knowledge. Stream names are from Streamnet.
Map By: Ronald McFarlane, NWIFC, May 1999
Fall Chinook Distribution
Water Types 1 - 4
100K Resolution Rivers (for background effect)
Primary Roads
Secondary Roads
Light Duty Roads
Other Roads
Railroad
Township Boundaries
Section Boundaries
WRIA 30 Outline
Major Waterways/Lakes
Marsh/Wetland/etc
WATERSHEDS
Headwaters
Lincoln Plateau
Adams
Little Klickitat
Swale
Marybill
T05R13E Township/Range ID
0 5 10 25 miles
2.5 7.5 12.5
Scale 1:300000
Conservation Commission
Northwest Indian Fisheries Commission

Coho (*Onchorynchus kisutch*)

General. Coho are not believed to be native to the Klickitat watershed; Lyle Falls (RM 2.2) was impassable to coho at the time the adults arrived in the late summer and early fall. Passage improvements and hatchery production have resulted in establishment of a small naturally spawning population in the lower part of the mainstem and tributaries.

This stock is of non-native origin is sustained by hatchery production. Hatchery plants were initiated prior to 1952, when releases first occurred from the Klickitat hatchery. Both early-run (Type S) and late-run (Type N) stocks have been released; the former are derived from local hatchery returns and Toutle River stock, while the latter are derived from local hatchery returns and Cowlitz River stock.

Smolt production is dominated by the hatchery component; evidence of natural juvenile production has been sporadic. No attempts at supplementation through outplanting have occurred.

Phenology (see Figure C7). Early-run coho enter the Columbia in mid-August and migrate into the watershed when the mainstem flow increases in response to the first fall rains (anytime from late September through October). Spawning occurs in late October. Late-run coho enter the Columbia in mid-to late September, and migrate into the watershed from late October through November. Spawning occurs from November through March, with a peak from December through early January.

There is no information on juvenile life histories specific to this watershed.

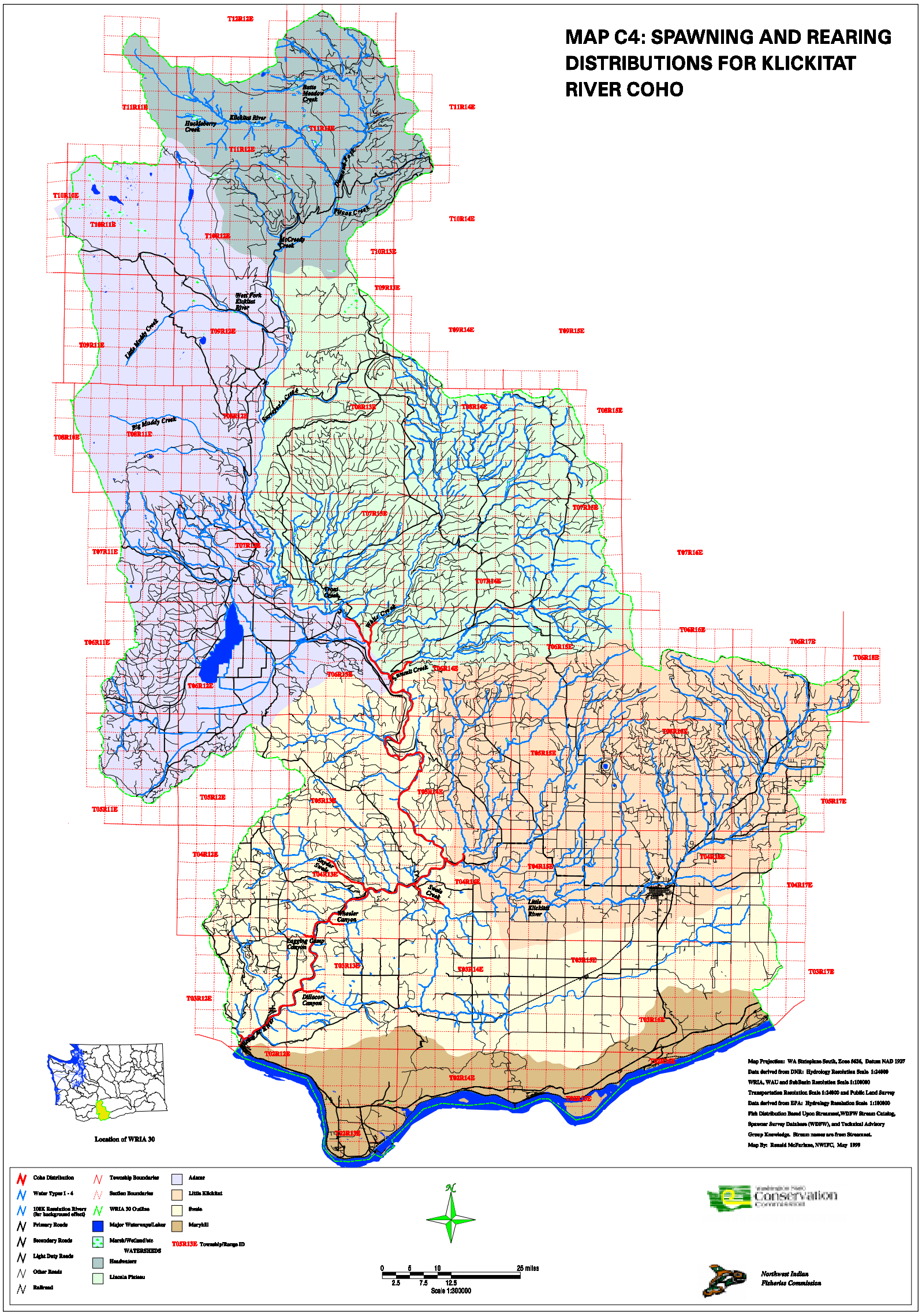
Stock status. Coho are identified as a depressed stock in the 1992 SASSI report (WDF and WDW 1993), due to chronically low adult returns. No data on natural production are available; natural spawning is presumed to be very low, and subsequent juvenile production is far below potential.

Spawning distribution (see Map C4). Limited information on spawning distribution exists; distribution is likely also limited by low numbers of natural spawners. Spawning has been observed in the mainstem from from Maddock Springs (RM 16.8 - also known as Twin Bridges) to the hatchery (RM 42.4). Spawning has also been observed at the lower ends of a number of tributaries, including Dofner Creek (RM 0.3), Swale Creek (RM 17.2) and the Little Klickitat River and Bowman Creek (RM 19.8). Spawning may also occur in Summit Creek (RM 37.3) and White Creek (RM 39.6).

Rearing distribution (see Map C4). Very limited information exists on rearing distribution; distribution is likely also limited by low natural production. Coho juveniles are assumed to rear in all areas where spawning occurs.

Figure C7. Phenology chart for Klickitat River Coho.

	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
Enter Columbia																														
Early																														
Late																														
Enter Klickitat																														
Early																														
Late																														
Spawning																														
Early																														
Late																														
Incubation							N	O		I	N	F	O	R	M	A	T	I	O	N		A	V	A	I	L	A	B	L	E
Emergence							N	O		I	N	F	O	R	M	A	T	I	O	N		A	V	A	I	L	A	B	L	E
Rearing							N	O		I	N	F	O	R	M	A	T	I	O	N		A	V	A	I	L	A	B	L	E
Smoltification/ Outmigration							N	O		I	N	F	O	R	M	A	T	I	O	N		A	V	A	I	L	A	B	L	E


MAP C4: SPAWNING AND REARING DISTRIBUTIONS FOR KLICKITAT RIVER COHO
Location of WRIA 30
Map Projection: WA Stateplane South, Zone 5626, Datum NAD 1927
Data derived from DNR: Hydrology Resolution Scale 1:24000
WRIA, WAU and SubBasin Resolution Scale 1:100000
Transportation Resolution Scale 1:24000 and Public Land Survey
Data derived from EPA: Hydrology Resolution Scale 1:100000
Fish Distribution Based Upon Streamnet,WDFW Stream Catalog,
Spawner Survey Database (WDFW), and Technical Advisory
Group Knowledge. Stream names are from Streamnet.
Map By: Ronald McFarlane, NWIFC, May 1999
Coho Distribution
Water Types 1 - 4
100K Resolution Rivers (for background effect)
Primary Roads
Secondary Roads
Light Duty Roads
Other Roads
Railroad
Township Boundaries
Section Boundaries
WRIA 30 Outline
Major Waterways/Lakes
Marsh/Wetland/etc
WATERSHEDS
Headwaters
Lincoln Plateau
Adams
Little Klickitat
Swale
Marybill
T05R13E Township/Range ID
0 5 10 25 miles
2.5 7.5 12.5
Scale 1:300000
Conservation Commission
Northwest Indian Fisheries Commission

Steelhead (*Onchorynchus mykiss*)

Summer steelhead

General. Summer steelhead are known to have existed historically in the Klickitat watershed. Bryant (1949) cites a report indicating "a fairly good run of spring steelhead" in the river.

This stock is considered to be of natural origin and is sustained by natural production. No steelhead production occurs at the hatchery, although hatchery plants of summer steelhead from the Skamania hatchery have occurred since 1980. There is some concern about interbreeding between the hatchery and wild stocks (WDF and WDW, 1993).

Phenology (see Figure C8). Adults enter the watershed from April through December with migration peaking from July through October. They hold in the mainstem or in tributaries until the spawning period, which occurs between January and March or April.

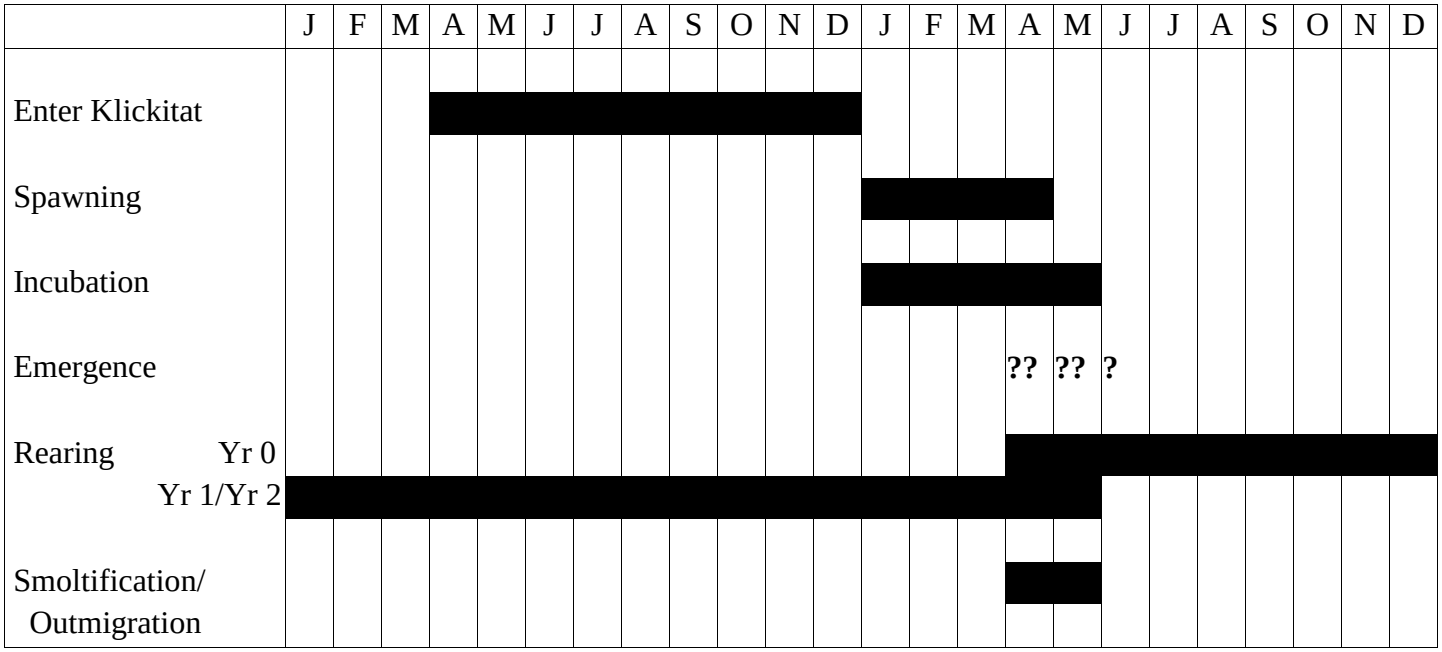
Little information is available on juvenile life histories specific to this watershed; timings are inferred from those of nearby stocks and smolt sampling on the mainstem conducted by WDW in 1990. Fry are believed to emerge from April through mid-June, and will rear for two years. Smoltification and out-migration occur in April and May, peaking in early May.

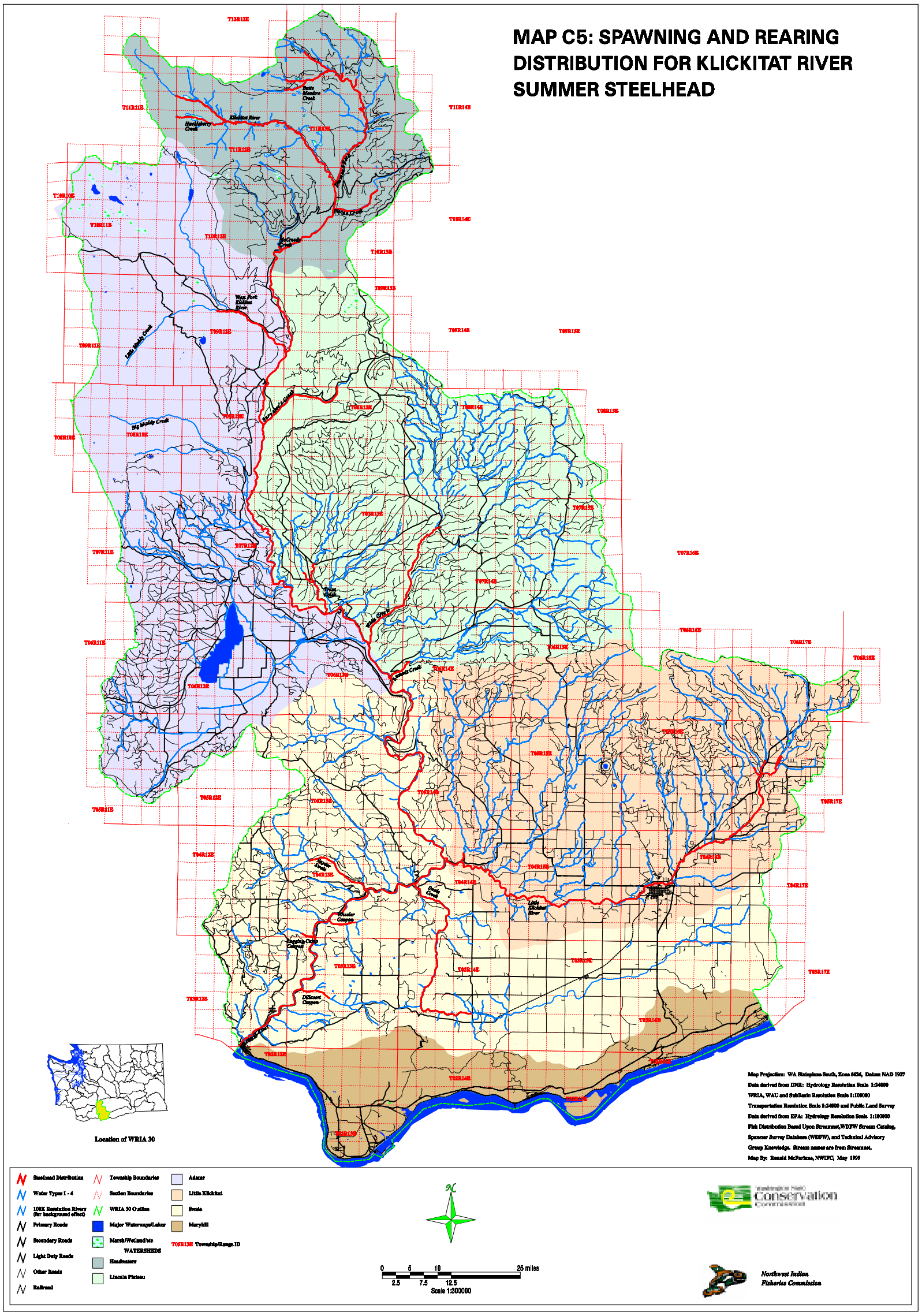
Stock status. The 1992 SASSI report (WDF and WDW, 1993) indicated that the stock status for summer steelhead is unknown. Limited spawner survey work conducted from 1980 through 1985 indicates very low utilization of the spawning habitat. Estimated total escapement based on these surveys ranged from 1335 (1985) to 5972 (1981) adults, with an average escapement of 2712 adults; natural escapement was estimated to be approximately one-third of total escapement (Hymer et al. 1992).

This stock is also a part of the Mid-Columbia Evolutionarily Significant Unit (ESU) for steelhead, which has been listed as "threatened" under the Endangered Species Act. This ESU includes all steelhead stocks in the Columbia River basin from Mosier Creek to the Yakima River, inclusive (NMFS, 1996).

Spawning distribution (see Map C5). Summer steelhead spawn throughout the mainstem Klickitat River and in the lower reaches of most of the major tributaries, including Swale Creek (RM 17.2) Little Klickitat River and Bowman Creek (RM 19.8), Summit Creek (RM 37.3), White Creek (RM 39.6), Trout Creek (RM 43.4), Piscoe Creek Creek (RM 75.1) and Diamond Fork (RM 75.1). Spawning above Castile Falls is was made possible by construction of tunnels and fishways, but utilization is extremely limited due to the continued difficult passage (see Access section).

Figure C8. Phenology chart for Klickitat River summer steelhead.




MAP C5: SPAWNING AND REARING DISTRIBUTION FOR KLICKITAT RIVER SUMMER STEELHEAD
Location of WRIA 30
Map Projection: WA Stateplane South, Zone 5626, Datum NAD 1927
Data derived from DNR: Hydrology Resolution Scale 1:24000
WRIA, WAU and SubBasin Resolution Scale 1:100000
Transportation Resolution Scale 1:24000 and Public Land Survey
Data derived from EPA: Hydrology Resolution Scale 1:100000
Fish Distribution Based Upon Streamnet,WDFW Stream Catalog,
Spawner Survey Database (WDFW), and Technical Advisory
Group Knowledge. Stream names are from Streamnet.
Map By: Ronald McFarlane, NWIFC, May 1999
Steelhead Distribution
Water Types 1 - 4
100K Resolution Rivers (for background effect)
Primary Roads
Secondary Roads
Light Duty Roads
Other Roads
Railroad
Township Boundaries
Section Boundaries
WRIA 30 Outline
Major Waterways/Lakes
Marsh/Wetland/etc
WATERSHEDS
Headwaters
Lincoln Plateau
Adams
Little Klickitat
Swale
Marybill
T08R13E Township/Range ID
0 5 10 25 miles
2.5 7.5 12.5
Scale 1:300000
Conservation Commission
Northwest Indian Fisheries Commission

Rearing distribution (see Map C5). Very limited information exists on rearing distribution; distribution is likely also limited by low natural production. Steelhead juveniles are assumed to rear in all areas where spawning occurs.

Winter steelhead

General. The existence of a winter steelhead stock has been inferred from bright steelhead observed in late winter and early spring steelhead catches (Howell, et al 1985).

This stock is considered to be of natural origin and is sustained by natural production. No steelhead production occurs at the hatchery, although hatchery plants of summer steelhead from the Skamania hatchery have occurred since 1980.

Phenology(see Figure C9). Adults enter the watershed from January through May, peaking in March. They hold in the mainstem or in tributaries until the spawning period, which occurs between March and June.

Little information is available on juvenile life histories specific to this watershed; timings are inferred from those of nearby stocks. Fry are believed to emerge from April through mid-June, and will rear for two years. Smoltification and out-migration occur in April and May, peaking in early May.

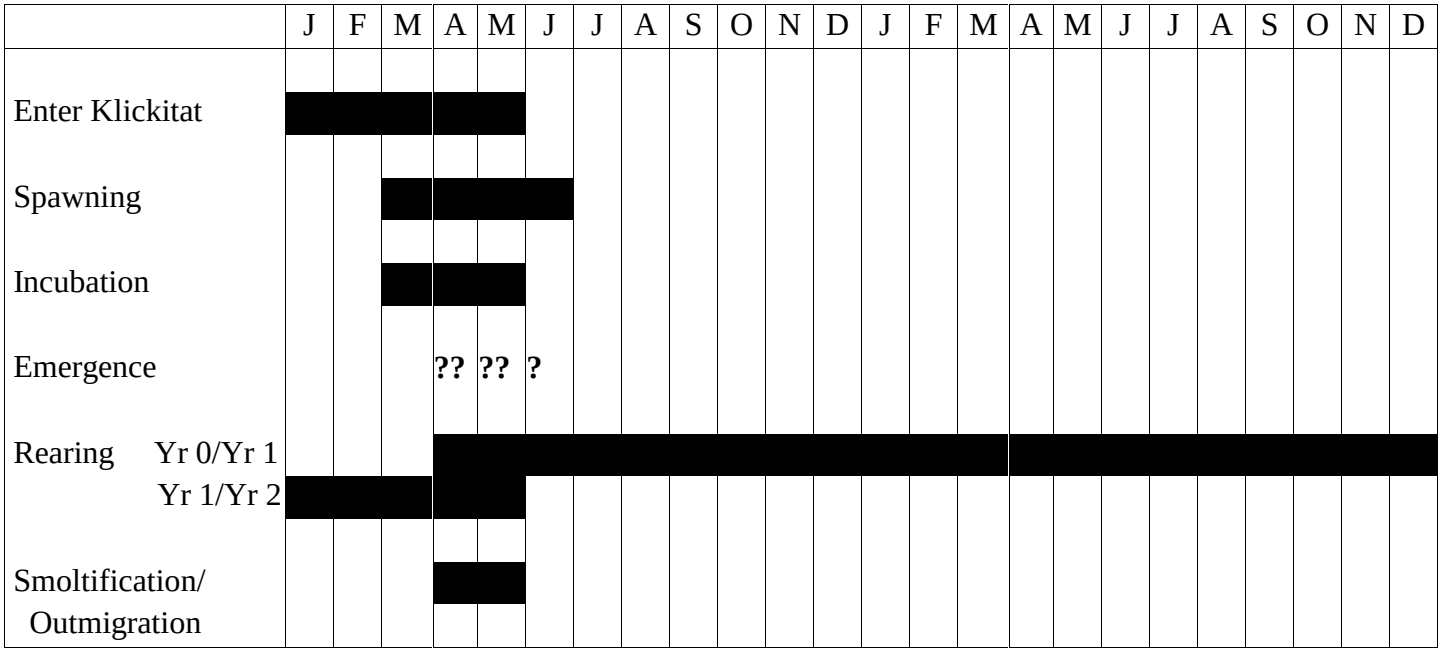
Stock status. The 1992 SASSI report (WDF and WDW, 1993) indicated that the stock status for winter steelhead is unknown. No escapement or natural production information exists; both are considered to be small.

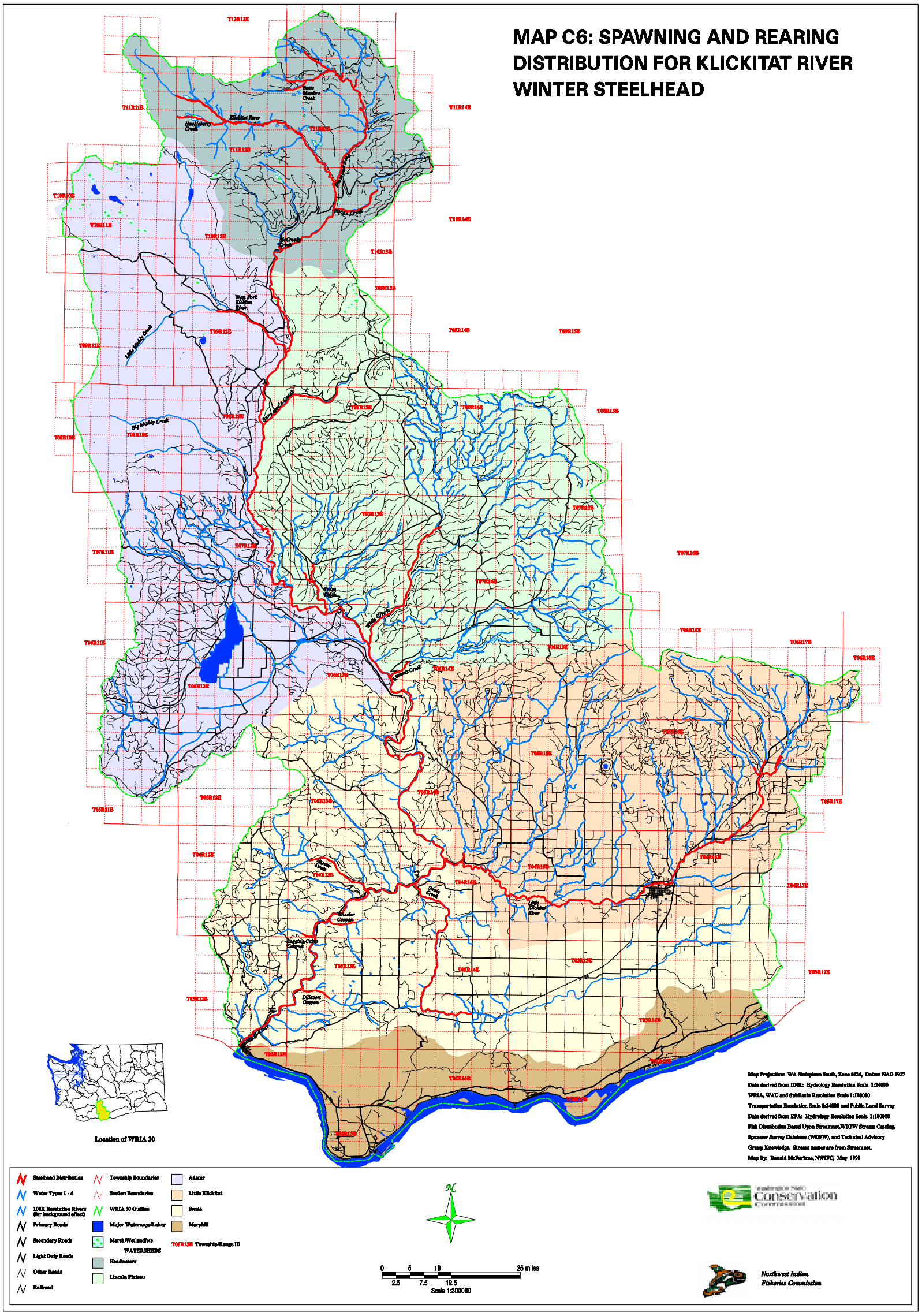
This stock is also a part of the Mid-Columbia Evolutionarily Significant Unit (ESU) for steelhead, which has been listed as “threatened” under the Endangered Species Act. This ESU includes all steelhead stocks in the Columbia River basin from Mosier Creek (Oregon) to the Yakima River, inclusive (NMFS, 1996).

Spawning distribution (see Map C6). No information on winter steelhead distribution is available. It is believed that they spawn in the lower mainstem, perhaps as far upstream as Castile Falls (RM 64.2).

Rearing distribution (see Map C6). No information exists on rearing distribution; distribution is likely also limited by low natural production. Steelhead juveniles are assumed to rear in all areas where spawning occurs.

Figure C9. Phenology chart for Klickitat River winter steelhead.




MAP C6: SPAWNING AND REARING DISTRIBUTION FOR KLICKITAT RIVER WINTER STEELHEAD
Location of WRIA 30
Map Projection: WA Stateplane South, Zone 5626, Datum NAD 1927
Data derived from DNR: Hydrology Resolution Scale 1:24000
WRIA, WAU and SubBasin Resolution Scale 1:100000
Transportation Resolution Scale 1:24000 and Public Land Survey
Data derived from EPA: Hydrology Resolution Scale 1:100000
Fish Distribution Based Upon Streamnet,WDFW Stream Catalog,
Spawner Survey Database (WDFW), and Technical Advisory
Group Knowledge. Stream names are from Streamnet.
Map By: Ronald McFarlane, NWIFC, May 1999
Steelhead Distribution
Water Types 1 - 4
100K Resolution Rivers (for background effect)
Primary Roads
Secondary Roads
Light Duty Roads
Other Roads
Railroad
Township Boundaries
Section Boundaries
WRIA 30 Outline
Major Waterways/Lakes
Marsh/Wetland/etc
WATERSHEDS
Headwaters
Lincoln Plateau
Adams
Little Klickitat
Swale
Marybill
T08R13E Township/Range ID
0 5 10 25 miles
2.5 7.5 12.5
Scale 1:300000
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D. LIMITING FACTORS: ACCESS

Natural structural barriers

Lack of access to potential habitat due to the presence of natural barriers to migration has been identified in previous reports (NWPPC 1990, Hymer et al. 1993) as a major limitation on the production potential of the watershed. Over most of its length, the Klickitat River has carved deep, steep-walled canyons into Columbia River basalt flows; this has two major consequences with respect to access: development of impassable or marginally passable falls and cascades where the river encounters more resistant bedrock, and restricted access to suitable habitat in many tributaries, where impassably high gradients occur close to the tributary confluence with the mainstem. The following is an overview of former and current natural barriers in the watershed (see Figure D1 for location).

Lyle Falls (RM 2.2). This is a series of five falls ranging in height from four to 12 feet. Prior to activities to improve passage, Lyle Falls was considered impassable during low water conditions in the summer and early fall; this effectively prevented fall chinook and coho from utilizing the watershed. In 1952, Washington Department of Fisheries removed rock and constructed two fishways at the falls; this, combined with subsequent planting and hatchery production, allowed these two species to become established. Passage for spring chinook and steelhead was improved as well. Currently, Lyle Falls is not regarded as a barrier to any salmon or steelhead stocks; although passage through the falls is considered "difficult" (BOR, 1990).

Castile Falls (RM 64.0). This is a series of 11 falls with a net elevation change of approximately 80 feet over one-half mile. This is considered the historic upper limit of anadramous fish use on the mainstem. Washington Department of Fisheries blasted obstructions and attempted to build a continuous 3200 foot tunnel; construction difficulties forced design modifications resulting in two shorter tunnels linked with an open fishway. The performance of this project has been deemed marginal, based on low returns above the falls (Hymer et al. 1990). Problems include obstructions at the upstream end, difficult hydraulic conditions at several locations, and the low attraction potential of the unlighted tunnels. Some attempts at addressing these problems (improved maintenance, modifications to improve hydraulic conditions) have occurred; however, performance of the fishway continues to be marginal.

Quality of potential habitat above the falls is very good for steelhead, spring chinook, and coho, perhaps the best in the watershed. Its location far above the hatchery greatly reduces the potential for interaction with hatchery fish, increasing the likelihood of eventual development of true wild stocks.

Little Klickitat River Falls (RM 6.1). This 16-foot falls is regarded as a passable by steelhead (WDW, 1991), but is likely impassable to coho. Habitat quality in the river above the falls is variable; up to approximately RM 18, quality ranges from fair to poor

due to low summer flows, high stream temperature, and grazing impacts to riparian habitat (BOR, 1990). Good to excellent habitat may be found in the mainstem beyond RM 18 and in several tributaries, including Spring Creek (RM 8.6) and East and West Prongs (RM 25.8).

W. Fork Klickitat River Falls (RM 4.6). This 12-foot falls is regarded as a barrier to all species. Habitat quality above the falls is considered fair to poor due to high gradients and high sediment loads from alpine glaciers, and cold (<6°C) water temperatures year-round.

Artificial structural barriers

Klickitat Hatchery Weir (RM 42.4). This is regarded to be a potential barrier to spring chinook under certain conditions. It is surmised that, in years of high hatchery returns, surplus hatchery fish congregating below the weir are not attracted by the wide and thin sheet of water spilling over the weir crest during the mid- to late summer and may not continue upriver to spawn naturally (BPA, 1990).

Snyder Creek: Old Champion Mill Sluiceway. This 2400 foot concrete sluiceway is part of the abandoned Champion Mill complex, and forms a depth and/or velocity barrier to all anadramous species. Three to four miles of high quality habitat for coho and steelhead exist above the barrier.

Road Culverts. Numerous road culverts throughout the watershed have been identified as actual or potential barriers. The Washington State Department of Transportation (WSDOT) has identified 11 culverts as barriers in their survey of state highways. These include four culverts on unnamed tributaries to the Little Klickitat River and US 97 (MP18.4, MP 23.95, MP25.45, MP 25.6), one on a tributary to Butler Creek and US 97 (MP 21.2), three on unnamed tributaries to the Columbia River and US 97 (MP 1.8, MP 2.1, and MP 5.1), two on Knight Creek and SR 142 (MP 3.2 and 5.1) and one on Dillacourt Creek and SR 142 (MP 5.1). In addition, culverts on White Creek and Trout Creek traversed by logging roads within the reservation have been identified as potential barriers.

Low Flow/Thermal Barriers

Swale Creek (RM 0.0 – RM 12.0). Swale Creek flows through the driest portion of the watershed (15 inches mean annual precipitation), and is diverted for irrigation (3 cfs total) in its upper reaches. During the summer, streamflow typically dimishes to less than 0.5 cfs, while stream temperatures may exceed 70°F, effectively reducing the available habitat to a series of stagnant pool and short reaches of intermittent flow and effectively precluding migration of juveniles through the area. Fair to good spawning and rearing habitat for steelhead and coho exists in this stream up to RM 12.

Little Klickitat River (RM 15.0 – RM 17.0). This section of the Little Klickitat River is subject to the diversion of essentially all its water at the town of Goldendale (DOE, 1997). Flows in the range of 1-3 cfs are common from June through January. It is uncertain to what extent migration may be limited by this condition, but any restrictions are believed to occur only with juvenile steelhead.

Key factors limiting habitat productivity

(Note: Refer to Map LF1 for the location of limiting factors identified in this section. Order of factors listed below does not imply priority.)

ACC-1: Poor design and operation of fishway/fish tunnel complex at Castile Falls (RM 64.0-64.5). A study funded by the Bonneville Power Administration to evaluate and recommend repairs and modifications is nearing completion; implementation may follow shortly thereafter. If successful, this project will provide access to approximately 35 miles of very good to excellent spawning and rearing habitat for spring chinook and steelhead. Activities to restore meadows and banks damaged by grazing along streams above Castile Falls would be complementary to this project.

ACC-2: Difficult passage at Lyle Falls (RM 2.2). The Yakama Nation is proposing installation of a fish counting station and modifications of the fishway to improve passability, especially for fall chinook and coho. All activities to restore and enhance access and habitat in the watershed would be complementary to this project.

ACC-3: Difficult passage at Little Klickitat Falls (RM 6.1). The Yakama Nation has considered installation of a fishway to improve passage for steelhead. If successful, access will be provided to approximately 25 miles of fair to excellent habitat. All activities to restore and enhance access and habitat above the falls would be complementary to this project, but especially restoration of degraded riparian habitat between RM 12 and 18.

ACC-4: Restoration of lower Snyder Creek. Full restoration involves removal of 1500 foot concrete sluiceway and creation of a natural channel and riparian zone. A project funded under 1999 federal salmon recovery funds will provide an interim improvement in access through installation of baffles or weir dams. If successful, this project will provide access to three to four miles of good to excellent habitat for coho and steelhead.

ACC-5: Repair/replacement of culverts (various locations in the watershed). Implementation requires a comprehensive culvert survey (see “Information Gaps” below).

Information Needs

1) Comprehensive Culvert Survey. Survey of all culverts intersecting fish-bearing streams in the watershed, including assessment of available habitat quantity and quality above the culvert to aid in prioritization of barrier correction.

E. LIMITING FACTORS: FLOODPLAINS/WETLANDS/RIPARIAN AREAS

Background

Development of floodplains and wetlands is limited over a large portion of the watershed by the geology and topography of the basin. Deeply incised canyons with narrow valley floors comprise most of the mainstem, as well as substantial portion of most fish bearing tributaries. The situation is alleviated as the channel network attains the plateau; under undisturbed conditions, channels are able to develop meander patterns and create floodplains and wetlands.

Floodplain Connectivity

As described above, most of the mainstem below Castile Falls (RM 64.0), as well as most of the fish-bearing tributaries which enter the mainstem below the falls, have highly constrained valley floors and are not capable of any significant floodplain development. SR 142 and an abandoned rail line encroach to a varying degree upon what little floodplain occurs on the mainstem between the mouth and the town of Klickitat (RM 14); the rail line stops at this point, but SR 142 continues to encroach on the mainstem floodplain to the confluence with the Little Klickitat River (RM 19.8). At this point, SR 142 turns east and encroaches on a short (less than a mile) stretch of the Little Klickitat River. Similarly, an abandoned spur line encroaches upon the floodplain along the entire fish-bearing length of Swale Creek.

On the plateau, relatively low valley gradients have allowed for alluvial floodplain development along the mainstem above Castile Falls (RM 64.5), the Little Klickitat River from RM 10 to approximately RM 22, and Swale Creek above Harms Road (RM 14.8). These reaches appear to be affected by floodplain encroachment over only relatively short stretches. The floodplain along the mainstem appears have some encroachment by a logging road between RM 66 and RM 70 and by a jeep trail between RM 71 and 77. The Little Klickitat floodplain has some diking above RM 10 and 18, and their is some encroachment by US 97 and rural residential development above RM 17.4.

Wetlands

No evaluation of wetlands is available at this time. Wetlands development appears to be constrained by topography in some portions of the watershed (see “Background” above) and climate (i.e. low rainfall) in other portions.

Riparian Function

The condition of riparian (streamside) areas is evaluated in the context of the ecological functions they are able to provide. These functions include stream shading, large and small wood inputs, bank stability, and refugia and food for some of the insects upon which salmonids feed. Intact riparian areas are generally characterized by a continuous strip of trees, shrubs, and herbaceous or grassy vegetation of sufficient with to provide these functions to a degree necessary to support sustainable salmonid populations.

As with floodplain and wetlands, riparian condition in this watershed is influenced by geology and topography, though in a much different way. In the canyon reaches described above, riparian areas appear to be more or less intact; steep hillslopes tend to limit access, and so much of the riparian forest remains. On the plateau reaches where agricultural and urban land uses occur, the riparian forest has been almost entirely removed, or is in a condition such that only minimal amounts of the aforementioned ecological functions can be provided.

Key factors limiting habitat productivity

(Note: Refer to Map LF1 for the location of limiting factors identified in this section. Order of factors listed below does not imply priority.)

<u>RIP-1: Degraded riparian habitat along the Little Klickitat River (above RM 12).</u> This area requires establishment of appropriate trees, shrubs, and herbaceous vegetation as necessary to allow for the eventual restoration of important ecological functions. Cattle exclusion (fencing) may be beneficial in some areas, especially where eroded/compacted streambanks and/or incised channels exist. Addressing this factor will result in cooler water temperatures, reduced sedimentation, and increased levels of woody debris input (with resulting improvements in habitat quantity and quality).

<u>RIP-2: Degraded riparian habitat along Swale Creek (RM 0 to Uecker Road, RM 14).</u> Establishment of appropriate trees, shrubs, and herbaceous vegetation as necessary to allow for the eventual restoration of important ecological functions. Cattle exclusion (fencing) may be beneficial in some areas, especially where eroded/compacted stream-banks and/or incised channels exist. Addressing this factor will result in cooler water temperatures, reduced sedimentation, and increased levels of woody debris input (with resulting improvements in habitat quantity and quality).

<u>RIP-3: Degraded meadow and riparian habitat along the mainstem Klickitat River (RM 77 to RM 85).</u> Establishment of appropriate trees, shrubs, and herbaceous vegetation as necessary to allow for the eventual restoration of important ecological functions. Cattle exclusion (fencing) may be beneficial in some areas, especially where eroded/compacted streambanks and/or incised channels exist. Addressing this factor will result in cooler water temperatures, reduced sedimentation, and increased levels of woody debris input (with resulting improvements in habitat quantity and quality).

Information Gaps

1) Improved information on floodplain connectivity and riparian condition. Evaluation of limiting factors associated with floodplain connectivity and riparian condition are based on cursory surveys and informal assessments. A more systematic, focused evaluation will provide a better overall picture of this aspect of watershed health and will allow for a more effective approach to restoration.

F. LIMITING FACTORS: SEDIMENT

Background

Sedimentation and turbidity in the watershed are viewed (NWPPC 1990) as a significant factor limiting habitat productivity in the watershed. Interestingly, the primary source of this sediment is naturally generated glacial silt from the eastern flanks of Mount Adams, which is delivered to the mainstem Klickitat by snowmelt runoff via Big Muddy and Little Muddy Creeks. Other sources of excess sediment, both natural and anthropogenic, are likely to be miniscule (at the watershed scale) compared to this source, though they may have notable effects on fish and fish habitat at the reach scale.

No systematic, watershed evaluation of sediment sources and impacts has been conducted in the watershed. Generally speaking, land-use related sediment sources in this watershed occur as a result of forest practices (e.g. harvesting, skidding, and road building across or adjacent to a stream), agricultural practices (e.g. rill irrigation, streamside grazing), or residential or commercial construction (land clearing and excavation in the vicinity of a stream). Problem areas identified include damaged meadows and riparian areas along the mainstem above Castile Falls (see Section E) and eroded/compacted streambanks and riparian areas along portions of the Little Klickitat River (above RM 12) and Swale Creek (RM 0 to RM 14).

Key factors limiting habitat productivity

(Note: Refer to Map LF1 for the location of limiting factors identified in this section. Order of factors listed below does not imply priority.)

<u>SED-1: Naturally-generated glacial sediments entering the Klickitat River at RM 53.8 (Big Muddy Creek) and RM 63.1 (W.F. Klickitat River)</u>. Installation of sedimentation ponds has been proposed on Big Muddy Creek to remove at least a portion of this sediment. No feasibility study of this proposal has been conducted to date.

<u>SED-2: Damaged meadows and eroded/compacted streambanks along the Klickitat River (RM 77 to Rm 85).</u> See factor RIP-3 in Section E.

<u>SED-3: Eroded/compacted streambanks along the Little Klickitat River (above RM 12).</u> See factor RIP-1 in Section E.

<u>SED-4: Eroded/compacted streambanks along Swale Creek (RM 0 to Uecker Road, RM 14).</u> See factor RIP-2 in Section E.

<u>SED-5: Chronic erosion from stream-adjacent logging roads (various locations in the watershed)</u>. Major sediment contributors should be identified as candidates for corrective action or abandonment.

G. LIMITING FACTORS: WATER QUANTITY/QUALITY

Background

No flow regulation occurs within the watershed; all flows in the watershed occur within a natural flow regimen, with the exception of portions of Outlet Creek, Hellroaring Creek, Swale Creek, and the Little Klickitat River, where diversions for water supply and irrigation occur. An instream flow study conducted in 1991 identified Swale Creek and the Little Klickitat River and a number if its tributaries (Blockhouse Creek, Bloodgood Creek, Bowman Creek,, Mill Creek) as having inadequate instream flows to support fish populations (anadramous and resident); these streams have been placed on the state "water quality impaired" (303d) list for instream flows. It is not known to what extent insufficient flows are land use related.

Identified water quality problems include high water temperatures in Butler Creek, Swale Creek, and the Little Klickitat River; these streams have been placed on the state "water quality impaired" (303d) list for temperature. Temperatures exceeding state water quality standards have been recorded in these streams primarily during low flow periods during the summer months; it is presumed that these exceedences are attributable to lack of stream shading due to degraded or non-existant riparian areas and low summer flows.

Key factors limiting habitat productivity

(Note: Refer to Map LF1 for the location of limiting factors identified in this section. Order of factors listed below does not imply priority.)

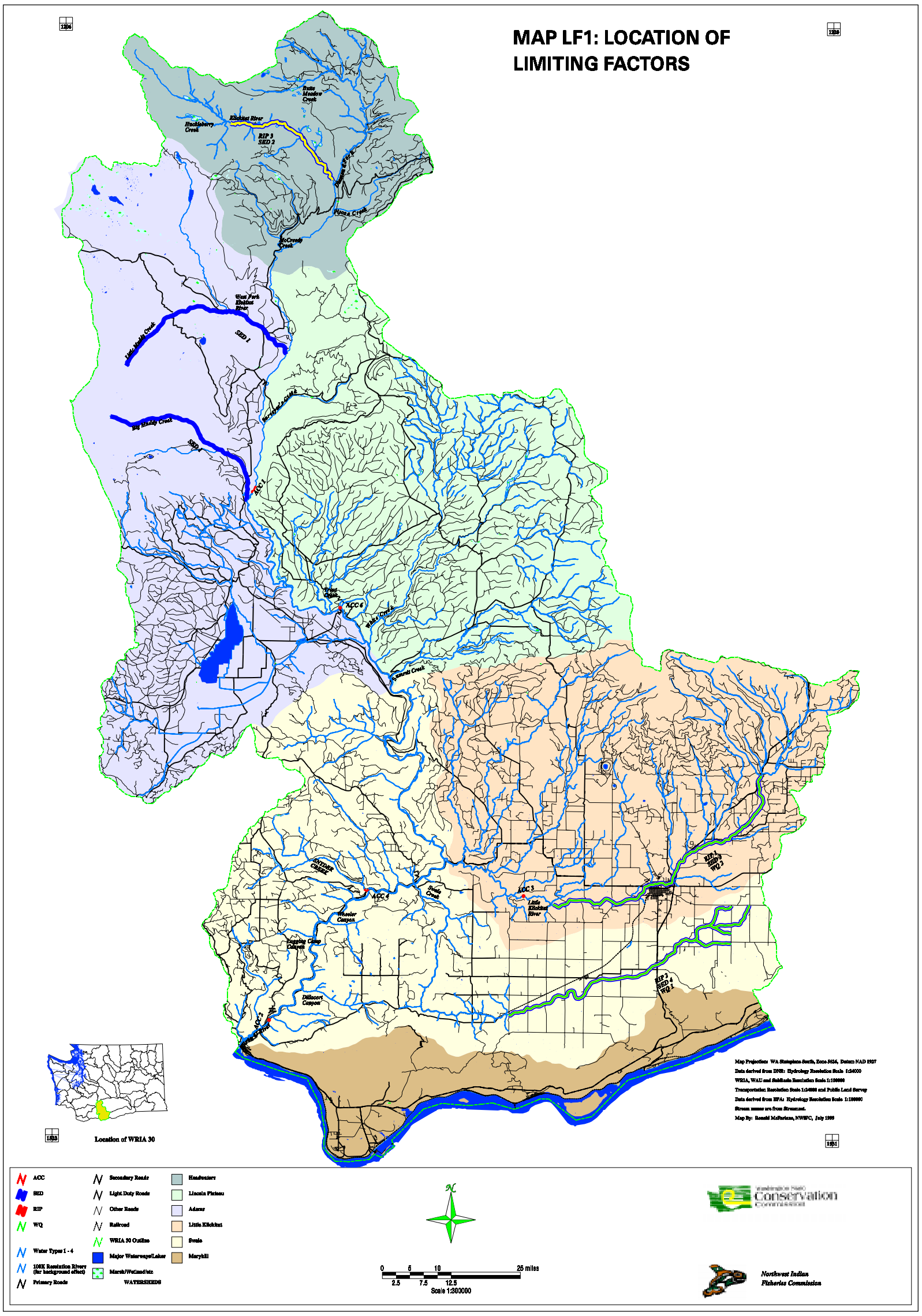
<u>WQ-1: Lack of riparian shading along Swale Creek from RM 0 to Uecker Road, RM 14:</u> See discussion under limiting factor RIP-2 in section E.

<u>WQ-2: Lack of riparian shading along Little Klickitat River above RM 12:</u> See discussion under limiting factor RIP-1 in section E.

Information needs:

1) In streams identified as "water quality impaired" for instream flows: an evaluation of the relative contribution of natural and land use factors (particularly water withdrawals) on low flows;

2) In streams identified as "water quality impaired" for temperature: coordination of stream temperature data collection and riparian inventory to identify reaches which are most responsive to riparian zone planting and restoration.


MAP LF1: LOCATION OF LIMITING FACTORS
Huckleberry Creek
Klickitat River
RIP 3
SED 2
Swan Meadow Creek
Mosier Creek
Pipeline Creek
McCready Creek
West Fork Klickitat River
Little Muddy Creek
SED 1
Big Muddy Creek
SED 4
ACC 1
ACC 6
Spring Creek
Spanish Creek
Gardner Canyon
ACC 5
Swale Creek
ACC 3
Little Klickitat River
Wheeler Canyon
Logging Camp Canyon
Dillacort Canyon
ACC 2
RIP 1
SED 3
WQ 2
RIP 2
SED 4
WQ 1
Location of WRIA 30
Map Projection: WA Stateplane South, Zone 5626, Datum NAD 1927
Data derived from DNR: Hydrology Resolution Scale 1:24000
WRIA, WAU and Subbasin Resolution Scale 1:100000
Transportation Resolution Scale 1:24000 and Public Land Survey
Data derived from EPA: Hydrology Resolution Scale 1:100000
Stream names are from Streamnet.
Map By: Ronald McFarlane, NWIFC, July 1999
ACC
SED
RIP
WQ
Water Types 1 - 4
100K Resolution Rivers (for background effect)
Primary Roads
Secondary Roads
Light Duty Roads
Other Roads
Railroad
WRIA 30 Outline
Major Waterways/Lakes
Marsh/Wetland/etc
WATERSHEDS
Headwaters
Lincoln Plateau
Adams
Little Klickitat
Swale
Maryhill
0 5 10 25 miles
2.5 7.5 12.5
Scale 1:300000
Conservation Commission
Northwest Indian Fisheries Commission

APPENDIX A: LITERATURE CITED

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APPENDIX B:
1998 SALMON RECOVERY LAW (ESHB 2496)

(Note: This appendix does not include revisions to this RCW enacted in the 1999 legislative session under ESHB 5595)

CHAPTER 75.46 RCW

SALMON RECOVERY

Sections

75.46.005 Findings--Intent.
75.46.010 Definitions.
75.46.020 Implementation--Summary to legislature--Recommendations.
75.46.030 State of the salmon report.
75.46.040 Governor's salmon recovery office--Creation--Purpose.
75.46.050 Independent science panel--Selection--Terms--Purpose.
75.46.060 Habitat restoration project lists.
75.46.070 Critical pathways methodology--Habitat work list.
75.46.080 Interagency review team--Duties.
75.46.090 Technical advisory groups.
75.46.100 Sea grant program--Technical assistance authorized.
75.46.110 Southwest Washington salmon recovery region--Created.
75.46.120 Work group--Evaluation of mitigation alternatives.
75.46.130 Appropriated funds.
75.46.900 Captions not law.

RCW 75.46.005 Findings--Intent. The legislature finds that repeated attempts to improve salmonid fish runs throughout the state of Washington have failed to avert listings of salmon and steelhead runs as threatened or endangered under the federal endangered species act (16 U.S.C. Sec. 1531 et seq.). These listings threaten the sport, commercial, and tribal fishing industries as well as the economic well-being and vitality of vast areas of the state. It is the intent of the legislature to begin activities required for the recovery of salmon stocks as soon as possible, although the legislature understands that successful recovery efforts may not be realized for many years because of the life cycle of salmon and the complex array of natural and human-caused problems they face.

The legislature finds that it is in the interest of the citizens of the state of Washington for the state to retain primary responsibility for managing the natural resources of the state, rather than abdicate those responsibilities to the federal government. The legislature also finds that there is a substantial link between the provisions of the federal endangered species act and the federal clean water act (33 U.S.C. Sec. 1251 et seq.). The legislature further finds that habitat restoration is a vital component of salmon recovery efforts. Therefore, it is the intent of the legislature to specifically address salmon habitat

restoration in a coordinated manner and to develop a structure that allows for the coordinated delivery of federal, state, and local assistance to communities for habitat projects that will assist in the recovery and enhancement of salmon stocks.

The legislature also finds that credible scientific review and oversight is essential for any salmon recovery effort to be successful.

The legislature therefore finds that a coordinated framework for responding to the salmon crisis is needed immediately. To that end, the salmon recovery office should be created within the governor's office to provide overall coordination of the state's response; an independent science team is needed to provide scientific review and oversight; the appropriate local or tribal government should provide local leadership in identifying and sequencing habitat restoration projects to be funded by state agencies; habitat restoration projects should be implemented without delay; and a strong locally based effort to restore salmon habitat should be established by providing a framework to allow citizen volunteers to work effectively. [1998 c 246 § 1.]

RCW 75.46.010 Definitions. The definitions in this section apply throughout this chapter unless the context clearly requires otherwise.

(1) "Adaptive management" means reliance on scientific methods to test the results of actions taken so that the management and related policy can be changed promptly and appropriately.

(2) "Critical pathways methodology" means a project scheduling and management process for examining interactions between habitat projects and salmonid species, prioritizing habitat projects, and assuring positive benefits from habitat projects.

(3) "Habitat project list" is the list of projects resulting from the critical pathways methodology under RCW 75.46.070(2). Each project on the list must have a written agreement from the landowner on whose land the project will be implemented. Projects include habitat restoration projects, habitat protection projects, habitat projects that improve water quality, habitat projects that protect water quality, habitat-related mitigation projects, and habitat project maintenance and monitoring activities.

(4) "Habitat work schedule" means those projects from the habitat project list that will be implemented during the current funding cycle. The schedule shall also include a list of the entities and individuals implementing projects, the start date, duration, estimated date of completion, estimated cost, and funding sources for the projects.

(5) "Limiting factors" means conditions that limit the ability of habitat to fully sustain populations of salmon. These factors are primarily fish passage barriers and degraded estuarine areas, riparian corridors, stream channels, and wetlands.

(6) "Project sponsor" is a county, city, special district, tribal government, a combination of such governments through interlocal agreements provided under chapter 39.34 RCW, a nonprofit organization, or one or more private citizens.

(7) "Salmon" includes all species of the family Salmonidae which are capable of self-sustaining, natural production.

(8) "Salmon recovery plan" means a state plan developed in

response to a proposed or actual listing under the federal endangered species act that addresses limiting factors including, but not limited to harvest, hatchery, hydropower, habitat, and other factors of decline.

(9) "Tribe" or "tribes" means federally recognized Indian tribes.

(10) "WRIA" means a water resource inventory area established in chapter 173-500 WAC as it existed on January 1, 1997.

(11) "Owner" means the person holding title to the land or the person under contract with the owner to lease or manage the legal owner's property. [1998 c 246 § 2.]

RCW 75.46.020 Implementation--Summary to legislature--Recommendations. By December 31, 1998, the governor shall submit a summary of the implementation of chapter 246, Laws of 1998 to the legislature, and include recommendations to the legislature that would further the success of salmon recovery. The recommendations may include:

(1) The need to expand or improve nonregulatory programs and activities;

(2) The need to expand or improve state and local laws and regulations; and

(3) The feasibility of forming a state-wide or regional community foundation or any other funding alternatives to assist in financing salmon recovery efforts. [1998 c 246 § 3.]

RCW 75.46.030 State of the salmon report. Beginning in December 2000, the governor shall submit a biennial state of the salmon report to the legislature during the first week of December. The report may include the following:

(1) A description of the amount of in-kind and financial contributions, including volunteer, private, and state, federal, tribal as available, and local government money directly spent on salmon recovery in response to actual, proposed, or expected endangered species act listings;

(2) A summary of habitat projects including but not limited to:

(a) A summary of accomplishments in removing barriers to salmon passage and an identification of existing barriers;

(b) A summary of salmon restoration efforts undertaken in the past two years;

(c) A summary of the role which private volunteer initiatives contribute in salmon habitat restoration efforts; and

(d) A summary of efforts taken to protect salmon habitat;

(3) A summary of collaborative efforts undertaken with adjoining states or Canada;

(4) A summary of harvest and hatchery management activities affecting salmon recovery;

(5) A summary of information regarding impediments to successful salmon recovery efforts;

(6) A summary of the number and types of violations of existing laws pertaining to: (a) Water quality; and (b) salmon. The summary shall include information about the types of sanctions imposed for these violations;

(7) Information on the estimated carrying capacity of new habitat created pursuant to chapter 246, Laws of 1998; and

(8) Recommendations to the legislature that would further the success of salmon recovery. The recommendations may include:

(a) The need to expand or improve nonregulatory programs and activities; and

(b) The need to expand or improve state and local laws and regulations. [1998 c 246 § 4.]

RCW 75.46.040 Governor's salmon recovery office--Creation--Purpose. (Expires June 30, 2006.) (1) The salmon recovery office is created within the office of the governor to coordinate state strategy to allow for salmon recovery to healthy sustainable population levels with productive commercial and recreational fisheries. The primary purpose of the office is to coordinate and assist in the development of salmon recovery plans for evolutionarily significant units, and submit those plans to the appropriate tribal governments and federal agencies in response to the federal endangered species act. The governor's salmon recovery office may also:

(a) Act as liaison to local governments, the state congressional delegation, the United States congress, federally recognized tribes, and the federal executive branch agencies for issues related to the state's endangered species act salmon recovery plans; and

(b) Provide the biennial state of the salmon report to the legislature pursuant to RCW 75.46.030.

(2) This section expires June 30, 2006. [1998 c 246 § 5.]

RCW 75.46.050 Independent science panel--Selection--Terms--Purpose. (1) The governor shall request the national academy of sciences, the American fisheries society, or a comparable institution to screen candidates to serve as members on the independent science panel. The institution that conducts the screening of the candidates shall submit a list of the nine most qualified candidates to the governor, the speaker of the house of representatives, and the majority leader of the senate. The candidates shall reflect expertise in habitat requirements of salmon, protection and restoration of salmon populations, artificial propagation of salmon, hydrology, or geomorphology.

(2) The speaker of the house of representatives and the majority leader in the senate shall each remove one name from the nomination list. The governor shall consult with tribal representatives and the governor shall appoint five scientists from the remaining names on the nomination list.

(3) The members of the independent science panel shall serve four-year terms. The independent science panel members shall elect the chair of the panel among themselves every two years. The members of the independent science panel shall be compensated as provided in RCW 43.03.250 and reimbursed for travel expenses in accordance with RCW 43.03.050 and 43.03.060.

(4) The independent science panel shall be governed by generally accepted guidelines and practices governing the activities of independent science boards such as the national academy of sciences. The purpose of the independent science panel

is to help ensure that sound science is used in salmon recovery efforts. The governor's salmon recovery office shall request review of salmon recovery plans by the science review panel. The science review panel does not have the authority to review individual projects or project lists developed under RCW 75.46.060, 75.46.070, and 75.46.080 or to make policy decisions.

(5) The independent science panel shall submit its findings to the legislature and the governor. [1998 c 246 § 6.]

RCW 75.46.060 Habitat restoration project lists. (1)(a) Counties, cities, and tribal governments must jointly designate, by official resolution, the area for which a habitat restoration project list is to be developed and the lead entity that is to be responsible for submitting the habitat restoration project list. No project included on a habitat restoration project list shall be considered mandatory in nature and no private landowner may be forced or coerced into participation in any respect. The lead entity may be a county, city, conservation district, special district, tribal government, or other entity.

(b) The lead entity shall establish a committee that consists of representative interests of counties, cities, conservation districts, tribes, environmental groups, business interests, landowners, citizens, volunteer groups, regional fish enhancement groups, and other restoration interests. The purpose of the committee is to provide a citizen-based evaluation of the projects proposed to promote salmon habitat restoration. The interagency review team may provide the lead entity with organizational models that may be used in establishing the committees.

(c) The committee shall compile a list of habitat restoration projects, establish priorities for individual projects, define the sequence for project implementation, and submit these activities as the habitat restoration project list. The committee shall also identify potential federal, state, local, and private funding sources.

(2) The area covered by the habitat project list must be based, at a minimum, on a WRIA, combination of WRIAs, an evolutionarily significant unit, or any other area as agreed to by the counties, cities, and tribes meeting the requirements of this subsection. Preference will be given to projects in an area that contain a salmon species that is listed or proposed for listing under the federal endangered species act. [1998 c 246 § 7.]

RCW 75.46.070 Critical pathways methodology--Habitat work list. (1) Critical pathways methodology shall be used to develop a habitat project list and a habitat work schedule that ensures salmon restoration activities will be prioritized and implemented in a logical sequential manner that produces habitat capable of sustaining healthy populations of salmon.

(2) The critical pathways methodology shall:

(a) Include a limiting factors analysis for salmon in streams, rivers, tributaries, estuaries, and subbasins in the region. The technical advisory group shall have responsibility for the limiting factors analysis;

(b) Identify local habitat projects that sponsors are willing to undertake. The projects identified must have a written

agreement from the landowner on which the project is to be implemented. Project sponsors shall have the lead responsibility for this task;

(c) Identify how projects will be monitored and evaluated. The project sponsor, in consultation with the technical advisory group and the appropriate landowner, shall have responsibility for this task; and

(d) Describe the adaptive management strategy that will be used. The committee established under RCW 75.46.060 shall have responsibility for this task. If a committee has not been formed, the technical advisory group shall have the responsibility for this task.

(3) The habitat work list shall include all projects developed pursuant to subsection (2) of this section as well as any other salmon habitat restoration project implemented in the region. The work list shall also include the start date, duration, estimated date of completion, estimated cost, and, if appropriate, the affected salmonid species of each project. Each schedule shall be updated on an annual basis to depict new activities. [1998 c 246 § 8.]

RCW 75.46.080 Interagency review team--Duties. (1) Representatives from the conservation commission, the department of transportation, and the department of fish and wildlife shall establish an interagency review team. Except as provided in subsection (6) of this section, habitat restoration project lists shall be submitted to the interagency review team by January 1st and July 1st of each year beginning in 1999.

(2) If no lead entity has been formed under RCW 75.46.060, the interagency review team shall rank, prioritize, and dispense funds for habitat restoration projects by giving preference to the projects that:

(a) Provide a greater benefit to salmon recovery;

(b) Will be implemented in a more critical area;

(c) Are the most cost-effective;

(d) Have the greatest matched, or in-kind funding; and

(e) Will be implemented by a sponsor with a successful record of project implementation.

(3) If a lead entity established under RCW 75.46.060 has been formed, the interagency review team shall evaluate project lists and may remove, but not add, projects from a habitat project list.

(4) The interagency review team shall provide a summary of funding for habitat restoration project lists to the governor and to the legislature by December 1st of each year.

(5) The interagency review team may annually establish a maximum amount of funding available for any individual project, subject to available funding. The interagency review team shall attempt to assure a geographical balance in assigning priorities to projects.

(6) For fiscal year 1998, the department of fish and wildlife, the conservation commission, and the department of transportation may authorize, subject to appropriations, expenditures for projects that have been developed to restore salmon habitat before completion of the project lists required in RCW 75.46.060(2).

(7) Where a lead entity has been established pursuant to RCW 75.46.060, the interagency review team may provide block grants to

the lead entity, subject to available funding. [1998 c 246 § 9.]

RCW 75.46.090 Technical advisory groups. (1) The conservation commission, in consultation with local government and the tribes, shall invite private, federal, state, tribal, and local government personnel with appropriate expertise to act as a technical advisory group.

(2) For state personnel, involvement on the technical advisory group shall be at the discretion of the particular agency. Unless specifically provided for in the budget, technical assistance participants shall be provided from existing full-time equivalent employees.

(3) The technical advisory group shall identify the limiting factors for salmonids to respond to the limiting factors relating to habitat pursuant to RCW 75.46.070(2).

(4) Where appropriate, the conservation district within the area implementing this chapter shall take the lead in developing and maintaining relationships between the technical advisory group and the private landowners under RCW 75.46.080. The conservation districts may assist landowners to organize around river, tributary, estuary, or subbasins of a watershed.

(5) Fishery enhancement groups and other volunteer organizations may participate in the activities under this section. [1998 c 246 § 10.]

RCW 75.46.100 Sea grant program--Technical assistance authorized. The sea grant program at the University of Washington is authorized to provide technical assistance to volunteer groups and other project sponsors in designing and performing habitat restoration projects that address the limiting factors analysis of regional habitat work plans. The cost for such assistance may be covered on a fee-for-service basis. [1998 c 246 § 11.]

RCW 75.46.110 Southwest Washington salmon recovery region--Created. The southwest Washington salmon recovery region, whose boundaries are provided in chapter 60, Laws of 1998, is created. If chapter 60, Laws of 1998 is not enacted by July 1, 1998, this section is null and void. [1998 c 246 § 12.]

NOTES:

Reviser's note: Chapter 60, Laws of 1998 took effect March 19, 1998.

RCW 75.46.120 Work group--Evaluation of mitigation alternatives. (1) The departments of transportation, fish and wildlife, and ecology, and tribes shall convene a work group to develop policy guidance to evaluate mitigation alternatives. The policy guidance shall be designed to enable committees established under RCW 75.46.060 to develop and implement habitat project lists that maximize environmental benefits from project mitigation while reducing project design and permitting costs. The work group shall seek technical assistance to ensure that federal, state, treaty

right, and local environmental laws and ordinances are met. The purpose of this section is not to increase regulatory requirements or expand departmental authority.

(2) The work group shall develop guidance for determining alternative mitigation opportunities. Such guidance shall include criteria and procedures for identifying and evaluating mitigation opportunities within a watershed. Such guidance shall create procedures that provide alternative mitigation that has a low risk to the environment, yet has high net environmental, social, and economic benefits compared to status quo options.

(3) The evaluation shall include:

(a) All elements of mitigation, including but not limited to data requirements, decision making, state and tribal agency coordination, and permitting; and

(b) Criteria and procedures for identifying and evaluating mitigation opportunities, including but not limited to the criteria in chapter 90.74 RCW.

(4) Committees established under RCW 75.46.060 shall coordinate voluntary collaborative efforts between habitat project proponents and mitigation project proponents. Mitigation funds may be used to implement projects identified by a work plan to mitigate for the impacts of a transportation or other development proposal or project.

(5) For the purposes of this section, "mitigation" has the same meaning as provided in RCW 90.74.010. [1998 c 246 § 16.]

RCW 75.46.130 Appropriated funds. Only those funds appropriated for the habitat restoration projects under this chapter are subject to the requirements of RCW 75.46.080. [1998 c 246 § 17.]

RCW 75.46.900 Captions not law. Captions used in this chapter are not any part of the law. [1998 c 246 § 18.]

APPENDIX C:
THE RELATIVE ROLE OF HABITAT IN HEALTHY POPULATIONS OF NATURAL SPAWNING SALMON

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During the last 10,000 years, Washington State anadromous salmonid populations have evolved in their specific habitats (Miller, 1965). Water chemistry, flow, and the physical stream components unique to each stream have helped shaped the characteristics of each salmon population. These unique physical attributes have resulted in a wide variety of distinct salmon stocks for each salmon species throughout the State. Within a given species, stocks are population units that do not extensively interbreed because returning adults rely on a stream's unique chemical and physical characteristics to guide them to their natal grounds to spawn. This maintains the separation of stocks during reproduction, thus preserving the distinctiveness of each stock.

Throughout the salmon's life cycle, the dependence between the stream and a stock continues. Adults spawn in areas near their own origin because survival favors those that do. The timing of juveniles leaving the river and entering the estuary is tied to high natural river flows. It has been theorized that the faster speed during out-migration reduces predation on the young salmon and perhaps is coincident to favorable feeding conditions in the estuary (Wetherall, 1971). These are a few examples that illustrate how a salmon stock and its environment are intertwined throughout the entire life cycle.

Salmon habitat includes the physical, chemical and biological components of the environment that support salmon. Within freshwater and estuarine environments, these components include water quality, water quantity or flows, stream and river physical features, riparian zones, upland terrestrial conditions, and ecosystem interactions as they pertain to habitat. However, these components closely intertwine. Low stream flows can alter water quality by increasing temperatures and decreasing the amount of available dissolved oxygen, while concentrating toxic materials. Water quality can impact stream conditions through heavy sediment loads, which result in a corresponding increase in channel instability and decrease in spawning success. The riparian zone interacts with the stream environment, providing nutrients and a food web base, woody debris for habitat and flow control (stream features), filtering runoff prior to surface water entry (water quality), and providing shade to aid in water temperature control.

Salmon habitat includes clean, cool, well-oxygenated water flowing at a normal (natural) rate for all stages of freshwater life. In addition, salmon survival depends upon specific habitat needs for egg incubation, juvenile rearing, migration of juveniles to saltwater, estuary rearing, ocean rearing, adult migration to spawning areas, and spawning. These specific needs can vary by species and even by stock.

When adults return to spawn, they not only need adequate flows and water quality, but also unimpeded passage to their natal grounds. They need deep pools with vegetative cover and instream structures such as root wads for resting and shelter from predators. Successful spawning and incubation depend on sufficient gravel of the right size for that particular population, in addition to the constant need of adequate flows and water quality, all in unison at the necessary location.

After spawning, the eggs need stable gravel that is not choked with sediment. River channel stability is vital at this life history stage. Floods have their greatest impact to salmon populations during incubation, and flood impacts are worsened by human activities. In a natural river system, the upland areas are forested, and the trees and their roots stores precipitation, which slows the
rate of storm water into the stream. The natural, healthy river is sinuous and contains large pieces of wood contributed by an intact, mature riparian zone. Both slow the speed of water downstream. Natural systems have floodplains that are connected directly to the river at many points, allowing wetlands to store flood water and later discharge this storage back to the river during lower flows. In a healthy river, erosion or sediment input is great enough to provide new gravel for spawning and incubation, but does not overwhelm the system, raising the riverbed and increasing channel instability. A stable incubation environment is essential for salmon, but is a complex function of nearly all habitat components contained within that river ecosystem.

Once the young fry emerge from the gravel nests, certain species such as chum, pink, and some chinook salmon quickly migrate downstream to the estuary. Other species, such as coho, steelhead, bulltrout, and chinook, will search for suitable rearing habitat within the side sloughs and channels, tributaries, and spring-fed "seep" areas, as well as the outer edges of the stream. These quiet-water side margin and off channel slough areas are vital for early juvenile habitat. The presence of woody debris and overhead cover aid in food and nutrient inputs as well as provide protection from predators. For most of these species, juveniles use this type of habitat in the spring. Most sockeye populations migrate from their gravel nests quickly to larger lake environments where they have unique habitat requirements. These include water quality sufficient to produce the necessary complex food web to support one to three years of salmon growth in that lake habitat prior to outmigration to the estuary.

As growth continues, the juvenile salmon (parr) move away from the quiet shallow areas to deeper, faster areas of the stream. These include coho, steelhead, bulltrout, and certain chinook. For some of these species, this movement is coincident with the summer low flows. Low flows constrain salmon production for stocks that rear within the stream. In non-glacial streams, summer flows are maintained by precipitation, connectivity to wetland discharges, and groundwater inputs. Reductions in these inputs will reduce that amount of habitat; hence the number of salmon dependent on adequate summer flows.

In the fall, juvenile salmon that remain in freshwater begin to move out of the mainstems, and again, off-channel habitat becomes important. During the winter, coho, steelhead, bulltrout, and remaining chinook parr require habitat to sustain their growth and protect

them from predators and winter flows. Wetlands, stream habitat protected from the effects of high flows, and pools with overhead are important habitat components during this time.

Except for bulltrout and resident steelhead, juvenile parr convert to smolts as they migrate downstream towards the estuary. Again, flows are critical, and food and shelter are necessary. The natural flow regime in each river is unique, and has shaped the population's characteristics through adaptation over the last 10,000 years. Because of the close inter-relationship between a salmon stock and its stream, survival of the stock depends heavily on natural flow patterns.

The estuary provides an ideal area for rapid growth, and some salmon species are heavily dependent on estuaries, particularly chinook, chum, and to a lesser extent, pink salmon. Estuaries contain new food sources to support the rapid growth of salmon smolts, but adequate natural habitat must exist to support the detritus-based food web, such as eelgrass beds, mudflats, and salt marshes. Also, the processes that contribute nutrients and woody debris to these environments must be maintained to provide cover from predators and to sustain the food web. Common disruptions to these habitats include dikes, bulkheads, dredging and filling activities, pollution, and alteration of downstream components such as lack of woody debris and sediment transport.

All salmonid species need adequate flow and water quality, spawning riffles and pools, a functional riparian zone, and upland conditions that favor stability, but some of these specific needs vary by species, such as preferred spawning areas and gravel. Although some overlap occurs, different salmon species within a river are often staggered in their use of a particular type of habitat. Some are staggered in time, and others are separated by distance.

Chinook salmon have three major run types in Washington State. Spring chinook are in their natal rivers throughout the calendar year. Adults begin river entry as early as February in the Chehalis, but in Puget Sound, entry doesn't begin until April or May. Spring chinook spawn from July through September and typically spawn in the headwater areas where higher gradient habitat exists. Incubation continues throughout the autumn and winter and generally requires more time for the eggs to develop into fry because of the colder temperatures in the headwater areas. Fry begin to leave the gravel nests in February through early March. After a short rearing period in the shallow side margins and sloughs, all Puget Sound and coastal spring chinook stocks have juveniles that begin to leave the rivers to the estuary throughout spring and into summer (August). Within a given Puget Sound stock, it is not uncommon for other chinook juveniles to remain in the river for another year before leaving as yearlings, so that a wide variety of outmigration strategies are used by these stocks. The juveniles of spring chinook salmon stocks in the Columbia Basin exhibit some distinct juvenile life history characteristics. Generally, these stocks remain in the basin for a full year. However, some stocks migrate downstream from their natal tributaries in the fall and early winter into larger rivers and Columbia River where they are believed to over winter prior to outmigration the next spring as yearling smolts.

Adult summer chinook begin river entry as early as June in the Columbia, but not until August in Puget Sound. They generally spawn in September and/or October. Fall chinook stocks range in spawn timing from late September through December. All Washington summer and fall chinook stocks have juveniles that incubate in the gravel until January through early March, and outmigration downstream to the estuaries occurs over a broad time period (January through August). Within a few of these stocks, is a component of juveniles that remain in freshwater for a full year after emerging from the gravel nests.

While some emerging chinook salmon fry outmigrate quickly, most inhabit the shallow side margins and side sloughs for up to two months. Then, some gradually move into the faster water areas of the stream to rear, while others outmigrate to the estuary. Most summer and fall chinook outmigrate within their first year of life, but a few stocks (Snohomish summer chinook, Snohomish fall chinook, upper Columbia summer chinook) have juveniles that remain in the river for an additional year, similar to many spring chinook (Marshall et al, 1995). However, those in the upper Columbia, have scale patterns that suggest that they rear in a reservoir-like environment (mainstem Columbia upstream from a dam) rather than in their natal streams and it is unknown whether this is a result of dam influence or whether it is a natural pattern.

The onset of coho salmon spawning is tied to the first significant fall freshet. They typically enter freshwater from September to early December, but has been observed as early as late July and as late as mid-January (WDF et al, 1993). They often mill near the river mouths or in lower river pools until freshets occur. Spawning usually occurs between November and early February, but is sometimes as early as mid-October and can extend into March. Spawning typically occurs in tributaries and sedimentation in these tributaries can be a problem, suffocating eggs. As chinook salmon fry exit the shallow low-velocity rearing areas, coho fry enter the same areas for the same purpose. As they grow, juveniles move into faster water and disperse into tributaries and areas which adults cannot access (Neave 1949). Pool habitat is important not only for returning adults, but for all stages of juvenile development. Preferred pool habitat includes deep pools with riparian cover and woody debris.

All coho juveniles remain in the river for a full year after leaving the gravel nests, but during the summer after early rearing, low flows can lead to problems such as a physical reduction of available habitat, increased stranding, decreased dissolved oxygen, increased temperature, and increased predation. Juvenile coho are highly territorial and can occupy the same area for a long period of time (Hoar, 1958). The abundance of coho can be limited by the number of suitable territories available (Larkin, 1977). Streams with more structure (logs, undercut banks, etc.) support more coho (Scrivener and Andersen, 1982), not only because they provide more territories (useable habitat), but they also provide more food and cover. There is a positive correlation between their primary diet of insect material in stomachs and the extent the stream was overgrown with vegetation (Chapman, 1965). In addition, the leaf litter in the fall contributes to aquatic insect production (Meehan et al, 1977).

In the autumn as the temperatures decrease, juvenile coho move into deeper pools, hide under logs, tree roots, and undercut banks (Hartman, 1965). The fall freshets redistribute them (Scarlett and Cederholm, 1984), and over-wintering generally occurs in available side channels, spring-fed ponds, and other off-channel sites to avoid winter floods (Peterson, 1980). The lack of side channels and small tributaries may limit coho survival (Cederholm and Scarlett, 1981). As coho juveniles grow into yearlings, they become more predatory on other salmonids. Coho begin to leave the river a full year after emerging from their gravel nests with the peak outmigration occuring in early May. Coho use estuaries primarily for interim food while they adjust physiologically to saltwater.

Steelhead have the most complex life history patterns of any Pacific salmonid species (Shapovalov and Taft, 1954). In Washington, there are two major run types, winter and summer steelhead. Winter steelhead adults begin river entry in a mature reproductive state in December and generally spawn from February through May. Summer steelhead adults enter the river from about May through October with spawning from about February through April. They enter the river in an immature state and require several months to mature (Burgner et al, 1992). Summer steelhead usually spawn farther upstream than winter stocks (Withler, 1966) and dominate inland areas such as the Columbia Basin. However, the coastal streams support more winter steelhead populations.

Juvenile steelhead can either migrate to sea or remain in freshwater as rainbow or redband trout. In Washington, those that are anadromous usually spend 1-3 years in freshwater, with the greatest proportion spending two years (Busby et al, 1996). Because of this, steelhead rely heavily on the freshwater habitat and are present in streams all year long.

Bulltrout/Dolly Varden stocks are also very dependent on the freshwater environment, where they reproduce only in clean, cold, relatively pristine streams. Within a given stock, some adults remain in freshwater their entire lives, while others migrate to the estuary where they stay during the spring and summer. They then return upstream to spawn in late summer. Those that remain in freshwater either stay near their spawning areas as residents, or migrate upstsream throughout the winter, spring, and early summer, residing in pools. They return to spawning areas in late summer. In some stocks juveniles migrate downstream in spring, overwinter in the lower river, then enter the estuary and Puget Sound the following late winter to early spring (WDFW, 1998). Because these life history types have different habitat characteristics and requirements, bulltrout are generally recognized as a sensitive species by natural resource management agencies. Reductions in their abundance or distribution are inferred to represent strong evidence of habitat degradation.

In addition to the above-described relationships between various salmon species and their habitats, there are also interactions between the species that have evolved over the last

10,000 years such that the survival of one species might be enhanced or impacted by the presence of another.

Most streams in Washington are home to several salmonid species, which together, rely upon freshwater and estuary habitat the entire calendar year. As the habitat and salmon review indicated, there are complex interactions between different habitat components, between salmon and their habitat, and between different species of salmon. For just as habitat dictates salmon types and production, salmon contribute to habitat and to other species.

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