4.0 Asotin Subbasin Aquatic Assessment

4.1 Selection of Focal Species

Three aquatic species were chosen as focal for Asotin Subbasin Planning: steelhead/rainbow trout *Oncorhynchus mykiss*, spring chinook *Onchorynchus tshawytcha* and Bull Trout *Salvelinus confluentus*. The criteria used to select focal species was the aspects of the Asotin Subbasin ecosystem that the life histories represent; the Endangered Species Act (ESA) status; the cultural importance of the species and whether or not there was enough knowledge of the life history of the species to do an effective assessment. Those species of which too little was known to be identified as focal at this time, but nevertheless may be representative of the subbasin ecosystem, could be included as "species of interest" (see section 4.7). The co-managers (Washington Department of Fish and Wildlife (WDFW) and the Nez Perce Tribe (NPT) in coordination with the citizen advisory group, subbasin planning team and the subbasin lead, developed and agreed up the above focal species. Asotin summer steelhead, spring chinook and bull trout life histories intersect a broad range of the aquatic ecosystem. Spatially, the life histories of these three species cover the entire subbasin from the mouth to the headwaters. These species also occupy all levels of the water column including slack water, swift water and the hyporheic zone. Not only are they present but also the ability of these species to thrive is dependent on being able to successfully occupy these areas. Temporally, these species are present (or were assumed to be present in the past) at one lifestage or another throughout much of the watershed in all seasons. The ability of these species to be present at a particular time in a particular area is also key to the success of these species. Given the wide range of both the spatial and temporal aspects of these life histories it can be assumed that having habitat conditions that are appropriate for these three species will also produce conditions that allow for the prosperity of other aquatic life in the Asotin Subbasin.

The legal status of these species is important to the people who have interest in the Asotin Subbasin. All three species are listed as threatened under the ESA (see sections 4.2.4.4; 4.3.4.4; 4.4.5). Currently the citizens, governments, state and federal agencies and tribes are engaged in planning for the recovery of each of the salmonids through different processes. The intention of subbasin planning to address listed species within the subbasin supports the inclusion of the only three federally listed aquatic species within the subbasin as focal species.

4.2 Asotin Subbasin Habitat Assessment Methods

The Asotin Subbasin habitat was assessed using the Ecosystem Diagnosis and Treatment (EDT) method; EDT is an analytical model relating habitat features and biological performance to support conservation and recovery planning (Lichatowich et al. 1995; Lestelle et al. 1996; Mobrand et al. 1997; Mobrand et al. 1998). It acts as an analytical framework that brings together information from empirical observation, local experts, and other models and analyses.

The Information Structure and associated data categories are defined at three levels of organization. Together, these can be thought of as an information pyramid in which each level builds on information from the lower level (Figure 4-1). As we move up the through the three levels, we take an increasingly organism-centered view of the ecosystem. Levels 1 and 2 together characterize the environment, or ecosystem, as it can be described by different types of data. This provides the characterization of the environment needed to analyze biological performance for a species. The Level 3 category is a characterization of that same environment from a different perspective: “through the eyes of the focal species" (Mobrand et al. 1997). This category describes biological performance in relation to the state of the ecosystem described by the Level 2 ecological attributes.

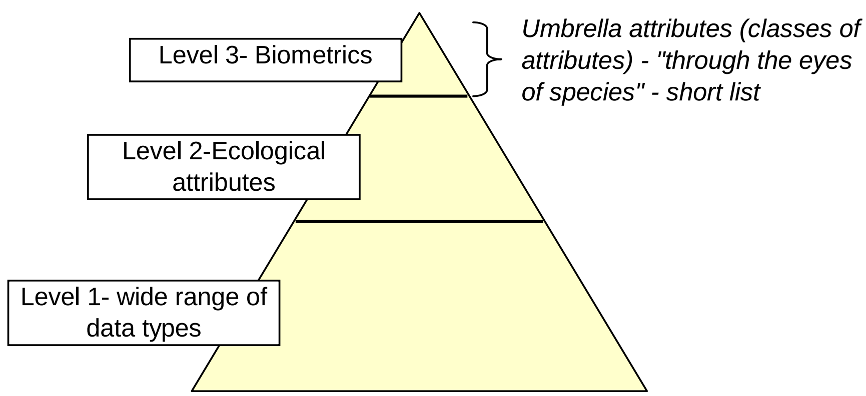


Figure 4-1. Data/information pyramid—information derived from supporting levels.

The organization and flow of information begins with a wide range of environmental data (Level 1 data) that describe a watershed, including all of the various types of empirically based data available. These data include reports and unpublished data. Level 1 data exist in a variety of forms and pedigrees. The Level 1 information is then summarized or synthesized into a standardized set of attributes (Level 2 ecological attributes) that refine the basic description of the watershed. The Level 2 attributes are descriptors that specify physical and biological characteristics about the environment relevant to the derivation of the survival and habitat capacity factors for the specific species in Level 3. Definitions for Level 2 and Level 3 attributes can be found at www.edthome.org , together with a matrix showing associations between the two levels and various life stages.

The Level 2 attributes represent conclusions that characterize conditions in the watershed at specific locations, during a particular time of year (season or month), and for an associated management scenario. Hence an attribute value is an assumed conclusion by site, time of year, and scenario. These assumptions become operating hypotheses for these attributes under specific scenarios. Where Level 1 data are sufficient, these Level 2 conclusions can be derived through simple rules. However, in many cases, experts are needed to provide knowledge about geographic areas and attributes where Level 1 data are incomplete. Regardless of the means whereby Level 2 information is derived, the characterization it provides can be ground-truthed and monitored over time through an adaptive process.

To perform the assessment we first structured the entirety of the relevant geographic areas, including marine waters, into distinct habitat reaches. The Asotin drainage was subdivided into the 37 stream segments by an assembled technical workgroup (Tables 4-1 and 4-2). We identified reaches on the basis of similarity of habitat features, drainage connectivity, and land use patterns. Such a detailed reach structure, however, is counterproductive for displaying results. Therefore the reaches were regrouped into the 17 larger "geographic areas" (Table 4-3). A set of standard habitat attributes and reach breaks developed by Mobrand Biometrics Incorporated (MBI) were used for the mainstem Columbia and Snake Rivers, estuarine, nearshore, and deep water marine areas. We then assembled baseline information on habitat and human-use factors and fish life history patterns for the watersheds of interest. task required that all reaches be completely characterized by rating the relevant environmental attributes.

Table 4-1. Stream reaches defined in Asotin Creek for the Ecosystem Diagnosis and Treatment analysis method.

Reach code	Reach location/description	Start RM	End RM
Asotin1	Asotin Cr mouth to end of diked section	0	1.8
Asotin2	Astotin Cr, end of diked section to George Cr	1.8	3.2
George1	George Cr, mouth to Pintler Cr	0	1.4
Pintler1	Pintler Cr, mouth to Ayers Cr	0	1.7
Pintler2	Pintler Cr, Ayers Cr to steelhead access limit	1.7	9.6
George2	George Cr, Pintler Cr to Stringtown Cr	1.4	5.4
George3	George Cr, Stringtown Cr to Wormell Cr	5.4	14.1
Wormell	Wormell Cr, mouth to access limit	0	.1
George4	George Cr, Wormell Cr to Hefflefinger Cr	14.1	16.1
Hefflefinger	Hefflefinger Cr, mouith to access limit	0	1.6
George5	George Cr, Hefflefinger Cr to Coombs Cr	16.1	16.6
Coombs	Coombs Cr, mouth to access limit	0	1
George6	George Cr, Coombs Cr to Trent Grade Rd culvert	16.6	18.8
George7(culvert)	Trent Grade Rd culvert	OBSTRUCTION	
George8	George Cr, Trent Grade Rd culvert to Forest Service line	18.8	19.8

George9	George Cr, Forest Service line to gradient break at RM 23.2 (last fork before source springs).	19.8	23.2
Asotin3A	Asotin Cr, George Cr to the Narrows	3.2	7.3
Asotin3B	Asotin Cr, the Narrows to Headgate Dam	7.3	9.1
Asotin4 (dam)	Headgate dam	OBSTRUCTION	
Asotin5	Asotin Cr, Headgate Dam to Charley Cr	9.1	13.8
Charley1	Charley Cr, mouth to County Road culvert	0	.2
Charley2	Charley Cr, County Road culvert to upper end of old state ponds	.2	4.0
Charley3	Charley Cr, upper end of old state ponds to Forest Service line	4.0	7.1
Charley4	Charley Cr, Forest Service line to gradient break at RM 13.0 (Sec 23)	7.1	13.0
Asotin6	Asotin Cr, Charley Cr to confluence of NF & SF Asotin Cr	13.8	15.2
NF Asotin1	NF Asotin Cr, mouth to Lick Cr	0	.8
Lick	Lick Cr, mouth to culvert (steelhead access limit)	0	.1
NF Asotin2	NF Asotin Cr, Lick Cr to Forest Service picnic area	.8	4.9
NF Asotin3	NF Asotin Cr, Forest Service picnic Aaea to South Fork of NF Asotin Cr	4.9	9.0
SF NF Asotin	South fork of NF Asotin Cr, mouth to gradient break at RM 1.9	0	1.9
NF Asotin4	NF Asotin Cr, South Fork of NF Asotin Cr to Middle Branch of NF Asotin Cr	9	9.3
Middle Branch NF Asotin	Middle Branch of NF Asotin Cr, mouth to gradient break at RM 2.0	0	2.0
NF Asotin5	NF Asotin Cr, Middle Branch of NF Asotin Cr to Cougar Cr and gradient break	9.3	14.2
SF Asotin1	SF Asotin Cr, mouth to Alder Cr	0	4.4
SF Asotin2	SF Asotin Cr, Alder Cr to Redhill Gulch Cr	4.4	8.8
SF Asotin3	SF Asotin cr, Redhill Gulch Cr to access limit at unnamed LB trib in Sec 14	8.8	10.8

Table 4-2. Stream reaches defined in Ten Mile Creek for the Ecosystem Diagnosis and Treatment analysis method.

Reach code	Reach location/description	Start RM	End RM
Tenmile1	Mouth to Snake River Road	0	.2
Tenmile2	Snake River Road to where Weissenfels Ridge Road leaves Creek	.2	1.8
Tenmile3	From where road leaves creek to end of seasonal dewatering	1.8	2.7
Tenmile4	dewatered area to Mill Creek	2.7	10.6
Millcreek1	Mouth to Mill Creek Road culvert	0	2.9
Millcreek2 (culvert)	Obstruction (Mill Creek Road Culvert)	OBSTRUCTION	
MillCreek3	Culvert to irrigation diversion (upper end of distribution)	2.9	5.1
Tenmile5	Mouth of Mill Creek to mouth middle branch of west draining canyons.	10.6	13.8
Middle Branch	mouth to upper end of steelhead use	0	1.9

Tenmile6	Middle branch to Weissenfels Pond, barrier	13.8	15.3
Tenmile7 (instream pond)	Weissenfels Pond (complete barrier)	OBSTRUCTION	
Tenmile8	Pond to upper end of potential distribution.	15.3	16.2

Table 4-3. Geographic Areas used for Asotin Cr subbasin assessment 2003.

Geographic Area	Location	EDT Reaches included
Lower Asotin	Mouth to George Cr	Asotin1 and Asotin2
Lower George	Mouth to Wormell Cr	George1, 2 and 3
Pintler	Mouth to Access Limit	Pintler1 and 2
Upper George	Wormell to Access Limti	George4 through George9
Upper George Tribs	Wormell Cr, Hefflefinger Cr, Coombs Cr	Wormell, Hefflefinger, Coombs
Middle Asotin	George Cr to Headgate Dam	Asotin3A through Asotin4
Charlie	Mouth to Access Limit	Charlie1 through 4
Upper Asotin	Headgate Dam to Forks	Asotin5 and 6
Lick	Mouth to Culvert	Lick
Lower NF Asotin	Mouth to SF of NF Asotin	NF Asotin1 through 3
Upper NF Asotin	SF of NF Asotin to Access Limit	NF Asotin4 and 5
NF Asotin Tribs	Middle Branch, SF of the NF Asotin	Middle Branch, SF of the NF Asotin
Lower SF Asotin	Mouth to Alder Cr	SF Asotin1
Upper SF Asotin	Alder Cr to Access Limit	SF Asotin2 and 3

A technical work group was formed for the Asotin basin for the purpose of rating the Level 2 habitat attributes for the freshwater stream reaches. The work groups drew upon published and unpublished data and information for the basin to complete the task. Expert knowledge about habitat identification, habitat processes, hydrology, water quality, and fish biology was incorporated into the process where data was not available. Attribute rating for EDT was coordinated by WDFW. Protocol for rating attributes was taken from “Attribute Ratings Guidelines (Appendix) and “Attribute ratings Definitions” (Appendix); written and distributed by MBI. In addition MBI personnel were available for consultation and rated some attributes when local resources were not available. The WDFW watershed steward served as coordinator for the attribute rating process. The sources used for rating the individual attributes are outlined in Table 4-4. The patient (current) condition attribute ratings represent a variety of sources and levels of proof (see **Appendix ##** for complete ratings, levels of proof and explanations of specific attribute rating methods). Levels of proof (or confidence levels) assigned to ratings are directly from developed rating methods by MBI specifically for the EDT process. The attributes assigned to each reach are assigned a numerical value from 1 to 5 where: 1 is empirical observation; 2 is expansion of empirical observation; 3 is derived information; 4 is expert opinion; 5 is hypothetical. The mean and standard deviation for confidence levels assigned to attributes are presented in Table 4. The template (historic) conditions were all considered to be the hypothetical or expert opinion of the resource professional that rated the attribute. The rating sources presented in Table 4-4 are by the agency or organization for which the individual is employed, represents or is affiliated; or the data/published source that was used.

Table 4-4. Attributes, attribute rating level of proof means/standard deviations and rating sources used for EDT analysis of Asotin Creek 2003. (All Template ratings considered hypothetical or expert opinion; EO= Expert Opinion)

Attribute	Level of Proof (patient ratings only)	Template Sources	Patient Sources
Alkalinity	Mean = 2.94 SD = .34	Washington Dept. of Fish and Wildlife (WDFW) Biologist	Direct or derived from United States Geological Service (USGS) sample site and Environmental Protection Agency (EPA) STORET site and database.
Bed Scour	Mean = 3.71 SD =.72	Washington State University/NRCS Hydrologist. Some revision by Mobrand Biometrics Incorporated (MBI).	Washington State University/NRCS Hydrologist EO. Some revision by MBI.
Benthic Community Richness	Mean = 3 SD = 0	Rated by MBI and reviewed by WDFW.	Rated by MBI and reviewed by WDFW.
Channel Length	Mean = 1 SD = 0	WDFW Biologist. Stream length increase proportionally with estimated increase in sinuosity historically. Estimated historical sinuosity from Rosgen stream type potential.	Channel length measured on Terrain Navigator® mapping program by WDFW biologist.
Channel Width Max	Mean = 3.5 SD =.71	Washington State University/NRCS Hydrologist and WDFW Biologist.	1993 United States Forest Service (USFS) Stream survey data; WDFW Biologist EO; Washington State University/NRCS Hydologist EO.
Channel Width Min	Mean = 2.68 SD =.81	WDFW Biologist.	USGS Gauging Station; 1993 USFS Stream Survey Data; WDFW Biologist EO
Confinement Hydromodifications	Mean = 1.85 SD = .99	Washington State University/NRCS Hydrologist and WDFW Biologist.	Washington State University/NRCS Hydrologist and WDFW Biologist EO.
Confinement Natural	Mean = 3 SD = 0	Washington State University/NRCS	Washington State University/NRCS Hydrologist

		Hydrologist and WDFW Biologist.	and WDFW Biologist EO.
Dissolved Oxygen	Mean = 2.35 SD = .9	WDFW Biologist.	WDOE Stream Gauge data; WDFW Biologist EO
Embeddedness	Mean = 3.06 SD = 1.01	WDFW Biologist; Washington State University/NRCS Hydrologist.	1993 and 1998 USFS Stream Survey Data; Derived from Asotin Creek Inventory and Assessment. NRCS 2001; Derived from data collected in 2001 for unpublished report; Washington State University/NRCS Hydrologist EO
Fine Sediment	Mean = 3.34 SD = .48	Washington State University/NRCS Hydrologist; WDFW Biologist; MBI.	1993 and 1998 USFS Stream Survey Data; Derived from Asotin Creek Inventory and Assessment. NRCS 2001; Derived from data collected in 2001 for unpublished report; Washington State University/NRCS Hydrologist EO; WDFW Biologist EO. 1993 and 1998 USFS Stream Survey Data; Derived from Asotin Creek Inventory and Assessment.
Fish Community Richness	Mean = 3 SD = 0	WDFW Biologist.	Derived from Instream Habitat Improvements. WDFW, Hallock and Mendel, 1985 and Lyon's Ferry Evaluation, Schuck and Mendel, 1986 and 1988. Derived from Assessment of Salmonids in George, Tenmile and Couse Creeks in Asotin County (2000) Mendel et al
Fish Pathogens	Mean = 1 SD = 0	N/A	From WDFW fish stocking records,
Fish Species Exotic	Mean = 3 SD = 0	N/A	From multiple WDFW surveys.
Flow High	Mean = 3.85 SD = .36	N/A	MBI and WDFW Biologist EO.
Flow Low	Mean = 3 SD = 0	N/A	MBI and WDFW Biologist EO.
Flow Diel Variation	Mean = 1 SD = 0	N/A	MBI and WDFW Biologist EO.
Flow Flashy	Mean = 4 SD = 0	N/A	MBI and WDFW Biologist EO.

Gradient	Mean = 2 SD = 0	WDFW biologist adjusted gradients for increase in stream length (sinuosity) historically. Gradients decreased by proportion of stream length increase; potential or historic sinuosity dervied from Rosgen stream typing.	WDFW Biologist estimations using Terrain Navigator.
Habitat Types (% of Backwater Pools, Glides, Beaver Ponds, Pools, Large Substrate Riffles, Small Substrate Riffles, Pool Tail-outs)	Mean = 3.88 SD = 1.14	WDFW Biologist; Washington State University/NRCS Hydrologist.	Washington State University/NRCS Hydrologist EO; WDFW Biologist EO; 2001, 2000, 1998, 1995, 1993 USFS Stream Survey Data
Habitat Off-Channel	Mean = 4 SD = 0	MBI	MBI
Harassment	Mean = 4 SD = 0	WDFW Biologist.	WDFW Biologist EO.
Hatchery Outplants	Mean = 1 SD = 0	N/A	WDFW fish stocking records.
Hydrologic Regime Natural	Mean = 3 SD = 0	MBI	MBI, Based on flow data from USGS station and MBI developed hydroregime categories.
Hydrologic Regime Regulated	N/A	N/A	N/A
Icing	Mean = 5 SD = 0	WDFW Biologist.	WDFW Biologist EO.
Metals in Water Column	Mean = 5 SD = 0	N/A	WDFW Biologist EO.
Metals in Soils and Sediment	Mean = 5 SD = 0	N/A	WDFW Biologist EO.
Misc Toxics	Mean = 4 SD = 0	N/A	WDFW Biologist EO.
Nutrients	Mean = 5 SD = 0	N/A	WDFW Biologist EO.
Obstructions	*Obstruction rated by percent passage of average adult. Obstruction ratings were the expert opinion of WDFW biologists.	N/A	Obstructions rated by WDFW Biologist EO.
Predation Risk	Mean = 4 SD = 0	N/A	WDFW Biologist EO.
Riparian Function	Mean = 4 SD = 0	N/A	WDFW Biologist EO.

Salmon Carcasses	Mean = 1 SD = 0	WDFW Biologist.	From numerous WDFW surveys.
Temperature Max	Mean = 1.91 SD = 1.04	WDFW Biologist. Derived from, "Ecological Investigations of the Tucannon River Washington by DW Kelley and Associates for H. Esmaili and Associates for USDA.	From Assessment of Salmonids in George, Tenmile and Couse Creeks in Asotin County (2000) Mendel et al. From Asotin Creek Instream Habitat Surveys 2000 Habitat Evaluation…Bumgarner and Schuck. 2001, 2000, 1998, 1995, 1993 USFS Stream Survey Data. Asotin Limiting Factors Analysis 2001.
Temperature Min	Mean = 5 SD = 0	WDFW Biologist.	WDFW Biologist EO.
Temperature Spatial Variation	Mean = 5 SD = 0	WDFW Biologist.	WDFW Biologist EO.
Turbidity	Mean = 2.91 SD = .29	WDFW Biologist.	Asotin Creek Watershed water quality/ water monitoring report, by WSU for Asotin CCD. USGS water quality data from website (Asotin Ck. Site).
Withdrawl	Mean = 1 SD = 0	N/A	WDFW Biologist in consultation with Asotin CCD.
Woody Debris	Mean = 2.68 SD = .47	WDFW Biologist.	Expanded from Asotin Creek inventory and assessment. 2001 NRCS; Asotin Creek Instream Habitat Alteration Projects…Bumgarner and Schuck 2001. WDFW. WDFW unpublished estimation data.

The template (reference) conditions for the watershed were estimated to determine the level of change from current conditions. Table 4-5 summarizes these conditions by geographic area. The lower elevations of the subbasin were assumed to have heavy cottonwood galleries and a healthy beaver population. This would have created a very complex habitat with long-lived large wood and many pools/backwater areas. As elevation in the subbasin increased to the mid level beaver would have decreased; riparian areas and side slopes would still have had pretty heavy cottonwood growth, giving way to mixed conifers as elevation increased. Large wood still would have been prevalent in the stream creating a pool/tail-out/riffle stream types with small cobble dominating. Sediment and embeddedness here, as throughout the watershed; would have been minimal due to heavy forested canopy in the high elevations and shrub/grassland cover in the mid to lower elevations. The upper elevations would have been forested with interspersed meadows. Snow and water retention in these areas would have been increased over current conditions. This would have increased flows during the summer months throughout the Asotin system. The stream at this elevation would have been very complex with lots of wood of all sizes. Step pool reaches would have been very common. Temperatures would have remained cool even in the summer in most years. The watershed as a whole was considered to have been ecologically fit for the species of fish that were likely to have resided here (i.e. the focal species) to thrive. It was that temperatures would have generally been lower and flow higher though, not greatly so. Large wood was assumed to have been much more prevalent throughout the watershed, as were the pools they help to create. Beaver was also thought to have been present in fair numbers, but only in the lower elevations.

Table 4-5. Asotin Creek geographic areas and description of assumed conditions used for rating EDT template attributes.

Geographic Area	Assumed Template Conditions
Lower Asotin	Heavy cottonwood galleries; many beaver ponds, low gradient = persistent Large Woody Debris (LWD); well developed and accessible floodplain; some increase in flow due to better ability to retain water in the watershed; increased bank-full widths due to increased floodplain access
Lower George	Some cottonwood growth changing to mixed conifer higher in area; LWD input locally and especially from Upper George; increased pools; higher, higher flows and cooler water in summer due to well developed riparian locally and upstream; some beaver; sediment reduced mainly due to better upland ground cover (forest and grasslands); decreased bank-full widths due to better developed stream banks
Pintler	Riparian area well developed in all areas, heavier with mixed conifers higher in system; slightly higher flows and cooler water in summer due to well developed riparian locally and upstream; increased pools; increased LWD; sediment reduced mainly due to better upland ground cover (forest and grasslands); decreased bank-full widths due to better developed stream banks
Upper George	Well developed mixed conifer/cottonwood riparian; increased LWD; increased pools; higher flows and cooler water in summer due to well developed riparian and increased canopy cover in sub-watershed; increased pools; increased LWD; sediment reduced mainly due to better upland ground cover (forest and grasslands) ; decreased bank-full widths due to better developed stream banks
Upper George Tribs	Riparian better developed, increasing with elevation, cottonwoods to mixed conifer; increased pools; higher flows and cooler water in summer due to increased riparian; increase in pools (step-pool type stream in higher elevations; sediment reduced mainly due to better upland ground cover (forest and grasslands); decreased bank-full widths due to better developed stream banks
Middle Asotin	Heavy cottonwood galleries; increase LWD local input and from above; increased pools; increase riparian zone and access to floodplain; some beaver; sediment reduced mainly due to better upland ground cover (forest and grasslands); some increase in flow due to better ability to retain water in the watershed; decreased bank-full widths due to better developed stream banks
Charlie	Well developed mixed conifer/cottonwood riparian; increased LWD;

	increased pools; higher flows and cooler water in summer due to well developed riparian and increased canopy cover in sub-watershed; increased pools; increased LWD; sediment reduced mainly due to better upland ground cover (forest and grasslands) ; decreased bank-full widths due to better developed stream banks
Upper Asotin	Cottonwood galleries with mixed conifer; increase LWD local input and from above; increased pools; increase riparian zone and access to floodplain; some beaver; sediment reduced mainly due to better upland ground cover (forest and grasslands); some increase in flow due to better ability to retain water in the watershed; decreased bank-full widths due to better developed stream banks
Lick	Increased floodplain; sediment reduced mainly due to better upland ground cover; some increase in flow due to better ability to retain water in the watershed; decreased bank-full widths due to better developed stream banks
Lower NF Asotin	Increase riparian/canopy cover; increased LWD; increased pools; sediment reduced mainly due to better upland ground cover (forest and grasslands); some increase in flow due to better ability to retain water; decreased bank-full widths due to better developed stream banks
Upper NF Asotin	Increase riparian/canopy cover; increased LWD; increased pools; sediment reduced mainly due to better upland ground cover (forest and grasslands); some increase in flow due to better ability to retain water; decreased bank-full widths due to better developed stream banks
Lower SF Asotin	Increased riparian cover and upland cover; sediment reduced mainly due to better upland ground cover (forest and grasslands); increase LWD; increased pools; some increase in flow due to better ability to retain water; decreased bank-full widths due to better developed stream banks
Upper SF Asotin	Increased riparian cover and upland cover; sediment reduced mainly due to better upland ground cover (forest and grasslands); increase LWD; increased pools; some increase in flow due to better ability to retain water; decreased bank-full widths due to better developed stream banks

We characterized three baseline reference scenarios for the Asotin Subbasin; predevelopment (historic or template as described above) conditions, current conditions, and properly functioning conditions (PFC). The comparison of these scenarios formed the basis for diagnostic conclusions about how the Asotin and associated summer steelhead performance have been altered by human development. The historic reference scenario also served to define the natural limits to potential recovery actions within the basin. Properly functioning conditions were a set of standardized guidelines that NOAA Fisheries provided that were designed to facilitate and standardize determinations of the effect for Endangered Species Act (ESA) conferencing, consultations, and permits focusing on anadromous salmonids (Stelle 1996). The objective of the diagnosis then became identifying the relative contributions of environmental factors to the losses in summer steelhead performance. To accomplish this, we performed two types of analyses, each at a different scale of overall effect.

The first analysis considered conditions within *individual stream reaches* and identified the most important factors contributing to a loss in performance corresponding to each reach. This analysis, called the *Stream Reach Analysis* (Appendix A), identified the factors (classes of Level 2 attributes) that, if appropriately moderated or corrected, would produce the most significant improvements in overall fish population performance. It identified the factors that should be considered in planning habitat restoration projects.

The second analysis was conducted *across geographic areas* relevant to populations, where each geographic area typically encompasses many reaches. This analysis, called the *Geographic Area Analysis*, identified the relative importance of each area for either restoration or protection actions. In this case, we analyzed the effect of either restoring or further altering environmental conditions on population performance. These results will be discussed in the management plan (Section 8.3.2). These results were available in two forms, scaled and unscaled. Scaled results take into account the length of the geographic area being analyzed by taking the original out put from EDT (i.e. percent productivity change, etc.) and dividing it by the length of stream in kilometers. This gives a value of the condition being measured per kilometer which represents the most efficient areas to apply restoration or protection measures. The unmodified results are termed unscaled. Both results are presented here, though the scaled version was given more weight in the conclusions portion of the assessment.

A Reach Analysis identifies the life stages most severely impacted (relative to historical performance) on a reach-by-reach basis, as well as the environmental conditions most responsible for the impacts. This three-part diagnosis can then be used to develop a plan designed to protect areas critical to current production, and to implement effective restoration actions in reaches with the greatest production potential.

The first pair of charts in Appendix A describe this analysis in greater detail. The rest of the charts in Appendix A consist of the Reach Analysis for the Asotin Subbasin. The Reach Analysis is intended to serve as a reference tool to be used in all types of watershed planning related to salmon conservation,recovery and habitat restoration.

4.3 Focal Species Summer Steelhead/ Rainbow Trout (*O. mykiss*)

4.3.1 Life history

<u>*Asotin Creek*</u>
Asotin Creek summer steelhead are a typical Snake River "A"-run strain. A-run steelhead enter freshwater from June to August and generally pass Bonneville Dam before August 25. They begin passing Lower Granite Dam in early June and can continue through the following spring. Adult steelhead may enter Asotin Creek as early as September or October and continue through May. Peak entry is believed to occur in February through April (Glen Mendel, WDFW, personal communication). Spawning

begins in late February or early March. Spawning peaks in early to mid-April and continues through mid-May.

There is little information on the adult age structure of Asotin Creek steelhead. Research completed on wild Tucannon and Touchet River steelhead (Snake and Columbia River ‘A-run’ fish respectively) shows that 60-65% return to spawn after one year in saltwater, and 35-40% return to spawn after two years in saltwater (Bumgarner et al. 2003). Three-salt age fish are extremely rare. Until more empirical data on Asotin Creek steelhead are available, a similar age structure to the Touchet/Tucannon fish will be assumed. Fewer than 1% of Asotin Creek summer steelhead are believed to be repeat spawners (Glen Mendel, WDFW, personal communication).

Juveniles emerge from spawning gravels in late May or June. They typically rear for more than one year in Asotin Creek before migrating to the ocean. Migration occurs from October through June with a peak in April (Glen Mendel, WDFW, personal communication). Most juveniles migrate in their second year, but a small percentage migrate at age 1, 3 or 4 (Stovall 2001). A small group of 100 steelhead smolts sampled at Lower Granite Dam showed that most fish (62%) outmigrated in their second year, though 34% migrated in their third year, and 4% migrated in their first year (Hassemer 1992, cited in Busby et al. 1996). Smolt trapping conducted in the Tucannon River between 1998 and 2001 (Bumgarner et al. 2003) showed that emigrating steelhead were about 40% age 1, 55% age 2, and 5% age 3 or 4. The actual makeup of steelhead smolts from Asotin Creek is unknown.

Tenmile and Couse Creeks
Tenmile and Couse Creek summer steelhead are a typical Snake River “A”-run strain. A-run steelhead enter freshwater from June to August and generally pass Bonneville Dam before August 25. They begin passing Lower Granite Dam in early June and can continue through the following spring. Adult steelhead may enter as early as March and continue through mid May. Peak entry is believed to occur in March or April (Glen Mendel, WDFW, personal communication). Spawning begins in late March or early April. Spawning peaks in early to mid-April and continues through mid to late May.

Juveniles likely emerge from spawning gravels in May or June. Steelhead typically rear for more than one year in before migrating to the ocean. Juvenile migration possibly occurs from as early as late October, but because of limited water available in the fall, migration is more likely from March through May, with a peak in April (Glen Mendel, WDFW, personal communication). Most juveniles (estimated at 60%) migrate in their second year, but a percentage (~40%) probably migrate at age 1 because of high growth rates (high rearing temperatures) and limited carrying capacity (limited water). The actual makeup of steelhead smolts from Tenmile Creek is unknown

4.3.2 Historical and Current Distribution

Asotin Creek
Little is known about the historical distribution of Asotin Creek summer steelhead. It seems likely that historic distribution was probably more extensive than at present. Adult

steelhead enter the basin during spring when high stream flows enable access throughout most of the basin. Some passage impediments exist (culverts, debris jams, etc.) but allow varying degrees of passage. Current juvenile distribution is reduced due to water withdrawals, late summer dewatering of stream reaches, degraded habitat quality that limits abundance, and possible barriers to migration in the sub-basin.

At present summer steelhead utilize all accessible portions of the creek with adequate flows and temperature for spawning and rearing (WDFW District 3 unpublished data; Glen Mendel, WDFW, personal communication; Bumgarner et al. (2002) (see Figure 4-2).

Tenmile and Couse Creeks

Little is known about the historical distribution of summer steelhead in Tenmile and Couse creeks. It seems likely that historic distribution was probably more extensive than at present. Adult steelhead enter the basin during spring when high stream flows enable access throughout most of the basin. Some passage impediments exist (culverts, debris jams, etc.) but allow varying degrees of passage. Current juvenile distribution is reduced due to late summer dewatering of stream reaches, degraded habitat quality that limits habitat carrying capacity and fish abundance.

At present summer steelhead appear to utilize all accessible portions of Tenmile and Couse creeks with adequate flows and temperature for spawning and rearing (Mendel et al. 2001, Mendel et al. 2004).

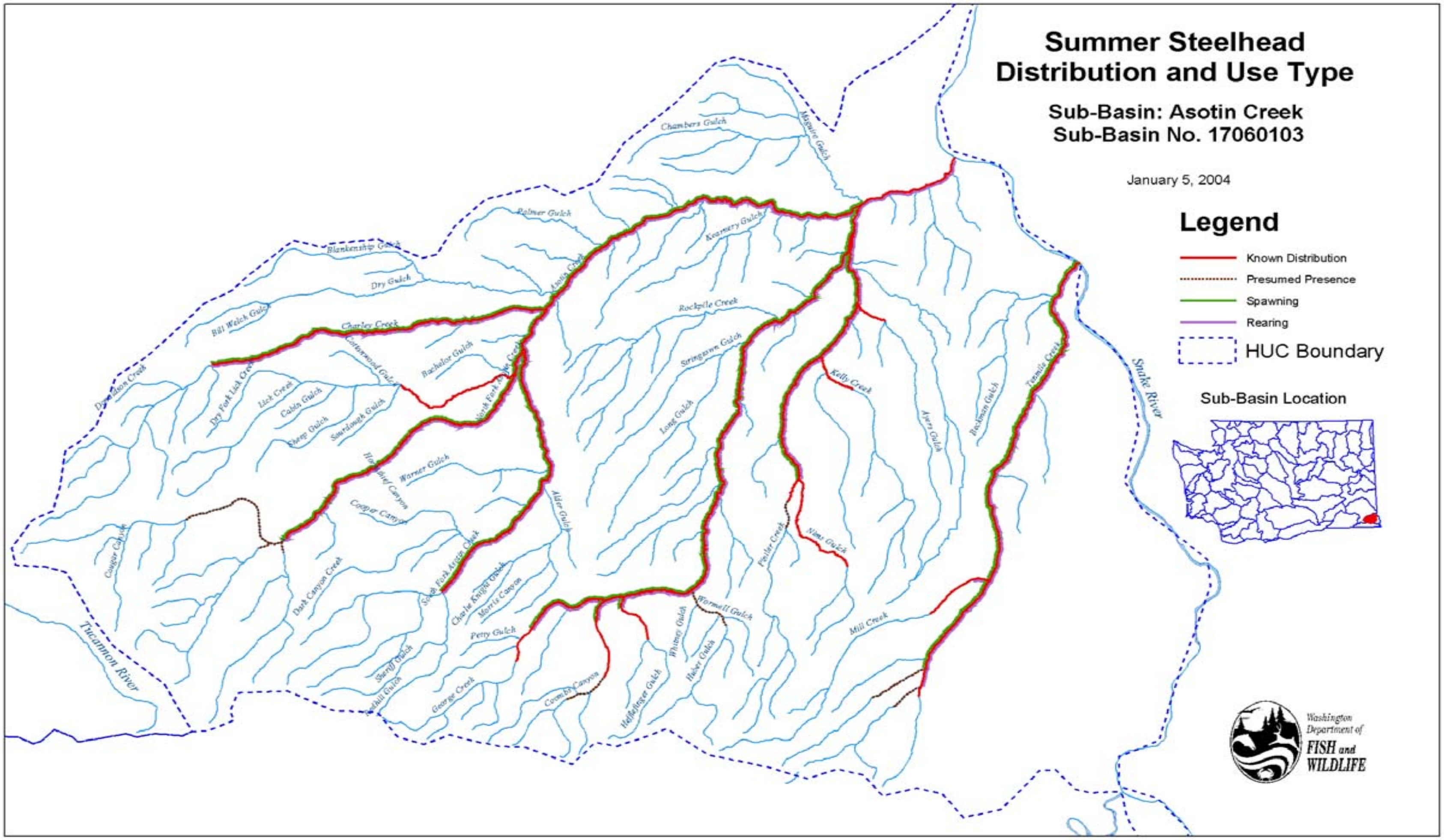


Figure 2. Current known and presumed distribution of summer steelhead in Asotin and Tenmile Creeks. Data from the WDFW Washington Lakes and Rivers Information System (WLRIS) database.

4.3.3 Population Identification

Genetic characteristics of Asotin Creek summer steelhead have been assessed using several methods and have been analyzed by both WDFW and NMFS researchers. Genetic data were obtained from samples of parr or pre-smolts taken in 1995, 2000 and 2001. It has been assumed that juveniles were produced by anadromous steelhead, and it is unknown if resident fish (if they occur) offspring were included in samples. In general, the Asotin population has genetic characteristics that place it clearly in the Snake River Basin Evolutionarily Significant Unit (ESU; Winans et al. In press). Additionally, Asotin Creek steelhead were more similar to other Snake River A-run populations than to B-run populations. The Interior Columbia Technical Recovery Team (TRT), a work group organized by NMFS for ESU recovery planning, has preliminarily identified Asotin Creek steelhead as an independent population in relation to all other Snake River Basin steelhead, considering genetic, geographic, phenotypic, environmental, and demographic data available (Interior Columbia Basin TRT, unpublished draft document July 2003).

Based on comparing data for allozyme genetic markers, Phelps et al. (1997) reported that Asotin Creek steelhead (1995 sample) were significantly different from all other Washington steelhead populations they had sampled. Their study did not include any other Snake River Basin populations, but did include populations in nearby Columbia drainages such as Touchet River (Walla Walla Basin) and Yakima Basin. Since 1997, analyses and characterizations of steelhead populations using allozyme data by WDFW and NMFS staff have shown that Asotin Creek steelhead (1995 sample) were significantly differentiated from a variety of other Snake River Basin populations, including Tucannon River (WDFW, unpublished data; NMFS, unpublished data). Winans et al. (In press) examined allozyme, DNA intron, and DNA microsatellite genetic markers for Asotin Creek steelhead and although their research did not focus on individual population relationships, Asotin Creek steelhead were differentiated from 31 Columbia Basin populations including 18 other Snake River A- and B-run, hatchery and wild, populations (G. Winans, NMFS, personal communication).

The NMFS has recently collected more extensive DNA microsatellite genetic marker data for Asotin Creek steelhead (1995, 2000 and 2001 samples) and a large number of steelhead populations in the Snake and Columbia basins. These data have been utilized by the Interior Columbia TRT. Based on this genetic marker data set, Asotin Creek steelhead were not well-differentiated from Tucannon River steelhead samples (Paul Moran, NMFS, personal communication). This relationship between Tucannon River and Asotin Creek steelhead needs to be explored to evaluate its implications in terms of population structure and gene flow. For example, it is important to know if a common hatchery stock has been planted or occurs as strays in both drainages.

Genetic characteristics of Tenmile and Couse creek summer steelhead have not been assessed. A small number of genetic samples have been collected, but not analyzed. The Interior Columbia Technical Recovery Team (TRT), a work group organized by NMFS for ESU recovery planning, has not identified Tenmile or Couse creek steelhead as an independent population, but has grouped them with the lower Grande Ronde population of steelhead (pg 9) in relation to all other Snake River Basin steelhead, considering genetic, geographic, phenotypic, environmental, and demographic data available (Interior Columbia Basin TRT, unpublished draft document July 2003). These fish are currently not recognized in SaSI population designations.

4.3.4 Asotin Creek Steelhead/Rainbow Trout Population

4.3.4.1 Population Characterization.

4.3.4.1.1 Empirical Data

Steelhead exist throughout most of the Asotin and Tenmile basins (Figure 4-2). WDFW has collected fish distribution and abundance data from various portions of the Asotin Basin for many years. However, data are available for only a few years for most portions of the Asotin and Tenmile basins (2000 and 2001). Data are limited or not available for some stream reaches.

The empirical data (Table 4-6) indicates the highest spawning and rearing occurs in different geographic areas. Redd densities are highest in the mainstem Asotin and North Fork Asotin Creek. The highest densities of age 1+ or older steelhead/redband trout have been found in the upper mainstem (above Headgate), in North Fork, South Fork, George Creek and Pintler creeks. The Pintler Creek and Tenmile Creek juvenile numbers in the table were reduced by 10 and 20%, respectively, to reflect that a portion of these streams were dry during the sampling period in 2000. The proportions of Tenmile, Pintler and George creeks that are dry each summer varies annually based on snow pack and precipitation. During 2000, all of George Creek maintained overland flow, but this is not usually the case.

Empirical data were used to expand estimated redd numbers (482) by 0.81 females/redd and a 60/40 female/male ratio to estimate adult abundance at 651 adults in the Asotin subbasin. Capacity was not calculated here, but a 2001 Potential Parr Production (PPP) estimate of capacity for the basin was 1,662 adults in Asotin.

Empirical data were used to expand estimated redd numbers from 2000 surveys (as was done above for the Asotin subbasin) to estimate an adult return of 49 steelhead in Tenmile. The WDFW Potential Parr Production model estimated carrying capacity to be 188. .

Asotin Creek adult summer steelhead escapements may have exceeded 1,000 adults between 1954 and 1961 (Mark Schuck, WDFW, personal communication, cited in Stovall (2001). The size of the population has declined considerably since construction of mainstem dams on the lower Columbia and Snake Rivers. For example, the Lower Snake River Compensation Program was based on an estimated 48% loss of salmon and steelhead attributed to the construction and operation of the four lower Snake River dams (Herrig 1998). Releases of hatchery-reared steelhead occurred in Asotin Creek for many years (see Artificial production section), and returning hatchery-origin adults contributed to the spawning population between 1985 and 2000. The releases were discontinued after 1997, and the creek was designated a natural production steelhead reserve area. The extent of the effects of hatchery fish on the wild population is unknown. A study was begun by WDFW in summer 2003 to monitor the status of the Asotin Creek steelhead population.

The EDT and empirical adult abundance estimate for Asotin and Tenmile clearly are not similar. EDT underestimated current adult abundance and capacity in Asotin and appeared to overestimate it in the Tenmile (see following section). Current EDT abundance is estimated at 175 adult steelhead in Tenmile, with a carrying capacity of 291. Current EDT abundance is estimated at 206 adult steelhead, with a current capacity of 426 adults in the Asotin Subbasin.

Table 4-6. Asotin Subbasin Steelhead empirical population data, 2000, 2001, 2002. *Pintler Cr Total Population and >1+ population estimates reduced by 10% to account for dry stream reaches during survey. **Tenmile Total Population and >1+ population estimat

Asotin Cr 2000, 2001									Age 1+		
	Length		**Mean #**	**# of**	**Redds**	**Mean**	**Total Density**	**Total Pop.**	**Density**	**Age 1+**	
Location	**Miles**	**Meters**	**of redds**	**Years**	**per mile**	**Width (m)**	**per/100m**	**Estimate**	**/100m2**	>1+ Pop.	>1+/mile
Mouth to George Ck	3.5	5635	0	N/A	N/A	9.6	28.5	15,417	6.04	3,267	934
George Ck to Headgate	6.9	11109	74	3	10.7	9.9	43.4	47,731	4.43	4,872	706
Headgate to Forks	7.3	11753	99	3	13.6	8.45	36.25	36,001	9.67	9,604	1,316
Charlie Ck	8	12880	37	3	4.6	3.16	60.25	24,522	17.75	7,224	903
North Fork Asotin	11.3	18193	136	3	12.0	7.14	58.4	75,860	16.56	21,511	1,904
South Fork Asotin to Alder	4.4	7084	24	3	5.5	4	44.1	12,496	22.3	6,319	1,436
Upper South Fork Asotin	4.4	7084	23	2	5.2	3.75	63.1	16,763	29.8	7,916	1,799
George Ck to Wormell	15.7	25277	64	2	4.1	3.55	75.75	67,973	34.77	31,200	1,987
Wormell to Upper George Ck	9	14490	15	2	1.7	2.9	48.38	20,330	32.42	13,623	1,514
Wormell Ck	0.1	161	0	N/A	N/A	3	N/A	0	N/A	N/A	N/A
Hefflefinger Ck	1.8	2898	3	1	1.7	2	72.7	4,214	20.8	1,206	670
Coombs Ck	1.2	1932	1	1	0.8	2.2	92.5	3,932	27.3	1,160	967
Pintler Ck	10.7	17227	6	1	0.6	2.42	70.3	26377*	34.98	13125*	1,227
TOTAL			**482**	redds				**351,615**		**121,028**	
			x 0.81 females/redd								
		=	390	females							
			/0.6 (proportion of females)								
		=	**651**	**total adult population estimate**							
PPP msh = 1,662 adults and parent to progeny of 1.07											
Tenmile Cr 2000, 2001, 2002											
	Length		**Mean #**	**# of**	**Redds**	**Mean**	**Total Density**	**Total Pop.**	**Density**	**Age 1+**	
Location	**Miles**	**Meters**	**of redds**	**Years**	**per mile**	**Width (m)**	**per/100m**	**Estimate****	**/100m2**	>1+ Pop.	>1+/mile.
Mouth to road that leaves Ck	1.8	2898	3	3	1.67	2.9	50	3,362	18.3	1,230	684
Seasonal dewatering to Mill Ck	8.8	14168	29	3	3.30	3.5	92.5	36,695	58.2	23,088	2,624
Mill Ck To Culvert	2.9	4669	0	1	0.00	0.2	0	0		0	0
Mill Ck above Culvert	2.2	3542	0	1	0.00	0	0	0	0	0	0
Mill Ck to Middle Branch	3.2	5152	4	1	1.25	1.6	10.5	692	7.9	521	163
Middle Branch	1.9	3059	0	1	0.00	1.9	9.7	451	0.3	14	7
M. Branch to Weissenfels Pond	1.5	2415	0	1	0.00	0.6	26	301	23.3	270	180
TOTAL			**36**					**41,502**		**25,124**	
			x 0.81 females/redd								
		=	29	females							
			/0.6 (proportion of females)								
		=	**49**	**total adult population estimate**							

4.3.4.1.2 EDT Analysis

Asotin and Tenmile Summer Steelhead Baseline Population Performance—Model results for Asotin Subbasin summer steelhead are based on life history assumptions summarized in Table 4-7 and 4-8. The EDT model estimated the average spawning population size of the current Asotin Creek summer steelhead to be 206 fish, with a carrying capacity of 423 fish and a productivity of just 2 adult returns per spawner (Table 4-9). The life history diversity value indicates only 18% of the historic life history pathways can be successfully used under current conditions. The analysis also suggests that the Asotin Subbasin has a much greater production potential for summer steelhead than it now displays, as historical abundance is estimated at 8,677 spawners, with a productivity of 21.6 returning adults per spawner and a life history diversity of 100%. Also in Table 9 are the EDT results for Tenmile.

Table 4-7. Life history assumptions used to model summer steelhead in Asotin Creek, Washington. *We modeled a genetic stock fitness of 100 %, though it is likely less due to past hatchery introductions and stray hatchery fish currently stocked in other areas.

Stock Name:	Asotin Creek Summer steelhead	
Geographic Area (spawning reaches):	All reaches	
River Entry Timing (Lower Granite Dam):	August 13-December 17; mean October 15	
River Entry Timing (Asotin R):	January 29-May 14; mean February 26	
Adult Holding:	Lower Granite Pool 68% Asotin R. 32%	
Spawn Timing:	April 9-May 28; mean April 30	
Spawner Ages:	63% 1-salt 34% 2-salt 3% 3-salt	
Emergence Timing (dates):	May 28-August 6; mean July 2	
Smolt Ages:	10% age-1 85% age-2 5% age-3	
Juvenile Overwintering:	Lower Granite and Little Goose pools:	21%
	Asotin R.:	79%
***Stock Genetic Fitness:**		100%
Harvest (Within Asotin Ck.):		0%

Table 4-8. Life history assumptions used to model summer steelhead in Tenmile Creek, Washington.

Stock Name:	Tenmile Creek summer steelhead	
Geographic Area (spawning reaches):	Tenmile: All reaches	
River Entry Timing (Columbia):	Bonneville Dam: mostly July-August, but as late as November	
River Entry Timing (Tenmile):	Early January through mid-April; mean entry date in mid-February	
Adult Holding:	Adults begin holding in Lower Monumental Pool and between September and February.	
Spawn Timing:	Begins week of March 1, ends 20th of May, with a peak in mid-April	
Spawner Ages:	60% 1-Salt, 39% 2-Salt, <1% 3-Salt	
Emergence Timing (dates):	Lasts 2 weeks beginning as early as mid April and as late as early July, with an average period of May 25 – June 8.	
Smolt Ages:	35% Age 1, 60% Age 2, 5% Age 3, <0.5% Age 4	
Juvenile Overwintering:	Snake River:	10% (late October – March)
	Tenmile Ck.:	90% (late October – March)
***Stock Genetic Fitness:**	90% wild	
Harvest (In-watershed):	No Harvest	

Table 4-9. Baseline spawner population performance parameters for Asotin and Tenmile Creeks, Washington summer steelhead as determined by EDT, 2003.

Scenario	Diversity Index	Productivity	Capacity	Adult Abundance
Asotin				
Patient (Current)	18 %	2.0	423	206
PFC	57 %	2.3	636	356
Template (Reference)	100 %	21.6	9,099	8,677
Tenmile				
Patient (Current)	2% (49)	(2.5)	(291)	(175)
PFC	44% (72)	(5.7)	(449)	(370)
Template (Reference)	100%	18.1 (25.1)	1,740 (1744)	1,644 (1676)

The EDT model appears to underestimate the current population size and carrying capacity in Asotin Creek compared with the empirical data (206 adults, 423 capacity from EDT vs. 651 current adults from empirical data). However, it is the opinion fo the writer that EDT likely overestimates the historical abundance (8,677) and productivity (21.6 returning adults per spawner). WDFW used the agency standard Potential Parr Production model for Asotin Creek data in 2001. That model estimated 1,662 as current potential carrying capacity with a parent to progeny ratio of 1.07.

There currently is not enough time to adjust the inputs or the model for EDT to adjust it to provide results that more closely approximate the current empirical estimate of adults in the basin. The obvious conclusion from the EDT model is that current abundance, productivity and life history pathways are substantially less than in the past. That theme is consistent with all other planning efforts in the basin. The results from EDT should adequately provide an evaluation of the relative importance of various habitat attributes, by stream reach or geographical area, for limiting steelhead or salmon production even without being adjusted to more closely match empirical abundance data.

4.3.4.2. Population characteristics consistent with VSP.

The NOAA Fisheries Technical Recovery Team (TRT) has identified Asotin Creek summer steelhead as an independent population, based primarily on their distance (135 km) from their nearest genetically similar population (Tucannon River)(TRT 2003). The NOAA Fisheries Viable Salmonid Population (VSP) document (McElhany 2000) identified four parameters that are key in determining the long term viability of a population, those are: abundance, population growth rate, population spatial structure and diversity. Specific targets for these parameters have not yet been developed by the TRT. The *interim* spawner abundance target for steelhead in Asotin Creek is 400 adults (Lohn 2002). We discuss each of these parameters briefly.

Abundance

The EDT analysis for Asotin Creek summer steelhead estimated a current adult abundance of 206 steelhead and an abundance of 356 fish with PFC. The difference between the interim TRT goal (400 adults) and our abundance estimate at PFC (346 adults) could easily be due to the unknown variance of our model estimates. Moreover, an examination of empirical data collected by the WDFW shows that the subbasin may be capable of supporting in excess of 600 spawners in its current condition in any one year. Surveys conducted since the mid-1980s suggest the population is highly variable (see 4.3.4.3 below) and averages below the TRT's interim goal. Data quality for the basin makes it difficult to conclude with any confidence the true variability of abundance for steelhead, or whether the population has experienced any significant bottlenecks because of critically low spawning numbers. The elimination of hatchery steelhead plants from the upper basin in the mid-1980s was followed by a decline in observed spawners. However, this smaller spawning population has persisted and has recently responded to improved ocean conditions with increased estimated escapement to the basin. Such a response is desirable and noted in the VSP guidelines, as are sufficient abundance to support compensatory processes to ensure resilience of the population, prevent inbreeding depression, and function as an important part of the basin's ecological processes. There is insufficient data for steelhead at present to conclude that current abundance meets VSP goals. We can only conclude that the population persists and appears capable of responding to within and out-of-basin changes in productivity at drive abundance.

Growth Rate (productivity)
Population productivity (returning adults / spawner) is at a point (2.0) to allow for limited population growth. This only improved slightly with PFC (2.3) indicating that Out-of Subbasin-Effects (OOSE) are playing an important role in limiting the productivity of the Asotin Creek steelhead population. An analysis of empirical data by WDFW using parr production as an indicator of trends over time concluded similarly: productivity fluctuated over time at or slightly above the replacement line (1.07). The effects of OOSE on a small population are critical and unless concurrent actions outside of the subbasin are taken with habitat initiatives in the subbasin, population response could be limited. Despite these concerns about adult replacement, juvenile population behavior over time still appears to retain the capacity for compensatory response at low adult escapement levels.

Spatial Structure
Asotin Creek basin is a comparatively small system, but spatially complex none-the-less, with steelhead spawning aggregates occurring in the mainstem and all four major tributary systems. There is no current evidence that steelhead subpopulations exist within the subbasin. There remains substantial connectivity within the system during the spring runoff that allows adult steelhead access throughout. Whether resident *O. mykiss* populations (redband trout) exist within Asotin Creek that are reproductively separate from their anadromous counterparts is presently unknown. Although resident trout spawners and redds have been documented in upper George Creek and elsewhere, and an identifiable resident phenotype does exist in the basin. Resident spawners and a separate phenotype would suggest that some isolation occurs, but there may also be a low level of spawning between resident and anadromous fish. Since WDFW began surveying the Asotin Creek subbasin in the early 1980s, spawning adults and juvenile steelhead have been documented throughout the basin. The number of redds observed and juvenile densities in all sampled areas have been highly variable during this time frame. Such variability suggests that the spatial distribution of spawners, or of suitable spawning/rearing habitat, changed over time within the basin. Anthropogenic impacts have negatively affected fish habitat quality over time(e.g. road and levee construction, grazing, elimination of riparian vegetation and stream channel connectivity). Likewise, stochastic environmental events (floods, log-jams, dewatered stream reaches) have affected habitat and fish distribution. Despite these factors, no known extirpations have occurred. Such population response seems to fit an island-mainland population structure as defined in the NMFS Technical memorandum describing a VSP (McElhany 2000), and suggests that sufficient spatial structure remains for the *O. mykiss* population to persist during the short term. The VSP document cautions that salmonid habitat is dynamic, and for a population to persist, its “habitat patches should not be destroyed faster than they are naturally created” (McElhany 2000). It further cautions that VSP is defined for populations to persist over a 100 year period and that loss of spatial structure

may eventually contribute to extirpation. Establishing a relationship between habitat loss and population collapse can be difficult, and may require monitoring over a longer time than is generally possible.

Diversity

Anthropogenic impacts to populations can decrease their diversity and jeopardize their existence. The four H's are capable of altering the population's structure and its ability adapt to localized stochastic or human caused conditions. Habitat change has been substantial over last 150 years in Asotin Creek and the Columbia Basin. These changes, combined with hatchery releases of trout and steelhead, and the ongoing effects of migration corridor impacts have undoubtedly stressed salmonid populations in the subbasin. Within the basin, whether resident *O. mykiss* populations (redband trout) exist that are reproductively separate from their anadromous counterparts is presently unknown. Resident trout spawners and redds have been documented in upper George Creek and elsewhere, and an identifiable resident phenotype does exist in the basin (REFERENCE). Resident spawners and a separate phenotype would suggest that some isolation occurs, but there may also be a low level of spawning between resident and anadromous fish. Further, it is unknown whether the two were distinct in the past, or they have developed through a loss of diversity caused by human actions.

The EDT estimated that only 18% of the life history diversity pathways are available to summer steelhead (*O. mykiss*)in Asotin Creek under current conditions, and that 57 % would be available under PFC. It is not known how the existing loss of pathways has affected population structure Neither is it not known how close these PFC estimates will be to TRT requirements for a VSP

We conclude that the quality, quantity and spatial structure of salmonid habitat in Asotin Creek has decreased and may have contributed to the loss of spring chinook in the basin, but at present, sufficient habitat remains to support *O. mykiss*. Whether recent habitat improvements and changes in stream management have been sufficient to reverse a generalized decline for the long term is unknown.

4.3.4.3 Population Status

Endangered Species Act Status

The Snake River Basin steelhead ESU, which includes Asotin Creek summer steelhead, was listed as threatened under the federal Endangered Species Act (ESA) by NOAA Fisheries in August, 1997 (62 FR 43937). Threatened status means that the listed group is likely to become endangered (in danger of extinction) within the foreseeable future throughout all or a significant portion of its range. The threatened determination for the ESU was made based on the following considerations:

- Severe declines in adult (escapement estimates) and juvenile abundance (parr densities) compared with historical levels, especially for B-run fish.
- The high proportion of hatchery-origin steelhead in the ESU (80% of steelhead passing Lower Granite Dam are hatchery fish) leading to concerns about straying and introgression with native steelhead, especially when the hatchery fish are from composite stocks that have been domesticated for several generations.

SaSI Status

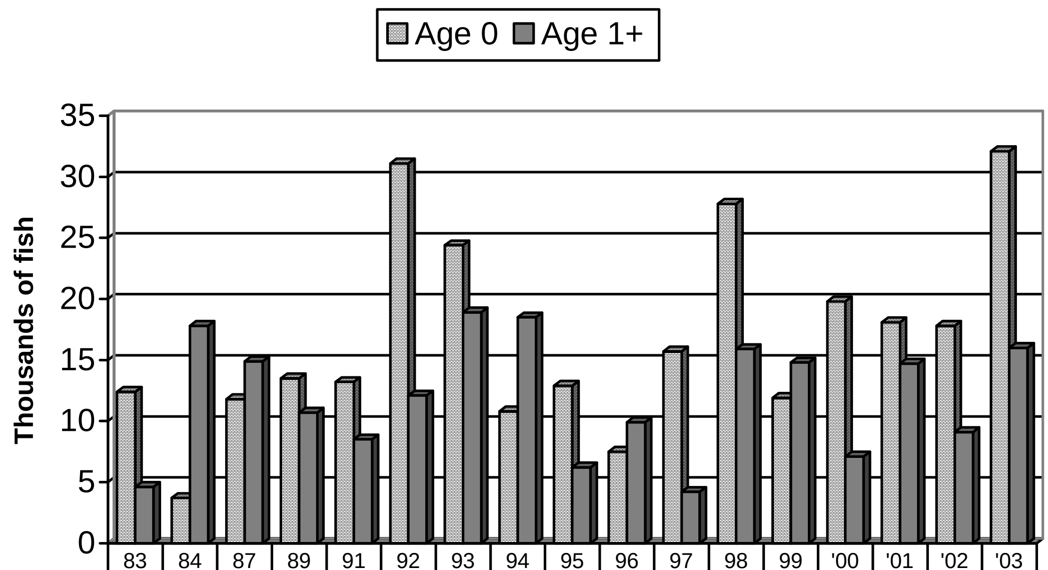
In the 1992 SASI (Salmon and Steelhead Inventory), Asotin Creek summer steelhead were rated depressed due to chronically low escapements (WDF, WDW and WWTIT 1993). This rating meant that production was believed to be below the level expected given the condition of the available habitat and natural variation in survival but above the level at which permanent genetic damage to the stock was likely. In 2002 the stock was again rated depressed based on chronically low escapements (WDFW and WTIT 2003). The current WDFW escapement goal for the stock is 160, though the goal generated by recent runs of the WDFW Potential Parr Production model (Gibbons et al. 1985) is 1,660 (Glen Mendel, WDFW, personal communication), and the NOAA Fisheries interim recovery goal is 400 natural-origin fish

The abundance data on which the 1992 and 2002 SaSI status ratings were made are shown in Table 4-10. The counts are for index areas only and do not represent escapement to the basin. They depict the variability among years and do provide an indication of the depressed nature of the population. The years with no data resulted from excessive spring flows that prevented spawning surveys, and incomplete years indicate observed redds without expansion for unsurveyed areas or correction for redd erasure over time.

Table 4-10. Spawner counts for Asotin Creek summer steelhead from index areas in the North and South forks, Charley Creek and the mainstem up to Headgate Dam. Index counts are from the WDFW SaSI database or from: Martin et al. (2000); Bumgarner et al. (2002, 2003); Schuck et al. (1998); Schuck et al. (1997).

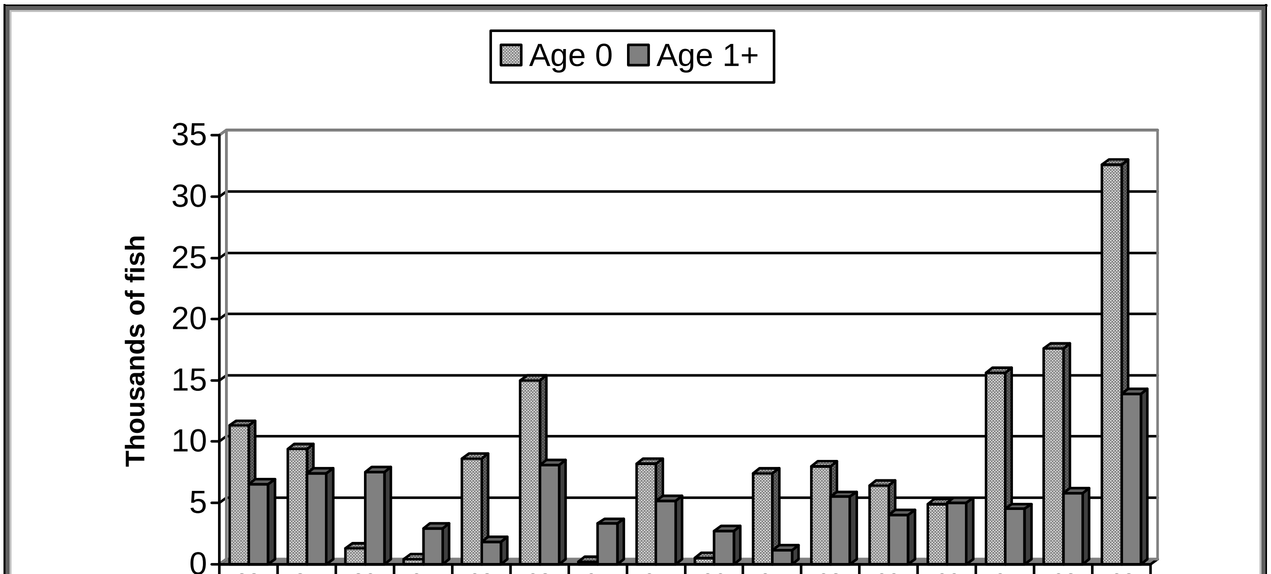
Year	Index Spawner Counts
1986	603
1987	363
1988	260
1989	600
1990	No data
1991	600
1992	93
1993	79
1994	118
1995	205
1996	118 (incomplete)
1997	No data
1998	51 (incomplete)
1999	273
2000	70
2001	397
2002	180 (incomplete)
2003	No data

Figures 4-3 to 4-5 (juvenile populations for index areas) provide an additional measure of relative population status. Juvenile densities are estimated with electrofishing surveys and populations are calculated for index areas. These index areas do not represent the entire Asotin subbasin, but the juvenile index estimates generally coincide with adults survey areas. These juvenile estimates generally coincide with adult survey areas. These data seem to support the possibility of recovering the depressed steelhead population by addressing habitat and abundance issues.



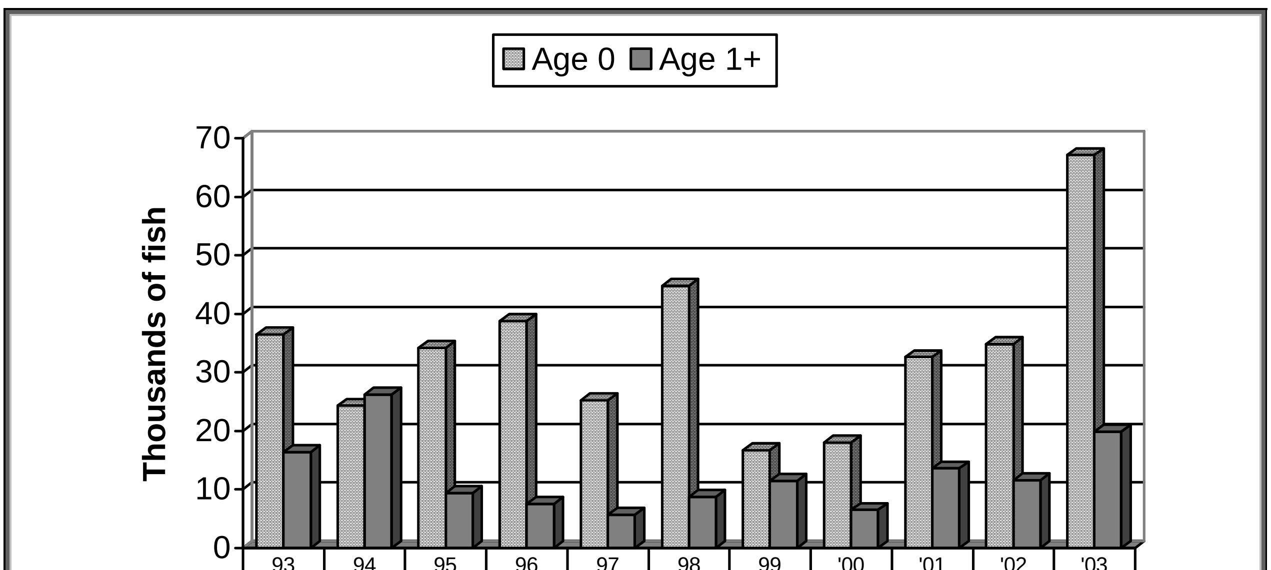
	83	84	87	89	91	92	93	94	95	96	97	98	99	'00	'01	'02	'03
Age 0	12.4	3.7	11.8	13.5	13.2	31.1	24.4	10.8	12.9	7.5	15.7	27.8	11.9	19.8	18.1	17.8	32.1
Age 1+	4.6	17.8	14.9	10.7	8.5	12.1	18.9	18.5	6.2	9.9	4.2	15.9	14.8	7.1	14.7	9.1	16

Figure 4-3. Estimates of natural juvenile steelhead abundance for most years on the North Fork of Asotin Creek from the confluence with the South Fork upstream 7.4 rkm to U. S. Forest Service Boundary, 1983-2003.



	83	84	89	91	92	93	94	95	96	97	98	99	'00	'01	'02	'03
Age 0	11.3	9.4	1.3	0.4	8.6	15	0.2	8.2	0.5	7.4	8	6.4	4.9	15.6	17.6	32.6
Age 1+	6.5	7.4	7.5	2.9	1.8	8.1	3.3	5.16	2.7	1.15	5.5	4	5	4.5	5.8	13.9

Figure 4-4. Estimates of natural juvenile steelhead abundance for most years on the South Fork of Asotin Creek from the confluence with the North Fork upstream 5.6 rkm to first bridge crossing, 1983-2003.



	93	94	95	96	97	98	99	'00	'01	'02	'03
Age 0	36.5	24.3	34.2	38.8	25.2	44.8	16.7	18	32.6	34.8	67.1
Age 1+	16.4	26.2	9.4	7.5	5.7	8.7	11.5	6.5	13.6	11.6	19.9

Figure 4-5. Estimates of natural juvenile steelhead abundance on the mainstem of Asotin Creek from Headgate Park to the confluence of the North and South forks (8.0 rkm), 1993-2003

4.3.4.4 Harvest Assessment

Sport fishing is prohibited for adult steelhead in Asotin Creek because the subbasin is managed by the WDFW as a wild steelhead refuge. Adult steelhead would be vulnerable to excessive exploitation in this small stream. Wild steelhead release regulations are in place in the Snake River basin and all of southeast Washington to protect naturally produced steelhead from harvest. Only marked hatchery fish can legally be harvested by sport fisheries in the Snake River Basin. Tribal harvest has not been closed in Asotin Creek by the Nez Perce Tribe.

Harvest rates in the Columbia basin have been reduced since the late 1980s and early 1990s to protect ESA listed salmon and steelhead. Sport fisheries in the lower Columbia River changed to wild steelhead release regulations in the mid or late 1980s. No harvest estimates are available for hatchery Asotin Creek steelhead since the 1988 release group. However, the Technical Advisory Committee under US v OR estimates harvest rates for naturally produced "A" run steelhead in the Columbia Basin. Net fishery harvest rates averaged about 18% in the 1980s, 15% in the early 1990s, and net fishery harvest rates were reduced to 4-6% in the 2001-2002 fisheries (Cindy LeFleur, WDFW, pers. Communication) (see the WDFW website under Col R Compact and table 21 on page 60 of Joint Staff Report July 16. Sport fisheries in the Columbia Basin currently have less than a 4% ESA impact (Cindy Le Fleur, WDFW, pers. Communication).

Juvenile steelhead may be harvested as trout in Asotin Creek during June through October of each year. Resident trout fisheries are closed during the peak of the juvenile salmon and steelhead out-migration in the Snake River (April, May and early June). Daily limits in mainstem Asotin Creek are 2 fish per day with an 8 in minimum size. Selective gear restrictions (no bait, single barbless hook, etc.) are in place to minimize mortality on wild steelhead in the North Fork of Asotin Creek (up to the USFS boundary). All other areas or tributaries are closed to fishing , including George Creek, Charlie Creek, the South Fork and upper North Fork, and their tributaries.

Descriptions of fisheries and their estimated effects on listed species of fish in the Snake River basin are discussed in the WDFW Fishery Management and Evaluation Plan (FMEP) for the incidental Take of listed species submitted under ESA Section 10/4d (submitted to NOAA-fisheries on Dec. 2, 2002). Similar FMEPs exist for the mid Columbia and lower Columbia fisheries. Estimates exist for harvest of Snake River wild steelhead in salmon and steelhead fisheries in the lower Columbia River from the Technical Advisory Committee (US v OR).fisheries in the lower Columbia River from the Technical Advisory Committee (US v OR).

Coded-wire tagged (CWT) steelhead have only been released in the Asotin subbasin during the spring of 1988. This release consisted of 137,847 Pahsimeroi stock steelhead from Idaho, with 39,812 of them tagged with CWTs. Expanded recoveries consisted of 3 fish from ocean fisheries, 85 from Columbia River sport and 240 from Columbia River net fisheries (Bumgarner et al. 2002). Another 11 fish were recovered from Columbia River hatchery or trap locations. Total expanded recoveries from outside the Snake River basin represented 0.25% of the number of fish released in 1988 and 60.1% of all expanded recoveries. Sport fisheries in the Snake River basin caught another 170 fish (expanded) from this release group (0.12% of the total released). Estimates of total fishery harvest on this coded-wire tag group are not feasible because fish that escaped to spawn naturally were not recovered and included in the coded-wire tag analysis.

Coded-wire tag information from WDFW's Grande Ronde River releases was used as a surrogate for Asotin Creek releases because of the lack of coded-wire tag groups Asotin Creek (Table 4-11). Hatchery fish from the Grande Ronde River releases were harvested at a high rate in the Columbia River net fisheries in the mid 1980s, but the rate declined to less than 6.0% of expanded recoveries in the late 1990s. Snake River Basin sport fisheries accounted for an increased percentage of recoveries in the late 1990s. However, these values do not adequately represent harvest locations or rates for wild, unmarked steelhead produced in Asotin Creek as all sport fisheries in the Columbia Basin are now selective fisheries for marked hatchery steelhead.

Table 4-11. Percentages of expanded coded-wire tag recoveries, by location, for Grande Ronde River releases.

				Release year			
Recovery location	85	86	87	97	98	99	00
Ocean fisheries	0.3	0.1	0.1	0	0	0	0
Columbia R. sport	6.2	4.9	6.5	6.1	4.3	6.8	6.0
Columbia R. net	45.1	52.5	55.0	2.0	3.5	6.0	5.5
Snake R. sport	34.4	24.3	35.4	72.4	47.9	72.6	61.1
Deschutes R.	3.2	5.0	2.2	2.0	0.8	1.2	4.7
Columbia R. traps	0	0.1	0.6	0	0	0	0

4.3.4.5 Hatchery Assessment

Between 1983 and 1986, Washington Department of Wildlife (one of the precursor agencies to present day WDFW) stocked summer steelhead smolts annually from Lyons Ferry Hatchery into Asotin Creek at the confluence of the North and South Forks (Table 4-12). Similar numbers of smolts were planted only at the mouth of the creek in the Town of Asotin between 1987 and 1997, after which smolt plants were discontinued. Spawning escapement in the upper reaches of the basin dropped significantly after adult returns from the 1986 release were complete. The incidence of hatchery adults in the population at present is considered low based on observations during spawning surveys of adipose clipped adult spawners (M. Schuck pers. comm.). During the period 1983-1986, Wells stock steelhead from the upper Columbia River, Pahsimeroi and Wallowa stock steelhead from the Grande Ronde River were used in the stocking program. Lyons Ferry Stock steelhead were used 1987-1997.It is unknown to what degree these fish interacted or hybridized with wild spawning fish but both spatial and temporal overlap is believed to have occurred. The WDFW intends to manage Asotin Creek for wild steelhead production and no longer releases hatchery steelhead into the subbasin. As most hatchery releases have been near the mouth of Asotin Creek it is suspected that little hatchery introgression has occurred into this population (Table 4-12).

A summer trout fishery (June-October) occurred throughout the mainstem creek and on North and South forks that was supported by hatchery reared rainbow trout. WDFW planted catchable sized trout in 4.6 miles of the North Fork, one mile of main Asotin Creek, and rarely in lower South Fork (Table 4-12). Areas of stream planted were in state ownership. The fishery occurred primarily in June and early July and represented 900-1,000 angler days each year. Schuck and Mendel (1987) estimated that wild fish contributed 18% of the trout harvest on Asotin Creek in the 1985 summer trout season. They believed that most of the wild fish were juvenile steelhead. A June closure of the North Fork to all vehicle traffic in the early 1990s severely limited access to the fishery and the access road up North Fork was destroyed during the 1996 flood. Trout plants had been eliminated in the North Fork after 1994 because of increasing concern about the ecological effects of hatchery trout on wild salmonids, as well as encouraging hooking mortality and harvest of them. Trout plants continued on the mainstem creek at a reduced level through 1999, after which they were discontinued. The long-term effects of trout plants on the wild population are unknown.

Hatchery fish are not known to ever have been stocked into Tenmile or Couse creeks. Five hatchery steelhead (based on adipose clips) have been documented in Tenmile Creek from 28 adults examined (includes one of unknown origin) in 2000 – 2002 (Glen Mendel, WDFW, district files). The origin of these 5 hatchery fish is unknown.

Table 4-12. Hatchery trout and steelhead releases into Asotin Creek 1983-1999.

YEAR	RB PLANTED	Stock	LOCATION	SSH PLANTED	Stock	LOCATION
1983	8,424	Spokane	Main/NF/SF	36,774	Wells	NF/SF conf.
1984	6,426	Spokane	Main/NF	33,005	Wallowa	NF/SF conf.
1985	5,685	Spokane	Main/NF/SF	31,500	Wallowa	NF/SF conf.
1986	6,588	Spokane	Main/NF	44,650	Wallowa	NF/SF conf.
1987	3,942	Spokane	Main/NF	22,950	LFH	Mouth
1988	5,022	Spokane	Main/NF	28,975	Wallowa	Mouth
1989	4,290	Spokane	Main/NF	29,975	Wallowa	Mouth
1990	3,969	Spokane	Main/NF	137,847	Pahsimeroi	Mouth
1991	5,184	Spokane	Main/NF	0		Mouth
1992	3,828	Spokane	Main/NF	0		Mouth
1993	3,955	Spokane	Main/NF	136,050	Oxbow	Mouth

1994	3,900	Spokane	Main/NF	30,460	LFH	Mouth
1995	2,035	Spokane	NF	35,800	LFH	Mouth
1996	1,950	Spokane	NF	38,500	LFH	Mouth
1997	2,000	Spokane	NF	39,997	LFH	Mouth
1998	2,074	Spokane	NF	0		Na
1999	2002	Spokane	NF	0		Na

4.3.4.6 Steelhead Assessment Summary

Restoration and Protection Potential

We assessed habitat priorities for Asotin Creek summer steelhead in three basic ways. Two of these ways emphasized the "where" of a subbasin management plan while the third emphasizes the "what". Places where a strategic plan should be focused were determined by identifying areas critical to preserving current production (viz., by identifying areas with high "Protection Value"), and by identifying areas with the greatest potential for restoring a significant measure of historical production (viz., by identifying areas with high "Restoration Potential"). The kinds of actions a subbasin management plan should include were determined by performing a "Reach Analysis" (Section 4.2.4.1).

The restoration potential within the Asotin watershed was 61% for life history diversity, 52% for productivity, and 28% for abundance (Figure 4-6). Such a result is to be expected for a Subbasin as far upriver as the Asotin and suggests that improving performance of Asotin summer steelhead is strongly tied to actions in the mainstem Columbia and Snake Rivers. Within the watershed, Charley Creek (61%) ranked the highest for restoration potential, followed closely by Upper Asotin (56%), when summing all three performance measures (abundance, productivity, and life history diversity) (Table 4-13). The next highest priority geographical areas were Lower George (51%), Lower North Fork (48%), and Upper George (41%). When scaling the potential for restoration benefit on a per kilometer basis the Lower Asotin ranked (7.5% / km), followed by the Upper Asotin (5.7% / km), the NF tributaries (4.6% / km), the Upper George tributaries (3.8% / km) and the Lower SF (Table 4-13). The largest potential for restoration of abundance (23%) and productivity (26%) was in Charley Creek, whereas Lower George (35%) and Upper George (29%) ranked highest for potential change in life history diversity (Table 4-13).

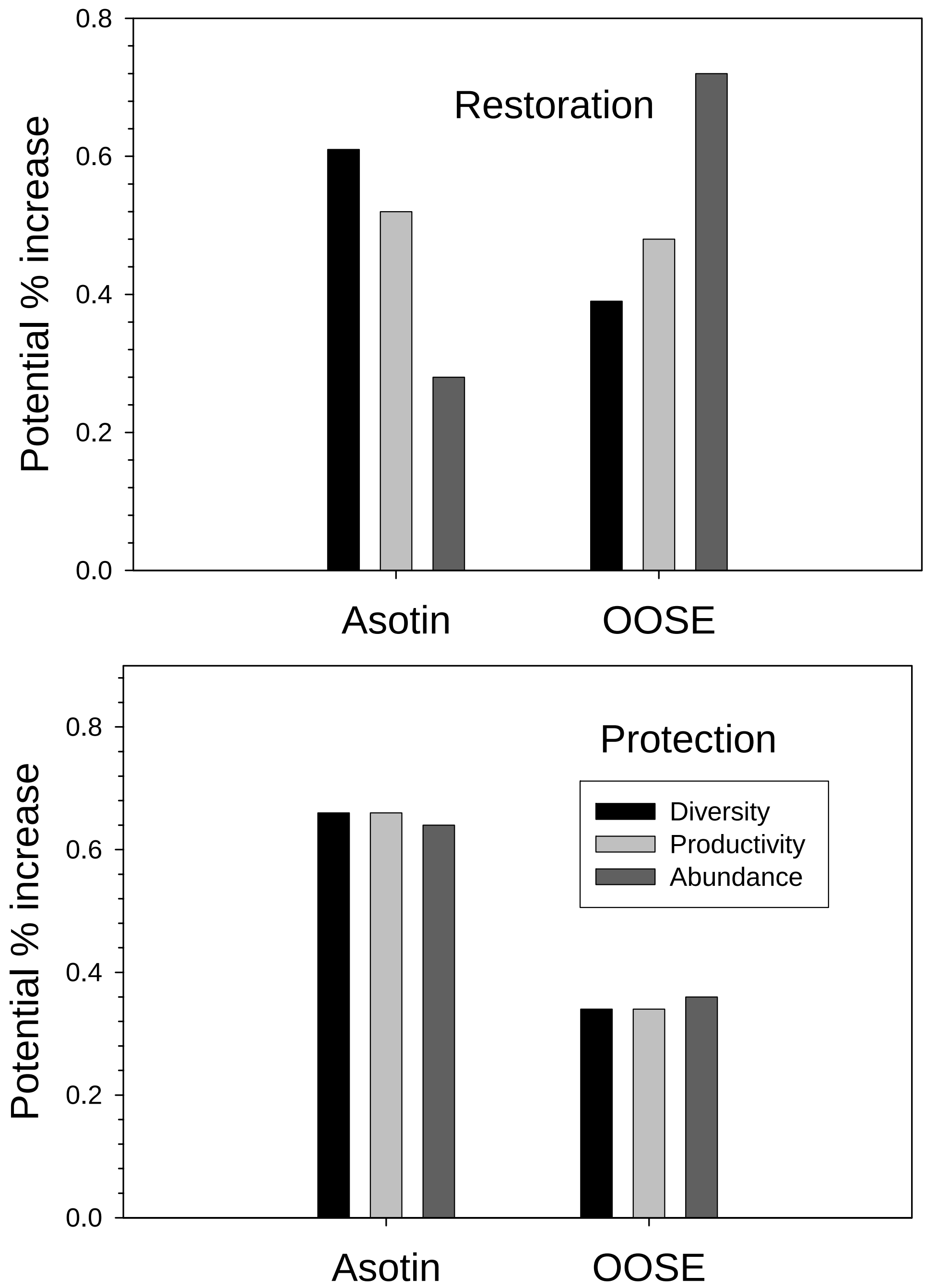


Figure 4-6. Contribution of reaches inside and outside the Asotin Subbasin to the total restoration and protection potential of Asotin Creek, Washington summer steelhead. Out Of Subbasin Effects (OOSE) include the Snake River and Columbia River mainstem

Table 4-13. Ecosystem Diagnosis and Treatment Model predictions of restoration potential for summer steelhead in Geographic Areas of the Asotin Creek watershed, Washington. The scaled rank adjusted the unscaled rank by dividing by the length of stream in the geographic area to evaluate restoration potential on a per kilometer basis. N(eq) is the equilibrium abundance of returning adult spawners.

				Unscaled		Scaled (% / km)	
Geographic area	**Diversity Index**	**Productivity**	**N(eq)**	**Sum**	**Rank**	**Sum**	**Rank**
Snake	91%	56%	272%	419%	1	1.8%	14
Columbia	47%	43%	111%	201%	2	0.4%	15
Charley	12%	26%	23%	61%	3	2.9%	7
Upper Asotin	17%	19%	20%	56%	4	5.7%	2
Lower George	35%	3%	13%	51%	5	2.3%	12
Lower NF	7%	23%	19%	48%	6	3.1%	6
Upper George	29%	4%	8%	41%	7	2.8%	8
Pintler	24%	2%	15%	40%	8	2.6%	9
Lower Asotin	17%	2%	20%	39%	9	7.5%	1
NF Tribs	20%	5%	5%	29%	10	4.6%	3
Lower SF	13%	6%	6%	25%	11	3.5%	5
Middle Asotin	20%	0%	4%	24%	12	2.5%	11
Upper NF	5%	8%	8%	21%	13	2.6%	10
Upper SF	4%	8%	8%	20%	14	1.9%	13
Upper George Tribs	14%	1%	1%	16%	15	3.8%	4

Reaches within the Asotin watershed accounted for 66% of the total protection value for productivity, 64% of the total protection value for abundance and 66% for life history diversity (Figure 4-6). Within the Asotin watershed, the Lower North Fork ranked first overall for degradation potential (protection value) with a cumulative potential of -148% [sum of degradation values for life history diversity (-37%), production (-42%), and abundance (-69%)](Table 4-14). The other top priority Geographic Areas included Charley (-99%), Upper Asotin (-64%), Upper North Fork (38%), and Upper South Fork (30%). When scaling the potential benefit of protection on a per kilometer basis the Lower North Fork (-9.4% / km) was still the number one priority, followed by the Upper Asotin (-6.5 % /km), Charley (-4.7 % / km), Upper North Fork (-4.6 % / km), and Upper South Fork (-2.9 % / km) (Table 4-14).

Table 4-14. Ecosystem Diagnosis and Treatment Model predictions of degradation potential (protection benefit) for summer steelhead in Geographic Areas of the Asotin Creek watershed, Washington. The scaled rank adjusted the unscaled rank by dividing by the length of stream in the Geographic Area to evaluate restoration potential on a per kilometer basis. N(eq) is the equilibrium abundance of returning adult spawners.

				Unscaled		Scaled (% / km)	
Geographic area	Diversity Index	Productivity	N(eq)	Sum	Rank	Sum	Rank
Lower NF	-37%	-42%	-69%	-148%	1	-9.4%	1
Snake	-41%	-36%	-67%	-144%	2	-0.6%	9
Charley	-34%	-26%	-38%	-99%	3	-4.7%	3
Columbia	-23%	-22%	-38%	-83%	4	-0.2%	12
Upper Asotin	-20%	-16%	-28%	-64%	5	-6.5%	2
Upper NF	-11%	-11%	-16%	-38%	6	-4.6%	4
Upper SF	-13%	-8%	-10%	-30%	7	-2.9%	5
Middle Asotin	-6%	-3%	-10%	-19%	8	-2.0%	6
Lower SF	-6%	-1%	-4%	-11%	9	-1.5%	8
Lower Asotin	-1%	-2%	-5%	-8%	10	-1.6%	7
Lower George	0%	0%	-6%	-6%	11	-0.2%	10
Upper George	0%	0%	-3%	-3%	12	-0.2%	11
Pintler	0%	0%	0%	0%	13	0.0%	13
Upper George Tribs	0%	0%	0%	0%	14	0.0%	14
NF Tribs	0%	0%	0%	0%	15	0.0%	15

Limiting Habitat Attributes

Hatchery and Harvest

Examination of the available assessment information suggests degraded habitat and out of basin effects are likely the factors that are currently most limiting the steelhead population in Asotin Creek. Hatchery releases and fisheries have likely had effects on steelhead in Asotin Creek, but their effects have been substantially reduced in the past 5-10 years as hatchery releases and harvest has been restricted. Hatchery fish are no longer stocked in Asotin Creek, although hatchery effects on the steelhead likely continue at a low level (as either genetic effects from past hatchery returns or current spawning by small numbers of hatchery strays from outside the Asotin Basin). Harvest effects are now limited to incidental harvest in sport fisheries or salmon net fisheries in the Snake or Columbia rivers, and as a small number of juveniles in trout fisheries within the Asotin Creek subbasin.

Asotin mainstem and George Creek subwatershed

Sediment load, channel stability, key habitat quantity and habitat diversity were the primary limiting factors for summer steelhead in the Asotin Creek mainstem and George Creek subwatershed. The exceptions were Hefflefinger and Coombs that where primarily limited by key habitat quantity and habitat diversity (Appendix A). Sediment load and channel stability had the biggest impact on egg incubation and habitat diversity and key habitat quantity were most important to age-0 and age 1 rearing. Flow was a common secondary limiting factor among these geographic areas, specifically related to low flows limiting early life history stages.

Charley Creek subwatershed
Habitat diversity, key habitat quantity and channel stability were the primary limiting factors for the Charley Creek subwatershed, although each reach in Charley Creek had different secondary habitat issues. In Charley 1 and 2, cold water temperatures were a problem for incubating eggs and key habitat quantity was lacking for prespawn migrants and prespawn holding adults. In Charley 3, sediment load was a major problem for incubating eggs. Finally, flow was a secondary limiting factor in Charley 4 (Appendix A).

South Fork and North Fork subwatersheds
Lower SF was primarily impacted by sediment load, key habitat quantity and habitat diversity, and secondarily effected by channel stability and low flows. Upper SF showed relatively little impacts from sediment load; however, its important to note that the sediment load problems identified in Lower SF may have originated in Upper SF. Habitat diversity, channel stability, and flow were the primary issues for Upper SF.

Many of the reaches in the North Fork subwatershed had only small to moderate problems with habitat diversity, channel stability and low flow.

Lick Creek was the only drainage in the North Fork subwatershed with major sediment load problems. Lick Creek was also limited by habitat diversity, key habitat quantity, channel stability, and flow. Despite the highly degraded conditions in Lick Creek, it had little restoration or preservation potential due to its small size and lack of suitable steelhead habitat, even in pristine conditions.

The reaches SF of the North Fork Asotin, Middle Branch NF, and NF Asotin 5 all had higher impacts due to habitat diversity, channel stability, and flow than the rest of the subwatershed. Once again these factors primarily effected egg incubation and juvenile rearing; however, the lack of habitat diversity also effected spawning.

Ten Mile Creek
Steelhead are impacted by sediment load and key habitat quantity throughout the Tenmile watershed. In the lower portions (Tenmile 1 through 3) of the watershed the impacts are primarily to egg incubation and fry life stages. In the upper watershed, sediment load still effects egg incubation, however, key habitat quantity in these reaches also has effects on pre-spawning adults. Habitat diversity also had consistently poor ratings throughout Tenmile with the most severe being in the lower reaches. Temperature also appears to be a limiting factor to steelhead production in Tenmile. Within the mainstem Tenmile temperature had high impacts on egg incubation survival in every reach except Tenmile4. Temperature also had a deleterious effect on fry and 0-age actuve rearing but only within Tenmile3.

Summary of Habitat Limiting Attributes

Throughout the Asotin Subbasin habitat diversity, sediment load and key habitat quantity were the most common limiting factor for steelhead (Table 4-15). For fry and subyearling parr, habitat diversity is a function of gradient, confinement, riparian function, LWD density and icing. Many of the Asotin Subbasin reaches may have gradients above 3 % (as measured by Terrain Navigator; see section 4.6) and a high degree of natural confinement can lessen habitat diversity. This condition has been exacerbated by hydromodifications, loss of riparian function and lack of large wood in the system. Icing was generally rated as moderate to high, depending on the elevation and location of the reach, with current conditions receiving the same values as historic conditions. In the category of key habitat quantity it appears that lack of pools are most limiting to pre-spawning holding and juvenile rearing life stages of both steelhead and spring chinook. EDT analysis indicates that restoration efforts should focus on restoring riparian function, minimizing manmade confinement (roads and dikes), and increasing LWD density. Sediment load and channel stability were common limiting factors for egg incubation and early life history stages of summer steelhead throughout the Asotin watershed (Appendix A). Restoration efforts should focus on reducing sediment load within the Geographic areas identified in Table 4-15 and described in the previous section; however, reaches upstream of steelhead distribution should also be evaluated and considered for restoration, if they are determined to be major contributors of sediment to the system.

Table 4-15. Geographic areas and attribute classes (Level 3's) from EDT analysis on Asotin Creek 2003.

Geographic area priority			Attribute class priority for restoration																
Geographic area	Protection benefit	Restoration benefit	Channel stability/landsc.1/	Chemicals	Competition (w/ hatch)	Competition (other sp)	Flow	Food	Habitat diversity	Harassment/poaching	Obstructions	Oxygen	Pathogens	Predation	Sediment load	Temperature	Withdrawals	Key habitat quantity
Lower Asotin (mouth to George)		A	B				B	C	B	C					A			A
Lower George (mouth to Wormell)			B				C		B						A	A		B
Pintler (mouth to access limit)		C	B				B		B						A	B		B
Upper George (Wormell to access limit)		C	A				C		B						B	B		C
Upper George Tribs (Wormell Heffelfinger Coombs)		C	A				C		B									B
Middle Asotin (George to Headgate Dam incl.)			C				C		B						B			B
Upper Asotin (above Headgate Dam to forks)	B	A	C				C		C	C					B			B
Charley (mouth to access limit)	C	B	C				C		C							B		B
Lower NF (mouth to SF of NF)	A	B	C				C		C						C			B
Upper NF (SF of NF to access limit)	C	C	B				C		C									B
NF Tribs (Lick, SF of NF, Middle Branch)		B	A				C		C						C			A
Lower SF (mouth to Alder)		B	C				C		C						B	C		B
Upper SF (Alder to access limit)		C	B				C		C									A
Snake		C																
Columbia																		C

Key to strategic priority (corresponding Benefit Category letter also shown)

A	B	C	D & E
High	Medium	Low	Indirect or General

1/ "Channel stability" applies to freshwater areas; "channel landscape" applies to estuarine areas.

4.4 Focal Species Spring Chinook

4.4.1 Life history

Little is known about spring Chinook life history within Asotin Creek. Adult spawners probably enter Asotin Creek from late April through early June. They move upstream to areas with sufficiently cool summer water temperatures (mainly in the North Fork). Spawning begins in late August and continues through the end of September with a peak in early to mid-September. By early October, all spawners have died.

Age composition of spring Chinook spawners in Asotin Creek is unknown but is thought to be similar to that of Tucannon spring Chinook. Most Tucannon adults spawn at age 4 (72%) or age 5 (26%), but a small percentage may spawn at age 3 (2%).

Juveniles rear in Asotin Creek for at least one year prior to migrating to the ocean. They migrate from October through June, with peak migration from March through May.

4.4.2 Historical and Current Distribution

There is essentially no good information on the distribution of Asotin Creek spring Chinook prior to European settlement. Spawning may have occurred in the South Fork Asotin Creek prior to 1935 (Stovall 2001). Presumed historic distribution is shown below in Figure 4-7.

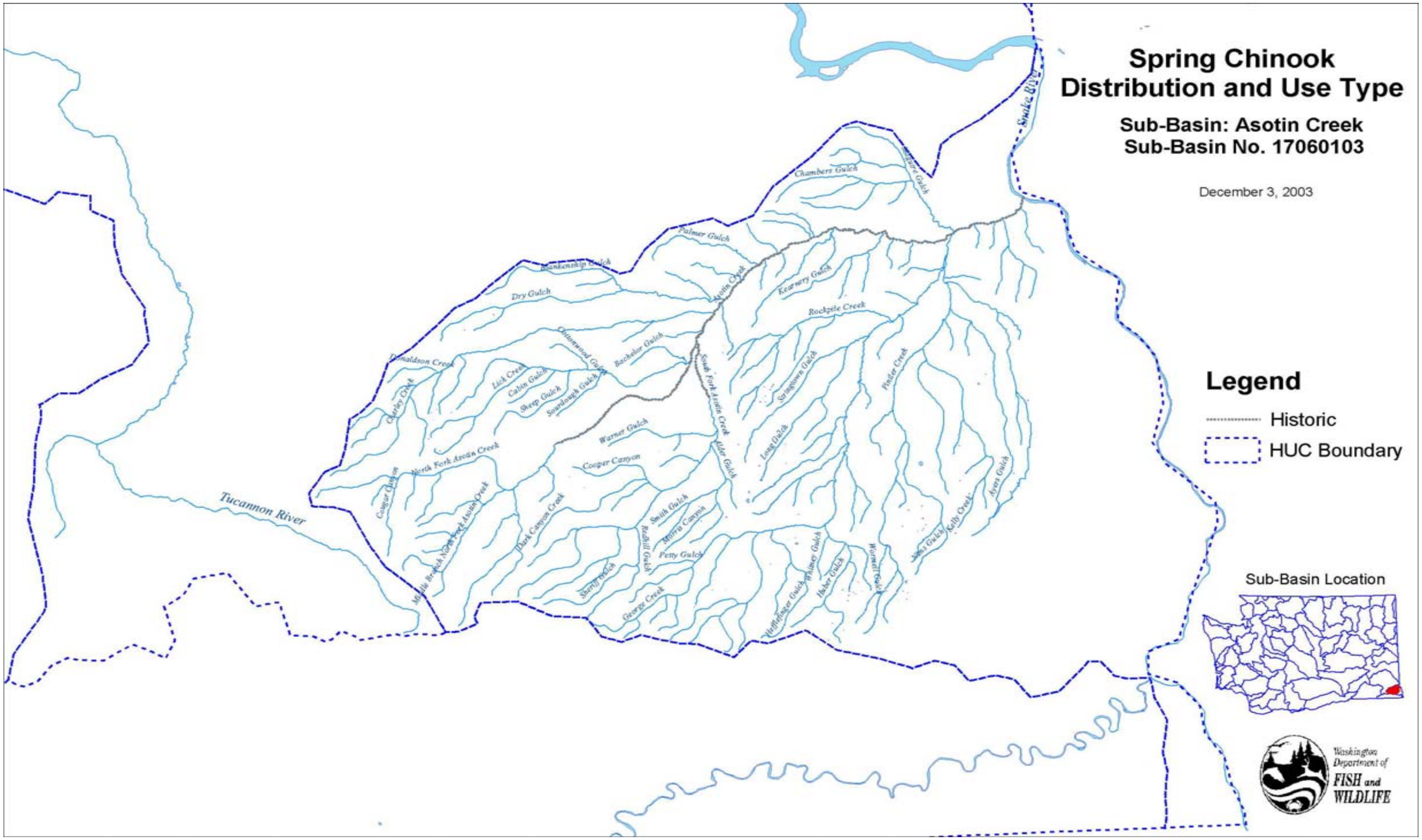


Figure 4-7. Presumed historic distribution of spring Chinook in Asotin Creek. Data from the WDFW Washington Lakes and Rivers Information System (WLRIS) database.

Currently spawning is known to occur in the North Fork Asotin Creek from a short distance above the Umatilla National Forest boundary downstream to the confluence with Lick Creek (Figure #), a distance of five or six river miles (WDF and WDW 1993). Small numbers of juvenile spring Chinook have been observed rearing in the South Fork Asotin Creek (Stovall 2001).

4.4.3 Population Identification

To our knowledge, genetic data for Asotin Creek spring chinook have not been collected or assessed to date. Sampling has likely been precluded by the extremely low abundance. The Interior Columbia Technical Recovery Team (TRT) has preliminarily identified Asotin Creek spring chinook as an independent population in relation to all other Snake River Basin spring/summer chinook on the basis of sufficient habitat to sustain a viable population, and sufficient geographic separation from other populations to provide substantial reproductive isolation (Interior Columbia Basin TRT, unpublished draft document July 2003).

4.4.4 Asotin Spring Chinook Population

4.4.4.1 Population Characterization.

4.4.4.1.1 Empirical Data

Few spring Chinook adults or juveniles currently exist within the Asotin Subbasin, and they are not known to historically or currently exist in Tenmile Creek. The abundance of adults, or their redds, in Asotin Creek has decreased (see spawning survey table in section 4.4.4.3) to zero or about half dozen per year over the past 15 years. Juvenile spring Chinook continue to be documented in very low numbers and with a distribution limited to the North Fork Asotin Creek, and rarely in the upper mainstem or lower South Fork. Spring Chinook smolts were documented migrating in Asotin Creek in the mid 1980s, but it is currently unknown whether the Asotin subbasin continues to produce more than a few dozen smolts per year. It is unknown whether spring Chinook in the Asotin subbasin are still of native stock or represent strays from elsewhere.

4.4.4.1.2 EDT Assessment

Asotin Creek Spring Chinook Baseline Population Performance—Model results for Asotin Spring Chinook are based on life history assumptions summarized in Table 4-16. The EDT model estimated the average spawning population size of the current spring chinook to be 158 fish, with a carrying capacity of 558 fish and a productivity of 1.4 adult returns per spawner (Table 4-17). The life history diversity value indicates only 29% of the historic life history pathways can be successfully used under current conditions. The analysis also suggests that the Asotin Subbasin has a much greater production potential for spring chinook than it now displays, as historical abundance is estimated at 4348 spawners, with a productivity of 14.9 returning adults per spawner and a life history diversity of 100%. Under Properly Functioning Conditions (PFC), the EDT model predicted an abundance of 1018 spawners with a capacity of 1439 spawners, a productivity of 3.4 returning adults per spawner, and a life history diversity of 86%.

Table 4-16. Life history assumptions used to model spring chinook in Asotin Creek, Washington. *We modeled a genetic stock fitness of 100 %, though it is likely less due to past hatchery introductions and stray hatchery fish currently stocked in other are

Stock Name:	Asotin Creek Spring Chinook	
Geographic Area (spawning reaches):	Asotin: Mainstem Asotin, from mouth to forks; George Cr, from mouth to Forest Service boundary line; Pintler Cr, mouth to Ayers Cr; Charley Cr, mouth to state ponds; NF Asotin Cr, mouth to SF of NF Asotin Cr; SF Asotin Cr, mouth to Redhill Gulch Cr.	
River Entry Timing (Columbia):	Bonneville Dam: late March – late May	
River Entry Timing (Tucannon):	Late April – late June	
Adult Holding:	Asotin: all inside Asotin Subbasin (between early May & mid September)	
Spawn Timing:	Between August 27 & October 7	
Spawner Ages:	2% jacks, 72% age-4, 26% age-5	
Emergence Timing (dates):	Late March – mid May	
Smolt Ages:	All age-1	
Juvenile Overwintering:	Snake River:	27% (late October – early March)
	Asotin:	73% (late October – early March)
***Stock Genetic Fitness:**		90% of wild fitness
Harvest (In-watershed):		No Harvest

Table 4-17. Baseline spawner population performance parameters for Asotin Creek summer steelhead as determined by EDT, 2003.

Scenario	Diversity Index	Productivity	Capacity	Adult Abundance
Patient (Current)	29 %	1.4	558	158
PFC	86 %	3.4	1,439	1,018
Template (Reference)	100 %	14.9	4,662	4,348

The EDT estimate that current spring Chinook abundance is 158 is not consistent with empirical data from WDFW's monitoring efforts over the past 2 decades. Empirical data would suggest average abundance is about 6 adults per year or less. The EDT estimate of current carrying capacity and PFC also seems generous considering the population abundance since the 1970s, or historical information since 1935.

4.4.4.2. Population characteristics consistent with VSP.

The NOAA Fisheries Technical Recovery Team (TRT) has identified Asotin Creek spring Chinook as an independent population, based primarily on their distance (135 km) from their nearest genetically similar population (Tucannon River)(TRT 2003). Specific targets for abundance, growth rate, spatial structure, and diversity have not yet been developed by the TRT and no interim spawner abundance target was set for spring Chinook in Asotin Creek (Lohn 2002). It is not clear if Asotin Creek would be included with the Lower Mainstem Tributary spawning aggregation that has an interim goal of 1000 spawners.

EDT model estimates suggest that spring Chinook are not a viable salmonid population in the Asotin Creek subbasin; this is confirmed by empirical data showing very small numbers of spring Chinook within the subbasin – they may be functionally extinct. Although specific criteria have not been established, the estimated productivity (1.4 returning adults per spawner) is not adequate for population growth and resistance to stochastic events and natural population cycles. Also, since current abundance (158 spawners) was estimated at 28 % of carrying capacity (558 spawners) the available habitat is clearly underseeded. If habitat were improved to PFC and abundance increased to 71 % of capacity then the number of spawners was predicted to increase to over 1000 fish, a level that is likely to represent a VSP. Likewise, an increase in life history diversity from 29 % (current) to 86 % (PFC) could provide Asotin Creek spring Chinook with enough genetic diversity and spatial structure to have a “negligible risk of extinction”.

Asotin Creek basin is a comparatively small system for chinook salmon. Despite its spatial complexity, spring chinook spawning aggregates likely historically occurred primarily in the mainstem, North Fork, and possibly George Creek. Currently, connectivity may exist within the system during the spring runoff that allows adult chinook access to most of these reaches, but habitat limitations and low summer stream flows probably limit pre-spawn holding to the mainstem and North Fork only.

Historical references suggest that a medium sized population of chinook existed within Asotin Creek (Stovall 2001: Pirtle 1957). The existing severely depressed, possibly functionally extinct, population suggests that the spatial distribution of spawners, or of suitable spawning/rearing habitat, changed dramatically over time within and outside of the basin. As described for steelhead in Asotin Creek, anthropogenic and stochastic environmental events have negatively affected habitat quality over time. It is unknown to what degree these changes contributed to the near complete disappearance of chinook from the basin. So little is known of Asotin Spring chinook that the nature of its historical population structure can only be theorized. Regardless, empirical data strongly suggest that survival factors, including spatial structure, are below the point where the population can persist during the short or long term.

The VSP document (McElhany 2000) cautions that salmonid habitat is dynamic, and for a population to persist, its "habitat patches should not be destroyed faster than they are naturally created". It further cautions that VSP is defined for populations to persist over a 100 year period and that loss of spatial structure may eventually contribute to extirpation. We conclude that the quality, quantity and spatial structure of salmonid habitat in Asotin Creek has decreased and may have contributed to the near complete loss of spring chinook in the basin. Whether recent habitat improvements and changes in stream management have sufficiently recaptured habitat structure to allow chinook to respond to rebuilding efforts is unclear.

4.4.4.3 Population Status

Endangered Species Act Status
The Snake River spring/summer Chinook evolutionarily significant unit (ESU), which includes Asotin Creek spring Chinook, was listed as threatened under the federal Endangered Species Act (ESA) in 1992 (57 FR 14653)[1]. Threatened status means that the listed group is likely to become endangered (in danger of extinction) within the foreseeable future throughout all or a significant portion of its range. The threatened determination for the ESU was made based on the following considerations (NMFS 1999):

- The recent average abundance of 3,820 natural spawners was significantly lower than historic levels, which may have been as high as 1.5 million adults in 1800s.
- Long- and short-term trends in abundance had generally been negative.
- Sixty-one percent of the total escapement was hatchery derived.
- Access to much historic spawning/rearing habitat had been blocked; remaining accessible habitat had been degraded.

NMFS has characterized the Asotin spring Chinook stock within the ESU as extinct (NMFS 1999). However, the Interior Columbia Basin Technical Recovery Team (TRT) has decided not characterize the stock as extinct at present because of the persistence of small numbers of spawners and juveniles (Michelle McClure, NOAA Fisheries, personal communication, Dec. 3, 2003). The TRT considers that the very small numbers of spring Chinook observed may be remnants of the native stock (ICBTRT 2003) or they may be hatchery or wild fish straying into the basin (Glen Mendel, WDFW, personal communication).

SaSI status
In 1992 the status of Asotin Creek spring Chinook was rated critical, based on a long-term negative trend in abundance and chronically low numbers of spawners (WDF, WDW and WWTIT 1993). This rating meant that production levels were so low that permanent damage to the stock was likely or had already occurred. At that time, the

[1] In 1994 the status of the ESU was temporarily reclassified to endangered (Federal Register vol. 59 no. 248 pp. 66784-66787, Dec. 28, 1994)

stock was considered to be in danger of extinction and to consist of probably fewer than 50 adults (WDF and WDW 1993).

In 2002, WDFW rated the stock as functionally extinct (WDFW and WTIT 2003). Contrary to the assumptions of the TRT, WDFW biologists consider that the very small numbers of Chinook currently seen in Asotin Creek (less than 6-12 per year) are likely strays from hatchery-based reintroduction efforts in the Clearwater River or from hatchery or wild strays bound for the upper Snake and Grande Ronde basins.

Given the very small numbers of fish, no genetic analysis has been conducted to resolve the identity of spring Chinook spawning in Asotin Creek. Consequently it is not possible to determine whether these fish are native, hatchery strays or a combination of the two. The abundance data on which the 1992 and 2002 ratings were made are shown in Table 4-18.

Table 4-18. Total numbers of redds and numbers of live plus dead spring Chinook counted in the North Fork Asotin Creek (data from WDFW SaSI database)

Year	Total redd count	Live + Dead Fish
1972	12	76
1973	13	21
1984	8	17
1985	1	8
1986	1	3
1987	3	6
1988	1	0
1989	0	0
1990	2	0
1991	0	0
1992	0	0
1993	2	1
1994	0	0
1995	0	0
1996	0	0
1997	1	0
1998	0	0
1999	0	0
2000	1	0
2001	4	4
2002	4	0
2003	1	0

Additional Information

Records beginning in the1930s indicate that at that time, numbers of spring Chinook in Asotin Creek were low (Stovall 2001). Population size was thought to be fewer than 100 spawners. The Chinook population was being effected by water withdrawal from the creek by 1934. In 1934, Washington Department of Game staff and local citizens rescued 25 adult spring Chinook that had been stranded downstream from the Headgate Dam at river mile 8. These fish were thought to represent the entire run. Surveys conducted from 1954 through 1956 estimated an average of 18 adult Chinook passing

Headgate Dam each year (Pirtle 1957 cited in Stovall 2001). However, "about 50" adult Chinook were passed above the dam in 1956 (Krakenberg 1957, cited in Stovall 2001).

In 1986, 181 spring Chinook migrants (size range 46 mm to 107 mm) were trapped in an inclined plane trap operated by Washington Department of Game personnel in the mainstem Asotin Creek, just downstream from the confluence with Charley Creek (Schuck et al. 1988).

4.4.4.4 Harvest Assessment

No fishery exists in the Snake River or Asotin Creek that targets Asotin spring Chinook. However, unmarked spring Chinook from Asotin Creek could potentially be harvested in lower Columbia River fisheries. Additionally, naturally produced fish could be lost to hooking mortality in hook and release fisheries in the Snake River, Asotin Creek, or downriver. Unfortunately, it is not possible to determine if any naturally produced spring Chinook from Asotin Creek are being harvested or killed out of basin.

Resident trout fisheries in Asotin Creek are closed during the overwintering and smolt migration periods. Selective gear restrictions (no bait, single barbless hooks, etc. are in place to minimize mortality during catch and release. Only the mainstem Asotin Creek and the North Fork up to the USFS boundary are open for trout fishing from June 1 through October. All other areas are closed to fishing.

Descriptions of fisheries and their estimated effects on listed species of fish in the Snake River Basin within WA are included in the WDFW Fishery Management and Evaluation Plan (FMEP) for the incidental take of listed species – submitted under ESA Section 10/4d (submitted to NOAA fisheries on Dec 2, 2002).

4.4.4.5 Hatchery Assessment

Washington has managed the spring chinook population in Asotin Creek as a wild population. There have been no documented releases of hatchery reared juvenile or adult chinook into Asotin Creek. Local managers document occasional spawning in the creek, but carcasses have not been recovered to determine whether strays from hatchery-based reintroduction efforts in the Clearwater River or from hatchery or wild strays bound for the upper Snake and Grande Ronde basins are contributing.

The Nez Perce Tribe and WDFW have identified the desire to rebuild the chinook population in Asotin Creek and that hatchery production may be required to achieve this goal. In the Tucannon Captive Broodstock Master Plan, Asotin Creek was recognized as a potential receiving area for surplus Tucannon River captive broodstock production. It is presently unclear how the TRT designation as a distinct population would effect decisions to out-plant hatchery reared fish.

4.4.4.6 Spring Chinook Habitat EDT Assessment Summary

Restoration and Protection Potential

We assessed strategic priorities for Asotin Creek spring Chinook in three basic ways. Two of these ways emphasized the "where" of a fish management plan while the third emphasizes the "what". Places where a strategic plan should be focused were determined by identifying areas critical to preserving current production (viz., by identifying areas with high "Protection Value"), and by identifying areas with the greatest potential for restoring a significant measure of historical production (viz., by identifying areas with high "Restoration Potential"). The kinds of actions a management plan should include were determined by performing a "Reach Analysis" (Section 4.2.4.1).

The restoration potential for spring Chinook within the Asotin Creek watershed was 68% for life history diversity, 69% for productivity, and 37% for abundance (Figure 4-7). Within the watershed, Lower George and Lower Asotin (161%) tied for the highest restoration potential, followed closely by Lower North Fork (147%), when summing all three performance measures (abundance, productivity, and life history diversity)(Table 4-19). The Upper Asotin (129%), Middle Asotin (102%), and Lower South Fork (74%) were other areas with high restoration potential (Table 4-19). When scaling the potential for restoration benefit on a per kilometer basis the Lower Asotin (31% / km), Upper Asotin (13% / km), Middle Asotin (10.7% / km), Lower South Fork (10.4% / km), and Lower George (7.1% / km) were the top Geographic Areas. The Lower George Geographic Area had the highest potential for restoring life history diversity (83%), whereas Lower North Fork ranked highest for productivety (93%), and Lower Asotin ranked highest for abundance (83%)(Table 4-19).

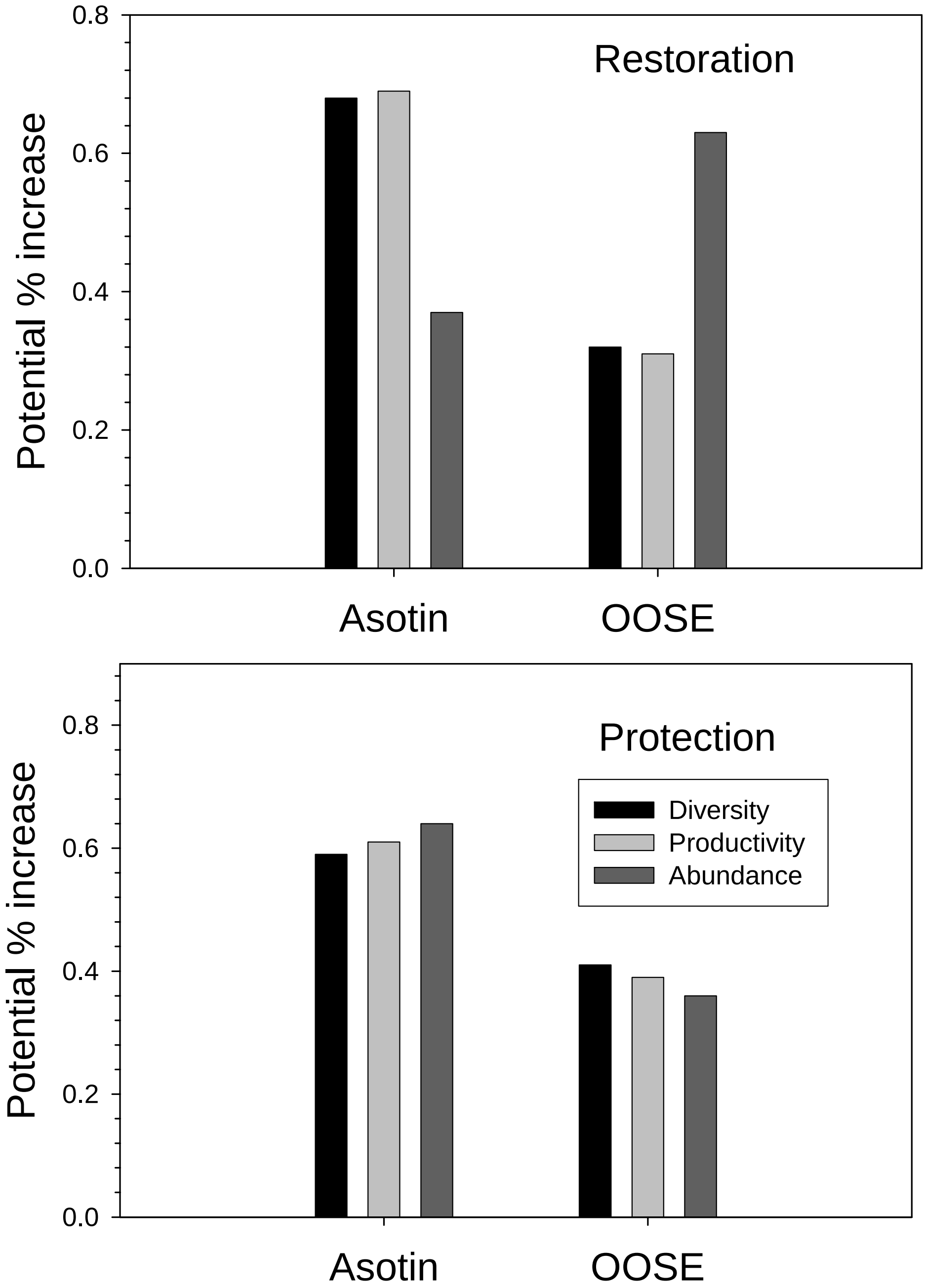


Figure 4-7. Contribution of reaches inside and outside the Asotin Subbasin to the total restoration and protection potential of Asotin Creek, Washington spring Chinook. Out Of Subbasin Effects (OOSE) include the Snake River and Columbia River mainstem and estuary.

The protection potential for spring Chinook within the Asotin Creek watershed was 59% for life history diversity, 61% for productivity, and 64% for abundance (Figure 4-7). Within the Asotin watershed, the Lower North Fork ranked first overall for degradation potential (protection value) with a cumulative potential of -213% [sum of degradation values for life history diversity (-48%), productivity (-65%), and abundance (-100%)](Table 4-20). The other top priority Geographic Areas included Upper Asotin (-

60%), Upper South Fork (-53%), Middle Asotin (-43%), and Lower South Fork (-24%). When scaling the potential benefit of protection on a per kilometer basis the Lower North Fork (-13.5% / km) was still the number one priority, followed by the Upper Asotin (-6.1 % / km), Upper South Fork (-5.2% / km), Middle Asotin (-4.5% / km), and Lower Asotin (-3.7% / km) (Table 4-20).

Table 4-19. Ecosystem Diagnosis and Treatment Model predictions of restoration potential for spring Chinook in Geographic Areas of the Asotin Creek watershed, Washington. The scaled rank adjusted the unscaled rank by dividing by the length of stream in the geographic area to evaluate restoration potential on a per kilometer basis. N(eq) is the equilibrium abundance of returning adult spawners.

				Unscaled		Scaled (% / km)	
Geographic area	Diversity Index	Productivity	N(eq)	Sum	Rank	Sum	Rank
Snake River	71%	68%	273%	412%	1	8.0%	12
Columbia River	65%	68%	275%	408%	2	1.4%	11
Lower George	83%	23%	56%	161%	3	7.1%	6
Lower Asotin	36%	42%	83%	161%	4	31.3%	1
Lower NF	9%	93%	45%	147%	5	9.3%	5
Upper Asotin	24%	60%	46%	129%	6	13.1%	2
Middle Asotin	43%	22%	37%	102%	7	10.7%	3
Lower SF	14%	34%	26%	74%	8	10.4%	4
Upper George	34%	5%	6%	45%	9	3.1%	8
Charley	15%	11%	13%	39%	10	1.9%	9
Upper SF	16%	11%	9%	37%	11	3.6%	7
Pintler	13%	1%	4%	18%	12	1.2%	10

Table 20. Ecosystem Diagnosis and Treatment Model predictions of degradation potential (protection benefit) for spring Chinook in Geographic Areas of the Asotin Creek watershed, Washington. The scaled rank adjusted the unscaled rank by dividing by the length of stream in the Geographic Area to evaluate restoration potential on a per kilometer basis. N(eq) is the equilibrium abundance of returning adult spawners.

				Unscaled		Scaled (% / km)	
Geographic area	Diversity Index	Productivity	N(eq)	Sum	Rank	Sum	Rank
Snake River	-58%	-59%	-107%	-224%	1	-3.8%	5
Lower NF	-48%	-65%	-100%	-213%	2	-13.5%	1
Columbia River	-15%	-17%	-28%	-60%	3	-0.2%	11
Upper Asotin	-17%	-14%	-29%	-60%	4	-6.1%	2
Upper SF	-14%	-18%	-21%	-53%	5	-5.2%	3
Middle Asotin	-7%	-9%	-27%	-43%	6	-4.5%	4
Lower SF	-9%	-4%	-11%	-24%	7	-3.4%	7
Lower George	-1%	0%	-19%	-21%	8	-0.9%	8
Lower Asotin	-1%	-3%	-15%	-19%	9	-3.7%	6
Charley	-5%	-3%	-6%	-14%	10	-0.7%	10
Upper George	-1%	0%	-8%	-10%	11	-0.7%	9
Pintler	0%	0%	0%	0%	12	0.0%	12

Limiting Attributes

Hatchery and Harvest

Examination of the available assessment information suggests degraded habitat and out of basin factors are likely the factors that are currently most limiting chinook in Asotin Creek. Hatchery releases and fisheries have likely had deleterious effects on the chinook in Asotin Creek. Stray hatchery fish may have a genetic effect on any native spring Chinook that remain in Asotin Creek. However, hatchery fish may be contributing to Chinook abundance and persistence in the Asotin subbasin. Hatchery steelhead and trout are no longer stocked in Asotin Creek and trout fisheries have been restricted within the subbasin. Unmarked chinook salmon are legally protected from harvest in sport fisheries within the Snake River Basin. Harvest effects are now limited to harvest in the lower river or ocean fisheries which are restricted to an ESA impact of no more than 2%. A small amount of hooking mortality may occur within the Asotin Creek subbasin during trout or other fisheries. Consequently, out of basin and habitat restoration within the subbasin should be emphasized to increase salmonid populations

Asotin Mainstem

The primary limiting factors for spring Chinook in the Lower Asotin geographic area were key habitat quantity, habitat diversity and sediment load (Appendix B). All life stages, except migrating smolts, were affected at moderate to extreme levels for degraded habitat diversity and key habitat quantity. Sediment load had high to extreme impacts on egg incubation, fry colonization, and age-0 over-winter rearing. Additionally, channel stability was a problem for egg incubation and harassment/poaching was a problem for spawning adults.

The primary limiting factors for spring Chinook the Middle and Upper Asotin Creek mainstem were key habitat quantity and habitat diversity. Most life stages were affected at moderate to high levels. Sediment load was a secondary limiting factor resulting in a high impact to egg incubation (except in reach Asotin6) and small to moderate impacts to several other life stages. Additionally, high temperatures were a problem for spawning and pre-spawning adults in the Upper Asotin, reach (Asotin6).

George Creek Subwatershed

The primary limiting factors for spring Chinook in the Lower George Creek geographic area were key habitat quantity, habitat diversity and sediment load (Appendix B). All life stages, except migrating smolts, were effected at moderate to extreme levels for degraded habitat diversity and key habitat quantity. Sediment load had high to extreme impacts on egg incubation, fry colonization, and age-0 over-winter rearing. Additionally, channel stability had a high impact to egg incubation in George1 and George2, and a moderate impact to egg incubation and all other early life history stages throughout the Lower George Creek. Flow was a secondary limiting factor, with increased high flows impacting fry colonization and decreased low flows impacting age-0 overwintering and prespawn holding. Other limiting factors included moderate to extreme impacts of channel stability to egg incubation and high impacts of maximum summer temperatures to spawning.

Key habitat quantity and habitat diversity were also the primary limiting factors in Upper George, but the impacts were less severe than in Lower George (appendix B). Sediment load continued to have a high impact on egg incubation, but was not as common a problem across other life history stages. Warm summer temperatures had high impacts on spawning and pre-spawning adults in George4 and 5, but moderate in George6.

Pintler Creek had primary limiting factors including key habitat quantity, habitat diversity and sediment load and secondary limiting factors including flow and dissolved oxygen. Additionally, channel stability was a problem for egg incubation.

Charley Creek Subwatershed
The primary limiting factors for spring Chinook in the Charley Creek geographic area were key habitat quantity and habitat diversity, effecting all life stages at moderate to extreme levels (appendix B). Warm summer temperatures had high impacts on spawning and pre-spawning adults. Fry colonization and age-0 overwintering also had small to moderate impacts across several other survival factors including channel stability, flow, food, and sediment load.

South Fork Subwatershed
The primary limiting factors for spring Chinook the South Fork of Asotin Creek geographic area were key habitat quantity and habitat diversity, effecting all life stages at moderate to extreme levels (Appendix B). Sediment load was a secondary limiting factor in SF Asotin1, impacting egg incubation at a high level and most other life history stages at low to moderate levels. Warm summer temperatures had high impacts on spawning and pre-spawning adults in SF Asotin1. Fry colonization and age-0 overwintering also had small to moderate impacts across several other survival factors including channel stability, flow, food, and sediment load.

North Fork Subwatershed
The primary limiting factors for spring Chinook the North Fork of Asotin Creek geographic area were key habitat quantity and habitat diversity, effecting all life stages at low to high levels (Appendix B). Sediment load was a secondary limiting factor in NF Asotin1, impacting most life history stages at low to moderate levels. Fry colonization and age-0 overwintering also had small to moderate impacts across several other survival factors including channel stability, flow, food, and sediment load.

Summary of limiting habitat attributes
Throughout the Asotin Creek subbasin, habitat diversity and key habitat quantity were the most common limiting factor for spring Chinook. For fry and subyearling parr, habitat diversity is a function of gradient, confinement, riparian function, LWD density and icing. Many of the Asotin reaches have gradients above 3 % and a high degree of natural confinement that depresses habitat diversity. Icing was generally rated as moderate to high, depending on the elevation and location of the reach, with current conditions receiving the same values as historic conditions. EDT analysis indicates that restoration efforts should focus on restoring riparian function (offchannel habitat, connection to the floodplain, and riparian vegetation), minimizing manmade confinement (roads and dikes), and increasing LWD density.

Key habitat quantity was limiting across various life stages in most geographic units. In general for current conditions, pools were reduced (29%) and riffles were increased (24%) when compared to the reference condition. In some reaches, pool tailouts were reduced by up to 10 % which affected spawning adults; in other reaches, primary pools were reduced up to 42 % which affected pre-spawn holding, age-0 over-wintering and other life stages. Key habitat quantity will have to be evaluated on a reach-by-reach basis, based on the data that was entered into the Stream Reach Editor for EDT.

Warm summer temperatures were a common problem for spawning, adult holding and egg incubation, and sediment load was a common limiting factor for egg incubation across many of the geographic areas. Increased peak flows, reduced low flows, and food (salmon carcasses and benthic productivity) were consistently low to moderate limiting factors for fry colonization and juvenile rearing life stages. The cumulative impact of these low-level limiting attributes could be important to the overall reduced productivity in the Asotin Creek Subbasin.

4.5 Focal Species Bull Trout

4.5.1 Life history

Bull trout are known to exist in the Asotin Basin, but very limited information exists regarding bull trout in this subbasin; bull trout are not known to exist currently or historically in Tenmile Creek. Bull trout have been documented periodically over many years by WDFW personnel conducting electrofishing, snorkeling or creel surveys, or while trapping for steelhead, in upper mainstem Asotin, Charlie Creek, the North and lower South Fork of Asotin creeks. In 1993, the USFS documented the presence of bull trout in the middle branch of the North Fork, the lower 1.5 miles of the South Fork of the North Fork and in Charlie Creek (Stovall2001). One additional bull trout was recently noted from the 1993 survey in upper George Creek by the USFS.

Bull trout are known to spawn in upper North Fork of Asotin and Cougar creeks (a tributary of the upper North Fork -Table 4-21) Spawning should occur from late August through October, similar to bull trout in the Tucannon River (USFWS 2002). Juvenile rearing is generally in the spawning areas, but subadult and adult bull trout may wander or migrate to other areas of the drainage during winter, spring and summer.

Table 21. Results of bull trout spawning surveys in the Asotin subbasin (USFWS, 2002).

Location	1996	1997	1998	1999	2000	2001	2002	2003
NF Asotin	3	0	ns	59	ns	ns		
Cougar Cr	ns	ns	ns	9	ns	ns		
Charlie Cr	ns	ns	0	0	0	ns		

ns= not surveyed

Migratory bull trout apparently existed as recently as the 1980's because bull trout were captured in the upper mainstem and lower North Fork of Asotin Creek in the springbut usually were not present in those locations in the summer and fall. Sub-adult and adult bull trout may migrate to the main stem Asotin Creek, or possibly to the Snake River to overwinter (similar to bull trout in the Tucannon or the Grande Ronde rivers). Presently, it is unclear whether both migratory and resident bull trout life histories remain, or whether only the resident form still exists.

4.5.2 Historical and Current Distribution

Current distribution is very limited in the Asotin subbasin, and they are not known to exist in Tenmile Creek. Current distribution includes the North Fork of Asotin and its upper tributaries (e.g. Cougar Creek). Recent observations include bull trout in the South Fork, Charlie Creek, the upper main stem Asotin and George Creek.

Historic distribution is unknown. However, it likely consisted of resident and fluvial (migratory) life histories and it probably included bull trout use in George Creek, Charlie Creek, and the North and South Forks of Asotin, and some of their major tributaries, as well as in the main stem of Asotin Creek, at least during winter and spring months.

4.5.3 Population Identification

Bull Trout in the Asotin subbasin were grouped into a Core Area in the Asotin subbasin in the Draft Bull Trout Recovery Plan (Chapter 24, USFWS 2002). A decision on whether there is only one population of bull trout in the Asotin subbasin is pending as part of the finalization of the Bull Trout Recovery Plan.

4.5.4 Habitat Assessment

Habitat conditions for bull trout were generally assessed in the Snake River Limiting Factors Report (Kuttle 2002) and in the draft Bull Trout Recovery Plan for the Snake River area (Chpt. 24). Numerous actions were proposed to improve bull trout habitat, but most were not specific to reaches of the Asotin subbasin. A few, such as Action 1.1.5 (restore a single thread channel with continuous overland flows in lower George Creek) in the Recovery Plan, mention specific areas the Asotin subbasin. Action 1.2.1 mentions surveying culverts and barriers in the Asotin subbasin and specifically mentions the Trent Ridge Road culvert and lower Charlie Creek, etc.

EDT modeling is currently not possible for bull trout. However, many of the habitat problems identified for spring Chinook or steelhead would apply to bull trout in the Asotin subbasin. Bull trout require colder water than either of the other aquatic focal species so warm water temperatures are likely more limiting for bull trout.

4.5.5 Population Status

The status of bull trout in the Asotin subbasin is classified as "unknown" but may be "critical" based on very low abundance (WDFW 1998). WDFW considers bull trout a “category 1” species on the state list of threatened and endangered species, and lists the Asotin Creek population as “high risk” of extinction (Stovall2001, WDFW 1998). Bull Trout in the Columbia Basin (including Asotin Creek) were listed as threatened under the Endangered Species Act in 1998.

4.5.6 Integrated Assessment

Bull trout appear to be in critical condition in the Asotin subbasin. They spawn and rear in the headwaters of the North Fork of Asotin. Artificial propagation is being considered to increase bull trout numbers and distribution within the Asotin subbasin (USFWS 2002). Barrier removal, reduction of instream sediment, and reducing or maintaining stream temperatures are some of the primary habitat recommendations in the draft bull trout recovery plan. This is consistent with the EDT analyses for steelhead and spring Chinook and with the results of the limiting factors report.

4.6 Integrated Assessment Analysis

Spring Chinook and Summer Steelhead EDT analysis limiting attributes

Within the Asotin subbasin the EDT analysis identified habitat diversity was the most common limiting habitat attribute for both steelhead and spring Chinook. For fry and subyearling parr, habitat diversity is a function of gradient, confinement, riparian function, LWD density and icing. Many of the Asotin reaches have gradients above 3 % and a high degree of natural confinement that depresses habitat diversity. Icing was generally rated as moderate to high, depending on the elevation and location of the reach, with current conditions receiving the same values as historic conditions.

Sediment load, channel stability, and flow were common secondary limiting factors for egg incubation and early life history stages of summer steelhead and spring Chinook throughout the Asotin watershed.

Warm summer temperatures were a common problem for spawning (pre-spawn holding) and egg incubation for spring Chinook, but appeared to have little effect on steelhead probably due to differences in spawn timing. Increased peak flows, reduced low flows, and food (salmon carcasses and benthic productivity) were consistently low to moderate limiting factors for fry colonization and juvenile rearing life stages. The cumulative impact of these low-level limiting attributes could be important to the overall reduced productivity in the Asotin Creek Subbasin.

Throughout the Asotin Creek subbasin key habitat quantity was also an important limiting factor for spring Chinook and steelhead. Key habitat quantity was limiting across various life stages in most geographic units. In general, for current conditions, pools were reduced (29%) and riffles were increased (24%) when compared to the reference condition. In some reaches, pool tailouts were reduced by up to 10 % which affected spawning adults; in other reaches, primary pools were reduced up to 42 % which affected pre-spawn holding, age-0 over-wintering and other life stages. Key habitat quantity will have to be evaluated on a reach-by-reach basis, based on the data that was entered into the Stream Reach Editor for EDT.

EDT analysis indicates that restoration efforts should focus on restoring riparian function (offchannel habitat, connection to the floodplain, and riparian vegetation), minimizing manmade confinement (roads and dikes), increasing LWD density and reducing sediment load throughout the watershed. Addressing these habitat attributes will benefit both steelhead and spring chinook.

Priority Areas for Restoration from EDT Analysis

EDT predicted considerable overlap of priority geographic areas for restoration for steelhead and spring Chinook in the Asotin Creek Subbasin. Lower Asotin, Upper Asotin, Lower North Fork, and Lower South Fork Geographic Areas ranked in the top six for both species (Table 4-22). The North Fork Tributaries and George Creek Tributaries were high priority for steelhead, but were not applicable to spring Chinook; whereas, the Middle Asotin ranked third for spring Chinook but only eleventh for steelhead (Table 4-22). The EDT model predicted 2-4 times the benefit of restoration actions for spring Chinook (9-31% / km) than for steelhead (3.5-7.5 % / km). In providing the final analysis of priority areas for restoration and protection for this assessment it was decided to use primarily the scaled version of the output. While there is value to be obtained in some venues by using both outputs; it was decided that in a truncated planning effort such as this that the value of a given attribute/or restoration project per kilometer of stream would give the greatest benefit. It gives us the best chance to provide the basis for a plan for the subbasin the most restoration/protection value for each dollar spent.

Table 4-22. Priority geographic areas for restoration of spring Chinook (Spr Chk) and summer steelhead (Stlhd) in the Asotin Creek Subbasin, Washington. Potential performance increase was the sum of the model predicted increases in life history diversity, productivity, and abundance for the scaled (% benefit/ km) EDT output. Results are sorted by steelhead ranking and do not represent an integrated priority list for all species.

	EDT Restoration Priority Scaled Rank		Potential Performance Increase (% / km)	
Geographic Area	Stlhd	Spr Chk	Stlhd	Spr Chk
Lower Asotin (mouth to George)	1	1	7.5%	31.3%
Upper Asotin (above Headgate Dam to forks)	2	2	5.7%	13.1%
NF Tribs (Lick, SF of NF, Middle Branch)	3	NA	4.6%	
Upper George Tribs (Wormell Heffelfinger Coombs)	4	NA	3.8%	
Lower SF (mouth to Alder)	5	4	3.5%	10.4%
Lower NF (mouth to SF of NF)	6	5	3.1%	9.3%
Charley (mouth to access limit)	7	9	2.9%	1.9%
Upper George (Wormell to access limit)	8	8	2.8%	3.1%
Pintler (mouth to access limit)	9	10	2.6%	1.2%
Upper NF (SF of NF to access limit)	10	NA	2.6%	
Middle Asotin (George to Headgate Dam incl.)	11	3	2.5%	10.7%
Lower George (mouth to Wormell)	12	6	2.3%	7.1%

Upper SF (Alder to access limit)	13	7	1.9%	3.6%
Snake	14	12	1.8%	8.0%
Columbia	15	11	0.4%	1.4%

Priority Areas for Protection from EDT Analysis

EDT analysis recommended geographic areas for protection in the Asotin for both steelhead and spring chinook. Protection here is defined as "protection of these areas in such a way as to prevent further degradation of the habitat attributes that are important to the focal species" (MBI products refer to this as "preservation"; for the purposes of this assessment the terms are synonymous). EDT predicted considerable overlap of priority geographic areas for protection of steelhead and spring Chinook in the Asotin Creek Subbasin (Table 4-23). The highest priority Geographic areas for protection of both species were Lower North Fork, Upper Asotin, Upper South Fork, and Middle Asotin; whereas Charley and the Upper North Fork were much higher priority for steelhead than Chinook (Table 4-23). .

Table 4-23. Priority geographic areas for habitat protection for spring Chinook (Spr Chk) and summer steelhead (Stlhd) in the Asotin Creek Subbasin, Washington. Potential performance decrease was the sum of the model predicted degradation in life history diversity, productivity, and abundance for the scaled (% benefit/ km) EDT output. Results are sorted by steelhead ranking and do not represent an integrated priority list for all species.

	EDT Protection Priority Scaled Rank		Potential Performance Increase (% / km)	
Geographic Area	**Stlhd**	**Spr Chk**	**Stlhd**	**Spr Chk**
Lower NF (mouth to SF of NF)	1	1	-9.4%	-13.5%
Upper Asotin (above Headgate Dam to forks)	2	2	-6.5%	-6.1%
Charley (mouth to access limit)	3	10	-4.7%	-0.7%
Upper NF (SF of NF to access limit)	4	NA	-4.6%	
Upper SF (Alder to access limit)	5	3	-2.9%	-5.2%
Middle Asotin (George to Headgate Dam incl.)	6	4	-2.0%	-4.5%
Lower Asotin (mouth to George)	7	6	-1.6%	-3.7%
Lower SF (mouth to Alder)	8	7	-1.5%	-3.4%
Snake River	9	5	-0.6%	-3.8%
Lower George (mouth to Wormell)	10	8	-0.2%	-0.9%
Upper George (Wormell to access limit)	11	9	-0.2%	-0.7%
Columbia River	12	11	-0.2%	-0.2%
Pintler (mouth to access limit)	13	12	0.0%	0.0%
Upper George Tribs (Wormell Heffelfinger Coombs)	14	NA	0.0%	
NF Tribs (Lick, SF of NF, Middle Branch)	15	NA	0.0%	

Analysis Discussion

The subbasin assessment has many findings that are comparable to other recent assessments and planning efforts. Habitat Diversity, Key Habitat by Lifestage, Sediment and Temperature were the most common limiting attribute identified with the assessment; this compared favorably with earlier assessments (Table 4-24).

Table 4-24. Assessments performed in the Asotin Subbasin and the key limiting factors identified.

Assessment	Key Limiting Factors Identified
EDT	Habitat Diversity (Includes: riparian Function, confinement, gradient, LWD density for most life stages); Sediment Load (Including embeddedness; and percent fines); Temperature; Key Habitat (pools and pool tail-outs)
LFA	Sediment; Confinement; Pools; Temperature
Subbasin Summary	water quality; riparian function; sedimentation; instream habitat (inc. pools and LWD); passage; non native species
Model Watershed Plan	sediment; pools; LWD density; temperature
Bull Trout Recovery Plan (draft)	LWD; temperatures; sediment; bank stability; loss of riparian, passage

The Limiting Factors Analysis performed for WRIA 35 (Kuttle, 2002) identified many of the same habitat problems as EDT or the other documents (such as sediment; confinement; lack of primary pools and temperature). That report also recommended protecting the North Fork, Middle Branch, SF of the North Fork, Cougar Cr, and upper George Creek (above Wormell) (Table 4-24). It also recommended reducing water temps, particularly in mainstem Asotin, SF, Lower Charlie, Lower George (below Wormell) and lower Pintler.

The Subbasin Summary (Stovall 2001) identified many of the same habitat issues as the EDT or Limiting factors reports, but it was not reach specific. The Summary identified key factors that occur at the local and regional level limiting fish production. These included water quality, geomorphic instability, riparian function, sedimentation, insufficient instream habitat, less than optimal passage/connectivity due to road culverts, out-of-basin effects, data gaps, the introduction and proliferation of non-native species, and ecological productivity.

The draft Bull Trout Recovery Plan (USFWS 2002) lists many of the same habitat issues, but as with the Summary it is not reach specific. Because bull trout are remaining in the headwater areas, the report tends to emphasize those areas. Proposed Critical habitat included the N. Fork, George Creek, Charlie Creek and the mainstem Asotin. The South Fork was not listed in the draft proposed critical habitat, but WDFW recommended including it in their response to the draft critical habitat designations. Results from EDT and the above works appear that to compliment the results of the Recovery Plan when complete.

The Model Watershed Plan (ACCD 1995) identified major watershed problems. These included: sediment deposition in spawning gravels; lack of resting and rearing pools; lack of large woody debris; high stream temperatures.

In short, if we examine EDT in light of other planning reports and our empirical data results we find a very similar story with a few slight differences:

1. Most age 1 and older steelhead production overlaps with recent spring Chinook and bull trout use areas in the upper reaches of the tributaries. The upper mainstem Asotin Creek is important for steelhead, and may be for passage and holding of bull trout and spring chinook. These areas are consistent with all the planning documents and most of the EDT results (see list below).

2. EDT results list the following geographic areas as the top 10 based on both protection and restoration for steelhead:

1. Upper mainstem Asotin
2. Lower NF Asotin
3. Charlie Ck
4. Lower Asotin (near the mouth) **
5. Middle Asotin (George to Headgate)**
6. Upper North Fork
7. Lower George (to Wormell)
8. Lower South Fork
9. Upper South Fork
10. Upper George Ck

Lower Asotin Creek and middle Asotin (George Creek to Headgate Dam) have not been listed as high priorities for steelhead restoration in previous planning efforts. EDT compares historic and current conditions and the larger the difference from historic to current the higher the results for restoration according to EDT. However, these stream reaches are currently marginal habitat for steelhead and lowest reach has the most human disturbance and development in the subbasin. Much of the lowest stream reach is diked for flood protection and development constrains options for fish habitat restoration. The opportunities for restoring this stream reach to approach historic conditions are very limited by the town of Asotin and rural development along the stream. Similar to the lower stream reach, the middle stream reach is likely far different than historic conditions. Roads and housing development in a very narrow valley have severely constrained Asotin Creek and will limit options for restoring this stream segment. It is very unlikely that historic conditions can be approached in either of these stream reaches and our empirical data suggests that steelhead production is limited in these areas.

3. The severity of impact to salmonids from several habitat attributes differs in the Limiting Factors Report and EDT for several reaches or geographic areas. For example, sediment is not shown to be a major problem in Charlie Creek from the results of the EDT analysis, but field observations and other planning documents would indicate this attribute is a significant limiting factor. Thus, in order to obtain a complete, balanced

picture of the subbasin conditions other assessments were taken into account when reaching the following conclusions. These include the afore-mentioned Limiting Factors Analysis (Kuttle 2002, Model Watershed Plan (ACCD 1995) and the Subbasin Summary (Stovall 2001)

Assessment Conclusions

Restoration Priority Geographic Areas

The following geographic areas have the **highest restoration value** in Asotin Cr according to the EDT analysis of steelhead and spring chinook and taking into account other factors, such as previous planning efforts and empirical data:

a. Upper Asotin (Headgate Dam to Forks)
b. Lower George Cr
c. Lower NF Asotin
d. Charlie Cr
e. Lower SF Asotin

These are not in ranked order.. The priority geographic areas were identified by considering first their rankings by the EDT analysis for restoration for both steelhead and spring chinook from tables 22 and 23. Then these were considered in the light of past planning efforts within the subbasin. NF Tribs and Upper George Tribs rate high according to EDT for restoration for steelhead. The areas, however, are not considered ever to have been spring chinook habitat and thus were not included in the EDT analysis for spring chinook. Since there would be no benefit to spring chinook they were eliminated from consideration.

Divergence from EDT - Lower Asotin ranked high for restoration when evaluated for both spring Chinook and steelhead. As noted above this is inconsistent with other assessments/planning efforts performed over the last 10 years on the Asotin Subbasin. While we agree with the EDT assessment that this area of the Asotin has probably diverged the furthest from historical conditions and thus would benefit the population the greatest if completely restored; we could not include it as a priority area for restoration for the reasons listed in the previous section. It should be noted that during the other planning efforts the Lower Asotin was mentioned as being a low priority for these same reasons. However, none of the other planning documents actually identified specific areas as being higher priority for restoration than others in the final documents. Restoration efforts in Lower George and Charlie Cr are likely to have only a moderate benefit to spring chinook. For purposes of the EDT model run we agreed that spring chinook were likely present in these areas historically. There is, however, no evidence that spring chinook now use these areas to any great extent or will in the near term. Lower George was included as a priority for restoration due to steelhead empirical data summarized in Table ##. Lower George had the highest densities and population estimates for >1+ steelhead. This clearly demonstrates its importance to the steelhead population. Clearly too, if one has been on this portion of George, is the need for active restoration. We are still unsure why this portion of George Creek ranked as such a low priority for restoration; this could very well be a factor of the lack of hard data available for many key attributes (see *EDT Analysis* and *Habitat Data* below).

Impacted Life Stages

Within the priority restoration geographic areas above the following life stages are the most impacted according to the EDT analysis (STS = steelhead; CHS = spring chinook):

a) Upper Asotin (Headgate Dam to Forks)
    i. Incubation (STS & CHS)
    ii. Fry (CHS)
    iii. Subyearling rearing (STS)
    iv. Overwintering (STS)
    v. Yearling rearing (STS & CHS)
    vi. Prespawning (CHS)
b) Lower George Cr
    i. Incubation (STS & CHS)
    ii. Fry (CHS)
    iii. Overwintering (STS & CHS*)
    iv. Subyearling rearing (STS & CHS)
    v. Yearling Rearing (STS)
c) Lower NF Asotin
    i. Incubation (STS)
    ii. Fry (STS & CHS)
    iii. Subyearling rearing (STS & CHS)
    iv. Overwintering (CHS)
    v. Yearling Rearing (STS)
    vi. Pre Spawning (CHS)
d) Charlie Cr
    i. Incubation (STS & CHS)
    ii. Fry (STS & CHS)
    iii. Subyearling rearing (STS)
    iv. Overwintering (CHS)
    v. Yearling (STS)
    vi. Pre Spawning (CHS)
e) Lower SF Asotin
    i. Incubation (STS & CHS)
    ii. Fry (STS & CHS)
    iii. Sub-yearling rearing (STS & CHS)
    iv. Overwintering (STS)*
    v. Pre Spawning (CHS)

*Though overwintering for spring chinook and steelhead in these two geographic areas were not in the top four when considering all three population performance measurements; it had an extremely high impact on productivity compared to pre-spawning (CHS) and spawning (STS) which were in the top four.

The impacted life stages are strictly from the EDT analysis. These represent the top four by life stage rank for the geographic areas as determined from the reach analysis. Life stage ranks are determined through EDT for each reach by considering all three EDT population performance measures (life history diversity, abundance and production). The individual reach analysis that make up the geographic areas were then considered in determining the top four life stages. Those life stages that were ranked in the top four within the reaches most often were determined to be the four most impacted life stages for the geographic areas. It should be noted that in order to develop a well targeted subbasin plan we determined to make this distinction in life stage impacts. However, throughout the system the habitat factors that were identified as most limiting to these life stages actually impact all life stages of salmonids to one degree or another. The previous assessment and planning documents did not usually go into this fine of detail, in that limited life stages were not clearly defined within specific reaches. These results are not inconsistent with previous assessments given that there appears to be general agreement on the limiting factors for the Asotin and that the affected life stages are determined for the EDT analysis using the latest literature.

Limiting Habitat Attributes

The following habitat attributes are considered to have the most impact within the above Asotin Cr reaches and key life stages listed above:

a) Upper Asotin (Headgate Dam to Forks)
   i. LWD
   ii. Confinement
   iii. Riparian Function
   iv. Sediment (Turbidity, Fines and Embeddedness)
   v. Key Habitat (pools)
   vi. Temperature
b) Lower George Cr
   i. LWD
   ii. Confinement
   iii. Riparian Function
   iv. Sediment (Turbidity, Fines and Embeddedness)
   v. Key Habitat (pools)
   vi. Flow
   vii. Bedscour
   viii. Temperature
c) Lower NF Asotin
   i. LWD
   ii. Confinement
   iii. Riparian Function
   iv. Sediment (Turbidity, Fines and Embeddedness)

v. Key Habitat (pools & glides)
vi. Bedscour
vii.

d) Charlie Cr
   i. LWD
   ii. Confinement
   iii. Riparian Function
   iv. Sediment (Turbidity, Fines and Embeddedness)
   v. Key Habitat (pools)
   vi. Bedscour
e) Lower SF Asotin
   i. LWD
   ii. Confinement
   iii. Riparian Function
   iv. Sediment (Turbidity, Fines and Embeddedness)
   v. Key Habitat (pools & glides)
   vi. Temperature

These habitat attributes were taken directly from the EDT analysis. They were then modified given local knowledge and to be consistent with previous assessment and planning documents. Please note the commonality of compromised habitat attributes in the above reaches. While this does show pervasive problems within the system, it also can potentially make managing to these priority reaches simpler; meaning the same types of projects can benefit multiple reaches.

Divergence from EDT - Sediment was not identified in the EDT analysis as a limiting factor in Charlie Cr, however, even casual observation of this creek proves that conclusion wrong. Other assessments clearly identified sediment as a limiting factor throughout the Asotin drainage, thus it is appropriate to be included here.

<u>Protection Priority Geographic Areas</u>

The following geographic areas have the highest protection value in Asotin Cr according to the EDT analysis and taking into account other assessment work and empirical data:

a. Upper NF Asotin
b. Upper SF Asotin
c. Lower NF Asotin
d. Charlie Cr
e. Upper Asotin
f. Upper George Cr
g. Headwaters (George Cr, Charlie Cr, NF and SF Asotin)*
h. NF Asotin Tribs
i. Lower SF Asotin

*Headwaters is a conglomeration of reaches covering the Bull Trout bearing (present or potential) waters upstream of the present reaches designated through the EDT process (see discussion in "E." below).

Standing out among this list is NF Asotin. Its upper and lower areas are high for protection. This and the inclusion of the Lower NF in the list of streams highly rated for restoration accentuates the current importance of this reach to salmonids in the subbasin. Upper Asotin, Charlie Cr and Lower SF are all also present on both lists. It is important to note that the inclusion on one list does not exclude a reach from being on the other. This simply means that according to the EDT analysis it is important to preserve the habitat that is there while doing restorative work. Upper George was not ranked particularly high when analyzed for Steelhead and Spring Chinook by EDT. Its inclusion though is consistent with other assessments and is on the list of core streams in the Bull Trout Recovery Plan (see comments below). It should be noted that many of the above protection reaches apply only to steelhead. It is unlikely that spring chinook would benefit from protection in Upper SF, Charlie Cr or George Cr because they use these areas very little if at all.

The lower South Fork Asotin stream reach was added to the list of areas EDT results indicated have high protection value based on information and conclusion in past planning documents, the sporadic presence of bull trout, and the fact that the entire reach is now in public ownership

Bull Trout

The assessment of Bull Trout and its habitat presented some difficulty in the Asotin Subbasin. Rules for Bull Trout in EDT had not been developed in time for this assessment. This coupled with a glaring lack of knowledge of even the basic life history of Bull Trout in the Asotin drainage put the fish at a distinct disadvantage when it came to naming priority habitats for protection and restoration. The Bull Trout Recovery Plan identified temperature as being the most limiting factor in the subbasin. Protecting the upper reaches from degradation is the key to modifying or maintaining bull trout suitable temperatures in the Asotin. EDT reaches and the geographic areas described thus far in the document were developed based on the distribution of steelhead and spring chinook, not Bull Trout. Given these two points, and to be consistent with other assessments such as the list of priority streams from the Recovery Plan, the upper reaches of George Cr, Charlie Cr, NF Asotin and SF Asotin not covered within the geographic areas (Headwaters under section "D" above) should be considered priority for protection. These areas quite probably represent the last good Bull Trout habitat in the Asotin Subbasin.

EDT Analysis

The EDT analysis used in this assessment has proved to be a valuable tool. While conducting this assessment we have tried to use this tool in a responsible manner. We believe that the most value from EDT is in the future. The time frame that we operated under and the shortage of data available for some key attributes (see below) encouraged us to use caution with the results. It is our determination that the current data set used for this EDT run should be re-examined and revised between each rolling provincial review. This should also occur before it is used for other planning efforts. We believe that its use in its present state for this Subbasin Plan was necessary, however, with more time and better data the model results can certainly be improved upon.

Habitat Data

While conducting this assessment and particularly while performing the attribute ratings for EDT, it became quite clear that in many cases we were lacking even the most basic habitat information. This made the assessment work quite difficult, particularly outside of the Forest Service lands where at least some basic surveys had been conducted. In order to properly assess the subbasin and provide better information for the management strategy process it is vital that additional habitat and life history surveys be conducted. There were some reaches for which we had no empirical data on habitat types (pools:riffles:glides, etc.), embeddedness, LWD density, winter temperature or percent fines. The entire subbasin is lacking in, bedscour, bankfull widths, flow and riparian function data. Gradient measurements for individual reaches was also a concern. Gradients were measured using Terrain Navigator; the accuracy of these gradients is unknown and needs to be ground-truthed. Gradients for EDT input were derived using Terrain Navigator software. These gradients have not been ground truthed and some doubt remains as to whether any of the reaches actually exceed 3%. This could lead to habitat diversity appearing to be a higher magnitude problem than it actually is. It is the strong finding of this assessment that the above information begin to be acquired as soon as possible in order to better inform the land managers, public and private, during future planning efforts.

Tenmile and Couse Creeks

Tenmile Creek was evaluated using EDT. Given that Tenmile includes only 12 reaches, two of which are point reaches to designate obstructions, it was not grouped into geographic areas for the purpose of identifying protection and restoration reaches. For Tenmile Creek the unscaled version of the EDT output was used to rank priority restoration and protection reaches. This was determined to be the most effective way of identifying important reaches for this area. As opposed to the Asotin assessment where we wanted to identify those areas with the greatest restorative and protective value per kilometer, we wanted to single out the reaches in Tenmile that could have the greatest impact on the subbasin population. The best way to accomplish this was to point out that reach(es) that if restored or protected, would give the greatest contribution to the subbasin population.

In general the mainstem Tenmile reaches ranked higher for restoration than the Mill Creek Reaches. Within that area the reaches from the end of the seasonally dewatered area to the mouth of the Middle Branch were considered highest in both restoration and protection value (Tenmile4 and 5)(Table ##). In both reaches in this area sediment load and channel stability were the most limiting factor on the most limited life stage, incubating eggs. Temperature impacts on incubating eggs and colonizing fry were also major factors affecting production but only in Tenmile4. Lack of key habitat and habitat diversity also were shown as problems according to EDT. Sediment load and habitat diversity (pools) are attributes that were also highlighted as problems by the Limiting Factors Analysis (Kuttle 2002). Tenmile in its entirety is flow limited. It is unknown and hard to estimate how much the change in land cover within this short, steep watershed has effected groundwater infusion during critical summer months. It is very possible that changes in land use practices throughout the basin could positively affect summer flows.

The relative contribution of Tenmile Creek to the overall population of steelhead in the Asotin Subbasin is small (see section 4.3.4.1.1). Thus, it was not considered with the geographic areas of Asotin Cr when identifying priority areas for restoration and protection. Though the relative contribution to the population is small the importance that Tenmile steelhead has to the population in terms of diversity is unknown. This assessment clearly shows that Tenmile4, which is the top restoration and protection reach, is the most important for consideration of protection or restoration strategies.

Table 4-25. Priority reaches for restoration and protection of summer steelhead in the Asotin Creek Subbasin, Washington. Potential performance increases and decreases were the sum of the model predicted increases and decreases in life history diversity, productivity, and abundance for the scaled (% benefit/ km) EDT output.

	EDT Restoration Priority Unscaled		EDT Protection Priority Unscaled	
Geographic Area	**Rank**	**Performance Increase**	**Rank**	**Performance Decrease**
Tenmile4 (dewatered area to Mill Cr)	1	215%	1	124%
Tenmile5 (Mill Cr to mouth of Middle Branch)	2	117%	2	84%
Tenmile2 (Snake River road to Weissenfels Rd)	3	104%	6	8%
Tenmile6 (Middle Branch to Weissenfels Pond)	4	77%	3	33%
Tenmile3 (Weissenfels Rd to seasonal dewatered area)	5	68%	7	4%
Middle Branch (Mouth to end steelhead distribution)	6	47%	4	25%
Tenmile1 (Mouth to Snake River Rd)	7	33%	9	0
MillCreek3 (Mill Cr Rd culvert to irrigation diversion)	8	31%	8	1%
Millcreek1 (Mouth to Mill Cr Road culvert)	9	28%	5	14%
Tenmile8 (Weissenfels Pond to end steelhead distribution)	10	0%	9	0

Impacted Life Stages and Limiting Habitat Attributes

Within the Tenmile4 reach, the following life stages are the most impacted and the following habitat attributes are the most limiting to those life stages according to the EDT analysis:

Tenmile 4 (dewatered area to Mill Cr)

i. Incubation (STS)
ii. Fry (STS)
iii. Overwintering (STS)
iv. Subyearling rearing (STS)

Tenmile 4 (dewatered area to Mill Cr)

i. LWD
ii. Riparian Function
iii. Sediment (Turbidity, Fines and Embeddedness)
iv. Key Habitat (pools)
v. Flow

The results of EDT above is not inconsistent with past assessments nor the technical knowledge of the Tenmile basin.

The lack of resources available within the timetable provided did not allow for an EDT assessment of Couse Creek. Couse Cr has a known spawning steelhead population and thus has some importance to the subbasin population as a whole. The results from EDT on Ten-Mile can generally be applied to Couse Cr. It is thought that sediment and lack of habitat diversity are limiting to steelhead production (Kuttle 2002).

4.7 Species of Interest

4.7.1 Introduction

Species of Interest (SOI) was included within the plan to provide a venue to present species that may have ecological and/or cultural significance but for which there is not enough known about the species to include them in the focal species category for planning purposes. SOI were submitted to the subbasin planning team for approval to be included within the plan. SOI that are submitted have an unknown quantity of ecological significance; in order to determine whether or not these species should be considered as focal for the subbasin more must be learned about subbasin specific life histories and conditions that may be limiting there productivity. Each SOI has a corresponding section within the research, monitoring and evaluation section that includes either a research plan for the SOI or a place holder with the intention of inserting a plan in a later iteration of the subbasin plan. Species of Interest were not to be submitted without either a research plan or the intention of developing one.

4.7.2 Species of Interest

Lamprey (this section submitted by the Nez Perce Tribe and is still under development)
Pacific lamprey (Lampetra tridentata) numbers have been in great decline since the installation of numerous dams and habitat degradation in the Columbia Basin. The Nez Perce Tribe regards Pacific lamprey as a highly valued resource harvested to this day as a subsistence food and is highly regarded for its cultural value.

It is believed that Pacific lamprey plays an important role in the food web, it may have acted as a buffer for salmon from predators, and may have been an important source of marine nutrients to oligotrophic watersheds.

The Nez Perce Tribe's goal relating to lamprey is to create a sustainable annual subsistence harvest and re-establish the lamprey's role in the Asotin and Tucannon subbasins.

What is Known: Inventory and Assessment by Subbasin Planning Team (SPT)

RM & E:

Proposed Research: *Assess population status, limiting factors, and rehabilitation potential for Pacific lamprey in the Asotin and Tucannon subbasins*

Goal: To define population status and rehabilitation potential of Pacific lamprey in the Asotin and Tucannon subbasins

Proposed M&E: Environmental and population status M&E. M&E sampling will include collection of life history, distribution, abundance by life stage, and genetic and homing behavior attributes of Pacific lamprey ammocoetes and macrothalmia in the Asotin and Tucannon subbasins. Genetic analysis of ammocoetes will be coordinated through ongoing programs (i.e. USGS lab at Cook WA). Homing behavior will include tagging of individuals (using methods consistent with ongoing programs) and subsequent evaluation upon recapture. Use data collected through habitat assessments and population surveys to identify potential restoration opportunities

Coordination Potential: Coordinate with ongoing lamprey evaluation programs, if any, and potential program cooperators (i.e. WDFW, CRITFC, CTUIR, NPT). Ensure that smolt traps are adequately equipped to collect lamprey and that trap operators are informed as to data collection procedures

Geographic Scope: Accessible anadromous waters in Asotin and Tucannon subbasins

Asotin Assessment Literature Cited

Asotin County Conservation District (ACCD). 1995. Model Watershed Plan.

Bumgarner, J., M. Small, L. Ross and J. Dedloff. 2003. Lyons Ferry Complex Hatchery Evaluation: Summer steelhead and trout report 2001 and 2002 Run Years. WDFW Report FPA 03-15 to USFWS Lower Snake River Compensation Plan, Boise, ID. 67 p, + appendices.

Bumgarner, J., M.. Schuck, S. Martin, J. Dedloff, L. Ross. 2002. Lyons Ferry Complex Hatchery Evaluation: Summer steelhead and trout report 1998, 1999, 2000 Run Years. WDFW Report FPA 02-09 to USFWS Lower Snake River Compensation Plan, Boise, ID. 68 p, + appendices.

Busby, P.J., T.C. Wainwright, G.J. Bryant, L. Lierheimer, R.S. Waples, F.W. Waknitz, and I.V. Lagomarsino. 1996. Status review of west coast steelhead from Washington , Idaho, Oregon and California. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-NWFSC-27.

Gibbons, R.G., P.K.J. Hahn and T.H. Johnson. 1985. Methodology for determining MSH steelhead spawning escapement requirements. Washington State Game Department, Fisheries Management Division. Report #85-11. Olympia, WA.

Hassemer, P.F. 1992. Run composition of the 1991-92-run-year Snake River summer steelhead measured at Lower Granite Dam. Report to the National Oceanic and Atmospheric Administration, Award NA90AA-D-IJ718 (available from Idaho Fish and Game, 600 South Walnut, Box 25, Boise, ID 83707-0025).

Herrig, D. 1998. Lower Snake River Compensation Plan Background. In Proceedings of the Lower Snake River Compensation Plan Status Review Symposium. Compiled by the USFWS. Boise, ID. 276 p.

ICBTRT (Interior Columbia Basin Technical Recovery Team). 2003. Independent populations of Chinook, steelhead and sockeye for listed evolutionarily significant units within the interior Columbia River basin domain. Working draft, July, 2003. NOAA Fisheries. Northwest Fisheries Science Center. Seattle, WA. Available at: (http://www.nwfsc.noaa.gov/trt/trt_columbia.htm)

Interior Columbia Basin Technical Recovery Team. Unpublished. Independent Populations of Chinook, Steelhead, and Sockeye for listed Evolutionarily Significant Units within the Interior Columbia River domain. Working Draft, July 2003. National Marine Fisheries Service, Seattle Washington.

Krakenberg, J. 1957. June 5 memo to J. Heg, Washington Department of Fisheries.

Kuttle, M. 2002. Salmonid Habitat Limiting Factors Water resource Inventory Areas 33 (Lower) and 35 (Middle) Snake Watersheds, and Lower sic miles of the Palouse River. Washington State Conservation Commission. Olympia, WA.

Lestelle, L. C., L. E. Mobrand, J. A. Lichatowich, and T. S. Vogel. 1996. Applied ecosystem analysis - a primer, EDT: the ecosystem diagnosis and treatment method. Project number 9404600. Report. Bonneville Power Administration, Portland, Oregon.

Lichatowich, J., L. E. Mobrand, L. Lestelle, and T. Vogel. 1995. An approach to the diagnosis and treatment of depleted Pacific salmon populations in freshwater ecosystems. Fisheries 20(1): 10-18.

Lohn, M.R, 2002. Appendix G, Interim Abundance and Productivity Targets for Interior Columbia Basin Salmon and Steelhead Listed under the Endangered Species Act (ESA) *in* Endangered Species Act Section 7 Consultation Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation Habitat Improvement Program. 2003. National Marine Fisheries Commission (NOAA Fisheries).

McElhany, P., M.H. Ruckelshaus, M.J. Ford, T.C. Wainwright, and E.P. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionarily significant units" by. U.S. Dept. of Commerce, NOAA. Tech Memorandum, NMFS-NWFSC-42. see also http://www.nwr.noaa.gov/1salmon/salmesa/4ddocs/4dwsvps.htm

Mendel, G., D. Karl, T. Coyle, M. Gembala. 2001. Brief Assessments of Salmonids and their Habitats in George, Tenmile and Couse creeks in Asotin County, 2000. WDFW report to Asotin Conservation District, contract 33012159. 25 p, + appendices.

Mendel, G., J. Trump, C. Fulton, and M. Gembala. 2004. Brief Assessments of Salmonids and Stream Habitat Conditions in Snake River Tributaries of Asotin, Whitman and Garfield Counties in Washington. March 2001-June 2003 – Final Report. WDFW Report to Washington State Salmon Recovery Funding Board, Olympia, WA, IAC contract #00-1696N. 89 p, + appendices.

Mobrand, L. E., J. A. Lichatowich, L. C. Lestelle, and T. S. Vogel. 1997. An approach to describing ecosystem performance "through the eyes of salmon". Canadian Journal of Fisheries and Aquatic Sciences 54: 2964-2973.

Mobrand, L., L. Lestelle, and G. Blair. 1998. Recovery of a Columbia River watershed from an ecosystem perspective: a case study using the EDT method. Contract #94AM33243. Final report to Bonneville Power Administration. Mobrand Biometrics, Inc., Vashon, Washington.

NMFS (National Marine Fisheries Service). 1999. West Coast Chinook fact sheet. NMFS Protected Resources Division. Portland, OR.

Phelps, S.P., S.A. Leider, P.L. Hulett, B.M. Baker, and T. Johnson. 1997. Genetic analyses of Washington Steelhead: preliminary results incorporating 36 new collections from 1995 and 1996. Unpublished WDFW Progress Report. Available upon request from WDFW Fish Program, Conservation Biology Unit, Olympia, WA.

Pirtle, R.B. 1957. Field studies to estimate the size and timing of runs of anadromous species in the Columbia and Spokane rivers and their tributaries above the confluence with the Snake River. Final report to the U.S. Army Corps of Engineers. Boise, ID.

Schuck, M., G. Mendel and S. Nostrant. 1988. Lyons Ferry evaluation study part II: 1986-1987 annual report. Washington Department of Wildlife, Fisheries Management Division. Report #86-13.

Schuck, M., G. Mendel, S. Nostrant. 1988. Assessment of Trout Production from Lyons Ferry/Tucannon Hatchery Complex; and Field Studies Summary. WDFW Report to USFWS, Lower Snake River Compensation Plan, Boise, ID. AFF 1/LSR-89-01. 78 p, + appendices.

Stovall, S.H. (ed.) 2001. Draft Asotin Creek subbasin summary. November 30, 2001. Prepared for the Northwest Power Planning Council. Asotin County Conservation District.

U.S. Fish and Wildlife Service. 2002. Chapter 24, Snake River Washington Recovery Unit, Oregon. 134 p. In U.S. Fish and Wildlife Service. Bull Trout (Salvelinus confluentus) Draft Recovery Plan, Portland, Oregon.

Van Doornik, B.M. Baker, P. Thornton, D. Rawding, A. Marshall, P. Moran, and S. Kalinowski. *In press*. Genetic stock identification of steelhead in the Columbia River Basin: an evaluation of different molecular markers. North American Journal of Fishery Management.

WDF (Washington Department of Fisheries), WDW (Washington Department of Wildlife) and WWTIT (Western Washington Treaty Indian Tribes). 1992 Washington State salmon and steelhead stock inventory. WDF. Olympia, WA.

WDF (Washington Department of Fisheries), WDW (Washington Department of Wildlife) and WWTIT (Western Washington Treaty Indian Tribes). 1992 Washington State salmon and steelhead stock inventory. WDF. Olympia, WA.

WDF and WDW. 1993. 1992 Washington State salmon and steelhead stock inventory. Appendix three—Columbia River stocks. WDF. Olympia, WA.

WDFW 1998. Washington Salmonid Stock Inventory, Appendix Bull Trout/ Dolly Varden. 437 p.

WDFW and Washington Treaty Tribes. 2003. SaSI 2002. WDFW. Olympia, WA. Available at: http://wdfw.wa.gov/mapping/salmonscape/.

WDFW and Washington Treaty Tribes. 2003. SaSI 2002. WDFW. Olympia, WA. Available at: http://www.wa.gov/wdfw/mapping/salmonscape.

Winans, G.A., M.M. Paquin, D.M. Van Doornik, B.M. Baker, P. Thornton, D. Rawding, A. Marshall, P. Moran, and S. Kalinowski. In press. Genetic stock identification of steelhead in the Columbia River Basin: an evaluation of different molecular markers. North American Journal of Fishery Management.