YAKIMA COUNTY SHORELINE CHARACTERIZATION

FINAL DRAFT REPORT

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1. INTRODUCTION

The purpose of this study is to conduct a baseline inventory of abiotic, biological and cultural conditions in Yakima County's shoreline jurisdiction to provide the basis for the County's Shoreline Master Program update as defined by the state's Shoreline Management Act (RCW 90.58). This characterization will help the County identify existing conditions, determine functions and values of shoreline resources, and explore opportunities for conservation and restoration of ecological functions within the shoreline jurisdiction. These findings will help provide a framework for future updates to the County's shoreline environment designations and shoreline management policies and regulations.

Methodology

Following DOE (2004) protocols, this shoreline inventory and analysis attempts to integrate findings in an accessible manner through narrative and associated maps to inform SMP planning decisions and to provide a baseline for adaptive management and cumulative impact assessment. The resulting shoreline characterization indicates management opportunities for protection of ecological functions, restoration of degraded habitat, improving public access, and supporting water-dependent use.

Using existing reports, the protocol begins with providing a regional context, including vicinity maps, that describes the regional setting, climate, topography and land uses, and indicates the extent of shorelines that are under SMA jurisdiction. This regional context sets the stage for the characterization of ecosystem-wide processes that are influencing the ecological functions within the shoreline jurisdiction, focusing on upland and adjacent land uses that affect the flow of water, sediment, nutrients and materials. This characterization uses existing regional plans, as well as data and information from existing, studies, data and technical information, to identify management issues and determine the relationship of ecosystem-wide processes to shoreline functions, the health of those functions, and measures to protect or restore healthy processes and functions. Management issues addressed include flooding, erosion and sedimentation, loss and fragmentation of habitat, water pollution, and exotic species.

Following the characterization of ecosystem-wide processes, the protocol requires the characterization of the shoreline jurisdiction's ecological functions, which first requires mapping preliminary reach boundaries and documenting the rationale used. By overlaying stream hydrology, land use, and aerial photos, reach boundaries are created by considering changes in land use and zoning, vegetation cover, and/or geomorphic units (e.g. notable changes in gradient, confinement, surficial geology).

After determining reach boundaries, assessment of the ecological function of each reach begins with overlaying biological features and critical physical areas, including fish and conservation areas, wetlands, riparian and aquatic vegetation, frequently flooded areas, and geologically hazardous areas, such as areas of slope instability or erosion. Next, possible impacts to ecological functions are determined by overlaying shoreline

modifications, including structures (e.g. bulkheads, docks, storm drains), facilities cutting across the shoreline (e.g. roads and bridges), and land uses (e.g. agriculture, impervious surfaces). The results of these overlays are provided in a narrative summary and tables describing existing shoreline functions as evidenced by the mapped physical, biological and modification features.

The final step in the shoreline characterization is to overlay cultural and regulatory constraints to future use of the shoreline, and combine that analysis with the analysis of ecological functions to identify opportunities for shoreline protection and use. Cultural resources, public access, and regulatory designations that define and/or constrain future uses are mapped and summarized in both narrative and tables. These include archaeological and historic sites, public access, and zoning designations. Ecological protection and restoration opportunities are then identified through the physical, biological and cultural modification synthesis map overlays, while public access and cultural resource protection needs and opportunities are identified through the cultural jurisdiction synthesis maps. Preliminary shoreline environmental designation boundaries are also determined for each reach, based on existing use patterns and the biological and physical characteristics of the shoreline.

Principal Data Sources

A number of Yakima County, State, and federal agency data sources, and technical reports were reviewed to characterize overall watershed conditions and to assess the ecological function of Yakima County's shorelines in this watershed context. Sources reviewed for this report include, but are not limited, the following:

1) Reports:

Interim Comprehensive Basin Operating Plan for the Yakima Project (U.S. Bureau of Reclamation 2002)

Salmonid Habitat Limiting Factors Analysis- Yakima River Watershed (Haring, 2001)

Yakima Sub-basin Plan (Northwest Power and Conservation Council 2004)

Tieton Watershed Plan. USFS. Naches Ranger District. Wenatchee National Forest. May 1996.

Bumping/American Watershed Analysis. Naches Ranger District. Wenatchee National Forest. April 1998.

Yakima Watershed Assessment (Tri-County Watershed Assessment). January 29, 2001.

Ahtanum Creek Watershed Assessment (Golder and Associates, Inc, 2004)

Draft Programmatic Environmental Impact Statement for ther Ahtanum Creek Watershed Restoration Program (DOE 2005)

2) Digital Databases

In addition, the following digital databases were also used as part of the inventory and analysis process:

Yakima County

The following databases were obtained from Yakima County:

- Geohazards
- Channel migration zones
- Aquic soils developed from Natural Resources Conservation Services Yakima County Soil Survey
- Riparian areas
- Critical aquifer recharge/susceptibility
- Floodgates
- County zoning

Federal and State

A number of additional federal and Washington State databases were used, including:

- Washington State Department of Natural Resources. (2000). Digital 1:100,000-scale Geology of Washington.
- United States Department of Agriculture, Natural Resources Conservation Services. (2004). Soil Survey Geographic (SSURGO) Database.
- Federal Emergency Management Agency Flood Insurance Program Maps.
- United States Fish and Wildlife Service. (2003). National Wetlands Inventory Data.
- Washington Department of Fish and Wildlife (2004). Priority Habitats and Species, StreamNet and Natural Heritage Site databases
- Washington State Department of Fish and Wildlife. (1997). GAP Species Data (modified by and received from Yakima County).
- Interior Columbia Basin Ecosystem Management Project. (1995). Potential Natural Vegetation.
- Washington State Department of Natural Resources. (1996). Digital 1:24,000-scale Transportation (Roads and Railroads) of Washington.
- United States Census Bureau. (2000). Census TIGER® 2000/ Line Data; Railroads. Data retrieved 2004 from www.geographynetwork.com.
- Washington Department of Ecology. (1998). 303(d) Listings.
- Washington State Department of Ecology. (1998). DOE Facilities.
- Washington State Department of Ecology. (2004). Leaking Storage Tanks.

3) Data Sources Developed by Geo-Ecology Research Group

The following digital datasets were developed from a variety of sources:

- Soil permeability, runoff, erosion characteristics. Reclassified soil data from United States Department of Agriculture, Natural Resources Conservation Services [NRCS] Soil Survey Geographic (SSURGO) Database through cross reference of digital data and the NRCS Yakima County Soil Survey information (1984). Data Acquired January 2004.
- Impervious surfaces. Estimated from 2002 1:24,000 Washington Department of Transportation color orthophotos
- Parcels land use (modified from Yakima County parcel information)
- SMP environmental designations (mapped from Yakima County SMP)
- Archaeological or historical resources as identified by the Washington State Department of Archaeology & Historic Preservation. Archaeological properties are of a sensitive nature and can be subject to vandalism. Records, maps, or other information identifying the location of archaeological sites are exempt from public disclosure per RCW 42.17.310 (1)(k). Sites are given as approximate positions, using offset polygons the width of the shoreline jurisdiction and 500 m in length.

Report Organization

The report is divided into three principal sections. After Section 1, the Introduction, Section 2 provides the regional context and characterization of watershed conditions and ecosystem-wide processes. Sections 3-8 provide the inventory and analysis of ecological functions in the shoreline jurisdiction by reach for each subbasin. These sections include a presentation and discussion of the shoreline reach breaks used, and separate discussions of the physical, biological, and cultural modification, and jurisdictional characteristics of each reach. These discussions are augmented by several tables in the appendix, as well as synthesis maps included in the accompanying DVD map portfolio. Each reach-level inventory and analysis includes a summary of shoreline conditions, including identification of potential opportunities for protecting and restoring ecological functions. Again, accompanying maps are included in the DVD map portfolio, which also include draft environmental designations.

Use of Map Portfolio

To provide final synthesis maps at appropriate viewing scales that will inform the analysis report and illustrate findings, we chose to use an electronic map portfolio accessed through ESRI ArcReader, a free, easy-to-use mapping application that allows users to view, explore, and print maps. ArcReader © is a great way to deliver interactive mapping capabilities that access a wide variety of dynamic geographic information.

Using ArcReader ©, anyone can view high-quality maps created using the ArcGIS© software (ESRI 2005).

The electronic map portfolio is divided into five DVD disks, labeled by sub-basin. Included on each DVD are 9 main folders:

- map folders
    - Physical geology and hazards (physical.pmf)
    - Soil characteristics (soil_characteristics.pmf)
    - Biological (biological.pmf)
    - GAP species information (GAP.pmf)
    - Cultural Modifications (cultural_modification.pmf)
    - Cultural Jurisdictional (cultural_jurisdiction.pmf)
    - Protection Opportunities (opp_protection.pmf)
    - Restoration Opportunities (opp_restoration.pmf)
    - Environmental Designations (Env_Desig.pmf)

To begin using ArcReader to view maps, install ArcReader by navigating to the folder 'ArcReader90' on the ArcReader 90 disk. Click on Setup.exe and follow on-screen instructions.

Once ArcReader has been successfully installed, navigate to one of the data/map folders within one of the five map folder disks labeled by subbasin. Each of these folders contains two other folders called 'data' and 'pmf'. Ignore the data folder. Open the pmf folder and double click the pmf file with the same name as the parent folder.

If ArcReader has been installed properly (note – ArcReader will not install on PCs running Windows 98.) the ArcReader map will open up. The table of contents has intentionally been disabled in each of these ArcReader maps. Upon opening, a warning will flash on screen telling you as much, click OK. You are now ready to view and print ArcReader map files.

Each of the map files opens to the full extent of the map. If the user navigates to **VIEW → BOOKMARKS,** then they can zoom the map to each individual reach or to the extent of the entire area. This option is always available to the user. The user may also explore the map data using the zoom tool. There are two sets of zoom tools in ArcReader ©. One tool (#1) is used to zoom within the data window and the second tool (#2) is used to zoom in on the entire map document (Figure A). In most cases the user will want to use the first zoom tool.

The user may also use the software to print maps by navigating to **FILE → PRINT** on the main menu.

Two different versions of maps published into ArcReader have been delivered to Yakima County:

1. **Maps displaying GAP data identification of species of concern**: data layers may be activated or deactivated on the map;
2. **All other map files**: Ability for user to manipulate data has been deactivated to simplify the viewing of maps.

When viewing GAP data, it may be necessary to navigate to **VIEW→ TABLE OF CONENTS** to open the **Table of Contents** window. The individual data layers can be activated and deactivated from the **Table of Contents** (Figure B).

Figure A

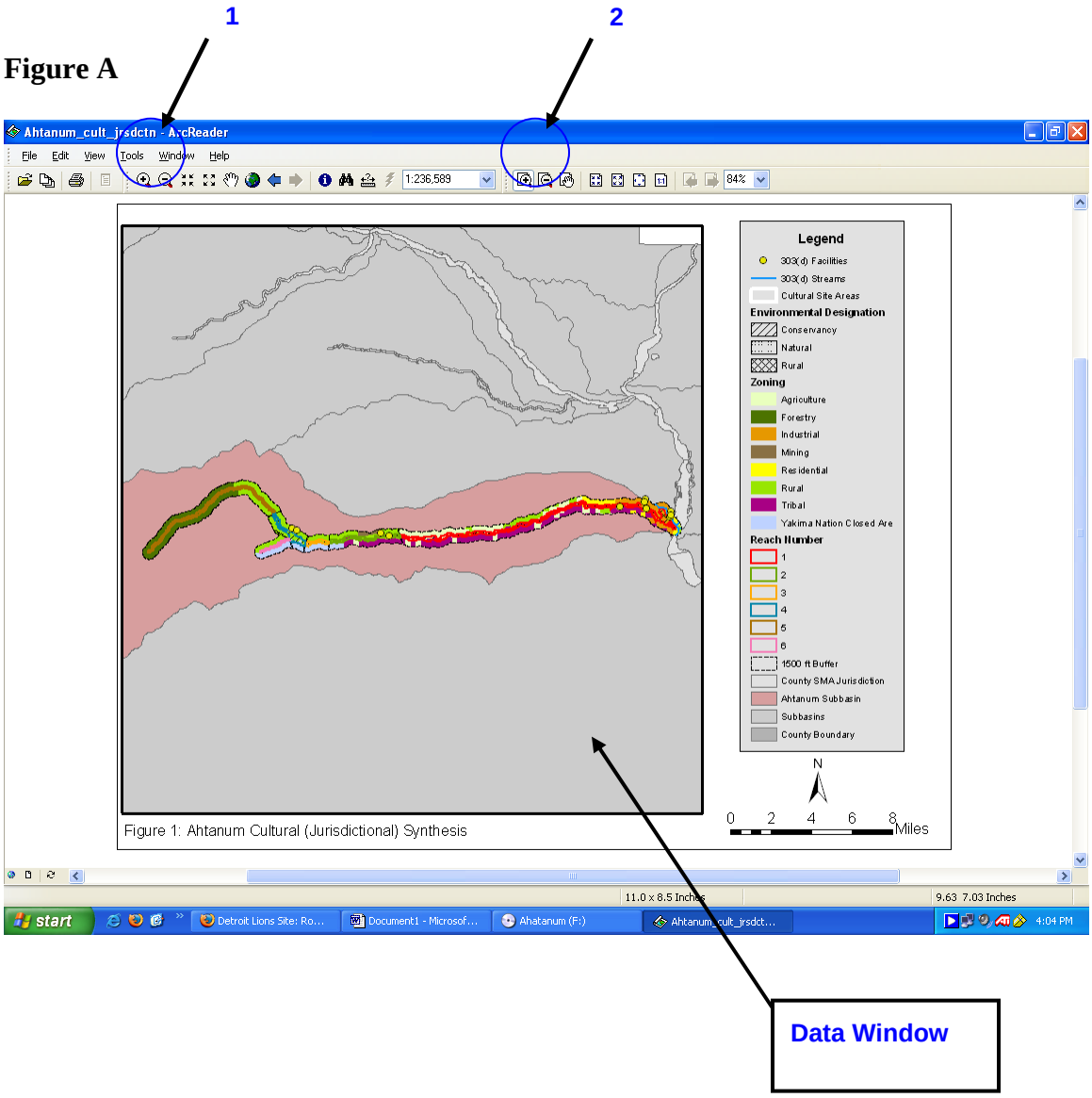
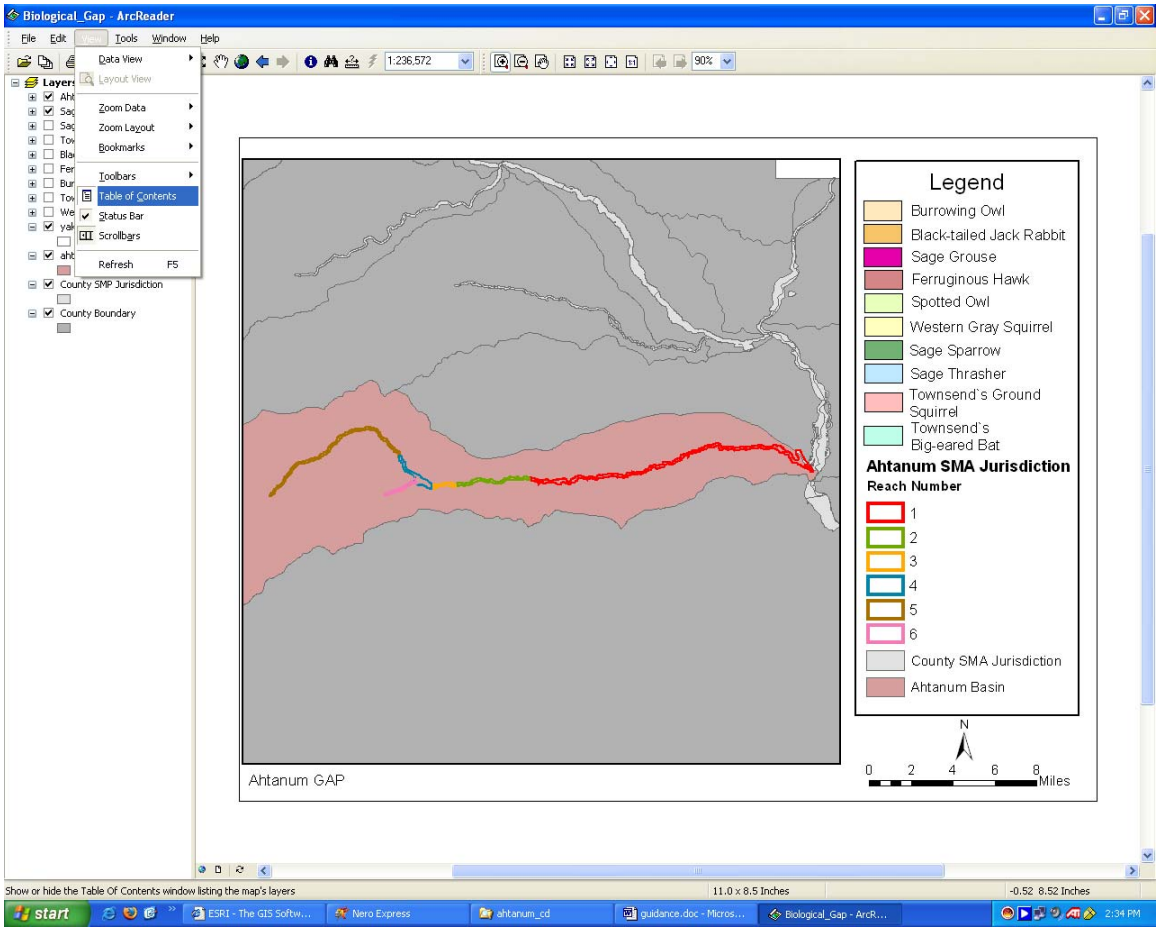


Figure B


Biological_Gap - ArcReader
File Edit View Tools Window Help
Data View
Layout View
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Bookmarks
Toolbars
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Status Bar
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1:236,572
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County SMP Jurisdiction
County Boundary
Legend
Burrowing Owl
Black-tailed Jack Rabbit
Sage Grouse
Ferruginous Hawk
Spotted Owl
Western Gray Squirrel
Sage Sparrow
Sage Thrasher
Townsend`s Ground Squirrel
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2. REGIONAL CONTEXT – YAKIMA RIVER BASIN

Portions of the following text have been primarily taken, in whole or in part, from the following reports: (Haring, 2001, 2004; TriCounty Water Resource Agency et al., 2000).

Topography

The Yakima River basin is located in south central Washington (Figure 1). The City of Yakima is the largest city and is centrally located in the basin. The basin includes most of Yakima and Kittitas counties as well as small portions of Benton and Klickitat counties. The majority of the Yakama Nation Reservation is located within the basin. The Yakima River drains an area of 6155 square miles (3,939,200 acres) and contains about 1900 river miles of perennial streams. Originating near the crest of the Cascade Range above Keechelus Lake, the Yakima River flows 214 miles southeastward to its confluence with the Columbia River. The Naches River, in the west, has four major tributaries: the Bumping, American, Tieton and Little Naches rivers. Ahtanum, Toppenish and Satus creeks join the Yakima in the lower subbasin.

The topography of the Yakima River basin includes a variety of land forms and land cover. In the higher elevations of the Cascade Mountains there are glaciated peaks and deep U-shaped valleys. The upper mainstem Yakima and Naches rivers, and several tributaries occupy broad valleys excavated by alpine glaciers. Lowlands typical of landforms associated with the Columbia Plateau are found along the lower half of the Yakima River (TriCounty Water Resource Agency et al., 2000). Elevations in the subbasin range from over 8,000 feet in the Cascades, where the river originates, to about 340 feet at the confluence of the Yakima and Columbia rivers (Rinella, et al., 1992). Topography in the basin is characterized by a series of long ridges extending eastward from the Cascades and encircling flat valley areas. The ridges rise 1,000 to 3,000 feet above the adjacent valley floors (Tri-County Water Resource Agency et al., 2000).

Climate

The climate of the Yakima River basin ranges from cool and moist in the mountains to warm and dry in the valleys. Annual precipitation near the crest of the Cascade Mountains ranges from 80 inches to 140 inches, whereas the lower elevations in the eastern part of the subbasin receive 10 inches or less. Summer temperatures average 55ºF in the mountains, and 82ºF in the valleys. In the summer, air from the interior of the continent usually results in high temperatures. Winter temperatures are fairly moderate. The Selkirk Mountains in Idaho and the Rocky Mountains in British Columbia shield the area from the very cold air masses that sweep down from Canada into the Great Plains. The predominantly westerly winds in the winter allow the area to benefit from the coastal maritime influence. Average maximum winter temperatures range from 25ºF to 40ºF, while average minimum winter temperatures range from 15ºF to 25ºF. Minimum temperatures of -20ºF to -25ºF have been recorded in most areas.

A sharp precipitation gradient in the Yakima River basin falls off in a generally southeasterly direction. Orographic cooling of moist maritime air passing over the

Cascade Mountains results in heavy precipitation on the windward slope and near the crest, and a rain shadow to the east. In a distance of 10 miles, annual precipitation falls from 100 inches or more at the crest of the Cascades to 48 inches at Bumping Lake and to 26 inches at Rimrock Lake. Within the next 15 to 20 miles, precipitation decreases to 8 to 10 inches on the valley floor. Virtually all of the streams in the subbasin originate at higher elevations where annual precipitation is 30 inches or more.

The rainy season in the valleys occurs during November through January, when about half the annual precipitation occurs. Snowfall in the valleys ranges from 20 to 25 inches and from 75 inches at 2,500 feet to over 500 inches at the summit of the Cascades. It is this mountain snow pack that provides most of the water for irrigated agriculture and streamflow.

Geology and Soils

The Yakima River basin straddles two very different physiographic and geologic provinces: the Cascade Mountains in northwestern part of the basin, and the Columbia Plateau to the southeast. The Cascade Mountains consists of continental formations of Eocene-age sandstone, shale, and some coal layers, and pre-Miocene volcanic, intrusive, and metamorphic formations. Tertiary- and Quaternary-age andesite and dacitic lavas, tuff, and mudflows from a broad north-south arch along the western edge of the Yakima Basin (Tri-County Water Resource Agency et al., 2000).

The principal rock of the Columbia Plateau is a series of basalt flows of tertiary age that cover older rock and lap onto the western edge of the Cascade Mountains. The majority of these basalt flows, interspersed with sedimentary layers is called the Columbia River Basalt Group. The thickness of the Columbia River Basalt Group within the lower and middle Yakima River basin ranges from 9,000 to 12,000 feet, growing thicker the down stream direction (TriCounty Water Resource Agency et al., 2000). The basalt plateau of the eastern basin was subsequently folded and faulted into a series of northwest-southeast trending anticlinal ridges and synclinal valleys, collectively called the Yakima Fold Belt. The valleys extend from the Cascades to the broad plains of the Columbia River. The antecedent Yakima River incised canyons and water gaps through the ridges and deposited gravels, eroded from uplifting mountains and ridges, in the valleys.

Alpine glaciers draining the Cascade crest down the Yakima and Naches valleys delivered large volumes of glacial outwash to the alluvial basins, resulting in partial filling of Cle Elum, Kittitas and upper and lower Yakima valleys with sand, gravel, and silt. Glaciation left many lakes (four of which were expanded to serve as storage reservoirs). Backwaters from the Ice-age Lake Missoula flood left thick silt deposits in the lower valley. Extensive portions of the eastern and southeastern subbasin are mantled by loess, a wind-deposited silt derived from outwash deposits.

Seven soil associations exist in the Yakima River basin. Four of these associations, (Weirman-Zillah, Renslow-Ritzville, Naches-Woldale and Warden-Shano), comprising about 18 percent of the basin area, are located in gently-sloping areas and are subject to intensive irrigated agriculture. These soil types are fine textured and easily eroded. Part

of the Rough Mountainous Land Association, these soils were formed in glacial till or outwash. They are of variable depth, stony, broken by outcrops of underlying rock, and valuable for timber production, summer grazing, wildlife habitat, recreation and, chiefly, as a watershed. In its role as watershed, this area merits protection from fires, erosion and uncontrolled development. In total, the soils of the Rough Mountainous Land Association make up 48 percent of the basin.

Soils on the ridge tops generally consist of the Rock Creek-Starbuck association, are shallow, well-drained and stony, and are formed in loess and loess mixed with weathered basalt. Topography is gently sloping to very steep along the drainages and hillsides. This association is valuable chiefly as range or wildlife habitat, although carrying capacity is low. Much of the area has been overgrazed. The Rock Creek-Starbuck association makes up 33 percent of the basin.

Intensive, irrigated agriculture occurs on the remaining 19 percent of the soils of the basin, which lie in valley bottoms and along the shoulders of the ridges. Most of the soils in this area are very fine, wind-deposited silts and sands on slopes in excess of 2 percent, with large erosion potential (Boucher 1984).

Vegetation and Riparian Habitat

Vegetation in the basin is a complex blend of forest, range, and cropland. Over one-third of the land in the Yakima basin is forested. Rangeland lies between cultivated areas, located in the fertile lower valleys, and the higher-elevation forests.

Forests predominate at higher elevations. Moisture and topography dictate the character of the forests in the subbasin. Along the eastern fringe of the timber zone, timber stands are scattered and occur mainly as narrow bands of trees in canyon bottoms. These meandering strips of timber merge into sparse Ponderosa pine and Oregon white-oak forests, which in turn give way to denser stands of mixed species in the higher moisture and elevation zones. As a result, a large portion of the timber volume is in a 30-mile-wide band following the crest of the Cascades. Forests in the basin are heterogeneous in species composition, and age and size class, in part, because of the different management objectives of the various landowners and, in part, because of the sharp gradient in moisture transition zones. In past years, large acreages have been clearcut in the upper Little Naches drainage. The cumulative effect of timber harvest on the ecological integrity of the streams that drain the upper Yakima River is a matter of great concern.

Between the forests and the valley floor lie the rangelands. Almost all shrub-steppe habitats in the subbasin are supported by highly fragile soils that are easily eroded. The four major plant associations in the Yakima River basin are the Big sagebrush/Bluebunch wheatgrass association (40 percent of existing rangeland), the Three-tip sagebrush/Idaho fescue association (5 percent existing rangeland), the Bitterbrush/Bluebunch wheatgrass association (35 percent existing rangeland), and the Sandberg bluegrass/Stiff sagebrush association (20 percent existing rangeland). Except for the small Three-tip sagebrush/Idaho fescue association, over 50 percent of all shrub-steppe associations are

in fair to poor condition today. The increased runoff and erosion from these areas may have a significant impact on water quality.

Riparian conditions are extremely varied, ranging from severely degraded to nearly pristine. Good riparian habitat generally is found along forested, headwater reaches, whereas degraded riparian habitat is concentrated in the valleys, frequently associated with agricultural activity, especially grazing, streamside tillage, or mowing. Recreational development is having an increasing impact, especially along upper reaches.

Land Ownership and Use

Patterns of land ownership within the Yakima basin are complex. Within the boundaries of the drainage, about 31 percent is privately-owned, 33 percent federally-owned, 22.5 percent tribally-owned, 9 percent state-owned, and the remainder is owned by local governments. Ownership of about 4 percent of lands was not available.

Approximately 38 percent of the Yakima River basin is forested, another 40 percent is rangeland, 15 percent cropland, and the remaining acreage includes other land uses and water bodies. The predominant types of land use in the Yakima River basin include grazing, timber harvesting, irrigated agriculture, and urbanization.

The economic base of the Yakima River basin is irrigated agriculture. The Yakima basin is among the leading agricultural areas in the United States, ranking fifth in the United States in total agricultural production. In 1995, agriculture in Benton, Kittitas and Yakima counties produced an estimated crop value of $1.3 billion (Tri-County Water Agency et al., 2000). According to the United States Department of Agriculture (USDA), in 1997 farmers in Benton, Kittitas, and Yakima counties, harvested cropland totaling 624,000 acres (these totals include Benton County lands outside of the Yakima River basin).

Major crops include apples, cherries, peaches, pears, prunes, grapes, mint, grain, corn, hops, timothy hay and alfalfa. Crops produced in Kittitas County are primarily timothy and alfalfa hay, much of which is exported outside the basin. Fruit production, including tree fruits and grapes, is located primarily in Yakima County, although Benton County also has significant apple and grape production (Tri-County Water Resource Agency et al., 2000). Livestock production and forestry are also important contributors to the economic base. The major industries in the basin are related primarily to the processing of agricultural and forest products.

Most high-elevation forests are on federal-, tribal-, and state-owned lands, generally characterized by steep topography considered unsuitable for agriculture. Most of this forestland is managed for commercial timber production. Major landowners in the forested portions of the subbasin include the Yakama Nation, USDA Forest Service, Boise Cascade, Plum Creek Timber Co., U.S. Timberlands, Inc., Washington State Department of Natural Resources, Champion International, and Burlington Northern. The forestlands are also considered suitable for grazing, and many owners currently have active grazing allotments. Additionally, Washington Department of Fish and Wildlife

owns and manages tracts in the forested portion of the subbasin for wildlife, although Boise Cascade controls the timber rights to some of those tracts.

Located in the east-central portion of the Yakima River basin, the US Army Yakima Training Center (YTC) occupies primarily shrub-steppe habitat. YTC is located in Kittitas and Yakima counties, and is used primarily for mechanized and armored infantry training.

The Yakama Nation Reservation occupies the southern portion of the Yakima River basin, being primarily in Yakima County with a small portion extending into Klickitat County. Most of this land is tribally-owned, with only a small portion within the reservation being "deeded land." City and county ownerships within the reservation are on valley floors near population centers. Privately owned lands are primarily used for agriculture, housing, commerce and industry, and are generally situated in valleys and on foothill slopes, where irrigation and transportation are accessible.

The predominant types of land use in the Yakima River basin include irrigated agriculture (1,000 square miles), urbanization (50 square miles), timber harvesting (2,200 square miles) and grazing (2,900 square miles). Cropland accounts for about 16 percent of the total basin area, of which 77 percent is irrigated. Although the area affected by timber harvesting and grazing is roughly five times the area affected by agriculture and urbanization, the intensity of activity makes agriculture and urbanization of primary importance to water quality.

A change from row crops to hay in the Kittitas Valley has gradually occurred, and there has been a shift from row crops to permanent crops (such as grapes, apples and pears) in the lower valley. These changes affect the amount of water needed for irrigation, the methods of applying irrigation water, and the quality of water draining from fields and returning to the Yakima.

Mining, wilderness designation, and hydroelectric projects are minor land uses in the Yakima River basin. Floodplain gravel-mining remains an intensive use. About two-thirds of the floodplain mining in Washington State has occurred along the Yakima River or the lower reaches of two of its tributaries, the Cle Elum and Naches rivers. The Selah Pit and surrounding pits comprise the largest pit complex in the state, at more than 230 acres in 1986 (Collins, 1997).

An extensive transportation net has been constructed since Euro-American development began in the Yakima River basin in the 1860s. This network includes an expansive series of interstate freeways, highways, and secondary roads, a forest road system, and railroad lines. Road and railroad building in sensitive riparian and floodplain areas has severely altered channel structure and function and reduced habitat quality and quantity within the Yakima River basin, particularly in the heavily developed lowland areas (the mainstem Yakima River in the vicinity of the city of Yakima and much of Satus Creek). Road development has also substantially modified channel structure in the Naches and Little Naches rivers. By narrowing and straightening the channel, roads, dikes, and road

embankments increase stream velocities substantially, inhibit the establishment of vegetation, and increase fine sediment delivered to streams. Floodplain roads have played the dominant role in simplifying tributary channels and eliminating off-channel habitat.

There is an extensive network of forest roads throughout the Yakima River basin, and new construction, into remote areas, continues on private lands (particularly in the upper basin). This high road density contributes to high stream temperatures by increasing runoff and decreasing water storage potential. In addition, the development and poor locating of roads, railroads, and powerline corridors has disconnected and segmented alluvial floodplains and processes, increased instability and erosion in hill slopes and stream banks, confined and straightened the channels, degraded or destroyed riparian habitat, compacted soils, elevated peak flows in headwater streams, and increased weed infestations, sediment, and pollutant levels in streams.

FLOW

Surface Water

Historic Flow Patterns

The glacially-influenced topography of the upper Yakima River watershed, including the five major natural glacial lakes (Keechelus, Big Kachess and Little Kachess, Cle Elum, and Bumping), and the broad and relatively low-gradient valleys created by alpine glaciers in the upper reaches of all the major streams greatly moderated the rate of snowmelt runoff delivery to the lower elevation portions of the basin. The broad alluvial valleys, both along the mainstem Yakima River and many of its tributaries, and the floodplains of the lower Yakima River downstream of Benton City further attenuated flood flows and spring peaks in the mainstem.

Stanford and Snyder (2002) visualize the large alluvial valleys and floodplains as downwelling in the upper portions of the valley and upwelling at the lower ends as the surficial aquifer is near to the ground surface, feeding and driving the formation of springbrooks and side channels that occur in these locations. Conceptually, even under natural conditions, discharge at various points in the stream channel within a given valley varied according to valley position. High discharge was present at the upper end of the valley and then decreased. Water returns to the river at some point in the lower third of the valley resulted in increased discharge until the next natural constriction was reached. Due to fluctuations in the level of the surficial aquifer, during and after the recession of the spring peak flow, the outflow from a given alluvial basin would have caused the net discharge from the lower end of the valley to exceed the discharge at the upper end of the valley.

In the high-elevation tributaries that now feed the reservoir system, spring runoff peaks were in early- to mid-June; in late May in the north-facing tributaries of the Naches and upper Yakima rivers; mid-May in the south-facing tributaries; and mid- to early-May in the low elevation tributaries. Tributaries in the Kittitas Valley and the low elevation

tributaries flow across large alluvial fans where they discharge from the higher-elevation valley to the main valley. These relatively steep and porous fans created naturally low flows and less than ideal migratory conditions on the fans in the summer and fall. At the base of the fans, water discharged from a network of cool wetlands and springs that feed more characteristically stable summer base flows.

Current Flow Patterns

In many ways, management of flows in the river system is according to two different systems. In the mainstem, flows are managed by the Bureau of Reclamation, which contracts with the larger irrigation districts for delivery of water to the major agricultural areas of the basin. In the tributaries, flows are managed by diversion for the most part. Currently, the models that are in use to compare pre-settlement flows in the mainstem are based on the existing physical configuration of the watershed and do not take into consideration the presence of the glacial lakes or the loss of inflow from tributaries due to changes in flow. The purpose of the existing model is to manage the delivery of irrigation water and track the complex accounting of irrigation returns and travel times of reservoir releases in the current physical configuration of the basin, and not necessarily to model to a pre-determined standard of accuracy pre-settlement flows and flow patterns.

Mainstem Changes in Flow

There have been numerous physical changes to the natural conditions in the Yakima River basin. Among these changes, the most important on the mainstem are the conversion of the glacial lakes to storage reservoirs, conversion of McAllister Meadows from a glacial outwash valley to Rimrock Reservoir, construction of the diversion dams and associated irrigation-water delivery systems, confinement of the river upstream and downstream of the Yakima Canyon, and the digging of drains. In many areas drains were constructed to combat rising water tables driven by the increase in irrigation, in other areas they were dug to lower the natural water table to increase agricultural acreage on soils with high productive potential.

These changes have allowed the management or regulation of flow. The total amount of available storage controlled by the reservoirs is approximately one-third of the total annual runoff in the basin. Total irrigation diversion totals over 1.5 times annual runoff, indicating that. during the irrigation season, water is returned to the river and diverted again many times. Regulation seeks to maintain high flow in the mainstem river during the irrigation season (May to mid-October). Of special concern in flow management is “flip-flop,” in which the retention of waters in Rimrock Lake and (to a much lesser degree, Bumping Lake) until late in the irrigation season (early September) is followed by the release of waters from this lake to provide water needed to support the Wapato and Sunnyside diversions for the remainder of the irrigation season in order to mitigate disturbance to salmon redds in the upper Yakima River.

These changes have resulted in seven different flow regimes on the mainstem Yakima and Naches rivers:

- Natural Areas: tributaries above the storage reservoirs and on the unregulated American and Little Naches rivers. Flows reflect natural flow regimes.

- Flip-flop minor Effects: Bumping Dam downstream to the confluence of the Naches and Tieton rivers. Flows in the Bumping River are modified by flip-flop operations, but after its confluence with the American River, flows are relatively natural due to the small storage and release capacity of Bumping Lake in relation to the entire watershed area of the upper Naches River.

- Flip-flop Major Effects: confluence of Tieton and Naches rivers downstream to the confluence of the Naches River with the Yakima River. These reaches exhibit an almost inverted hydrograph, with greatly suppressed spring peak flow due to retention of waters in Rimrock Reservoir, an extended summer low-flow period, annual peak flows occurring in September and October when Rimrock provides the majority of downstream flows, and greatly depressed winter flows.

- Flip-flop Major Effects: upper Yakima River from the base of storage dams on Kachess, Keechelus, and Cle Elum reservoirs downstream to the confluence of the Naches River. The flow pattern of this reach exhibits a greatly extended spring peak lasting until early September due to release of stored water in the reservoirs, at which point flows are decreased and a minimum flow maintained throughout the fall and winter.

- Gap-to-Gap Reach: confluence of the Naches and Yakima rivers (Selah Gap) to Wapato Dam (Union Gap). This reach exhibits near bank-full flows maintained through the summer and fall to the end of the irrigation season, annual low-flow has been shifted from October to September, and winter low-flows are greatly depressed.

- Wapato Reach: Union Gap to Prosser Dam. The presence of two, major irrigation diversion dams (Wapato Dam and Sunnyside Dam) immediately downstream from Union Gap, has resulted in spring peak flows that are significantly reduced by diversion, with flows decreasing precipitously to summer low-flows that are both greatly lower and longer, and winter flows that are also significantly lower.

- Lower River: Prosser Dam to mouth. Flows in this reach exhibit a large reduction in average annual-flow due to export of irrigation water from the Yakima River basin to the mainstem Columbia River, resulting in reduced spring and winter flows, although the shape of the hydrograph may be the most similar to the historic hydrograph of any of the lower-river reaches.

Tributary Changes in Flow

In general, major changes in intra-annual flows have been the result of diversion for purposes of irrigation or stock water. The effects of changes in flow in the tributaries are similar to those in the mainstem. Riparian plant communities cannot successfully

reproduce under the altered and lengthened low-flow regime, or the greatly lengthened high-flow regime where creeks are used as conveyance. Shifting the spring peak-flow earlier in the year and reducing its magnitude may also hinder or prevent migration of some salmonid stocks such as the late portion of Steelhead spawning, and possibly the entire Spring chinook migration timing. Spring chinook are not presently found in the tributaries, although there is strong evidence that they used to exist in Toppenish and Ahtanum creeks.

Groundwater/Hyporheic

The Columbia River basalts, located within the Columbia Plateau, represent a locally important aquifer system including interbeds and overlying sediments. The overlying alluvial aquifers are highly permeable and are heterogeneous and anisotropic, due to their deposition within the fluvial environment where the processes of cut and fill alluviation by the Yakima River and tributaries occurred. The rocks of the Cascade Mountain province store and transmit little water via aquifer systems, and the majority of runoff occurs as overland flow.

In both the Cascade and Columbia Plateau regions, recent glacial activity and the network of tributary and main channel flow deposited large amounts of lacustrine and fluvial material in the valleys. This geologic template produced a series of groundwater basins separated by natural knick points (e.g., Selah and Union Gaps) and longer canyons (e.g., Yakima Canyon) (Kinnison and Sceva 1963). The Yakima River cuts through four large subbasins (Rosyln, Kittitas, Upper Yakima and Lower Yakima). This geological setting influences the hydrologic cycle.

Historically, the hydrologic cycle in each basin was characterized by extensive exchange between the surface, hyporheic, and groundwater zones (Kinnison and Sceva 1963; Ring and Watson 1999). This exchange would have occurred mainly in the vast alluvial valleys and floodplains, which would have functioned as hydrologic buffers, distributing the energy of peak flows and moving cool, spring melt-water out onto the floodplains. This inundation would annually recharge the shallow, surficial aquifers; a process that would occur potentially well into summer due to extensive and long-lasting snow pack in the Cascades (Ring and Watson, 1999).

Groundwater recharge of this nature would have provided a source of groundwater that would have maintained base flow and cooler thermal refugia as summer progressed and air temperatures increased, as well as maintaining warmer winter temperatures that would prevent or reduce the risk of anchor ice (Ring and Watson, 1999).

Reaches associated with alluvial floodplains have been shown to be centers of biological productivity and ecological diversity in gravel bed rivers (Stanford and Ward 1988; Independent Scientific Group 1996). In the Yakima basin, bedrock constrictions between alluvial subbasins control the exchange of water between streams and the aquifer system. Under pre-development conditions, vast alluvial floodplains were connected to complex webs of braids and distributary channels. These large hydrological buffers spread and diminished peak flows, promoting infiltration of cold water into the underlying gravels.

Side-channels and sloughs provided a large area of edge habitat and a variety of thermal and velocity regimes. For salmon and steelhead, these side-channel complexes increased productivity, carrying capacity, and life history diversity by providing suitable habitat for all freshwater life stages in close physical proximity.

At a large spatial scale, each of the Yakima subbasins is conceptualized as being downwelling, or losing surface water to the hyporheic and groundwater systems at the upstream end, and upwelling, or gaining surface water from the groundwater and hyporheic systems at the downstream end (for example, by Stanford and Ward 1988 and Tockner and Schiemer 1997). The hyporheic zone (zone of shallow groundwater made up of downwelling surface water) extended the functional width of the alluvial floodplain and hosted a microbe- and invertebrate-based food web that augmented the food base of the ecosystem. As snowmelt-generated runoff receded through the summer, cool groundwater discharge made up an increasing proportion of streamflow. Much of this groundwater upwelled from the gravel into complex channel networks upstream of bedrock constrictions.

Upwelling is driven by the decreasing size of the sedimentary aquifers, causing groundwater to move back into the river, tributaries and irrigation drains. Annual inundation and recharge also maintained the connectivity and flow of backwater, or spring-brook habitats. These habitats are critical for successful completion of the life-history cycles of numerous fish species and other biota (e.g., Morgan and Hinojosa 1996; Tockner and Schiemer 1997). Historic maps and photographs indicate that these types of habitats were much more abundant prior to anthropogenic alteration of the floodplain (archive, USBR Yakima Office, Morris Uebelacker, CWU, pers. comm.).

Channel Form

Five distinct channel provinces are very apparent along the altitudinal gradient from source to mouth; 1) high gradient, largely constrained headwaters, 2) expansive anastomosed or braided alluvial floodplains, 3) constrained canyons, 4) meandering with expansive floodplains containing oxbows, and 5) deltaic floodplain at the confluence with the Columbia River.

Irrigation

Six major reservoirs are located in the subbasin and form the storage component of the federal Yakima Project, managed by the Bureau of Reclamation. The Yakima River flows out of Keechelus Lake (157,800 acre feet), the Kachess River from Kachess Lake (239,000 acre feet), the Cle Elum River from Cle Elum Lake (436,900 acre feet), the Tieton from Rimrock Lake (198,000 acre feet) (the North Fork of the Tieton River connects Clear Lake (5,300 acre feet) with Rimrock Lake), and the Bumping from Bumping Lake (33,700 acre feet). All reservoirs, except Rimrock Lake, were natural lakes before impoundment. The non-federal Wenas Dam stores irrigation water for use in the lower Wenas Valley in the middle subbasin. Together, storage reservoirs capture approximately one-third of the annual basin-wide runoff. Storage volume equals 1.07 million-acre feet, which leaves an average of 3.86 million-acre feet of unregulated runoff annually (USBR 1983, 1999). Storage is insufficient to control all flooding. For

example, flood stage discharge at Umtanum Creek, in the Yakima Canyon, is estimated to occur on about a 5-year return interval (Chris Lynch, USBOR-YFO pers. comm.).

Six major, low-head diversion dams are on the mainstem Yakima, and several smaller dams are on the Naches (Figure 6). From uppermost to lowermost, the Yakima dams are Easton (RM 202.5), Roza (RM 127.9), Wapato (RM 106.6), Sunnyside (RM 103.8), Prosser (RM 47.1), and Horn Rapids (RM 18.0). The major dams on the Naches are Wapatox (RM 17.1) and Naches Cowiche (RM 3.6). Diversion dams are shown in Figure 6. Each of these diversion dams maintains screening structures that were installed in order to prevent upstream migration of adults or downstream entrainment by juvenile salmonids into the irrigation systems.

Groundwater recharge occurs via precipitation and from the application of irrigation water, the latter of which increases recharge over pre-irrigation times by about a factor of 10 (Tom Ring, pers. comm.). Kinnison and Sceva (1963) noted that water table elevations rose substantially during the onset of irrigation in the first half of the century. Because of this, drains often were cut to reduce high water tables and prevent the development of alkaline soils. Thus, the pattern of ground water recharge has been substantially altered with post-irrigation recharge following the seasonal patterns of irrigation. Historically, recharge would have occurred mainly in the winter and spring when evapotranspiration was low and precipitation was high. The result has been a reduction in the frequency, magnitude and duration of floodplain inundation because of reservoir storage. Thus, recharge of cold, spring-melt water into the aquifer systems has been replaced by recharge of warmer water derived from irrigation later in the spring and summer.

The diversions at Sunnyside and Wapato typically divert one-half of the entire river flow during the irrigation season, from May to October, while Prosser diverts 1400 cubic feet per second (cfs) most of the year, both for irrigation and power production. Because of regulation and withdrawals for irrigation, the Yakima River experiences periods of both dewatering and elevated flows relative to the historic discharge regime (Parker and Storey 1916; Vaccaro 1986a; Conservation Advisory Group 1997; SOAC 1999; USBR 1999). For example, at Union Gap and Parker, regulation has reduced annual discharge (mean based on data from 1926-77) from 4732 cfs to 3813 cfs at Union Gap and 2295 cfs at Parker (Vaccaro 1986a). Declines of this magnitude would significantly affect the processes of cut and fill avulsion that historically maintained habitat heterogeneity. Furthermore, the average annual 7-day minimum mean discharge at Parker for the same time period was 131 cfs (Vaccaro 1986a). Vaccaro (1986a) estimated that composite error of historic discharge estimates was 12% relative to the 21% change in discharge by regulation at Union Gap and the 52% change at Parker. At present, legislation calls for flows below Sunnyside and Prosser to range from 300 to 600 cfs, depending on the estimated supply of water.

SALMON HABITAT

Distribution

Salmonids are present in the Yakima River and its tributaries. Historically, the Yakima River supported substantial numbers of Spring, Summer, and Fall chinook, Coho, Sockeye, Summer steelhead, and Bull trout, as well as other resident salmonid species and non-salmonids. Currently, the Yakima River continues to provide a corridor for adult access to upstream habitats and juvenile migration downstream. Various portions of the river continue to provide spawning habitat and rearing habitat for different salmonid species, although, as to be expected, not all river segments provide all habitat needs for all species.

A wide variety of resident native and non-native trout, native resident fishes, and introduced resident fishes occupy the waters of the Yakima River. Game fish include the native Rainbow and Westslope cutthroat trout and the introduced Eastern brook and brown trout. Native rough fish include the Chiselmouth, Mountain whitefish, Northern pikeminnow, Mountain sucker, Redside shiner, Speckled dace, and Tui chub. Non-native rough fish include the Brown bullhead, Carp, Channel catfish, Crappie, Largemouth and Smallmouth bass, and Yellow perch.

Passage

There are four major irrigation diversion dams in the lower reaches of the Yakima River, two of which (Wapato Dam and Sunnyside Dam), lie in Yakima County, in the upper-Yakima Valley. The primary impacts to adult salmonids include passage delay due to bedload clogging of fish ladders and/or large woody debris snagged against ladder exits.

Occasionally, high September temperatures in the Yakima Valley reaches of the Yakima River delay entry of Steelhead spawners, and low flows below Sunnyside Dam in drought years might delay migrating Spring chinook. Conditions in the Yakima River are generally sufficient to enable Fall chinook to access the lower 1.5 miles of Marion Drain.

Water Quality

Washington Department of Ecology has rated the Yakima River from the confluence with the Cle Elum River (RM 299) to the mouth as having Class A, or “excellent” water quality (for detailed description, see Water Quality Standards for Surface Waters of the State of Washington, Chapter 173-201A), while the American, Bumping, upper Naches and upper Yakima rivers were classified as AA, or “exceptional.” However, there are some specific water quality parameters that do not conform to this classification. Seventy-two stream and river segments throughout the Yakima River basin have been placed on the 303(d) list of threatened and impaired water bodies by Washington Department of Ecology (Figure 5) (DOE 1996, candidate list for 1998, Federal Clean Water Act 1977).

Temperature

Of these listed segments, 83 percent were cited as exceeding temperature standards. Specifically, temperatures exceeded 70°F in Yakima River and tributaries from Columbia River confluence to Cle Elum River, and 61°F in the upper Yakima, American and Bumping rivers.

Numerous studies have cited temperature in the lower Yakima River, particularly below Prosser, as a serious barrier to migration and to completion of salmonid life histories (Lilga 1998; SOAC 1999; Conservation Advisory Group 1997; Vaccaro 1986b; Pearsons et al. 1996; USBR 1999). This is particularly true during the irrigation season, when temperatures are often stressful or lethal to salmonids (Lilga 1998; Lichatowich and Mobrand 1995; Lichatowich et al.1995; Fast et al. 1991). For example, Lilga found that temperatures in the lower river from June through November (1996) were lethal (>60°F) for salmon egg and fry incubation between 60 and 85 percent of the time. Temperatures are stressful for juveniles (>65°F) between 25 and 65 percent of the time and stressful for adults (>60°F) between 60 and 85 percent of the time. Lilga (1998) also examined the utility of using increased in-stream flows to decrease temperature in the lower river. She found that there was no relationship between mean daily summer stream temperature and flow, and that about 70% of the variation in water temperature was explained by air temperature. Several variables thought to influence in-stream temperatures were not measured as part of this study. These included subsurface flow from surficial aquifers, withdrawals, surface flow from tributaries and irrigation returns, channel morphology, variation in water velocity, upstream temperature conditions, solar insulation, and topographic and riparian shading effects (Lilga 1998). Because of these uncertainties, Lilga concluded that a numerical model needed to be implemented before an accurate assessment could be made of the relationship between in-stream flows and temperature.

In a similar study, Vaccaro (1986b) analyzed the effect of four different management scenarios on in-stream temperatures for the 1981 irrigation season. Scenarios ranged from estimated natural conditions (e.g., no storage, diversion or return flows) to various reductions in irrigation withdrawal and return flows (e.g., 50% reduction in all canals; 50% reduction in the major canals—hypothetically derived from increased irrigation efficiency). Interestingly, simulated natural conditions yielded higher in-stream temperatures in August, compared to any of the regulated scenarios. This is almost certainly a direct effect of hypolimnetic releases from four of the five storage reservoirs (all but Rimrock) (see also Vaccaro 1986b). Natural surface releases would have been relatively warmer as stratification occurred in the lakes as summer progressed. Vaccaro also found that although August temperatures were warmer, mean temperatures throughout the irrigation season were lower at Prosser and Kiona. Although many potential sources of error were noted, not included was the potential effect of groundwater inflow and the interaction between historical spring flooding and inundation of the alluvial aquifer with cool, spring melt-water (as previously discussed) (Ward 1985; Bansak 1998; Ring and Watson 1999).

An analysis of the lower basin in August 1997, using digital aerial thermography indicated that there are numerous sources of cooler water entering the system from many spring brooks and some tributaries (Holroyd 1998). Influx of relatively cooler ground water likely was much greater prior to regulation—potentially providing thermal refugia for biota, including outmigrating smolts and returning adult salmon (Ring and Watson 1999). Ring and Watson (1999) concluded that the natural ability of the alluvial floodplains to moderate in-stream temperatures has been seriously compromised because of the change in the natural flow regime (as discussed previously) and because of the significant alteration and disconnection of the floodplain.

Pesticides/Herbicides

Standards set for DDT and DDT byproducts (including, in most cases, PCB's and other pesticides and herbicides such as endosulfan, parathion, endrin, aldrin and dieldrin) were exceeded in 15 percent of the listed reaches. Six of these nine sites were located below the City of Yakima, and four of the nine were located in the Yakima River proper. In essence, longitudinal linkage within the river has led to a downstream increase in contamination, with specific point sources entering from Snipes, Spring, Sulphur, Wide Hollow and Cherry creeks, and Granger and Moxee drains.

Instream Flow

Instream flows were cited as exceeding standards set by the State in eight reaches, including the Yakima River near Toppenish and Horn Rapids, and Cowiche Creek.

Suspended Sediments

A sediment budget also was constructed for the lower Yakima, because of the link between TSS and DDT (Joy and Patterson 1997). Results indicated that in 1995, inputs from tributary and irrigation returns contributed a significant quantity of the sediment load for the river. For example, Moxee Drain contributed 35 tons/day in the latter part of the irrigation season, while the Naches River contributed only 27 tons/day, even though discharge in the Naches was 14 times greater than Moxee Drain.

SHORELINE JURISDICTION BREAKS

Yakima County contains eighteen sub basins (Ahtanum Creek, Burbank, Cowiche Creek, Granger, Hanford, Lower Naches, Mabton- Prosser, Moxee, Roza Creek, Satus Creek, Selah, Sunnyside, Tieton, Toppenish, Umtanum Creek, Upper Naches, Wenas Creek, and Wide Hollow), fifteen of which contain creeks or rivers designated as Shoreline Management Program(SMP) Streams (Fig. 1). Eight SMP streams flow through or along these fifteen sub basins.

Jurisdictional boundaries were obtained from Yakima County, based on a county definition of "wetlands" (i.e. shorelands), pursuant to the authority of RCW 90.58.030(f) and WAC 173-22-040(2) and subject to county regulations, which are as follows:

a) Subject to Subsection d below, wherever the "floodway" has been established by a

flood hazard study prepared by the Federal Insurance Administration, shorelines jurisdiction shall be the floodway plus 200 feet, measured on a horizontal plane, or the lO0-year floodplain, whichever is lesser.

b) Subject to Subsection d below, whenever the l00-year floodplain has been identified by a flood hazard study prepared by the U. S. Corps of Engineers but where no "floodway" has been identified, shorelines jurisdiction shall be the l00-year floodplain boundary or 200 feet, measured in a horizontal plane, from the ordinary high water mark, whichever is greater.

c) Whenever there are no detailed floodplain or floodway studies from either the Federal Insurance Administration or the Corps of Engineers, shorelines jurisdiction shall be 200 feet, measured on a horizontal plane, from the ordinary high water mark.

d) Under no circumstances shall shorelines jurisdiction be less than 200 feet, measured on a horizontal plane, from the ordinary high water mark.

To categorize distinct reaches of the county's shorelines for characterization, the shoreline jurisdiction was classified into forty preliminary reaches based on biophysical characteristics, as well as general land uses. Tables in each subbasin analysis indicate the location of shoreline segments, as well as the justification for breaks between reaches.

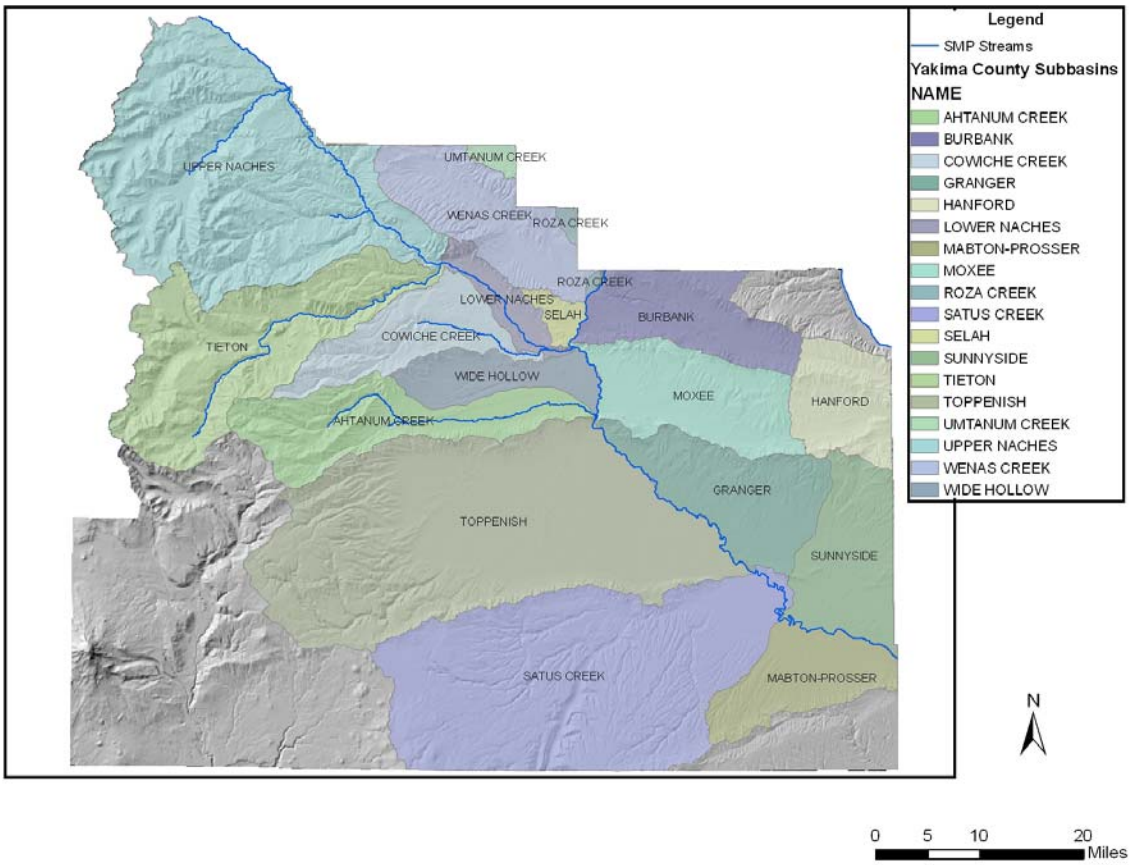

Fig. 1. SMP streams and subbasins in Yakima County.