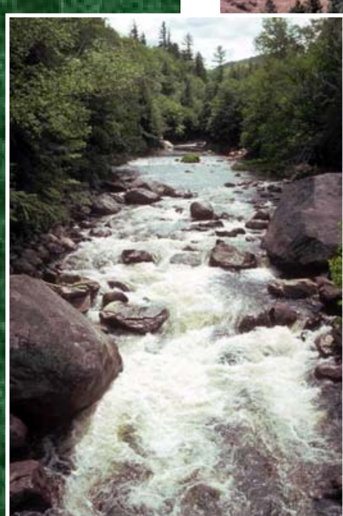
Watershed Management Plan
Yakima River Basin

Yakima River Basin
Watershed Planning Unit

and

Tri-County Water Resources Agency





January 2003

Prepared by Economic and Engineering Services, Inc.
in Association with
Montgomery Water Group, Inc.
R.C. Bain & Associates
and
McKenzie Consulting

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Funded by Grant No. G9800288 and G0200298, provided by Washington State Department of Ecology under the Watershed Management Act, RCW 90.82.

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Acronyms and Abbreviations

af	acre foot
afy	acre-feet per year
ASR	aquifer storage and recovery
BIA	Bureau of Indian Affairs
BOD	biochemical oxygen demand
CA	Coordinating Agency
CAFO	confined animal feeding operation
CC	Conservation Commission
CD	Conservation Districts
cfs	cubic feet per second
CHD	County Health Department
CNTY	Counties
CPD	County Planning Department
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CWA	Clean Water Act
DFW	Washington State Department of Fish and Wildlife
DNR	Washington State Department of Natural Resources
DO	Dissolved oxygen
DOH	Washington State Department of Health
DOT	Washington State Department of Transportation
Ecology	Washington State Department of Ecology
EDT	ecosystem diagnosis and treatment
EES	Economic and Engineering Services, Inc.
EIS	Environmental Impact Statement
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
ESHB	Enhanced Substitute House Bill
ESU	evolutionary significant unit
GIS	Geographic Information Systems
GPS	global positioning system
IAC	Interagency Council
ID	Irrigation Districts
IDKCCD	Kittitas County Conservation District
IND	Industry
KCWP	Kittitas County Water Purveyors
KID	Kennewick Irrigation District
KRD	Kittitas Reclamation District
Landowners	individual landowners, local water purveyors
LHFA	limiting habitat factors analysis
MAF	million acre feet

M&I	municipal and industrial
MOA	Memorandum of Agreement
MWG	Montgomery Water Group
NAWQA	National Water Quality Assessment
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
O&M	Operation and Maintenance
pfc	properly functioning condition
PP&L	Pacific Power and Light Company
PSA	public service announcement
PTC	private timber companies
PWS	Public Water Systems
QA	Quality Assurance
QC	Quality Control
RCW	Revised Code of Washington
SEPA	State Environmental Policy Act
SOAC	Systems Operations Advisory Committee
SRFB	State Salmon Recovery Fund Board
TCWRA	Tri-County Water Resource Agency
TMDLs	Total Maximum Daily Loads
TWSA	Total Water Supply Available
USBR	United States Bureau of Reclamation
USDA	U.S. Department of Agricultural
USGS	United States Geological Survey
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
WCC	Washington State Conservation Commission
WCD	County Water Conservancy Boards
WD	Water Districts
WDOA	Washington State Department of Agriculture
WIP	Wapato Irrigation District
WMA	Watershed Management Act
WQA	Water Quality Act
WRAC	Water Resources Advisory Committee
WSU	Washington State University
WSUCE	Washington State University Cooperative Extension
YN	Yakama Nation
YRB	Yakima River Basin
YRBWEP	Yakima River Basin Water Enhancement Project

Executive Summary

Executive Summary

The Watershed Plan provides a "road map" developed under local leadership.

The Yakima River Basin Watershed Planning Unit was formed in 1998 to develop a comprehensive watershed management plan for the Yakima River Basin. The Planning Unit represents local governments, citizens and landowners, irrigation districts, conservation districts, State agencies and others. With assistance from the Tri-County Water Resources Agency (TCWRA), the Planning Unit is pleased to present this Watershed Management Plan for the Yakima River Basin. The Watershed Plan provides a "road map" for maintaining and improving the Basin's economic base, planning responsibly for expected growth in population, managing water resources for the long-term, and protecting the Basin's natural resources and fish runs.

This Watershed Plan was developed under local leadership, using a grant from the State of Washington under the provisions of the Watershed Management Act (Chapter 90.82 RCW). During the four year period for Plan development, landowners, local governments, the Yakama Nation and state and federal agencies have continued to work on improving watershed conditions throughout the Yakima Basin. This planning process provides additional support and focus for many of these ongoing activities.

The Plan covers the entire Yakima Basin (Exhibit ES-1), with the exception of the Yakama Nation Reservation. As requested by the Yakama Nation, the Planning Unit has refrained from planning with respect to the Reservation. In regards to the remainder of the Basin, the primary emphasis of this planning process has been on the mainstem Yakima and Naches River Systems, where water users rely heavily on the federal Yakima Irrigation Project. Tributary subbasins are treated in less detail, and may benefit from additional planning efforts in the future, guided by local residents and their elected officials.

Objectives for Water Resources Management in the Yakima Basin

The Yakima River Basin Watershed Planning Unit identified seven goals.

The Yakima River Basin Watershed Planning Unit identified seven goals for balanced management of water resources in the Yakima Basin. These are:

- ❑ Improve the reliability of surface water supply for irrigation use;

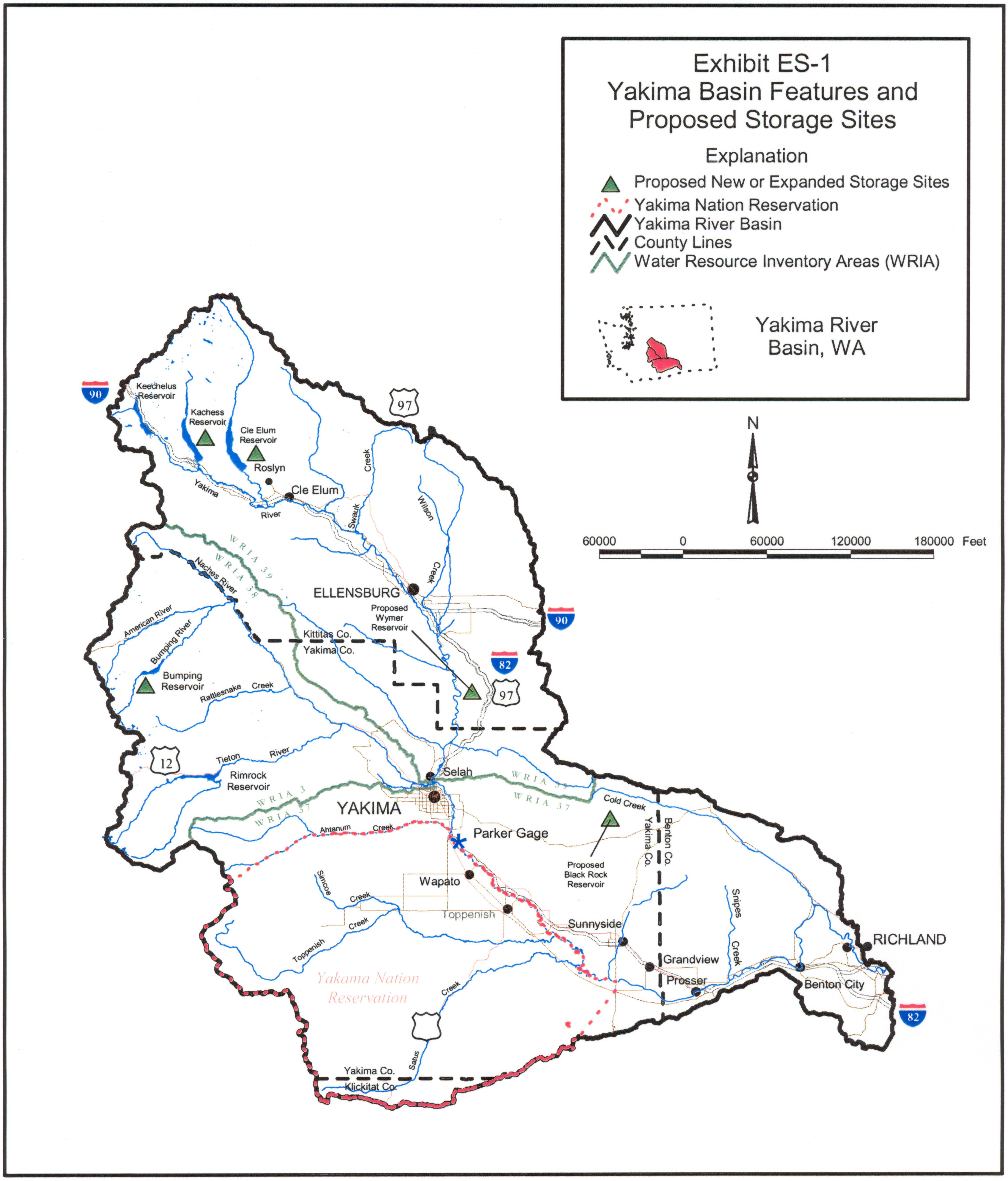
Exhibit ES-1
Yakima Basin Features and
Proposed Storage Sites
Explanation
Proposed New or Expanded Storage Sites
Yakima Nation Reservation
Yakima River Basin
County Lines
Water Resource Inventory Areas (WRIA)
Yakima River
Basin, WA
N
60000 0 60000 120000 180000 Feet
Keechelus Reservoir
Kachess Reservoir
Cle Elum Reservoir
Roslyn
Cle Elum
Yakima River
Swauk Creek
Wilson Creek
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Naches River
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Proposed Wymer Reservoir
American River
Bumping River
Bumping Reservoir
Kittitas Co.
Yakima Co.
Rattlesnake Creek
Tieton River
Rimrock Reservoir
Selah
YAKIMA
Ahtanum Creek
Parker Gage
Cold Creek
Proposed Black Rock Reservoir
Benton Co.
Yakima Co.
Wapato
Toppenish
Simcoe Creek
Toppenish Creek
Sunnyside
Grandview
Prosser
Snipes Creek
RICHLAND
Benton City
Yakama Nation Reservation
Satus Creek
Yakima Co.
Klickitat Co.
90
97
82
12
WRIA 37

- Provide for growth in municipal, rural domestic and industrial demand;
- Improve instream flows for all uses with emphasis on improving fish habitat;
- Maintain properly functioning habitat and enhance degraded habitat;
- Protect, improve and sustain ground water quantity and pumping levels of aquifers for the benefit of current and future use;
- Protect surface and ground water from contamination;
- Maintain economic prosperity by providing an adequate water supply for all uses.

The actions recommended were selected to ensure all seven objectives are addressed.

The actions considered and recommended by the Planning Unit were carefully selected to ensure all of these seven objectives are addressed as a joint program.

Water Supply and Flow Management

The Planning Unit recommends a strategy for surface water management and a strategy for ground water management.

Surface Water Management

Most of the water used in the agricultural sector within the Yakima Basin comes from surface water resources. The Yakima Irrigation Project, managed by the federal Bureau of Reclamation, provides the largest share of surface water to farmers in areas served by the mainstem Yakima and Naches River systems, and also provides water to the City of Yakima and some other uses. The mainstem system is the primary focus of the surface water management section of this Plan. Managing this system to provide adequate and reliable water supplies and to provide stream flows needed by fish species presents an on-going challenge.

The Watershed Planning Unit identified two key issues with respect to surface water: reliability of supply and stream flow.

These two issues are closely related, and managing them jointly presents a key challenge for the Yakima Basin. To meet this challenge, the Planning Unit identified and reviewed three alternative approaches to managing surface water resources. These included reliance on water-use efficiency and transfers, medium storage enhancement, and major storage enhancement.

Only a major enhancement of the Basin's water storage capacity can offer the needed improvements in water supply reliability, while simultaneously permitting significant improvements in stream flow management.

The Planning Unit recommends Alternative I-1, "Major Storage Enhancement, with Targeted Improvements in Water Use Efficiency and Additional Actions." Only a major enhancement of the Basin's water storage capacity can offer the needed improvements in water supply reliability, while simultaneously permitting significant improvements in stream flow management. Potential environmental impacts associated with storage enhancement are very reasonable, in comparison with the benefits. Storage sites are available that are either offstream or involve enlargement of facilities at existing storage sites. Therefore, enhancement of the Basin's storage capacity will not involve new blockage of salmon runs. Under this Alternative, stored water should not be used to expand irrigation beyond those lands already entitled to water from the Yakima Irrigation Project.

Substantial investment in infrastructure is needed to provide significant, long term benefits for the region's residents, the regional and state economy, and endangered fish.

The major storage alternative will be expensive, with estimates ranging from $1.07 billion to $2.58 billion, depending on the mix of projects involved. However, the Planning Unit believes that substantial investment in the Basin's water resources infrastructure is needed to provide significant, long term benefits for the region's residents, the regional and state economy, and endangered fish. A critical element in implementing this approach will be seeking the necessary funding, from a combination of federal, state and local sources.

A number of individual storage projects were identified that could be combined in implementing the recommended alternative. Projects that have been proposed at various times include Black Rock Reservoir, Wymer Reservoir, enlargement of the existing Bumping Lake, and modifications to existing facilities at Kachess and Cle Elum Lakes. The costs and benefits vary for these different projects. The Planning Unit does not intend to select or recommend any one project site. Further work will be needed by the various organizations involved in moving forward on storage initiatives, to refine information on the feasibility, permitting, cost, funding sources and other factors.

The preferred alternative is consistent with, and supportive of YRBWEP.

With regard to water use efficiency, transfers, and other surface water management actions, the preferred alternative is intended to be consistent with, and supportive of the federal Yakima River Basin Water Enhancement Project (YRBWEP). The preferred alternative includes extensive modifications to irrigation systems to improve water use efficiency and reduce diversions. However, as shown by the analysis in this Plan document, the water-use efficiency measures and other provisions of YRBWEP cannot by themselves meet the challenge of improving water supply reliability and instream flows simultaneously. To do this, additional storage capacity is also needed.

Because of its lead role in managing storage projects and funding water-use efficiency under YRBWEP, the Bureau of Reclamation will be a major partner with local governments and irrigation districts in implementing the recommended alternative.

The State of Washington, through its respective agencies, should also work collaboratively with the other involved parties to help focus and carry out the recommended alternative. Governor Gary Locke has indicated support for enhanced storage in the Yakima Basin on several occasions. Focused State support, coordinated across agencies, will be essential in carrying through the recommended alternative.

At the outset of the watershed planning process, the Initiating Governments (TCWRA) determined that the plan would not involve recommending minimum instream flows be adopted into State law. The primary reason was that target flows established by the U.S. Congress under YRBWEP were already in place for the mainstem system, and are used in operating the Bureau of Reclamation facilities.

This decision was revisited periodically during the planning process. In response to the availability of new funding ($300,000) for setting instream flows in year 2001, the TCWRA and Planning Unit again considered this issue. It was deemed that the amount of funding available and the time frame required by the State (completion concurrent with completion of this Watershed Plan) were inadequate to enter into this arena. The original decision was therefore confirmed.

Ground Water Management

Although the largest quantities of water used in the Yakima Basin are from surface sources, ground water is a key source of supply for many municipal, industrial and domestic uses. In addition, ground water serves as either a primary or supplemental supply for irrigation in many areas, and is particularly important in some tributary subbasins that do not have access to the mainstem Yakima Irrigation Project. Ground water and surface water resources may be interconnected in some locations, which gives rise to management challenges.

At this time a major study of the ground water systems of the Yakima Basin is underway, under the terms of a Memorandum of Agreement among Ecology, the Bureau of Reclamation and the Yakama Nation. The U.S. Geological Survey (USGS) is carrying out this study, which is expected to be completed in year 2007.

Ground water alternatives address issuance of new water rights only. Existing water rights are not affected.

The Watershed Planning Unit recognizes that detailed planning for ground water would be premature prior to completion of the USGS study. Therefore the alternatives defined and evaluated for management of ground water resources are very general at this time, and focus on providing policy direction for management of ground water after the USGS study is completed. The Planning Unit defined four alternative approaches to managing ground water resources. These alternatives address issuance of new water rights only. Existing water rights are not affected and will continue to be covered under the provisions of existing State law. The alternatives range from extensive development of new ground water supplies to prohibition on development of new supplies.

Alternative II-2 strikes an appropriate balance between the need for water supply, the need to protect the Basin's ground water resources, and the need to manage stream flows.

The Planning Unit recommends Alternative II-2, "Limit New Ground Water Development to Selected Uses," as the preferred alternative. This alternative strikes an appropriate balance between the need for water supply the need to protect the Basin's ground water resources for long-term, sustainable uses, and the need to manage stream flows in those areas where surface and ground waters are interconnected.

Ground water alone cannot meet the Planning Unit's objectives. Enhancement of surface water storage is also needed.

Ground water alone cannot meet the Planning Unit's objectives with regard to water supply and economic prosperity. Therefore, this recommendation is made with the recognition that enhancement of surface water storage is also needed (see above).

In areas served by the Yakima Irrigation Project the Planning Unit identifies a preference for meeting the need for agricultural irrigation from surface water supplies while reserving new development of ground water for other uses, including but not limited to growth in municipal, industrial and domestic needs[1]. There are two main reasons for this recommendation. First, water needed for these purposes must be of high quality, and treatment to meet state and federal drinking water standards is typically more costly for surface water than for ground water. Second, the quantities required for municipal, industrial and domestic uses are small in comparison with agricultural needs. Since the Basin's aquifers may be subject to depletion if over-pumped, reserving ground water for these purposes can contribute to long-term viability of the ground water resource.

Conditions in tributary subbasins without access to Yakima Irrigation Project water are different, and separate criteria will need to be developed locally, to fit local needs for new supplies in these areas.

The most likely means of implementing this alternative would be adoption of rules by the Department of Ecology defining the criteria for issuance of new ground water rights. Any rules adopted should specifically identify the areas where differing criteria will apply, since these criteria will be different for areas with access to Yakima Irrigation Project water, compared with tributary subbasins. Due to Ecology's obligations under the Memorandum of Agreement discussed above, this approach cannot be fully developed or implemented until the USGS study of Yakima Basin ground water resources is completed (i.e. after 2007).

The recommended alternative also includes management techniques to prevent long term declines in ground water levels.

The recommended alternative also includes management techniques to prevent long term declines in ground water levels. This includes data collection and management; attention to water-use efficiency; enforcement action against unauthorized uses; use of voluntary water rights transfers; and avoidance of pumping practices that would deplete aquifers over the long term.

Environmental Enhancement (Non-Flow Elements)

This Plan also addresses additional environmental enhancement actions. Key topics in this regard include surface water quality, ground water quality, and fish habitat conditions. For these topics, "alternatives" were not defined as

[1] Other uses, such as stock watering, dairies, frost protection, and environmental uses also need attention.

for water supply and flow management (see above). This is because the various actions described for improvement of water quality and fish habitat generally are not mutually exclusive. Instead, a comprehensive environmental enhancement program can consist of many interrelated actions. The ability to carry out these actions depends largely on the availability of funding, staffing and other resources.

Surface Water Quality Strategy

The Planning Unit identified a wide range of actions related to improvement of surface water quality. Collectively, these address forest practices; impacts from agriculture; municipal and industrial stormwater management; gravel mining; impacts of recreation sites; wastewater treatment plants; and management of water storage facilities and ground water. In addition, the Surface Water Quality Strategy identifies actions involving coordination of agencies engaged in water quality activities; improving the information base for water quality decisions; and addressing water-quality standards to ensure they reflect natural background conditions.

The Planning Unit identified six priority actions for surface water quality.

Within this overall context, the Planning Unit identified six priority actions for surface water quality:

- Improve irrigation management;
- Improve crop land management;
- Address livestock impacts;
- Improve interagency coordination;
- Improve understanding of water-quality cause-and-effect relationships; and,
- Expand water-quality monitoring activities.

The Planning Unit recommends that the Surface Water Quality Strategy be used by local governments, private sector organizations, and State agencies as they propose and fund activities to improve water quality.

Management of Ground Water Quality

As noted above, many communities in the Yakima Basin rely on ground water for their drinking water supplies. In general, the large and medium-sized public water systems have the ability to adequately manage and protect ground water quality as it pertains to their supplies. However, small water systems and individual households more susceptible to problems from ground water contamination. Therefore, the Watershed Plan emphasizes protection of ground water supplies located outside the service areas of large water systems.

Six management objectives were identified for ground water quality.

Six management objectives were identified, with specific actions listed under each one. The six objectives are:

1. Improve public understanding and awareness of issues related to drinking water quality;
2. Assess susceptibility of ground water supplies to contamination on a regional basis;
3. Improve ability to detect and monitor impacts to ground water supplies;
4. Improve local wellhead protection programs;
5. Minimize impacts of land use activities on ground water supplies; and,
6. Clean up sources of ground water contamination.

Assuming limited resources will be available to fully implement the ground water quality strategy Objectives 1 and 2 were assigned the highest priority; Objectives 3 and 4 have a medium priority; and Objectives 5 and 6 have the lowest priority. The lead implementer of the ground water strategy is envisioned to be local health districts in each county, subject to their funding resources, staff availability, and competing priorities involving public health.

Fish Habitat Enhancement

Five objectives for protection and enhancement of fish habitat were identified.

The Planning Unit developed a fish habitat enhancement strategy providing a prioritized approach and list of actions for consideration by the Yakima Basin Lead Entity for salmon recovery and by local governments, state agencies and other organizations as they propose and fund habitat-related activities. Five objectives for protection and enhancement of fish habitat were identified in the following priority order:

1. Protect existing high-quality aquatic environments;
2. Protect and enhance fish migration corridors;
3. Enhance downstream reaches and connect associated floodplains in tributary and mainstem reaches to benefit fish production;

4. Prioritize enhancement of damaged aquatic habitats that are still functional; and,
5. Protect existing habitat conditions from further degradation.

In addition, three programmatic objectives were identified, without assignment of priorities:

- Improve watershed-wide information base;
- Focus on habitat condition to measure the effectiveness of habitat enhancement actions; and,
- Ensure water quality and habitat standards reflect natural regional conditions.

A range of specific actions were identified to contribute towards each of these eight objectives.

This habitat strategy can be integrated with project review undertaken by the local Lead Entity for salmon recovery.

The watershed plan provides an implementation framework describing how this habitat strategy can be integrated with project review undertaken by the local Lead Entity for salmon recovery, and with local and state regulatory and non-regulatory programs.

Framework for Plan Implementation

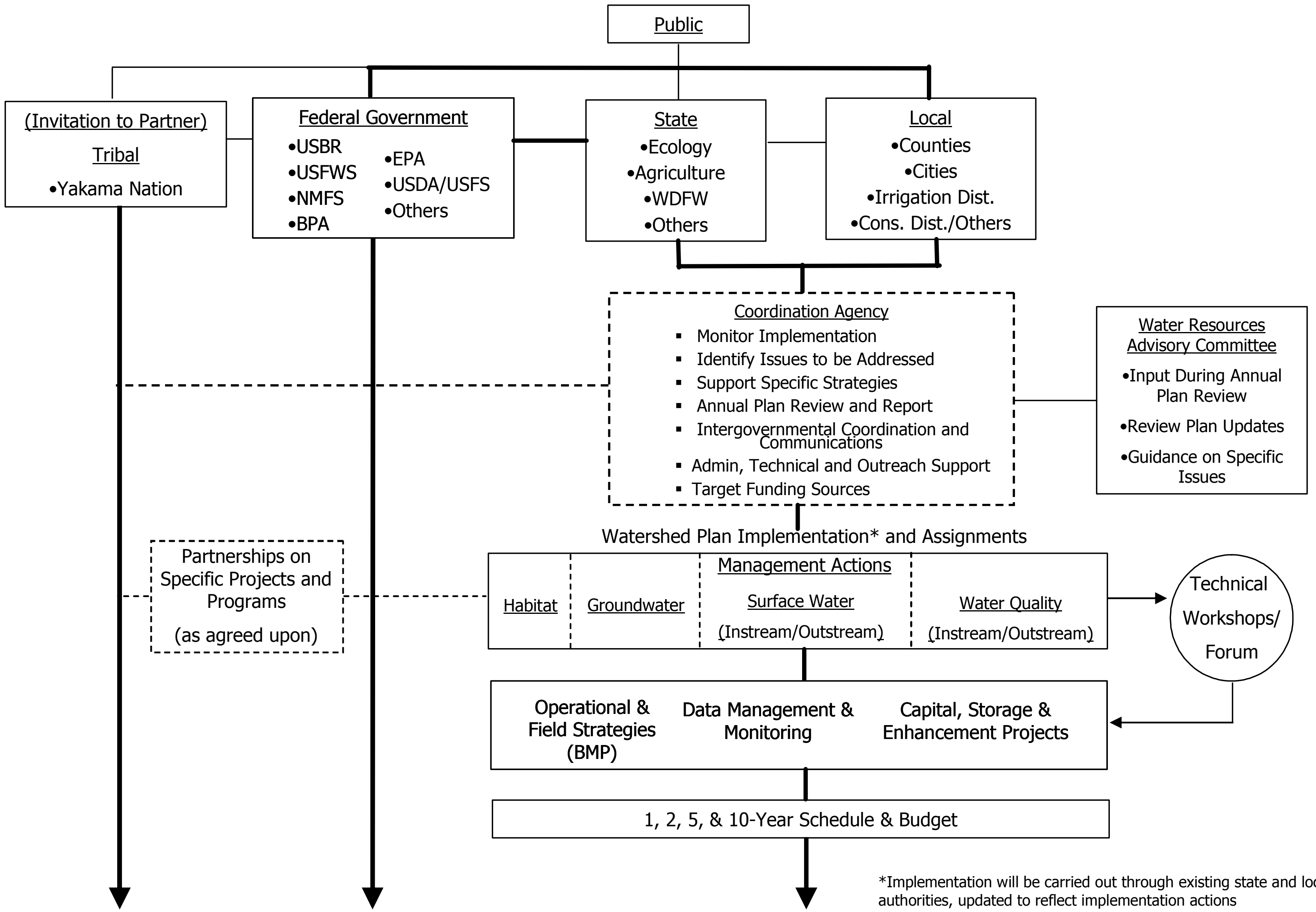
One of the key aspects of the Watershed Planning process is local leadership, and this aspect should be continued throughout the implementation phase.

The Yakima River Basin Watershed Planning Unit was formed expressly for the purpose of developing this Watershed Plan. The Planning Unit itself has no authority in State law to carry out the Plan provisions, but will rely instead on its member organizations and others to carry out the Plan. These include local governments, special districts, state and federal agencies, and citizens and landowners throughout the Yakima Basin. One of the key aspects of the Watershed Planning process is local leadership, and this aspect should be continued throughout the implementation phase. Exhibit ES-2 presents a proposed framework for intergovernmental coordination.

The Planning Unit accepts that any strategies, actions, obligations or potential obligations assigned to local, state or federal agencies, and tribes if they participate in plan implementation in the future are directly associated with securing necessary funding, resources, and legislative authorizations where required, and are subject to applicable rules and regulations, the Administrative Procedures Act and SEPA and NEPA requirements.

Exhibit ES-2

Conceptual Framework for Intergovernmental Coordination



*Implementation will be carried out through existing state and local authorities, updated to reflect implementation actions

Plan implementation will also depend in large measure on effective cooperative relationships with the federal government and Yakama Nation. A program for integrating the Plan provisions with federal and tribal activities will need to be developed as part of the implementation process.

Some means of coordination is needed. The Planning Unit proposes a locally-based "Coordination Agency."

Because Plan implementation will necessarily involve many different organizations, some means of coordination is needed to ensure the Plan yields real results. The Planning Unit proposes that a locally-based "Coordination Agency" be designated to coordinate implementation actions. This role could be performed by the existing Tri-County Water Resources Agency (TCWRA). However, it is also possible that another existing organization could provide this coordination activity; or that a new organization could be formed for this purpose. For any of these options, annual funding will be needed, on the order of $50,000 to $200,000. At this time, the source of this funding has not been determined. At the statewide level, a committee on implementation of watershed plans recently recommended that the state provide matching grants for this purpose, but action by the Legislature will be needed before it is known whether State funding will be available.

It is suggested that a "Water Resources Advisory Committee" also be formed to assist during the implementation process.

It is suggested that a "Water Resources Advisory Committee" also be formed to assist during the implementation process. The existing Planning Unit can be transformed and reorganized to fulfill this need, providing ongoing guidance and stakeholder input as the Plan is implemented. This can include State agencies in an advisory role, perhaps through the existing State Caucus established in support of the Watershed Plan process.

This Plan identifies specific implementation responsibilities that could be carried out by a wide range of organizations, if they agree to do so. This Plan does not mandate these responsibilities, nor could it do so under State law. Therefore, Plan implementation depends entirely on whether the organizations indicated agree to follow through with the recommended actions. The Plan provisions have been designed with flexibility in mind, and with the recognition that implementing organizations cannot carry out actions unless they have (or can obtain) financial and staff resources to do so. It is also recognized that other constraints exist, such as legislative authorizations, rule making, and ordinance development that may effect the implementation of different strategies and actions.

"Lead responsibilities" are proposed in this Plan for nine organizations. Appropriate management or elected decisionmakers for each of these organizations should review the proposed responsibilities and determine whether they are willing to carry them out.

Table ES-1 lists the "lead responsibilities" proposed in this Plan for nine organizations. Chapter 8 also provides more detail about the technical and process aspects for each of the actions listed in Table ES-1. The full Plan lists additional proposed responsibilities for each of these organizations, which would be in a supporting capacity, rather than a lead capacity (see Chapter 8), and also identifies supporting responsibilities for other organizations not listed here.

It is suggested that the appropriate management or elected decisionmakers for each of these organizations review the proposed responsibilities and determine whether they are willing to accept them. For those actions that are accepted, it is suggested that a formal recognition of the responsibilities that are accepted be provided by each organization. It is also suggested that the formal response recognize applicable conditions, limitations, and constraints associated with each responsibility. Such commitments may be expressed through a variety of means, ranging from verbal commitments and letters of support; to binding agreements or contracts. It is recognized that the formal commitments to accept implementation responsibilities by Counties and State agencies become final when the Yakima Basin Watershed Plan is adopted by the Counties in accordance with RCW 90.82.130.

Exhibit ES-3 provides a proposed schedule for initiating and carrying out the implementation of this Watershed Plan

Plan Approval Process

The Planning Unit recommends this plan for approval by Benton, Kittitas and Yakima Counties.

In accordance with the Watershed Management Act, the Planning Unit recommends this plan for approval by Benton, Kittitas and Yakima Counties. The Plan will be submitted to the three Counties for their consideration, including a public hearing process and a joint session of the three County Commissions. This approval process is required under the Watershed Management Act. For more information, see Chapter 90.82.130 RCW.

Table ES-1
Proposed Lead Responsibilities for Selected Organizations(1)

Implementing Organization	Actions
Coordination Agency	• Intergovernmental Coordination and Communications • Pursue Additional Funding • Monitor Plan Implementation • Information Clearinghouse • Support Specific Strategies • Identify Issues/Barriers to be Addressed • Targeted Public Outreach • Prepare Annual Progress Report • Coordinate Watershed Plan Updates • Administrative Support
Counties	• Plan Adoption • Establish Coordination Agency and Water Resources Advisory Committee • Update land use regulations to protect headwaters, improve off-channel connectivity, and improve management of riparian areas consistent with Habitat Strategy • Co-lead with Cities to support service expansion by public water systems within urban growth areas to replace exempt well use • Manage stormwater in unincorporated areas consistent with surface water quality strategy • Develop detailed ground water quality management strategies, focused on public awareness and susceptibility assessment • Hold County Workshop(s) to develop more detailed habitat enhancement strategies at the county or subbasin level
Cities	• Define specific ground water management actions consistent with overall objectives of watershed plan. Address elements such as water-use efficiency, transfers, expanded service by public water systems within urban growth areas to replace exempt well use, etc. • Manage wellhead protection areas • Cities periodically review reuse opportunities during utility plan updates projects • Manage stormwater in incorporated areas consistent with surface water quality strategy • Update land use regulations to improve off-channel connectivity, and improve management of riparian areas consistent with Habitat Strategy

Notes:
1. See Tables 8-1 and 8-2 for additional detail.

Table ES-1 (cont)
Proposed Lead Responsibilities for Selected Organizations[1]

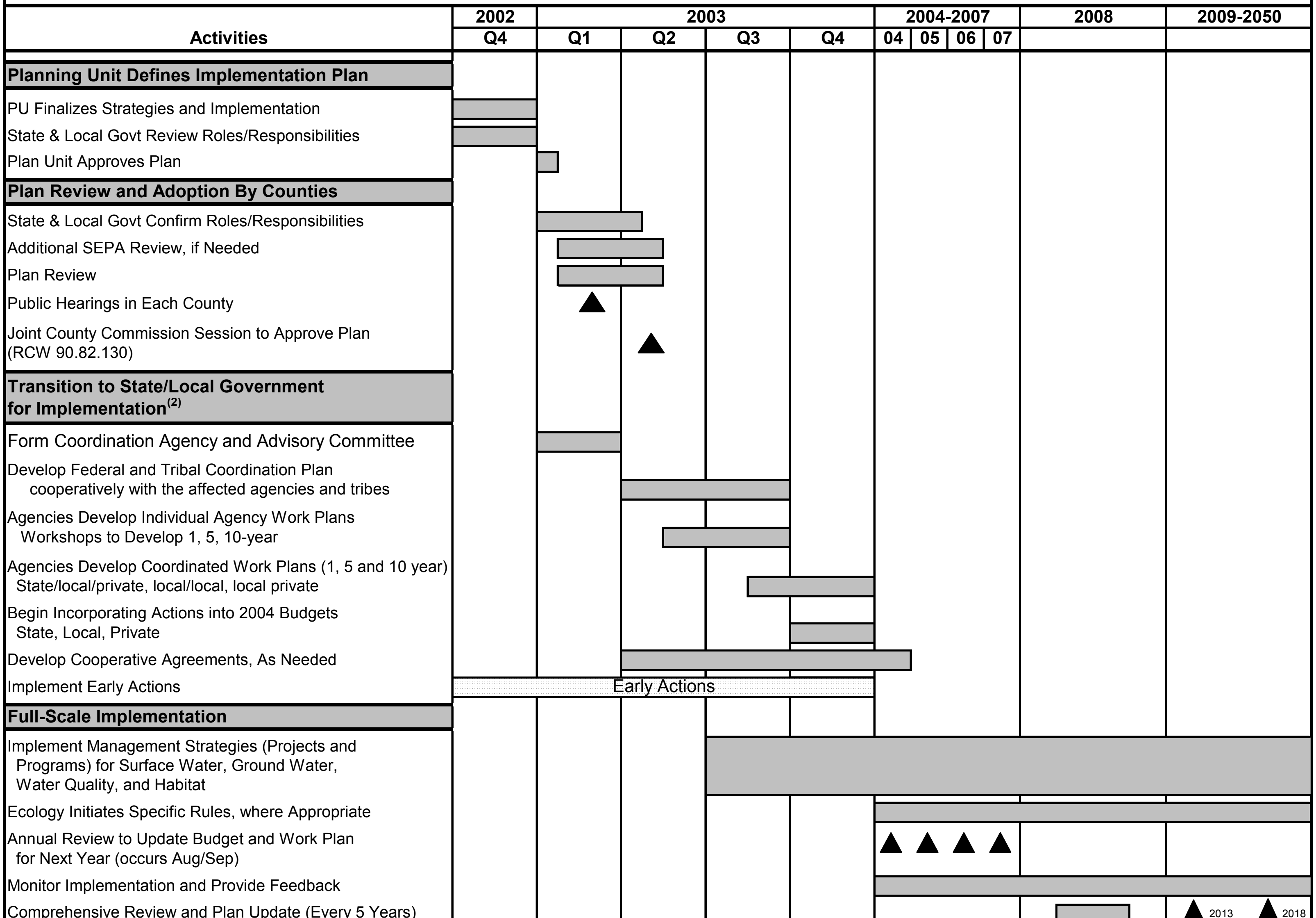
Implementing Organization	Actions
Ecology	• Work with local water users and affected groups to establish formal program for issuance of new ground water rights in Yakima Basin, consistent with Watershed Plan, Alternative II-2 (Selective Restrictions on New Ground Water Development) • Develop and implement TMDLs for water quality parameters • Refine water quality criteria for temperature • Process water right transfer/change applications in a timely manner (in cooperation with county water conservancy boards) • Track progress of USGS Study and provide input to its application and associated policy decisions. Support local governments in tracking this process • Seek funding for a study to better define background turbidity levels • Administer other permitting processes and programs consistent with water quality and habitat strategies • Work with responsible parties to clean up sources of groundwater contamination
Irrigation Districts	• Work with USBR to implement water use efficiency projects, including establish agreements, and design and construction • Identify projects and seek funding for habitat and water quality enhancement actions
Conservation Districts	• Work with landowners to implement BMPs and projects that improve irrigation and cropland management, and reduce livestock impacts consistent with water quality and habitat strategies • Identify projects and seek funding for habitat and water quality enhancement actions
US Bureau of Reclamation	• Seek authorization and funding from Congress to conduct feasibility studies, prepare environmental review, obtain permits (including ESA Section 7 consultation) and design and construct recommended storage project(s), consistent with recommended surface water strategy, Alternative I-1. • Review existing flow management regime, identify opportunities to enhance instream flows for fish and implement where possible • Continue working with irrigation districts to implement water use efficiency projects through agreements, funding and other actions
Washington Department of Fish and Wildlife	• Monitor aquatic habitat conditions • Improve watershed-wide information base by developing and updating data management tools (e.g. SHIAPP and EDT) • Administer permitting processes and programs consistent with surface water, water quality and habitat strategies • Identify projects and seek funding for habitat enhancement actions
County Water Conservancy Boards	• Process water right change/transfer applications in a timely manner (in cooperation with Ecology)

Notes:
1. See Tables 8-1 and 8-2 for additional detail.

Conclusion

Under local leadership, the Yakima River Basin Watershed Planning Unit has drawn on the collective knowledge, input and hard work of over 100 citizens, landowners, local government staff, state and federal agency representatives and others in developing this Watershed Plan. The Plan provides a comprehensive review of water resource needs and solutions for the Yakima Basin. The Planning Unit and TCWRA intend that this Plan serve as a "road map" to resolving the many outstanding issues that need continued attention to ensure that water resource management supports healthy communities, a healthy economy and a healthy environment. To bring this about, continued efforts will be needed over a period of many years, involving local leadership, citizen and stakeholder input, and support from the State of Washington and the federal government.

Exhibit ES-3
Yakima Watershed Plan - Proposed Implementation Schedule[1]



[1] Implementation schedule may be limited by available funding/resources, legislative authorizations, implementing rules and existing workloads.

[2] To coincide with budget preparation cycle for 2004.

Section I

Introduction and Existing Conditions

Section I of this Watershed Plan provides introductory information related to the watershed planning process and water resource conditions in the Yakima River Basin. This section contains two chapters. Chapter 1, Introduction and Purpose, describes the planning framework under the State of Washington's Watershed Planning Program. Chapter 2, Existing Conditions, describes the landscape, political geography, demographic conditions, water resources, and related information on the Yakima Basin. Readers who are familiar with this information may wish to proceed directly to subsequent sections of this Plan.

Chapter 1

Introduction and Purpose

Chapter 1
Introduction and Purpose

Water resources serve as the foundation of human activity, economic prosperity, and ecological health in the Yakima River Basin. The majority of the lands in the basin receive little direct precipitation, particularly in the summer months. These lands are therefore dependent on water from spring snowmelt in the Cascade Range, ground water resources, and the base flows fed by ground water throughout the dry months of the year. Reservoirs in the Basin capture flows for use during the drier months.

A range of needs must be met by the Yakima Basin's limited supply of water. The Basin serves as one of the most productive agricultural areas of Washington State, and irrigated lands provide most of the income in the Basin's agricultural sector. The Basin provides habitat for fish species that have recently been listed under the federal Endangered Species Act, and sustains non-listed fish and wildlife as well. Residents, commercial businesses and industrial users require water to meet their everyday needs, and these needs are growing as the Basin's population grows. Finally, the Yakima Basin's rivers, streams and lakes offer recreational opportunities and natural beauty for citizens and visitors to the Basin.

Given a limited resource and a range of needs for water, it has historically been difficult for citizens, businesses and public agencies to make water-resource management decisions. The Yakima Basin has had a long history of legal actions with regard to water resources, fish and wildlife, and related matters. Water resource management has grown more challenging as new rules and regulations have come into effect, such as the federal Clean Water Act and Endangered Species Act, and as the Basin seeks to ensure its agriculture-based economy can compete in worldwide commodity markets.

Under these circumstances, the State of Washington's Watershed Planning program offers a locally-led approach that can contribute to improved decision-making with regard to the Basin's water resources. This Watershed Plan was prepared under the provisions of the Watershed Planning program. The Plan reviews alternatives for improving water resource management in the Yakima Basin, and recommends a preferred alternative for implementation.

1.1 Legal Basis for Planning

In 1998 the Washington State Legislature passed the Watershed Management Act (Chapter 90.82 RCW) to provide a framework for citizens, interest groups, and government organizations to resolve water-resource issues in each of the State's major watersheds. The Act offers funding for areas that wish to undertake planning and specifies ground rules for use of the funding. WMA identifies a group of "initiating governments" that are empowered to select a lead agency; apply for grant funding; determine the overall scope of planning; and convene a "Planning Unit." The initiating governments include specified county and city governments, certain public entities that distribute water supplies, and, if they choose to join the process, tribes with reservation lands within the watershed.

The Watershed Management Act identifies the Planning Unit as the group that develops and initially approves the watershed plan. Following approval by the Planning Unit, WMA calls for a joint session of the County Commissioners of all Counties in the watershed to consider the plan. The joint session of County Commissioners can recommend changes in the plan, but only the Planning Unit can make such changes. Once the plan has been approved by both the Planning Unit and joint session of County Commissioners, it requires Counties and State agencies to implement plan elements which they agreed to implement.

The Watershed Management Act identifies four topics that can be addressed as part of a watershed plan. Water quantity must be addressed if grant funding is received. Water quality, habitat, and setting of instream flows by State rule can also be addressed, but are optional under the law. The law specifies certain types of information that must be gathered in preparing a watershed plan. It also identifies a range of water-resource management strategies that must be considered. The law states that watershed plans must be consistent with efforts already under way in each watershed, and should not duplicate these efforts.

1.2 Application of Watershed Planning in the Yakima Basin

In the Yakima Basin, the Tri-County Water Resource Agency (TCWRA) represents the initiating governments that are required for initiating the watershed planning process[1]. Representation on the TCWRA includes Benton, Kittitas, and Yakima Counties; the Cities of Yakima and Ellensburg; and three irrigation districts, Sunnyside Valley Irrigation District, Roza Irrigation District, and Yakima-Tieton Irrigation District. TCWRA serves as the lead agency for watershed planning, and received grant funding to develop a watershed plan from the Washington State Department of Ecology (Ecology). Representing the initiating governments, TCWRA initially defined the scope of planning to include three of the four elements identified in the law: Water Quantity, Water Quality, and Habitat.

TCWRA convened a Planning Unit, which held its first meeting in October 1998. The membership of the Planning Unit is listed at the front of this Plan Document. The Planning Unit formed a Steering Committee, and has formed various technical committees and work groups during the various phases of the planning process.

[1] The Yakama Nation (YN) joined other governments as a member of TCWRA from January through August 1999, then withdrew. WMA requires tribes with reservation lands in the management area to be invited to join as an initiating government, but does not require concurrence by the YN in order for planning to proceed.

The Steering Committee has the role of facilitating, coordinating and integrating the internal and external activities of the Planning Unit and has a range of specific duties assigned by the Planning Unit. The technical committees and work groups have had the role of guiding development of draft materials for consideration by the full Planning Unit. TCRWA has provided staff for the process, and has contracted with professional service providers to assist the Planning Unit assess watershed conditions and develop the Watershed Plan.

This process builds directly on a variety of previous and ongoing planning activities. These include activities undertaken by the Yakima River Watershed Council, Yakima Valley Conference of Governments, counties, cities and irrigation districts within the Basin, U.S. Bureau of Reclamation, Yakima River Basin Conservation Advisory Group, U.S. Geological Survey, Ecology, Washington Department of Fish and Wildlife, Yakama Nation and many other organizations. These previous and ongoing planning activities provide a foundation for much of the watershed plan. The Planning Unit includes many representatives who have participated in these related planning activities and continue to do so.

1.3 Process for Developing the Watershed Plan

In accordance with the Watershed Management Act, this Watershed Plan has been developed in three phases. Phase I was an organizing phase, held during 1998. During the organizing phase the TCWRA was formed, through a Memorandum of Agreement among the initiating governments. A Planning Unit was organized, and the scope of planning activities was determined. Phase II was an assessment phase, to gather technical information regarding the water resources of the Yakima Basin. The assessment was carried out during 1999 and 2000, with a final Watershed Assessment report issued in January 2001. It involved four technical committees working closely with the professional team led by Economic and Engineering Services, Inc. (EES). The Assessment document provides much of the information that was used in developing this Plan, and should be consulted by interested readers. Further information on the process for conducting the Assessment is contained in Section 1.3 of the Assessment report.

Phase III of the process was the Planning Phase, carried out in 2001 and 2002. This process was carried out in three stages. First, the Planning Unit convened a Scoping Committee in the summer of 2001. The Scoping Committee reviewed the goals and objectives defined by the Planning Unit, and the results of the Assessment Phase. They then defined a set of needs and tasks for developing the Watershed Plan[2]. At this time, the technical committees of the Planning Unit were reorganized into four workgroups:

- ❑ Environmental/Instream Work Group (with two subgroups: Habitat and Water Quality)

[2] Scoping Committee, "Phase 3 Scoping Matrix," October 18, 2000.

- Water Supply and Management Work Group
- Public Involvement Work Group (with two subgroups: State Environmental Policy Act [SEPA] and Outreach)
- Intergovernmental Work Group

Members of these work groups are listed at the front of this Watershed Plan document.

As part of Phase III, the work groups and EES team developed a series of Technical Memoranda exploring a range of topics related to the Plan. These technical memoranda, listed in Table 1-1, provide the background and basis for the water resource management alternatives presented in this Plan.

Following completion of the draft technical memoranda in fall 2001, a series of workshops was held with the Steering Committee, work group chairs, and other interested members of the Planning Unit to shape the development of this Plan document. A scope of work was developed early in 2002, which included additional research and modeling related to surface water management. This Plan document was then prepared, incorporating results as appropriate from the Watershed Assessment, the Technical Memoranda, and the new research and modeling activity.

Every chapter of the watershed plan had extensive input from Planning Unit members, both in meetings that led to drafting of the respective chapters, and in comment processes used for each technical memorandum. In addition, following preparation of the first complete draft of the plan in November 2002, Planning Unit members, state agency staff, and other interested parties provided over 200 comments covering every section of the Plan. The consulting team prepared responses to every comment, and the Planning Unit's Steering Committee then reviewed and discussed the responses. Following Steering Committee review, the responses were distributed to the full Planning Unit. All responses were approved at the Planning Unit meeting in December 2002. A document listing all comments and responses is available from TCWRA.

Table 1-1
List of Supporting Documents Prepared during Planning Process

- Watershed Assessment January 2001
- Voluntary Water Transfers as a Strategy for Meeting Planning Objectives (January 2002)
- Water Use Efficiency in the Agricultural Sector (February 2002)
- Reliability of Surface Water Supply for Irrigation, Yakima Project Water Users (January 2002)
- Storage Strategies (January 2002)
- Water Supply Needs for Instream Flows (January 2002)
- Municipal, Domestic and Industrial Water Needs and Supply Strategies (January 2002)
- Potential Effects of Climate Variability and Change (February 2002)
- Water Reuse Opportunities in the Yakima Basin (draft November 2002)
- Wymer Dam and Reservoir Project Review (draft November 2002)
- Wymer Dam Kittitas Valley Supply Alternative (draft November 2002)
- Hydrologic Modeling of Surface Water Alternatives (draft November 2002)
- Issues Related to Management of Ground Water Supplies (January 2002)
- Surface Water Quality Strategy (January 2002)
- Water Quality Monitoring Plan (December 2001)
- Water Quality Research Projects (December 2001)
- Strategy to Protect Ground Water Quality (January 2002)
- Maintain and Enhance Habitat (April 2002)
- Barriers to Plan Implementation (April 2002)
- Comments and Responses on Yakima Basin Watershed Plan (December 2002)

For purposes of the State Environmental Policy Act (SEPA), TCWRA is identified as the lead agency for this plan. TCWRA undertook scoping under SEPA and provided opportunities for public comment at Planning Unit meetings. Following scoping, TCWRA issued a “Determination of Significance” (DS). However, upon preparation of the draft Plan document in fall 2002, TCWRA withdrew the DS and issued a Determination of Non-Significance (DNS).

The reasons for this DNS are that: 1) the Watershed Plan does not propose specific capital projects that would be harmful to the environment; 2) the Plan contains optional strategies, rule-making, and actions that would require separate review under SEPA by implementing agencies prior to implementation if they would have a probable adverse impact on the environment; and, 3) the goals of the Watershed Plan would have beneficial impacts if achieved.

1.4 Planning Unit Goals

At the end of 1999 a workshop was held to identify goals and objectives for the Planning Phase. A Scoping Committee convened in year 2000 then consolidated these goals and objectives into the following seven substantive goals[3]:

- Improve the reliability of surface water supply for irrigation use;
- Provide for growth in municipal, rural domestic and industrial demand;
- Improve instream flows for all uses with emphasis on improving fish habitat;
- Maintain properly functioning habitat and enhance degraded habitat;
- Protect, improve and sustain ground water quantity and pumping levels of aquifers for the benefit of current and future use;
- Protect surface and ground water from contamination;
- Maintain economic prosperity by providing an adequate water supply for all uses;

These goals were approved by the Planning Unit to guide the development of the watershed plan. Each of the water resource management alternatives discussed in this Plan is evaluated in terms of its ability to meet all seven goals.

1.5 Planning Area

The Planning Area for the watershed planning process is the entire Yakima Basin, with the exception of the Yakama Nation Reservation (see Exhibit 1-1). The Reservation occupies approximately 892,000 acres, or 23 percent of the Basin (based on GIS analysis of mapping data provided by Ecology. Note: additional Reservation land lies outside the Yakima River Basin). As requested by the Yakama Nation, the Yakima River Basin Watershed Planning Unit has refrained from planning with respect to water resource use or management on the Reservation. However, the Steering Committee of the Planning Unit has determined that some types of information regarding the Reservation may be necessary to fully understand water resource conditions within the overall Yakima Basin. Therefore public information involving water resources on the Reservation has been compiled during the planning process.

[3] In addition, four procedural goals were identified, related to identifying barriers to plan implementation; identifying funding sources, education and public involvement, and early implementation projects.

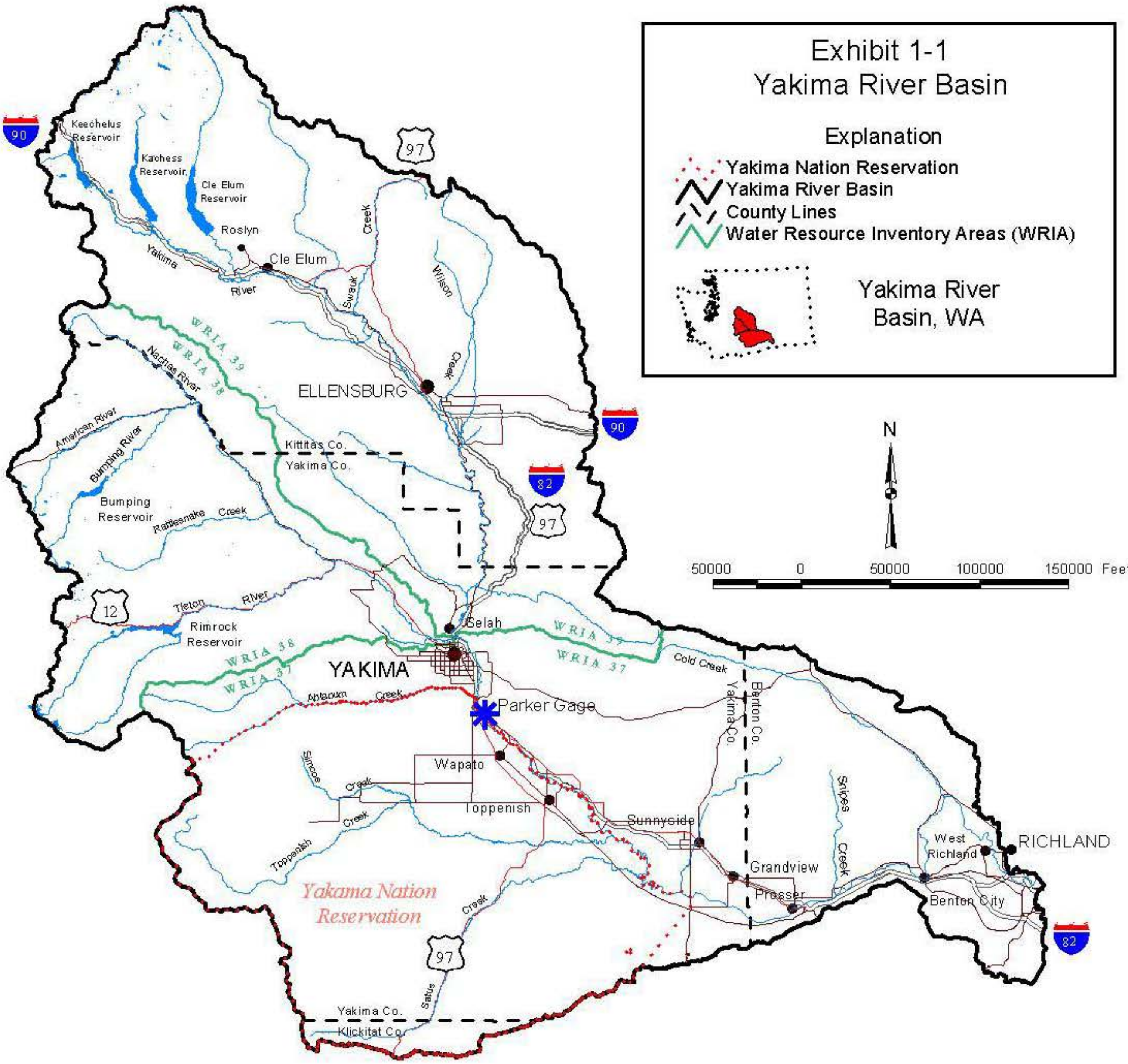


Exhibit 1-1
Yakima River Basin

The surface waters of the Yakima Basin include the mainstem Yakima and Naches Rivers. The U.S. Bureau of Reclamation (USBR) manages the mainstem system through its system of storage reservoirs. In addition, there are many tributary streams, most of which do not have federal storage facilities, and therefore are not managed by USBR. In addressing surface water management, this Watershed Plan focuses primarily on the mainstem river system. While the tributaries are important, each tributary has its own needs, issues and involved parties. The Planning Unit recognizes that significant issues with regard to water supply, instream flow, habitat and water quality still remain to be resolved in the tributaries, and that funding will be needed to carry out this work. In order to be effective and responsive to local needs, planning carried out in the tributaries should involve the local residents and landowners. The Watershed Assessment report contains further information on water resources of the tributaries.

1.6 Plan Limitations

Consistent with the requirements of Chapter 90.82.120 RCW, nothing within this Watershed Plan shall:

1) Conflict with existing state statutes, federal laws, or tribal treaty rights;
2) Impair or diminish in any manner any existing water rights;
3) Require a modification in the basic operations or a federal reclamation project with a water right priority date before June 11, 1998, or alter in any manner whatsoever the quantity of water available under the water right for the reclamation project;
4) Affect or interfere with an ongoing general adjudication of water rights, including *State v. Acquavella*, Cause No. 77-2-01484-5, Yakima County Superior Court;
5) Modify or require the modification of any waste discharge permit issued under chapter 90.48. RCW;
6) Modify or require the modification of activities or actions taken or intended to be taken under a habitat restoration work schedule developed under chapter 246, Laws of 1998; or
7) Modify or require the modification of activities or actions taken to protect or enhance fish habitat if the activities or actions are consistent with the parameters and requirement of Chapter 90.82.120(1)(g).

   Furthermore, the identification and estimation of surface and ground water rights for various entities and persons developed during the planning process are for the sole purpose of estimating water needs and availability, and to provide a general understanding of water-resource and management issues in the Yakima Basin to assist in watershed planning. The estimates of water rights are neither an admission nor an opinion on the validity or extent of any respective water right by any participant in the planning process, the Tri-County Water Resource Agency, or any other entity or person identified with the Watershed Assessment. This Watershed Plan and the identification and estimation of water rights within this Watershed Plan may not be used by any entity or person for any other purpose except to assist the Tri-County Water Resource Agency, the Yakima River Basin Watershed Planning Unit, and its Committees, in watershed planning as set forth in Chapter 90.82 RCW.

Any strategies, actions, obligations, or potential obligations assigned to local, state, or federal agencies, and tribes if they participate in plan implementation in the future, are directly associated with securing necessary funding and resources, legislative authorizations where required, and are subject to all applicable state and federal requirements including SEPA and NEPA.

1.7 Plan Implementation

The Watershed Management Act does not provide a specific framework for implementation of watershed plans. Implementation issues have been explored recently by a statewide "Phase 4 Watershed Plan Implementation Committee," which had developed a draft Report to the Legislature at the time this Plan document was written. Chapter 8 of this Watershed Plan addresses implementation issues, and identifies potential roles for the various entities with responsibilities for water resources and land use management in the Yakima Basin. Chapter 8 also discusses a potential role for a "Coordinating Agency" such as TCWRA in the implementation process.

1.8 Organization of Plan Document

This Watershed Plan document is organized as follows:

Section I: Introduction and Existing Conditions

Chapter 1: Introduction and Purpose
Chapter 2: Existing Conditions

Section II: Water Supply and Flow Management

Chapter 3: Management of Surface Water Resources
Chapter 4: Management of Ground Water Resources

Section III: Environmental Enhancement (Non-Flow Elements)

Chapter 5: Management of Surface Water Quality
Chapter 6: Management of Ground Water Quality

Chapter 7: Management of Fish Habitat Conditions

Section IV: Implementation

Chapter 8: Implementation Program

Chapter 2

Existing Conditions

Chapter 2
Existing Conditions

This Chapter summarizes existing conditions in the Yakima Basin, including water supply systems, surface water flows, ground water conditions, surface water quality, ground water quality and fish habitat. The information contained in this chapter was drawn from the Watershed Assessment (YRB Planning Unit, 2000) and various technical memoranda developed during the Planning Phase (see Table 1-1). For more detailed information, the reader should refer to those documents.

2.1 Physical Setting

Exhibit 1-1 (see previous Chapter) displays key features of the Yakima River Basin. The Basin occupies approximately 6,150 square miles. Its headwaters are situated along the crest of the Cascade Range. The mainstem Yakima River is joined by a number of tributaries and flows generally southeast until it joins the Columbia River. Maps showing various reaches of the Yakima and Naches Rivers, and tributary subbasins, are included in Appendix 2-A.

Throughout the Basin precipitation is seasonal, with approximately 60 to 80 percent of annual precipitation occurring from October to March (Rinella et al. 1992). The Cascades intercept moist air moving inland from the Pacific Ocean, capturing this moisture as precipitation. Much of this precipitation falls as snow during the winter months and becomes stored in the Cascade Range snowpack. As a result, runoff in the Yakima Basin exhibits a pronounced spike from April to June, with lower levels of runoff occurring during the remaining months of the year. Climatic conditions vary with elevation, with generally warmer and drier conditions occurring at lower elevations.

2.2 Land Use, Population, and Jurisdictions

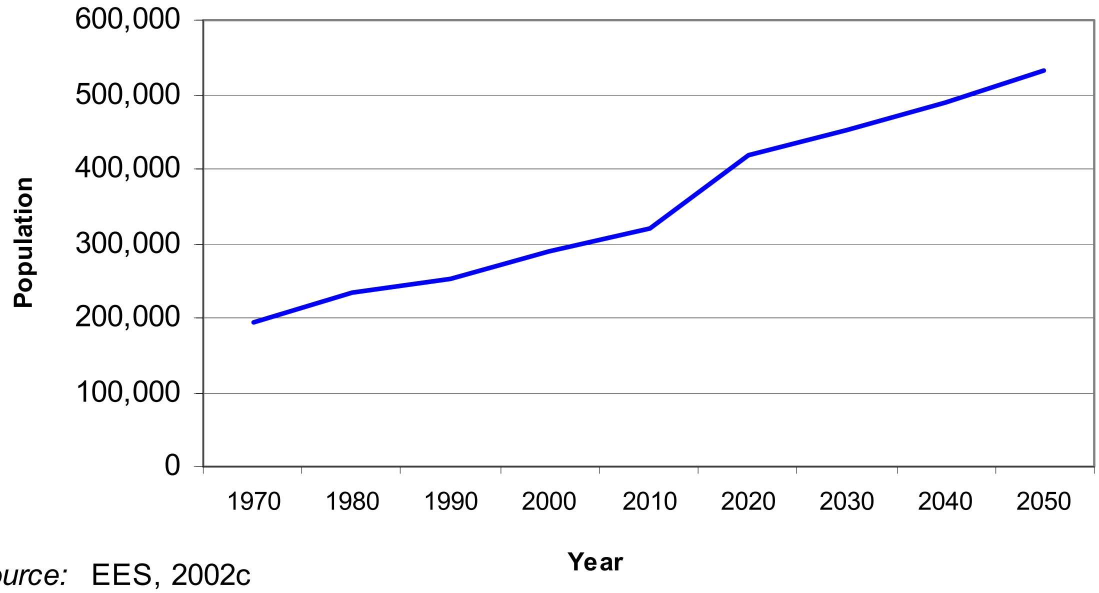
Existing land cover in the Yakima Basin is approximately 50 percent non-forested or rangeland; 29 percent forested; 21 percent agricultural, and less than 1 percent urban developed land. Agricultural activity provides the basis of the Yakima Basin economy, and includes crop production, livestock and dairy industries, as well as related food processing industries. Timber production and related industrial activity is part of the Yakima Basin economy.

The population of the Yakima River Basin was approximately 288,000 in year 2000[1]. Based on 1990 Census data, the population is evenly divided between urban residents (53 percent) and rural residents (47 percent). Based on projections developed for this Watershed Plan, the Basin's population is projected to increase to

[1] Population estimates were developed for this plan prior to the 2000 Census. For the Yakima Basin as a whole, the year 2000 Census is approximately 10 percent higher than the figures presented for year 2000 in the Watershed Assessment and technical memoranda.

over 418,000 by year 2020, and 531,000 people by year 2050 (EES, 2002c). Population growth projections are summarized in Exhibit 2-1.

Exhibit 2-1
Historic and Projected
Population Growth 1970 - 2050
Yakima River Basin



Source: EES, 2002c

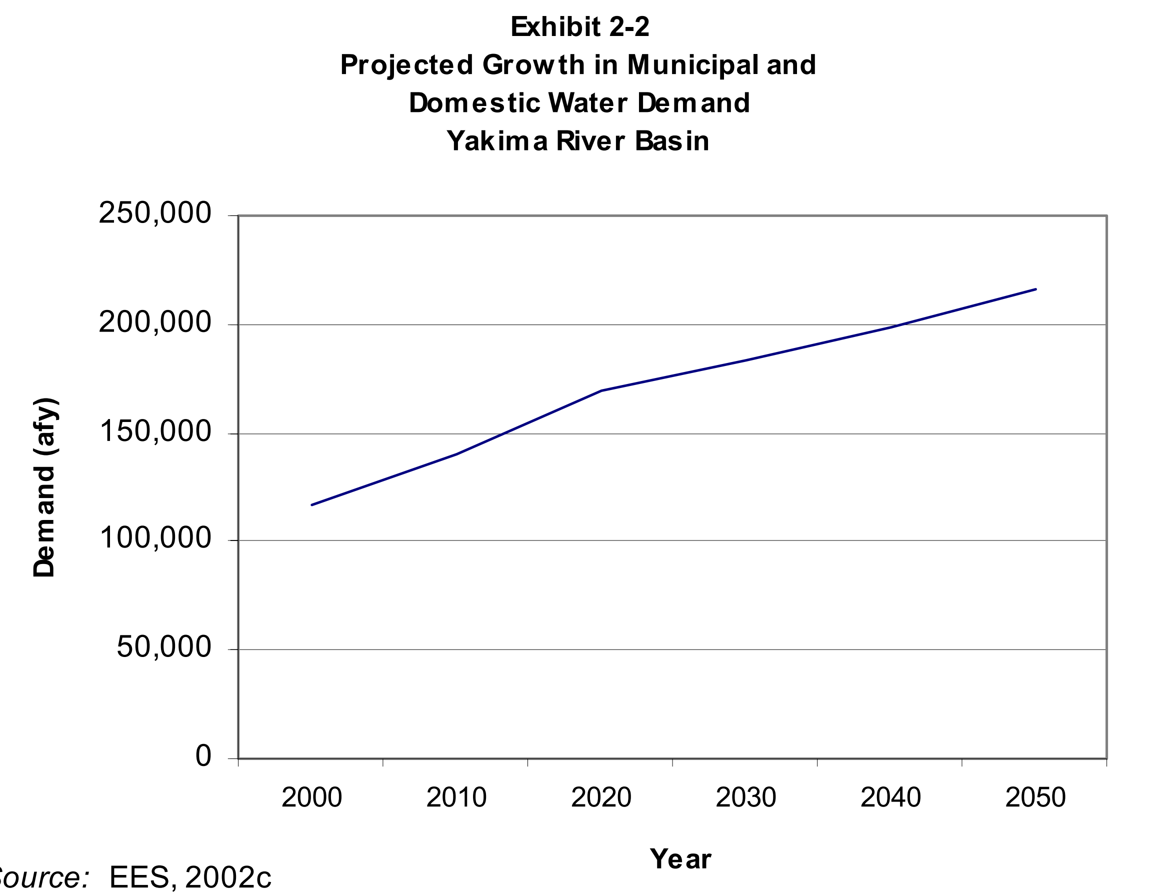
Yakima County occupies about half of the Yakima Basin (Exhibit 1-1). Most of Kittitas County is also in the basin, with the exception of the Columbia River drainage east of Naneum Ridge. Approximately half of Benton County, north of the Horse Heaven Hills ridgeline, lies within the Yakima Basin. The land specifically reserved as the Yakama Indian Reservation by treaty occupies about 20 percent of the Basin. There are 23 incorporated cities and towns in the Basin. The largest of these are Yakima, Ellensburg, and Richland[2].

2.3 Municipal, Industrial and Rural Domestic Water Needs

Communities in the Yakima Basin rely upon a variety of interrelated systems to meet their needs for domestic water supply, landscape irrigation, commercial supply and industrial supply. Such systems include large municipal systems, small public water systems, individual household wells, and wells owned by self-supplied industrial users. Table 2-1 presents current and projected demands through year

[2] Approximately 42 percent of Richland's population resides within the Yakima Basin. The remaining population of Richland lives within the Columbia River drainage.

2020 for public water systems and domestic uses. Total demands are projected further, to year 2050, in Exhibit 2-2. The tables are not fully comprehensive, in that they do not include landscape irrigation served by irrigation districts or ditch companies, nor does it include self-supplied industrial uses. However, those landscape and industrial uses served by public water systems are included.



Source: EES, 2002c

The demands shown include water delivered by public water systems and individual household wells. They do not include water delivered by irrigation districts and private ditch companies, nor do they include water used by self-supplied industrial facilities in the Basin.

Table 2-1
Current and Projected Demands
Public Water Systems and Domestic Uses
(Systems Serving 1,000 Connections or More Listed Individually)

	No. of Services	ADD (1) (20) (mgd)			MDD (1) (21) (mgd)			Annual Demand (22) (afy)		
	1999	2000	2010	2020	2000	2010	2020	2000	2010	2020
Upper Yakima Subarea										
Ellensburg (5)	3,230	4.3	5.4	6.3	9.9	11.8	13.3	4,820	6,053	7,062
Cle Elum (6)	1,000	0.8	0.9	1.0	2.1	2.3	2.6	897	1,009	1,121
Other Community and Class B PWS (16)	3,111	2.8	3.4	4.1	5.6	6.9	8.1	3,139	3,845	4,551
Non-Community PWS (19)	881	0.9	1.1	1.3	1.8	2.2	2.6	988	1,210	1,432
Yakima Training Center (17)	4	0.08	0.08	0.08	0.16	0.16	0.16	90	90	90
Households with own well (18)	5,602	5.0	6.2	7.3	10.1	12.4	14.6	5,652	6,924	8,195
Upper Yakima Total	13,828	13.9	17.1	20.0	29.6	35.6	41.4	15,585	19,130	22,451
Middle Yakima Subarea										
City of Yakima (potable supply) (7)	16,756	15.3	16.4	17.3	30.6	32.8	34.6	17,151	18,384	19,393
City of Yakima (irrigation supply) (7)		NA	2.0	2.0	NA	4.0	4.0	NA	2,242	2,242
Nob Hill Water Assoc. (8)	7,595	3.4	4.2	5.1	6.9	8.9	10.6	3,811	4,708	5,717
Selah (12)	1,682	2.6	3.0	3.3	6.0	7.2	8.2	2,915	3,363	3,699
Union Gap (13)	1,200	1.1	1.2	1.4	2.2	2.5	2.8	1,211	1,398	1,586
Terrace Hts. (Yak. Co.) (14)	1,104	0.6	0.9	1.1	1.6	2.3	3.1	673	1,009	1,233
Other Community and Class B PWS (16)	3,489	3.1	3.6	4.1	6.3	7.3	8.2	3,520	4,066	4,611
Non-community PWS (19)	154	0.2	0.2	0.2	0.3	0.4	0.4	173	199	226
Yakima Training Center (17)	109	0.08	0.08	0.08	0.16	0.16	0.16	90	90	90
Households with own well (18)	18,720	16.8	19.5	22.1	33.7	38.9	44.1	18,887	21,814	24,741
Middle Yakima Total	50,809	43.2	51.1	56.7	87.7	104.4	116.3	48,430	57,274	63,539
Naches Subarea										
(No systems with 1,000 connections)		---	---	---	---	---	---	---	---	---
Community and Class B PWS (16)	1,474	1.3	1.6	1.8	2.7	3.1	3.6	1,487	1,755	2,022
Non-Community PWS (19)	607	0.6	0.7	0.8	1.2	1.4	1.7	680	803	925
Households with own well (18)	2,575	2.3	2.7	3.2	4.6	5.5	6.3	2,598	3,066	3,533
Naches Subarea Total	4,656	4.3	5.0	5.8	8.5	10.0	11.6	4,765	5,623	6,481
Lower Yakima Subarea										
Sunnyside (9)	2,956	2.9	3.3	3.8	5.8	6.7	7.7	3,251	3,699	4,260
Grandview (10)	2,300	2.8	3.7	4.8	7.3	9.4	11.9	3,139	4,148	5,381
Toppenish (11)	2,000	1.8	2.1	2.4	3.6	4.2	4.7	2,018	2,331	2,643
Wapato (15)	1,104	1.2	2.5	2.8	3.4	5.6	6.4	1,345	2,803	3,139
Benton City (2)	729	0.2	0.7	1.2	1.1	2.2	3.4	224	785	1,345
Prosser (4)	1,600	2.8	3.2	3.5	4.8	5.5	6.1	3,139	3,587	3,924
Richland (3)	5,451	8.2	8.7	13.7	18.9	24.2	29.4	9,192	9,753	15,358
West Richland (3)	2,200	2.6	3.5	5.6	5.4	8.1	10.6	2,915	3,924	6,278
Other Community and Class B PWS (16)	6,777	6.1	7.0	8.0	12.2	14.1	16.0	6,837	7,897	8,957
Non-Community PWS (19)	272	0.3	0.3	0.4	0.5	0.6	0.7	305	352	399
Households with own well (18)	14,498	13.0	15.1	17.1	26.1	30.1	34.2	14,627	16,894	19,161
Lower Yakima Total	39,887	41.9	50.1	63.2	89.1	110.7	131.1	46,992	56,172	70,844
Yakima Basin Total	**109,180**	**103.3**	**123.3**	**145.7**	**215.0**	**260.8**	**300.3**	**115,772**	**138,199**	**163,316**

PWS = Public Water System (listed in DOH Water Facilities Inventory); ADD = Average Daily Demand; MDD = Maximum Daily Demand
MGD = Million Gallons per Day;   NA = Data not available
Note on Conversion to Acre-feet per year (AFY) or Acre-feet per day (afd):
To convert a value in mgd to a value in afy, multiply mgd by 1,121. To convert a value in mgd to a value in afd, multiply by 3.07.
Note: many of the communities receive additional water for residential irrigation, from surface water supplied by irrigation districts, ditch companies, etc.
(1) Projections provided by water systems for various years were placed on an even footing to allow comparison. This was done by computing an annual growth rate for the data provided, then applying this growth rate to generate values for years 2000, 2010 and 2020.
(2) Water Capital Facilities Plan, 1997, Benton City and personal communication, JUB Engineering.
(3) Regional Water Supply Plan for Cities of Kennewick, Pasco, Richland and West Richland, EES, 1998. For Richland 42% of service area is in Yakima Basin.
(4) Water System Plan, City of Prosser, and personal communication, Mike Flory.
(5) City of Ellensburg, Water Comprehensive Plan (Draft - October 1999).
(6) Personal communication, Jim Leonard, City of Cle Elum.
(7) Values from Table 9. MDD obtained using an approximate peaking factor of 2.0. Yakima is served primarily with surface water, though wells contribute a small percentage of supply.
(8) Personal communication, David England, Nob Hill Water Association.
(9) Personal communication, Steve Schut, City of Sunnyside.
(10) Personal communication, Cus Artega, City of Grandview, from 1995 Water Comprehensive Plan.
(11) Personal communication, City of Toppenish staff.
(12) Personal communication, Huibregtse, Louman, Associates.
(13) Estimated based on number of connections listed by DOH.
(14) Personal communication, Joe Stump, Yakima County Public Works, from 1997 Water System Plan.
(15) Personal communication, Ed Martindale, City of Toppenish.
(16) From DOH Water Facilities Inventory (1999).
(17) Letter from U.S. Army to EES.
(18) In each subarea, the total number of households was calculated in the Assessment, using an average number of persons per household from U.S. Census data for the Yakima Basin. Households served by own well was calculated as total households less total connections served by PWS.
(19) From DOH Water Facilities Inventory (1999). Includes both Transient Non-Community and Non-Transient Non-Community Public Water Systems.
(20) For Public Water Systems smaller than 1,000 connections, and households with own wells, average day demand was calculated based on a water use factor of 900 gallons per day (approximately 1 acre-foot per day).
(21) Where data was not available directly from a Public Water System, maximum day demand was calculated from average day demand, using a peaking factor of 2.0
(22) Simple conversion from average daily demand figure. (Note system sizing based on maximum day demand, not annual demand).

2.4 Agricultural Irrigation

2.4.1 Yakima Irrigation Project

The U.S. Bureau of Reclamation (USBR) operates the Yakima Irrigation Project, which provides the water supply for most of the water users who divert surface water from the Yakima, Naches, and Tieton Rivers. USBR operates the Yakima Irrigation Project to meet a number of objectives, including water supply, fish and wildlife, and safety needs. Section 3 of the Watershed Assessment document provides a description of project operations. The Yakima Project provides water to about 361,000 irrigated acres and represents about 70 percent of the total surface water diversions for major irrigation entities in the Yakima River basin.

The Yakima Project includes five major reservoirs with a total capacity of 1,065,400 acre-feet.[3] A sixth reservoir, Clear Lake, has a capacity of 5,300 acre-feet and is used primarily for recreational purposes. All six reservoirs were constructed between 1909 and 1933.

The storage facilities of the Yakima Project do not have a large volume of carryover storage and must be replenished each year in the winter and spring months, in order to provide a full water supply for the next irrigation season. Therefore, the system is not well suited to provide water over a series of dry years. One example of this was the three dry years that occurred in 1992 through 1994.

Total Water Supply Available and Proration

The USBR prepares forecasts of the expected Total Water Supply Available (TWSA) for the Yakima Project. TWSA represents the combined quantity of unregulated flow, return flow, and stored water available for use. The forecast is used to determine the adequacy of water supply to meet entitlements. For purposes of developing this Watershed Plan, TWSA also provides a convenient measure of the quantity of water available for use in the Yakima Basin mainstem system, operated by the federal government.

Since 1995 the forecast of TWSA is also used to determine the magnitude of target flows over Sunnyside and Prosser Diversion Dams pursuant to the Title XII of Public Law 103-434, passed by the U.S. Congress. From 1992 to 1995, the USBR operated the Yakima Project to provide the same target flows as contained in the Title XII legislation. Instream flow needs (target flows) are met from TWSA prior to determining if proration is necessary.

Proration is the process the USBR employs in water-short years to allocate the TWSA. There are two classes of water entitlements. Nonproratable water users have water rights with priority dates filed prior to 1905. Proratable water users have water rights with a later priority date, and

[3] Currently Keechelus Reservoir is drawn down for dam safety reasons and the current capacity of Project Reservoirs is 1,047,600 acre-feet.

therefore have a lower priority. Nonproratable entitlements have not been cut back in any year to date. Any shortages that may occur after the non-proratable water rights are met are shared equally by all of the proratable water users.

Table 2-2 presents a list of water users located upstream of Sunnyside Diversion Dam (Parker gage) and their non-proratable and proratable water supplies. The entitlements shown are subject to change, as they do not reflect the current status of the Yakima River Basin Adjudication process. The total volume of entitlements supplied by USBR above the Parker gage is approximately 2.5 million acre feet (MAF) for the April through October time period. Of those entitlements, 51%, or 1.28 MAF are proratable.

The Yakima Project has been operated to provide water deliveries to water users with diversions located upstream of the Parker gage. Reservoir releases from Yakima Project reservoirs have not been required to supply lower Yakima River basin water users. Accordingly, these lower Yakima River users, such as the Kennewick Irrigation District, which has a 102,674 acre-feet proratable entitlement were not included in Table 2-2. The total estimated diversions in the lower Yakima River basin are 336,000 acre-feet annually. The lower Yakima River basin water users have relied on naturally occurring runoff and irrigation return flow that enters the Yakima River downstream of the Parker gage. The irrigation return flow emanates from the Roza Irrigation, the Sunnyside Division, the Wapato Irrigation District, and other smaller water users. A concern is implementation of water use efficiency measures in those irrigation districts will reduce the volume of irrigation return flow and create the need to release flow from Yakima Project reservoirs to supply lower Yakima River basin water users. The Kennewick Irrigation District and Columbia Irrigation District are seeking funding for a project to pump water from the Columbia River in lieu of diversions from the Yakima River, which will eliminate the potential issue of the reduced irrigation return flow.

Of the water users having an entitlement of at least 5,000 acre feet, 15 have at least a portion of their water rights in the proratable category. Four of these users rely entirely on proratable supplies, and are therefore are most at risk of experiencing supply shortages during dry years. These include two large irrigation districts: the Kittitas Reclamation District and Roza Irrigation District; the smaller Broadway Irrigation District; and the City of Ellensburg[4]. The remaining 11 users range from 1 percent to 53 percent proratable, of their total supplies from the Yakima Irrigation Project. It should be noted that some users with proratable supplies supplement their supply with ground water. However, ground water must be pumped, and therefore is more costly to use than surface water from the Yakima Project.

[4] Although Ellensburg's entitlement from this source is entirely proratable, the City has alternative supplies from ground water and therefore is not entirely dependent on this source of supply.

Table 2-2
Entitlement Summary
April – October

Water User Above Parker Gage	Non-proratable Entitlement (AF)	Pro-ratable Entitlement (AF)	Total (AF)
Wapato I.P.	305,613	350,000	655,613
Sunnyside Division	315,836	142,684	458,520
Roza I.D.		375,000	375,000
Kittitas Reclamation District		336,000	336,000
Yakima-Tieton I.D.(1)	75,865	26,544	102,409
Naches Selah	49,658	4,486	54,144
Cascade(2)	49,525		49,525
Ellensburg Town	47,758		47,758
Westside	31,128	8,200	39,328
Selah-Moxee I.D.	27,493	4,281	31,774
Yakima Valley Canal	23,720	4,305	28,025
Union Gap I.D. (Old Fowler Ditch)	20,697	4,642	25,339
South Naches Channel	22,946		22,946
Naches Union I.D. (Formerly Gleed Ditch)	22,819		22,819
Wapatox (Irr. – U & L)	20,230		20,230
Fruitvale Power	17,708		17,708
Old Union(3)	17,675		17,675
Naches Cowiche	15,096		15,096
Woldale (Olson)	12,973		12,973
Hubbard-Granger	11,165		11,165
Yakima City (Irr)	8,805	1,500	10,305
Yakima City (M&I)	4,859	4,500	9,359
Boise Cascade	9,159	100	9,259
Kelly & Lowry	8,490		8,490
Taylor	8,000		8,000
Chapman & Nelson	7,641		7,641
Mills & Son	7,530		7,530
Bull	6,471		6,471
Richartz	6,364		6,364
Ellensburg Power	6,031		6,031
City/Ellensburg M & I		6,000	6,000
Moxee Ditch Co.	4,245	960	5,205
Other Entitlements, Under 5,000 AF	53,663	2,390	56,053
Totals:	1,219,163	1,271,592	2,490,755

Source: Adapted from Yakima River Watershed Council, 1998.
(1) Based on conditional Final Order issued on May 10, 2001.
(2) July 20 to October 15 use 16,800 acre feet. Not to exceed flow of 150 cfs.
(3) This agrees with contract minus water that had been transferred to City of Yakima for use by city at changed point of diversion.

In terms of the quantity of water involved, and by extension the irrigated acreage exposed to water shortages, the five water users with the largest proratable supplies are Roza Irrigation District, Kittitas Reclamation District, Wapato Irrigation Project, and the Sunnyside Division. Each of these users has many individual farm operators. In dry years, the shortage of water supply reduces agricultural production. Because of the importance of agriculture in the Basin's overall economy, this causes substantial economic disruption in communities of the Yakima Basin (NEA, 1997).

Table 2-3 provides a list of the years that proration occurred. The percentage of proratable entitlements provided during each year that proration occurred is also shown. Deliveries of proratable supplies ranged from 37 percent to 88 percent of full entitlement in those years. A water user that is entirely dependent on proratable supply (e.g. Roza I.D.) would receive only that percentage of their full entitlement. A water user having a mixture of proratable and non-proratable supplies (e.g. Sunnyside Division) would receive their full entitlement of non-proratable water; and a limited portion of their proratable entitlement.

Table 2-3
April 1 Forecast of TWSA for Years that Proration Occurred

Year	Beginning Storage (AF)	Natural Flow (AF)[1]	Return Flow (AF)[1]	Estimated April 1st – September 30th TWSA (AF)	% of Proratable Entitlements Provided During The Year
1973	821,000	1,187,000	350,000	2,343,000	80%
1977	889,800	797,000	350,000	2,036,800	66%
1979	603,100	1,677,000	350,000	2,630,100	65%
1987	524,800	1,670,900	350,000	2,545,700	68%
1988	392,900	1,787,200	350,000	2,530,100	88%
1992	816,300	1,186,600	350,000	2,352,900	58%
1993	354,900	1,295,500	350,000	2,000,400	67%
1994	296,000	1,369,700	350,000	2,015,700	37%
2001	383,895	946,105	350,000	1,680,000	37%

Source: *Watershed Assessment Yakima River Basin (EES, 2000)* and USBR news release (April 10 and August 2, 2001).
[1]Natural Flow and Return Flows are estimates based upon hydrologic conditions and experience of USBR in operating the Yakima Project
AF = acre-feet

Table 2-3 understates the effect of dry years on proratable water supplies under current operating criteria, due to an increase in target flows that occurred in 1992. The USBR implemented a higher instream flow target at Sunnyside Diversion Dam (as measured at the Parker Gage) at that time (prior to the passage of Title XII legislation). The flows required at Sunnyside Dam act as a constraint on the availability of water for water supply. When higher target flows were established, this had the effect of reducing the amount of water supply available. If the Title XII target flows had been in place during all the years shown in Table 2-3, the percentages of entitlements received by proratable water users would have been lower, in all of the years listed in the table prior to 1992.

2.4.2 The Wapato Irrigation Project

The Wapato Irrigation Project (WIP) is located within the boundaries of the Yakama Nation Reservation, and is operated by the Bureau of Indian Affairs in consultation with the Yakama Nation and the Wapato Irrigation District. Water supplied to the WIP is diverted from the Yakima River at the Wapato Diversion Dam, as part of the Yakima Irrigation Project supplies. As noted above, the WIP has a combination of proratable and non proratable supplies.

As requested by the Yakama Nation, this Watershed Plan does not identify water resource management actions for the Reservation. Therefore, the WIP is not discussed further in this Plan. It is noted, however, that there is a relationship between the quantity of water needed to supply WIP and the total quantity of water supplied by the Yakima Project for all project users in each year.

2.4.3 Yakima River Basin Water Enhancement Program

Title XII of Public Law 103-434 authorized Phase II of the Yakima River Basin Water Enhancement Project (YRBWEP). The purposes can be summarized as:

(1) to protect, mitigate, and enhance fish and wildlife;

(2) to improve the reliability of water supply for irrigation;

(3) to improve the efficiency of water delivery and use;

(4) to realize at least 110,000 acre feet of water savings per year for fish and wildlife; and at least 55,000 acre feet of water savings per year for irrigation, by year 2002;

(5) to encourage voluntary transactions among public and private entities which result in water conservation measures, practices, and facilities; and

(6) to provide for the implementation of certain projects by the Yakama Indian Nation.

Through the YRBWEP Conservation Program, grants are available to irrigation districts or other eligible entities to improve their irrigation systems. The Conservation Program is structured in four phases:

(1) Development of water conservation plans;
(2) Feasibility investigation of specific water conservation measures;
(3) Implementation; and
(4) Post-implementation monitoring and evaluation

The water savings that result from the program will be directed towards all purposes of the Yakima Project. However, based on the water savings goals listed above, USBR is requiring 65% of the water saved through water use efficiency measures be used for instream flows, while 35% of the saved water will remain available for irrigation. Diversion reduction agreements are required of participants in the program.

To date, six Water Conservation Plans consistent with Phase 1 of the program have been developed by irrigation districts. Other districts have prepared plans with funding from Ecology or from other USBR funding programs. Feasibility investigations (phase 2) are under way by some districts for efficiency measures recommended in the Plans. The USBR has provided no implementation funds (phase 3) since the program was passed into law in 1994 (see Section 7.2). Therefore, none of the 165,000 acre-feet savings per year envisioned in Title XII has been achieved to date.

In enacting YRBWEP, Congress also established target flows for the Yakima River mainstem. These flows are defined at two points: Sunnyside and Prosser Diversion Dams. The target flows are discussed further in Section 2.6.1 of this Watershed Plan.

2.4.4 Surface Water Supplies Outside the Yakima Irrigation Project

In addition to the water supplied by USBR to users of the Yakima Irrigation Project, many irrigators, ditch companies, cities, businesses and others hold separate water rights under the State of Washington's system of water law. These include surface water rights in tributary streams, as well as ground water rights. Even in areas that are served by the USBR's Yakima Project, individual landowners may have their own private water supplies that are used in combination with water they obtain from the Yakima Project. In tributary subbasins that are not served by the Yakima Irrigation Project, all water users depend on supplies that are independent of the Project's supply. These water supplies are not under federal management.

For purposes of this Watershed Plan, surface water supplies outside the federally operated mainstem Yakima River system are not analyzed in detail. The Watershed Assessment provides further information regarding stream flows and surface water rights in the tributaries. As noted in Section 1.5, each tributary has its own needs, issues and involved parties. The Planning Unit recognizes that significant issues with regard to water supply, instream flow, habitat and water quality still remain to be resolved in the tributaries with local participation, and that funding will be needed to carry out this work.

2.5 Ground Water Resources

2.5.1 Aquifers of the Yakima Basin and Relationship to Surface Waters

The primary ground water resources of the Yakima Basin are aquifers associated with the Columbia River Basalt Group, including basalt aquifers such as the Saddle Mountains, Wanapum and Grande Ronde Formations; and sedimentary deposits such as the Ellensburg Formation.

The relationships between surface and ground water are important in managing water resources in the Yakima Basin. Pumping ground water from some aquifers at some locations may reduce flows in surface waters. This reduction in flow may affect fish and other aquatic resources, or may impair senior water rights. In other cases, pumping ground waters may have little effect on surface waters, or may have effects that are delayed in time or occur at locations far from the well. These effects can be very difficult to quantify.

At the same time, management of surface waters can affect ground water supplies. Where surface water is diverted and applied to irrigated lands, some of the water may percolate down into underlying aquifers and raise the water table. This effect can be seasonal, or long term. Conservation measures in the agricultural sector can reduce infiltration, causing water tables to drop. This may affect users of both the ground water and surface water resource.

Based on the results of the Watershed Assessment it is difficult to define the Yakima Basin's ground water resource in quantitative terms suitable for effective management. In many locations, issues such as the long-term effect of pumping on water levels; the effect of ground water withdrawals on stream flows; the hydraulic interactions among different aquifers cannot be quantified using available data.

The USBR, Ecology, and Yakama Nation are currently participating in a joint study of the ground water resources of the Yakima River Basin and their interactions with surface water. The USGS has been contracted to take the lead role in gathering and analyzing data. This study is currently anticipated to be complete in 2007[5]. Detailed analysis of existing data combined with analysis of the data collected during this study is expected to provide improved information for management of ground water resources.

2.5.2 Estimated Uses of Ground Water

The Watershed Assessment developed estimates of ground water usage in the Yakima Basin. Because of the lack of direct data, indirect methods were employed in developing estimates of ground water uses. These estimates are

[5] Vaccaro, John, USGS, personal communication, May 17, 2002.

considered to be provisional. Estimated ground water uses in the Yakima Basin are summarized in Table 2-4. This information is also displayed in Exhibit 2-3. The total quantity of ground water use on an annual average basis is estimated to be 490,766 acre-feet per year, excluding supplemental water rights[6]. When supplemental water rights are included, this total rises to 666,630 acre-feet per year (this value is applicable only in years when both primary and supplemental rights are fully exercised).

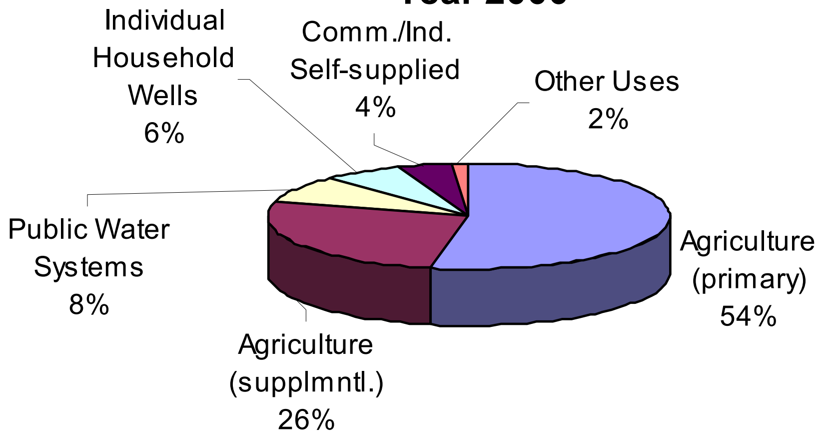
Table 2-4
Estimate of Total Ground Water Uses in Year 2000
Yakima River Basin (Acre-feet per year)

	Subarea (1)				
Type of Use	**Upper Yakima**	**Middle Yakima**	**Lower Yakima**	**Naches**	**Total**
Agriculture Total	19,556	206,924	255,914	47,173	529,567
Primary	*18,371*	*157,535*	*146,492*	*31,305*	*353,703*
Supplemental	*1,185*	*49,389*	*109,422*	*15,868*	*175,864*
Public Water Systems	9,933	12,409	31,413	2,167	55,922
Individual Household Wells	5,652	18,887	14,627	2,598	41,764
Commercial/Industrial Self-Supplied	904	21,509	3,250	3,685	29,348
Other Uses	326	1,081	7,140	1,482	10,029
Illegal Uses	N/A	N/A	N/A	N/A	N/A
Total w/o supplemental Ag.	35,186	211,421	202,922	41,237	490,766
Total Including Supp. Ag.	36,371	260,810	312,344	57,105	666,630

N/A = Not Available
(1) For definition of geographic subareas, see Watershed Assessment document.
Source: Watershed Assessment (YRB Planning Unit, 2001)

[6] Supplemental rights are associated with a primary right and may be used when the primary right is not available. In the Yakima Basin, supplemental ground water rights are typically supplemental to a surface water right.

Exhibit 2-3
Estimated Uses of Ground Water in Year 2000



Source: Watershed Assessment (YRB Planning Unit, 2001)

2.6 Instream Flows

2.6.1 Legal Requirements for Instream Flows

A variety of legal requirements exist related to instream flows in the Yakima River Basin. Generally these are based on court orders and federal legislation related to the Yakima Irrigation Project.

The State of Washington has not established minimum instream flows in the Yakima Basin. Acting as initiating governments for the watershed planning process, TCWRA chose not to include setting of instream flows by rule in the scope of the planning process. This decision was based on two factors:

- First, target flows are already established for the mainstem Yakima River under the federal YRBWEP program (see below); and
- Second, flow setting in the tributaries was not undertaken due to the general approach within this Watershed Plan of focusing on the mainstem river system (see Section 1.5).

Instream flows in the Yakima River Basin mandated by the Courts are not quantified. Rather, the amount of water necessary to maintain fish life is to be determined annually depending on existing prevailing conditions. Specific mandates from the State and federal courts include orders directed at USBR's operation of the Yakima Project to reduce impacts on the fisheries resource; orders with respect to treaty reserved rights for fish; and orders with respect to instream flows to support treaty fishing rights at "usual and accustomed places."

In addition to the target flows mandated by Congress (see below), USBR has some general instream target flows at various reaches in the river system. These operational target flows are identified in the Watershed Assessment report.

Federal Target Flows from YRBWEP

"Target flows" have been defined at two points in the Yakima River Basin, as mandated by Congress through YRBWEP (Title XII of the Act of October 31, 1994, U.S. Congress [Public Law 103-434]). The legislation provides that the Yakima Project Superintendent shall estimate the water supply which is anticipated to be available to meet water entitlements, and provide instream flows in accordance with the criteria in Table 2-5. This new operational regime was institutionalized in 1995 but initiated by the Yakima Project Superintendent in 1992, prior to passage of the Title XII legislation. The target flows cover the months of April – September (irrigation season), but do not define flows for the remaining months of the year. Operational target flows for other times of year and locations are set by the USBR in consultation with the Systems Operating Advisory Committee (SOAC). Those operational target flows are negotiated annually and are based upon biological needs of fisheries.

Target flows are defined in a way that requires they be increased as water conservation elements of YRBWEP are implemented over time. Table 2-5 displays the target flows at this time, without implementation of conservation elements; and what they would be if the conservation goals of YRBWEP were fully met. For further information on YRBWEP, see the Watershed Assessment report.

Table 2-5
Target Flows at Sunnyside and Prosser Diversion Dams

Water Supply Estimate[1] for Period (million acre feet)				Target Flow (cfs) from date of estimate through October downstream of Sunnyside and Prosser Diversion Dams	
April through September	May through September	June through September	July through September	Without Basin Conservation Program	With Basin Conservation Program
3.2	2.9	2.4	1.9	600	900
2.9	2.65	2.2	1.7	500	800
2.65	2.4	2.0	1.5	400	700
<2.65	<2.4	<2.0	<1.5	300	300[2]

Source: Adapted from Title XII legislation as presented in USBR 1999

[1] "Estimate" refers to the Project Superintendent's water supply estimate.
[2] Only increased with reduced diversions below Sunnyside.

2.6.2 Instream Flow Conditions

Instream Flows in Mainstem Yakima River

An estimate was made of the additional instream flow provided through the Yakima Irrigation Project since the operations of the Project have changed to increase instream flows (Bain/MWG, 2002). Although the Title XII legislation, which institutionalized target flows in the Yakima River, passed in 1994, the USBR operated the Yakima Project to provide increased flows since the early 1990s. The estimate focused on dry years, since these are the years in which instream flow levels are most critical.

Average monthly flows in the Yakima River at Parker were obtained for four dry years that occurred after target flows were implemented (1992, 1993, 1994 and 2001). Those flows were compared to flows for two dry years prior to the increase in instream flows (1973 and 1977). Averages for a combination of both sets of years were used in the calculations.

Table 2-6 presents a summary of the average monthly flows at the Parker gage before and after the change in project operations. In the two water-short years that occurred during the 1970s, the average monthly flow at Parker was in the range of 87 to 844 cfs for the April through September time period. In the four water-short years after USBR modified project operations, the average monthly flow at Parker was in the range of 336 to 1,921 cfs for those same months. The increases in average flows range from 187 cfs in June, to 722 cfs in April. Part of this difference can be attributed to a difference in timing of runoff during the spring snowmelt. However, a large part of the difference was obtained from storage, as the Yakima Project was on “storage control” from May through September during those years.

Table 2-6
Comparison of Instream Flows at Parker
Before and After Change in Project Operations
(cfs, except where noted)

Year	Yakima River Average Monthly Flow at Parker					
	April	May	June	July	Aug.	Sept.
Before Change in Project Operations						
1973	384	455	232	118	133	124
1977	183	234	330	249	295	249
1979	647	844	369	233	118	87
Average	405	511	310	200	182	153
After Change in Project Operations						
1992	849	544	420	407	366	442
1993	1,921	1,509	567	399	402	443
1994	1,089	719	460	336	389	408
2001	649	802	544	448	398	398
Average	1,127	894	498	398	389	423
Increase in Average Flow (cfs)	722	383	187	198	207	269
Increase in Volume of Water (acre-feet)	42,907	23,478	11,133	12,123	12,690	16,003

A summary of the additional volume of water used to support instream flows for each month of the irrigation season is shown in the bottom row of Table 2-6. These values are expressed in acre-feet, and can be summed for different portions of the irrigation season as follows:

- 118,000 AF for the April – September time period;
- 75,000 AF for the May-September time period; and
- 52,000 AF for the June – September time period.

The additional volume of water used to support instream flows results in a smaller water supply during the period of storage control (usually starting in May). That reduction in water supply is likely in the range of 52,000 to 75,000 acre-feet during water short years.

Further discussion of instream flow objectives for the mainstem Yakima River is included in Section 3 of this Watershed Plan. Readers should also refer to the Technical Memorandum prepared on this topic (Bain and MWG, 2002).

Instream Flows in Naches River

The Naches River is a tributary to the Yakima River. However, it is an important part of the mainstem system for managing the Yakima Irrigation Project, due to the presence of Rimrock and Bumping Lakes within the Naches River Basin. Like the Yakima River, flows in the Naches River are managed by USBR as part of Yakima Project operations. The Naches River joins the Yakima River above the City of Yakima. Therefore Naches River flows contribute to the Yakima River flows that pass over Sunnyside and Prosser Diversion Dams, to meet the federal target flows.

The Wapatox canal formerly diverted 300 to 450 cfs from the Naches River at River Mile 17.1 to PP&L power plants and returned flow to the Naches River at River Mile 9.7. Therefore, existing flows within this reach were lower. The mouth of the Naches River is located downstream of the point where the Wapatox Canal flows return to the river. Therefore existing flows at this location were higher. The USBR recently acquired these facilities and has greatly reduced the quantity diverted. This has improved flows in this "Wapatox Reach" of the Naches River.

Further discussion of instream flow objectives for the Naches River is included in Section 3 of this Watershed Plan. Readers should also refer to the Technical Memorandum prepared on this topic (Bain and MWG, 2002).

Instream Flows in Additional Tributaries

Further information on instream flows in the remaining tributaries that were reviewed as part of the watershed planning process is presented in the Technical Memorandum prepared on this topic (Bain and MWG, 2002).

2.7 Habitat Conditions for Fish

Habitat conditions in the Yakima River were assessed, with an emphasis on bull trout, steelhead and spring chinook salmon habitat. Bull trout were listed as threatened in the Columbia River watershed by the U.S. Fish and Wildlife Service (USFWS) in June 1997. Steelhead were listed as threatened in the mid Columbia River watershed by the National Marine Fisheries Service (NMFS) in March 1999. Spring chinook salmon have not been listed as either threatened or endangered, but were considered for listing in March 1998 and are considered a species of interest for purposes of this watershed plan. A variety of other anadromous and resident fish species are present in the Yakima Basin as well, as discussed in the Watershed Assessment.

2.7.1 Summary of Habitat Conditions

For purposes of characterizing habitat conditions, descriptions were developed of six reaches of the mainstem river system (Yakima and Naches Rivers); and 13 tributary subbasins. These areas are shown in Exhibits 2-4 and 2-5. More detailed maps of each reach and subbasin are included in Appendix 2-A.

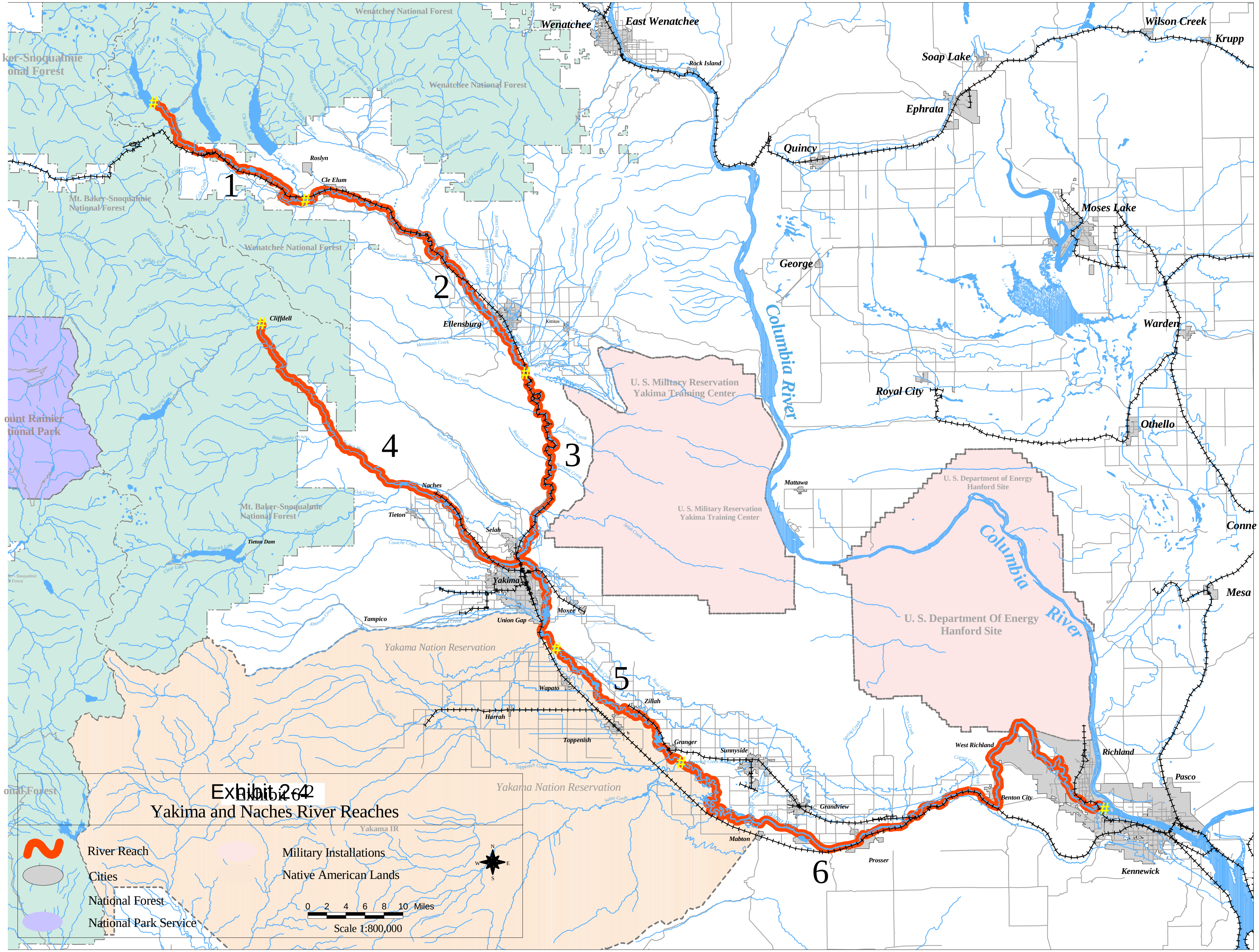


Exhibit 2-4
Yakima and Naches River Reaches
River Reach
Cities
National Forest
National Park Service
Military Installations
Native American Lands
0 2 4 6 8 10 Miles
Scale 1:800,000
N
E
S
W
1
2
3
4
5
6
Wenatchee National Forest
Mt. Baker-Snoqualmie National Forest
U. S. Military Reservation Yakima Training Center
U. S. Department Of Energy Hanford Site
Yakama Nation Reservation
Yakama IR
Columbia River
Wenatchee
East Wenatchee
Rock Island
Soap Lake
Wilson Creek
Krupp
Ephrata
Quincy
Moses Lake
George
Warden
Royal City
Othello
Mattawa
Mesa
Roslyn
Cle Elum
Cliffdell
Ellensburg
Kittitas
Naches
Tieton
Tieton Dam
Selah
Yakima
Moxee
Union Gap
Tampico
Wapato
Harrah
Toppenish
Zillah
Granger
Sunnyside
Grandview
Mabton
Prosser
West Richland
Benton City
Richland
Pasco
Kennewick

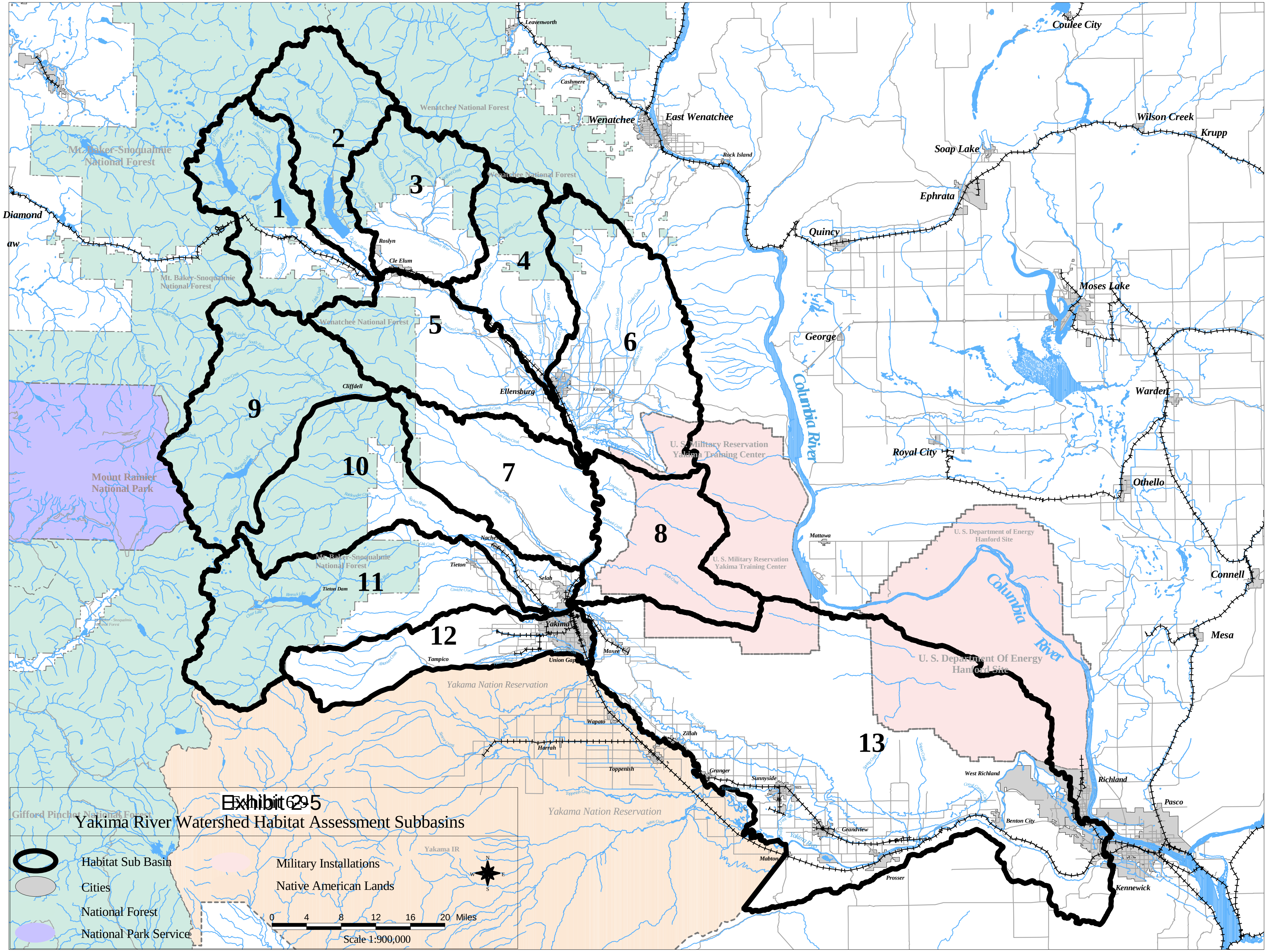


Exhibit 2-5
Yakima River Watershed Habitat Assessment Subbasins
Habitat Sub Basin
Cities
National Forest
National Park Service
Military Installations
Native American Lands
0 4 8 12 16 20 Miles
Scale 1:900,000
1
2
3
4
5
6
7
8
9
10
11
12
13
Leavenworth
Cashmere
Wenatchee
East Wenatchee
Rock Island
Coulee City
Wilson Creek
Krupp
Soap Lake
Ephrata
Quincy
Moses Lake
George
Warden
Royal City
Othello
Connell
Mesa
Mattawa
Diamond
Roslyn
Cle Elum
Ellensburg
Kittitas
Cliffdell
Naches
Tieton
Tieton Dam
Selah
Yakima
Moxee
Union Gap
Tampico
Wapato
Harrah
Zillah
Toppenish
Granger
Sunnyside
Grandview
Mabton
Prosser
Benton City
West Richland
Richland
Pasco
Kennewick
Wenatchee National Forest
Mt. Baker-Snoqualmie National Forest
Mount Rainier National Park
Gifford Pinchot National Forest
U. S. Military Reservation Yakima Training Center
U. S. Department of Energy Hanford Site
Yakama Nation Reservation
Yakama IR
Columbia River

Table 2-7 presents a summary of habitat conditions in the six mainstem river reaches. Table 2-8 presents similar information for the 13 subbasins.

Table 2-7
Habitat Conditions and Problems Matrix - Mainstem River Reaches

Watershed Unit		Habitat Conditions / Problems
Reach #1	**Yakima River Mainstem** *Keechelus Dam* *to* *Cle Elum River*	Reach includes some of most productive spawning habitat for spring chinook and steelhead in Yakima Basin. Problems are associated with flow releases, (fluctuations low in-stream flows) localized bank sloughing, woody debris deficiencies near developed shorelines and elevated water temperatures.
Reach #2	**Yakima River Mainstem** *Cle Elum River* *to* *Wilson Creek*	Reach considered the most productive spawning reach for spring chinook and steelhead in the entire Yakima Basin, particularly between Cle Elum and Easton Dam where channel complexity/LWD/pools, gravels are excellent. Downstream reaches confined by levees, highways have lost riparian function and channel complexity. Sustained high summer flows from reservoir releases not optimum for rearing juveniles which need more side channel access. Sediment loads high during winter/spring runoff events, mainly from Teanaway River.
Reach #3	**Yakima River Mainstem** *Wilson Creek* *to* *Parker Dam*	Reach highly channelized in Yakima Canyon where complexity is low and flow velocities from reservoir release higher than optimal for rearing juveniles which need side channel refuge. Water quality generally excellent although high sediments are periodically received from Wilson Creek and Teanaway River. Sediment settles behind Roza Dam and is a problem to downstream spawning areas when flushed out. Woody debris nearly absent as recruitment limited to up river sources. Levees/highways confine channels near the City of Yakima restrict floodplain function.
Reach #4	**Naches River Mainstem** *Little Naches River* *to* *Nachess River Mouth*	Reach highly productive for spawning, second best in basin. Problems include lack of off channel rearing habitat; channel confinement by levees/road limiting riparian function (e.g. LWD recruitment), numerous diversions resulting in low flow problems mainly associated with Wapatox Power Canal which significantly impact flow in a 7 mile reach and cause water temperature increases.
Reach #5	**Yakima River to Mainstem** *Parker Dam* *to* *Toppenish Creek*	Reach important as a migratory corridor and of secondary importance for spawning; instream flow significantly lower than upstream reaches, serious water quality problems, including fecal coliform, sediment loads from agricultural drains and associated pesticide residues. Portions of reach channelized with deficient riparian cover, off channel habitats exist with potential for more connectivity to local sloughs and oxbow lakes.
Reach #6	**Yakima River Mainstem** *Toppenish Creek* *to* *Mouth*	Reach seriously degraded by toxicants (metals, PCBs, pesticides), fecal coliform, and elevated temperatures. Sediments from drains blanket slough like river bottom. Flows significantly reduced in 10 mile stretch near Prosser due to Chandler Power Plant. Localized deficiencies in riparian shade and off channel rearing. Important migratory corridor. Fall chinook spawn in this reach.

Table 2-8
Habitat Conditions and Problems – Tributary Water Bodies

Watershed Unit	Habitat Conditions/Problems
Gold Creek	Relatively pristine watershed but lacks sufficiently large woody debris to stabilize channel. Low flows and high temperatures are problems. Bull trout migration from Lake Keechelus adversely affected by reservoir drawdown.
Lower Kachess River	Limited woody debris and gravel recruitment below Kachess Dam, dam blocks fish passage, water temperatures elevated from impounded water in late summer, high summer flows suboptimal for rearing juveniles.
Upper Kachess River	Lack of large woody debris. Limited side channel habitats for rearing juveniles (bull trout) in steeper upper reaches. Sediment erosion related to roads, recreation. Dam blocks access to anadromous fish.
Box Canyon Creek	Sediment concerns from compacted recreational sites and streambank erosion. Lack of channel definition within Kachess Reservoir during drawdown impacts bull trout migrations from the lake.
Cabin Creek	Extensive impacts associated past timber harvest, landslide barrier to fish passage three miles from mouth, riparian areas logged, channel instability from slopes above riparian areas, water temperature exceedances, numerous landslides.
Big Creek	Fish passage barriers, low stream flows caused by agricultural diversions, unscreened diversions, deficiencies in large woody debris and lack of riparian shade. Impacts from past forest fires.
Lower Cle Elum River	Limited woody debris and gravel recruitment below Cle Elum Dam, dam blocks fish passage, temperature elevated from impoundment in late summer in dry years, high summer flows suboptimal for rearing juveniles.
Upper Cle Elum River	Large woody debris and riparian shade generally deficient but adequate in wilderness areas above Salmon LaSac. Upper watershed has high quality bull trout habitat, sediment erosion from recreational vehicles.
Teanaway River	Mainstem has seasonal low flow problems. Upper reaches experience serious erosion mainly due to timber harvest and roads. Riparian shade and large woody debris deficient due to logging of riparian areas and natural conditions. Water temperature elevated, limited rearing habitat, especially in North Fork. Some channels are entrenched. Lacks appropriate width to depth ratios.
Swauk Creek	Low flows mainly a natural condition. Mainstem confined and straightened along state highway with high scouring by peak flows due to altered gradient, and lack of complexity (due to insufficient large woody debris). Past mining has disturbed channel substrates. Surface erosion from logging, forest roads and grazing.
Reecer Creek	Channels confined, straightened and entrenched through agricultural area, numerous barriers and unscreened diversions, channels used as irrigation laterals, irrigation return flows increase turbidity, nutrients.
Dry Creek	Low flows, high sediment load during runoff events, some habitat for rearing near mouth.
Taneum Creek	Low flows near mouth, although recent improvements to flow, passable fish barriers, some deficiencies in woody debris but generally adequate pool habitats. Water temperature exceedances. Habitat generally good.
Manastash Creek	Numerous unscreened diversions, fish passage barriers, low flows and dewatered reach during summer embedded spawning gravel from fine sediment erosion from roads, clear cuts and recreational areas, large woody debris and riparian shade deficiencies, water temperature exceedances.
Wilson Creek	Lower reaches have numerous unscreened diversions, fish passage barriers, degraded riparian zones, channels straightened and entrenched, and receive irrigation return flows and urban stormwater. Sections are piped through City of Ellensburg. Upper reaches have high quality habitat (e.g. Naneum Creek).

Table 2-8 (cont)
Habitat Conditions and Problems – Tributary Water Bodies

Watershed Unit	Habitat Conditions/Problems
Cherry Creek	Numerous unscreened diversions, fish passage barriers, degraded riparian zone, channels straightened and entrenched, receives irrigation drainage, channels used as irrigation laterals, suspended sediment and associated pesticide residues are documented water quality problems, elevated water temperature, silty bottom substrates. High summer flows maintained by imported water provide false attraction for migrating salmonids.
Lmuma Creek	Six mile perennial reach with limited rearing potential near mouth, high sediment load during runoff events, riparian impacts by cattle and military vehicles, intermittent flow in most of watershed.
Burbank Creek	Limited rearing potential near mouth, high sediment load during runoff events, riparian impacts by military vehicles, intermittent streamflow.
Selah Creek	Limited rearing potential near mouth, high sediment load during runoff events, riparian impacts by military vehicles, intermittent streamflow.
Umtanum Creek	Limited area with good spawning and rearing habitat; impassable waterfall eight miles from mouth. Low flows.
Lower Wenas Creek	Degraded habitat below Wenas Dam which blocks fish passage to the upper watershed, numerous small barriers, diversions cause flow depletion on lower 9 miles, severe riparian damage and elevated temperature in some reaches.
Upper Wenas Creek	Access blocked by Wenas Dam, seasonal low flows (natural condition), forested area with significant riparian zone but information lacking on stream habitat quality.
Little Naches River	Extensively logged watershed with sediment erosion problems (e.g. embedded gravels, riparian zone damage), deficient large woody debris. High water temperatures. Natural waterfall barriers.
American River	Generally excellent habitat with good spawning gravels and abundant woody debris, fish passage problems in natural gorge during low flow. Some impassable waterfalls.
Lower Bumping River	Supports spawning below unladdered dam, high flows during spawning elevated water temperatures.
Upper Bumping River	High quality habitat for bull trout, anadromous fish migration blocked by dam. Fine sediment problems in gravels in selected tributaries. Natural waterfall barriers in watershed.
Rattlesnake Creek	Accessible high quality habitat. Peak flows scour channel. Some waterfall barriers and culvert passage problems.
Lower Tieton River	Tieton Dam blocks access to upper watershed, increased flow releases during September (flip-flop) suboptimal for rearing salmonids, low winter flows due to storage, deficient gravel recruitment and deficient large woody debris/ pool development below dam.
Upper Tieton River	Generally excellent habitat for bull trout with generally abundant woody debris and pool development. Inaccessible to anadromous fish due to unladdered dam. Sediment erosion problems attributed to logging, grazing and recreation.
Cowiche Creek	Numerous barriers and diversions (some unscreened), degraded riparian areas and low flows in North Fork, sediment problems (e.g. bank sloughing) and water temperature exceedances.
Ahtanum Creek	Fish passage barriers and dewatered reaches due to irrigation diversions (some unscreened) block access to upper forested watershed where habitat is generally good. Livestock impacts in riparian areas. Riparian areas suboptimal. Sedimentation from roads. Pesticide residues documented in water, sediment and fish tissue.
Wide Hollow Creek	Fish passage problems and numerous irrigation diversions (some unscreened). Urban stormwater impacts, entrenched channels in lower reach. Grazing impacts near mouth. Pesticides and elevated temperatures and fecal coliform. Riparian areas suboptimal but shade cover available.

Table 2-8 (cont)
Habitat Conditions and Problems – Tributary Water Bodies

Watershed Unit	Habitat Conditions/Problems
Spring Creek	Fish passage barriers exist, although anadromous fish utilization occurs due in part to false attraction flows from canal releases; high pesticide residues from agricultural drainage; channels are entrenched and lack complexity and have virtually no woody debris, water temperatures are high.
Snipes Creek	Channel used as a wasteway; false attraction flows are a concern, channels entrenched and lack complexity, dissolved oxygen does not meet standards. Some riparian shade but little woody debris.
Sulphur Creek	Channel functions as a wasteway; false attraction flows attract migratory fish, significant water quality problems including numerous pesticide exceedances and high water temperatures. Silty bottom substrates
Corral Canyon Creek	Seasonal fish barrier and diversion steeply incised channel receives agricultural drainage, streambank cover in lower mile and grazing impacts in upper drainage.

Primary sources of information for Tables 2-7 and 2-8 habitat conditions summary can be found in the Watershed Assessment and in the technical memorandum developed on habitat (Bain, 2002a).

2.7.2 Aquatic Life and Habitat Factors

This section provides information on Yakima River aquatic life and general fish habitat needs.

Fish Habitat Needs

Fish have different habitat needs based in part on their life history stages. Anadromous fish migrate and have unique needs throughout the aquatic system which may be frustrated by the presence of dams or other barriers, low stream flows, and high temperatures during times of passage. Resident fish have year round requirements as well as specific habitat needs during critical times such as spawning. Salmonids need colder temperatures than many non game fish (e.g. dace, sculpin) and require higher dissolved oxygen concentrations particularly over spawning gravels. Some resident salmonids (e.g. bull trout) require lower water temperatures. Successful salmonid reproduction requires channel and substrate stability and adequate winter water flow to prevent freezing. Adults use pools, large woody debris, large boulders and undercut banks for resting and foraging. Juveniles also use side channels and smaller wood in the water. Channels to accommodate fish moving between safe wintering areas and summer foraging areas are also necessary.

Habitat preferences and timing of life cycle stages such as spawning and incubation of eggs differ for anadromous and resident salmonid fish found in the watershed. See Table 2-9 for examples of habitat preferences of the targeted species (steelhead, spring chinook and bull trout) (Boise Cascade

1996). [7] Habitat needs of different life cycle stages vary by species. Resident rainbow trout generally spawn from February through June; the peak spawn period is generally earlier at low elevations as compared with higher elevations in the upper Yakima River system. Steelhead spawning times are similar. Spring chinook spawning areas need to be protected during late summer and through the fall and winter.

Table 2-9
Selected Information for Targeted Salmonid Species [(a)]

	Steelhead	Spring Chinook	Bull Trout
Adult Migration	February – June	August – September	N/A
Spawning	March – June	August – October	September – October
Incubation	Spring/Summer	August – June	Emerge in April
Out Migration	June	March –June	N/A
Water Temperature	Prefer 10-13°C	12-14°C	9-15°C

[(a)]Adapted from Tabulation in Teanaway Watershed Analysis –Boise Cascade Corporation

2.7.3 Overview of Habitat Factors and Conditions

Based upon habitat needs of targeted species, habitat factors were selected for the Yakima River watershed assessment considering information derived from technical reports and studies. The resulting habitat factors were grouped as shown below in Table 2-10. A description of each of these habitat factors is provided in the Watershed Assessment report. Section 2.7.4 of this Plan provides a summary of the fifteen habitat factors selected for a comparative evaluation of habitat conditions of different water bodies in the basin.

Table 2-10 Freshwater Habitat Factors

Water Quality/Quantity	Physical/Geomorphic Factors	Ecological Interactions
*False Attraction Flows	*Channel Width, Depth, Gradient	Competition (hatchery & other)
*Low Flow and Dehydration	*Channel Stability	**Food Web**
*Flow Peaks/Fluctuations	*Channel Complexity	
Velocity/Turbulence	*Channelization/Alterations/ Levees	Predation
Dissolved Oxygen		Disease and Stress
*Suspended Sediment	Dredging & Filling	*Riparian Shade/Streambank Cover
*Temperature	*Barriers, Screens and Diversions	*Large Woody Debris
Nutrients	*Spawning Gravels/Recruitment	Side Channels/Wetlands
Toxicants	*Off-Channel Habitat	
Pathogens	*Pools and Riffles	
	Ground water Contributions/Losses	

*The 15 habitat factors selected for comparative evaluation.

Using the freshwater habitat factors outlined above, habitat conditions were assessed in the basin comprising six mainstem river reaches and 13 tributary subbasins. As might be expected, the Yakima River Basin has a mix of high quality, degraded but functional, and highly degraded habitat. Different

[7] Boise Cascade Corporation, Teanaway Watershed Analysis, 1996.

habitat limiting factors exist depending upon geographic location and current and historical land uses adjacent to a water body.

2.7.4 Habitat Conditions Prioritization and Comparative Analysis

Fish habitat conditions were rated in 31 tributaries, the Naches River mainstem, and five mainstem Yakima River reaches discussed above[8]. Conditions in each water body were tabulated in ratings from a total of 15 separate habitat factors primarily reflecting physical conditions, including two water quality parameters (temperature and sediment). The factors were selected based upon the major categories of habitat factors that affect the survival of salmonids. A summary of these factors are provided below. The order of factors has no relation to the importance of each issue. Brief explanations and comments are provided on the individual factors and their importance to fish. See the watershed assessment for more detail on these factors and supporting references.

Habitat Factors Used In Comparative Analysis

***False Attraction Flows**:* Water is imported into some subbasins from the Yakima River or from adjacent subbasins usually to supply irrigation needs. Releases from irrigation canals (e.g., operational spills) and tailwater discharges, which reflect characteristics of imported water sources, can attract migrating salmonids homing in on their natal waters. False attraction is a problem if fish are lured into habitats that are poor for spawning or isolated from natural spawning populations. Delays in spawning also occur and may lead to higher pre-spawning mortality.

Low Flow and Dehydration: Low flow problems exist in the watershed and may be related to diversions, changes in watershed characteristics, or to climatic conditions. There are tributary reaches that have completely dry stream beds at times, usually in late summer in water short years.

Flow Peaks/Fluctuations: Excessive flow can create problems for fish in a variety of ways. High velocities can harm young fish especially in channelized or entrenched reaches where lower velocity side channel waters are inaccessible. Additionally, excessive peak flows can scour channels moving gravels and destroying established nests (redds). Increased frequency of peak flow (i.e. disturbance frequency and increased energy) can add to bank erosion and lead to channel changes such as entrenchment, which can cut off side channel rearing areas. Benefits of high velocity during flood events do exist as woody debris can be added to enhance stream complexity

[8] There are over 500 annotated footnotes in Section 6 of the Phase 2 Assessment, many of which deal with water quality conditions in specific areas. Reference sources for water quality include USGS NAWQA reports, Conservation District reports, Watershed Assessments by USFS and DNR, 1998 303(d) listings, and water quality monitoring information also gathered from knowledgeable individuals through direct communications.

and fine sediments may be washed from silted stream gravels leaving a cleaner more easily aerated spawning substrate thus improving a damaged habitat. High flow events also have a role in forming channels and help recruit large woody debris (LWD) and gravel. Rapid changes in flow due to reservoir releases of power plant operations can be a concern to fish. The USBR has examined short-term flow variability because it has been demonstrated that excessive, cyclic dewatering and rewatering of shallow or slack water habitats on weekly, daily, or even hourly schedules can reduce biotic productivity. These shallow water habitats are especially important to survival of early life history stages of fish that cannot survive in the strong currents of the main channel. Stability of these habitats allows necessary food web organisms to develop in rearing areas for young fish.

Channel Width, Depth, and Gradient: Stream channels obviously must have sufficient water depth to allow fish to move from place to place, and gradients must not be impassable. Small fish may survive in disconnected pools or shallow water for a time depending on shade and cover. Some species such as steelhead may be capable of negotiating steeper gradients than other salmonids.

A width to depth ratio can be used to relate sufficient depth and acceptable gradients for fish populations. By using such a ratio, the relationship between stream depth, stream surface width, and stream gradient can be quantified. In general terms, large stream widths and small stream depths result in large ratios while small stream widths and small stream depths result in small ratios. A steep gradient decreases stream width and increases stream depth while a mild gradient increases stream width and decreases stream depth. A functional stream has an average width:depth ratio of around 12, ranging from less than 10 to not greater than 20. Channels with width:depth ratios greater than 12 experience high bank stress, followed by bank erosion while channels are considered degraded when width exceeds 20 times depth.[9] Gradients in excess of 12 percent are generally considered poor to fair for fish habitat.

Channel Stability: Stream channels erode and can become entrenched as a result of downcutting caused by numerous natural and unnatural events. Bank erosion contributes fine sediment, which can affect spawning gravels and inhibit development of food web organisms (e.g., aquatic insects) important to fish life. Entrenchment can limit floodplain function and cut off access to side channel rearing areas. Channel migration can strand redds and scouring can destroy redds.

Channel Complexity: Complexity exists where the following characteristics are present: combination of high gradient step pool channels and low gradient braided channels, ample large woody debris and/or large rocks to

[9] Rosgen, D. 1996. Applied River Morphology. Wildland Hydrology, Pagosa Springs, Colorado.

encourage development of pools, overhanging backs and streambank cover. Channel complexity is important for rearing allowing young fish cover and shade to elude predators. Complexity also helps provide clean cool water for all life stages. Downstream areas below the forested zone may lack some of these attributes, but are enhanced by streambank vegetation and debris washed from upgradient areas.

Channelization/Alterations/Levees: There have been stream alterations in the past including mainstem channel dredging activities and complete realignment of certain tributaries necessary for railroads, highways, or flood control levees.. Some of these activities are associated with past mining activities (e.g., Swauk Creek); others were to accommodate agricultural activities or construction. Some streams have been piped or channelized through urban areas (e.g., Wilson Creek) near Ellensburg. There are examples of channel changes associated with highway construction related to both I-82 and I-90. Dredging is more common in areas near the mainstem where gravel has been extracted. Past gravel operations associated mainly with highway construction have created lake-like environments along the floodplain, some of which may have potential as rearing areas but lack complexity and offer few places for young fish to hide. Complex habitat is important in wide floodplain areas but is currently limited throughout most of the Yakima River due to channelization and levees.

Flood control levees have been built along portions of the mainstem Yakima River and Naches River over the past century. This information is recorded on U.S. Army Corps of Engineers maps and from County Public Works personnel. Either levees or adjacent highway or railroad corridors control some areas of the river. Channelized, constrained river channels inhibit floodplain functions such as woody debris recruitment, shade canopy, and side channel access. Channel constraints may also reduce moisture retention/release from otherwise flood prone soils.

Flood plain encroachment and filling is a potential problem often associated with highways or other structures. Floodplain areas that have been developed for agriculture generally have lost functional wetlands some of which could provide rearing habitat.

Barriers, Screens and Diversions: Fish passage is a major concern in some tributaries and at major storage dams in the upper Yakima River and Naches River watersheds. Diversion structures associated with withdrawals block access mainly during the irrigation season when removable checks are in place. There are diversion structures such as culverts that are barriers to year-round passage. Storage dams, such as Cle Elum, block many miles of relatively pristine stream habitat that once supported anadromous fish. Upstream and downstream fish passage systems are being studied for some of these dams (e.g., Cle Elum) as part of the Yakima Enhancement Project. Additionally, the U.S. Bureau of Reclamation (USBR) is beginning an appraisal study on fish passage in 2002 for all five USBR dams, with a more detailed feasibility study scheduled for 2004. There are Fish Passage Assessment Guidelines (DFW, 1998) which include prioritization approaches that address related habitat surveys. Screening of diversions in fish bearing waters is important for reducing fish mortality. Adequately screened diversions prevent fish from being impinged on a screen surface and from being routed through a pump impeller. Unscreened diversions exist and remain of particular concern on several tributaries in the Yakima River Watershed.

Spawning Gravels/Recruitment: Fish habitat can be impacted by type of substrate. A clean well-aerated gravel substrate with a gravel recruitment source can provide excellent spawning habitat and will produce organisms such as mayflies that are important to the food web. A gravel that has been plugged with fine sediment will have diminished value. A stream meandering through a floodplain area with ample gravel subsoils will replenish gravels. Gravels wash in during run-off events or as channels shift. A stream running through a deep fine-textured soil or when flowing across bedrock will usually be less productive spawning habitat for salmonids. Inventories of potential gravel recruitment areas and recruitment mechanisms have been carried out in other watersheds and are needed in the Yakima River System. In-river structures, such as a water diversion, can block or alter gravel distribution and recruitment.

Off-Channel Habitat: Off-channel habitat (refugia) necessary for juvenile salmonid survival during peak flow events and periods of cold weather is generally lacking throughout much of the mainstem Yakima River due to levees, roads, railroads, and floodplain/floodway filling for land uses. This habitat type is also necessary for early rearing of fall chinook salmon when rapid growth in the first weeks of life is necessary for the fish to become large enough to survive downstream impacts (predators, mainstem Columbia River passage, and estuarine conditions). High quality off-channel habitat is comprised of slow velocity water that contains various types of instream cover (depth, woody debris, boulders, etc).

Pools and Riffles: Pools and riffles provide desirable fish habitat and streams are sometimes rated for habitat quality based on the quantity and quality of resting pools per mile. Generally large pools are those greater than 20 square meters in area and at least one meter deep. The USFS Yakima Watershed Analysis (undated), standard for low gradient streams (2 percent or less) is one or more primary pools every 5 to 7 bank full widths. A primary pool should cover at least 50 percent of the low flow channel and have a maximum depth of 0.9m according to USFS standards. Other criteria (National Marine Fisheries Services, August 1999, The Habitat Approach) (NMFS 1999) show need for at least one pool greater than 3 feet deep per reach for functional streams. Pool to riffle ratios, pool quality, and pool quantity have all been affected by flow alterations, channelization, and streambank instability throughout much of the Yakima River basin.

Riparian Shade/Streambank Cover: Riparian shade varies depending on the density and type of native vegetation, topography, and soils as well as land use practices, stream width, and channel complexity.

Streambank cover is a related riparian function particularly important to the survival of young salmonids. Streams with adequate reaches of undercut banks and other complexity features such as upturned stumps, pools and riffles formed by large woody debris provide desirable habitat. It is recognized that not all stream reaches will have the complexity achieved within forested areas.

Large Woody Debris: Large woody debris (LWD) along with large rocks and boulders provide needed structure for pool formation. A lack of woody debris recruitment is often an issue due to past timber harvest practices in riparian areas, presence of levees, large dams, fire or land clearing activities. On smaller tributaries in forested areas criteria exist as to the desired size of woody debris and debris placement, while criteria have not been standardized for large mainstem rivers. For instance, USFS standards call for at least 60 pieces of LWD per mile greater than 0.1 meters in diameter and 2.0 meters long. Other criteria for the east slopes of the Cascades call for 20 or more pieces of LWD per mile greater than 12 inches diameter for functional streams. (NMFS, 1999)

Larger woody debris jams help to trap and store fine sediments thus protecting downgradient spawning areas. They also absorb energy to increase bank and channel stability. Woody debris jams also facilitate mid-channel pools and create backwater habitat along stream margins or in side channels. Woody debris also harbors food organisms and helps to trap salmon carcasses important to maintenance of the food web.

Water Quality – Temperature and Sediment: Water quality standards for water temperature vary with stream classification. Class AA (Extraordinary) waters have an upper temperature limit of 16ºC with minimal changes allowed due to human activities. The applicable standard for Class A waters is 18ºC; however the mainstem of the Yakima River below the mouth of the Cle Elum River has a standards exception allowing a temperature maxima of 21ºC.

Ecology issued a preliminary review draft on temperature criteria in 1998 which evaluates standards for protecting aquatic life. [45] This document addresses temperature requirements for Char and Salmonids and identifies temperature needs for spawning season which are cooler than the 18°C standard except that single (e.g. one day) daily maximum values of 19°C are allowed at the onset of spawning. Spring Chinook spawn during late summer- early autumn (August – September), when elevated water temperatures may occur. However, steelhead spawn earlier, typically before June 1, and lower daily peak temperature values are recommended (e.g. 13°C). [46] Char (bulltrout) spawn in late summer – early autumn and have still lower water temperature needs during spawning and single daily maximum values are significantly cooler (8-10°C) than those identified for Chinook salmon or steelhead.

Suspended sediment causes turbidity, creates problems for fish in the water columns and in stream bottom substrates after sedimentation occurs. Excessive sediment in the water column can impede fish growth rates, cause mortality, and modify fish movements and migrations. Sediment also prevents successful development of fish eggs and aquatic inserts important to the food web (EPA, 1976).

Habitat Conditions Evaluation and Comparative Analysis Methodology

The habitat condition evaluation and comparative analysis is based upon a rating system where an open circle denotes generally acceptable or good conditions for each category, a half filled circle denotes fair condition (i.e. moderate problems), and a fully darkened circle denotes poor conditions or more serious concerns. This information is presented in Table 2-11 for the tributaries and Table 2-12 for the mainstem Yakima and Naches Rivers. Footnotes are included to clarify or explain basis for some ratings. Explanatory notations are included for selected ratings.

Yakima River mainstem conditions were found to be more suitable in the upper three reaches and generally deteriorate in a downstream direction. The figure indicates that Reach 2 was best, followed by Reach 1 and the Naches River, and then Reaches 3, 4, and 5. There are exceptions within the reach designations that are not revealed by the overall ratings, such as flow related problems associated with the reach affected by the Chandler Power Plant. Habitat conditions are better in the reach between Keechelus Dam and Wilson Creek than in the lower area below Sunnyside Dam. The scores represent a generalized rating of condition.

2.8 Surface Water Quality

Water quality is a key consideration in planning for the Yakima River Basin. This Watershed Plan focuses on surface water quality due to its significant role in many of the key issues regarding water resources management within the Yakima Basin. Ground water quality was also addressed, but at lower level of detail.

Table 2-11 Habitat Matrix – Yakima River Tributaries

WATERWAY	False Attraction Flow	Flow	Flow Peaks/ Fluctua -tions	Channel Width, Depth & Gradient	Channel Stability	Channel Complexity	Channel Alterations & Levees	Barriers, Screens & Diversions	Spawning Gravels/ Recruit-ment	Off-Channel Habitat	Pools & Riffles	Riparian Shade	Large Woody Debris	Temp	Sedi-ment
Gold Cr	○	◒	○	◒	●	○	○	○ a	●	○	○	◒	◒	◒	○
Kachess River	○	◒	○	○	○	○	○	●	◒	○	◒	◒	◒	◒	○
Cabin Creek	○	○	◒	○	●	◒	◒	●	◒	◒	●	●	●	◒	◒
Big Creek	◒	●	◒	○	◒	◒	○	◒	○	◒	◒	◒	◒	◒	○
Cle Elum River	○	○	◒	○	○	○	○	●	○	○	◒	◒	◒	◒	○
Teanaway River	○	●	◒	◒	◒	◒	○	◒	◒	◒	●	●	●	●	● f
Swauk Creek	○	●	●	●	●	◒	○	◒	◒	◒	◒	◒	◒	◒	◒
Reecer Creek	●	◒	◒	●	◒	●	●	●	◒	●	●	●	●	◒	◒
Taneum Creek	◒	◒	◒	◒	◒	◒	○	◒	●	◒	◒	◒	◒	◒	○
Manastash Cr	●	●	◒	◒	◒	◒	○	●	●	◒	◒	●	●	◒	◒ e
Wilson Creek	●	○	◒	◒	◒	●	◒	●	◒	●	◒	●	●	◒	◒
Cherry Creek	●	◒	◒	●	◒	●	●	●	●	●	●	●	●	◒	●
Umtanum Cr	○	◒	○	◒	○	◒	○	◒	○	○	○	◒	◒	◒	○
Wenas Creek	○	●	○	◒	●	●	●	●	◒	●	●	●	●	●	◒
Lmuma-Burbank	INTERMITTENT STREAMS – SOME REARING HABITAT NEAR CREEK MOUTH									◒					◒
American River	○	○	○	○	○	○	○	○	○	◒	◒	◒	○	◒	○

Table 2-11 Habitat Matrix – Yakima River Tributaries (cont)

WATER-WAY (cont.)	False Attraction Flow	Flow	Flow Peaks/ Fluctua -tions	Channel Width, Depth & Gradient	Channel Stability	Channel Complexity	Channel Alterations & Levees	Barriers, Screens & Diversions	Spawning Gravels/ Recruit-ment	Off-Channel Habitat	Pools & Riffles	Riparian Shade	Large Woody Debris	Temp	Sedi-ment
Bumping River	○	◒	◒	○	○	○	○	●	◒	◒	◒	◒	○	◒	○
Little Naches R.	○	◒	○	○	○	◒	○	◒ d	◒	●	●	●	●	◒	○
Rattlesnake Cr	○	○	◒	◒	○	○	○	◒	○	◒	○	◒	○	◒	○
Tieton River	○	◒	●	○	◒	◒	○	●	◒	◒	◒ b	◒ b	◒ b	◒ j	○
Cowiche Cr	◒	◒	●	○	◒ b	◒	○	●	◒	◒	◒ c	◒ c	◒ b	●	◒ g
Ahtanum Cr	○	●	◒	○	◒	●	◒	●	◒	◒	●	◒	●	●	○
Wide Hollow Cr	○	◒	◒	◒	◒	●	◒	●	◒	◒	◒	◒	◒	◒	◒
Spring-Snipes Cr	●	◒	◒	◒	◒	●	◒	●	◒	●	●	●	●	◒	◒ h
Corral Canyon Cr	○	◒	◒	◒	◒	●	◒	●	◒	●	●	●	●	◒	◒
Sulphur Creek Wasteway	●	◒	◒	●	●	●	●	●	●	●	●	●	●	◒	◒ i
Moxee Drain	●	◒	◒	●	●	●	●	●	●	●	●	●	●	●	◒
Granger Drain	●	◒	◒	●	●	●	●	●	●	●	●	●	●	◒	◒ i

a Drawdown of Keechelus Reservoir creates fish access difficulties to Gold Creek affecting bulltrout.

b Rating based on conditions below Tieton Dam, conditions are acceptable in upstream reaches

c Rating based on North Fork Cowiche Creek; South Fork is acceptable

d Most barriers on Rattlesnake Creek are natural waterfalls.

e Primary sediment concern is upper watershed spawning gravels, particularly Northfork.

f High seasonal sediment load during spring runoff.

g USGS Ag index was only applied to South fork upstream of agricultural areas.

h Snipes Creek = fair, Spring Creek=poor

i Sediment loads are being reduced through local efforts in response to TMDL and other efforts

j Dissolved oxygen concentrations below state standards as measures by USFS below Tieton Dam.

RATING KEY

○ GOOD ◒ FAIR ●

Table 2-12 Habitat Matrix – Yakima River Mainstem and Naches River

YAKIMA RIVER MAINSTEM	False Attraction Flow	Flow	Flow Peaks/ Fluctuations	Channel Width, Depth & Gradient	Channel Stability	Channel Complexity	Channel Alterations & Levees	Barriers, Screens & Diversions	Spawning Gravels/ Recruitment	Off-Channel Habitat	Pools & Riffles	Riparian Shade	Large Woody Debris	Temp	Sedi-ment
Keechelus Dam to Cle Elum R.	○	◒	◒ a	◒	○	◒	○	◒ b	○	◒	◒	◒	◒	◒	○
Cle Elum River to Wilson Cr	○	◒	○	○	○	◒	●	○	○	◒	○	◒	◒	◒	○ f
Wilson Creek to Parker	○	○	○	○	○	◒	◒	◒ c	○	●	●	● d	● e	◒	◒ g
Parker to Toppenish Creek	○	●	○	◒	○	◒	◒	◒ c	○	◒	◒	◒ d	◒ e	●	◒ h
Toppenish Creek to Mouth	○	○	○	●	○	●	◒	◒ c	◒	●	◒	● d	● e	●	● h
Naches River	○	◒	◒	◒	◒	○	◒	○	○	●	◒	◒ d	◒ e	◒	○

a USBR is correcting flow fluctuations from reservoir releases with revised ramping rates.
b Keechelus Dam is unladdered. No migratory fish passage to or from upstream tributaries.
c Barriers and diversion exist but are passable (major, diversion, or screened near river).
d River widths preclude extensive shading by trees prevalent near river in this climate zone (e.g. cottonwoods).
e High flows wash large woody debris downstream, fewer opportunities for establishment of large trees due to highways, levees, and climate.
f Affected by high sediment loads from Teanaway River during winter/early spring runoffs.
g Affected by sediment loads from Wilson/Cherry Creeks during spring/summer.
h Progress being made through TMDL implementation; inputs from Yakama Reservation agricultural drains impact Yakima River.

RATING KEY

○ GOOD ◒ FAIR ● POOR

A number of previous studies and planning processes have addressed water quality. The Watershed Assessment prepared during the planning process drew on these studies as well as additional sources of raw data regarding water quality. These included reports prepared by the U.S. Geological Survey (USGS) under the National Water Quality Assessment (NAWQA) program. NAWQA provided the most extensive study of surface water quality in the Yakima Basin, and is complemented by many other studies on specific water quality topics.

For a summary of state water quality criteria, see the Watershed Assessment document.

2.8.1 303(d) List and Total Maximum Daily Loads (TMDLs)

The federal Clean Water Act (CWA) includes provisions addressing surface waters that do not meet established water quality standards. The State of Washington is directed to identify surface-water bodies that do not achieve water quality standards. These water bodies are commonly known as the "303(d) list." In the Yakima Basin 150 listings have been placed on 70 water bodies listed on the 303(d) list. Ecology has a program to develop water quality cleanup plans for each listed stream segment. These cleanup plans are known as "Total Maximum Daily Loads" or TMDLs.

TMDL Reports completed by Ecology in the Yakima Watershed, and accepted by EPA as of October 30, 2002:

- ❑ Lower Yakima River DDT and Suspended Sediment TMDL 97-321
- ❑ Teanaway River Temperature TMDL 01-10-019
- ❑ Granger Drain Fecal Coliform TMDL 01-10-062
- ❑ Upper Yakima OCP and Sediment TMDL 02-03-012

Also, regarding metals listings in the Upper Yakima River. The report titled:

- ❑ Concentrations of 303(d) Listed Metals in the Upper Yakima River (# 00-03-024). Recommends that the Upper Yakima River be removed from the 303(d) list for: Copper, Cadmium, Mercury and Silver.

TMDL projects that Ecology is currently working on:

- ❑ Wilson Creek Sub Basin Bacteria TMDL

During the fall and winter of 2002, Ecology will be reviewing the 303(d) listings in the Yakima River Basin that are not currently being addressed in one of the above TMDLs. From these listings, more TMDL projects could result. Direction from the community (ies) in the watershed will be sought through this process.

For a current listing of TMDL projects and status reports, see Ecology's website for its water quality program.

2.8.2 Water Quality Parameters

A wide variety of physical, chemical, and biological parameters have been studied with respect to surface-water quality in the Yakima Basin. With respect to surface water, the Watershed Assessment focused on the following set of water quality parameters:

- Temperature;
- Dissolved oxygen (DO);
- Nutrients (i.e. substances that stimulate growth of aquatic plants);
- Fecal indicator bacteria;
- Suspended sediments and turbidity; and
- Pesticides.

Taken as a group, these parameters include most of the water quality problems that have been identified as significant, basin-wide issues by State and/or federal regulatory agencies and by previous studies of water quality in the Yakima Basin. The Watershed Assessment describes sources and causes of impairment for each of these parameters.

2.8.3 Surface Water Quality Conditions

Water quality conditions were rated in 31 tributaries and five (5) mainstem Yakima River reaches. Conditions in each water body were tabulated in ratings for six water quality parameters and three more generalized water quality ratings. Mainstem river reaches are as defined in Section 6 of the Watershed Assessment report. The 31 tributaries are based generally on the 303(d) listings, but do not include all of the smaller creeks in the headwaters areas.

References for specific parameters and water bodies are included in Sections 5 and 6 of the Watershed Assessment document[10]. The six parameters included pesticides, sediments, dissolved oxygen, temperature, fecal coliform and "other," which included notations on pH, nutrients and metals. These parameters are similar to those covered in the review of water quality conditions presented in Sections 5.2.2 and 5.2.3 of the Watershed Assessment document. The three more general ratings included the number of 303 (d) listings in 1998 for a particular water body, the USGS Agricultural Index (which covers a series of parameters) and the ratings published in the 1990 Salmon and Steelhead Production Plan. The last two general ratings were not applicable to all water bodies but were included as informational items on the charts.

[10] Reference sources for water quality used in the Assessment include USGS NAWQA reports, the TMDL study on the Lower Yakima River, Conservation District reports, Watershed Assessments by USFS and DNR, 1998 303(d) listings, the Yakima Valley Conference of Governments Water Quality Plan, and water quality monitoring information gathered from knowledgeable individuals through direct communications. See reference list appended to this memorandum, and the Planning Unit's Watershed Assessment document

The rating matrix format utilizes a qualitative ranking system to provide a general indication of water quality conditions. An open circle denotes generally acceptable or good conditions for each parameter, a half filled circle denotes fair conditions (i.e. moderate problems), and a fully darkened circle denotes poor conditions or more serious concerns. Footnotes are included to clarify or explain the basis for some ratings. Notations are included for other generalized ratings such as the number of listings on the 1998 3030(d) list and the overall ratings assigned in the Salmon and Steelhead Plan (e.g. E=excellent, G=good, F=fair, P=poor). A matrix rating for the tributary streams is provided in Table 2-13. A similar matrix rating for water quality conditions in the five Yakima River mainstem reaches is provided in Table 2-14.

The water quality ratings were then ranked using a simple point score system normalized to 100 points as a perfect score. The scoring system used for mainstem reaches and tributaries was the same. The water quality factors also are incorporated in a separate technical memorandum on habitat enhancement, since water quality is also viewed as a habitat factor.

2.9 Ground Water Quality

Ground water in the Yakima River Basin is used for agricultural, municipal, domestic, and other purposes. Water quality considerations vary for these different uses. For example, the quality of ground water in the Yakima Basin is rarely a limitation if the water is used for agricultural purposes. However, ground water quality must be much higher for drinking water purposes, and in some cases requires treatment to meet state and federal drinking water standards.

Ground water is the main source of drinking water supplies in the Yakima Basin, both for public water supplies, and individual domestic wells. With the exception of the Cities of Yakima and Cle Elum, all of the cities, towns, and unincorporated communities rely on ground water for their indoor, domestic water supplies[11]. Degradation of ground water quality can pose public health threats, raise the cost of treating municipal supplies, and potentially force abandonment or limit the use of supplies.

Degradation of ground water can also potentially affect environmental quality, in locations where ground water discharges to surface water. On the other hand, in many cases ground water discharging to surface water can improve the quality of surface water, in terms of some parameters such as temperature.

[11] Some communities also use ground water, in whole or in part, for landscape irrigation. Other communities use ground water for domestic supply, but surface water for landscape irrigation.

Table 2-13
Water Quality Conditions Rating Matrix – Yakima River Tributaries

SUBBASIN	Pesticides	Sediment	Dissolved Oxygen	Temp.	Fecal Coliform	Other	1998 303d List	USGS Ag. Index	Salmon/ Steelhead 1990
Gold Creek	○	○	○	◒	○	○	○ 1	——	——
Kachess River	○	○	○	◒	○	○	○ 1	——	——
Cabin Creek	○	◒	○	◒	○	○	○ 2	——	○ E
Big Creek	○	○	○	◒	○	○	○ 2	——	○ G
Cle Elum River	○	○	○	◒	○	○	○ 4	——	○ G_E
Teanaway River	○	[e] ●	○	●	○	○ metals	● 15	○	○ E
Swauk Creek	○	◒	○	◒	○	○	○ 5	——	◒ F_G
Reecer Creek	○	◒	◒	◒	◒	○	○	——	——
Taneum Creek	○	○	○	◒	○	○	○ 4	○	○ G
Manastash Creek	○	[a] ◒	○	◒	○ [b]	○	○ 3	[d] ○	○ G
Wilson Creek	◒	◒	○	◒	◒	◒ metals	◒ 4		◒
Cherry Creek	●	●	○	◒	●	◒ nutrient s	◒ 10	◒	
Umtanum Creek	○	○	○	◒	○	○	○ 0	○	
Wenas Creek	◒	◒	○	●	◒	◒ ph	○ 1	——	● [c] P
Lmuma-Burbank-Selah		◒	INTERMITTENT STREAMS – SEDIMENT LOAD FROM RUNOFF EVENTS						
Naches River	○	○	○	◒	○	◒ metals pH	○ 4	○	○ E
American River	○	○	○	◒	○	○	○ 1	○	○ E, D
Bumping River	○	○	○	◒	○	○	○ 1	○	○ G

Table 2-13 (Cont)
Water Quality Conditions Rating Matrix – Yakima River Tributaries

SUBBASIN	Pesticides	Sediment	Dissolved Oxygen	Temp.	Fecal Coliform	Other	1998 303d List	USGS Ag. Index	Salmon/ Steelhead 1990
Little Naches River	○	○	○	◒	○	○	○ 6	○	○ E
Rattlesnake Creek	○	○	○	◒	○	○	○ 3	○	○ E
Tieton River	○	○	○	◒ [f]	○	○	○ 1		○ G
Cowiche Creek	◒	[d] ◒	○	●	◒	◒ ph	● 13	——	——
Ahtanum Creek	◒	○	◒	●	◒	○	○ 1	◒ d	◒ F_G
Wide Hollow Creek	◒	◒	○	◒	◒	◒ ph	● 12	◒	● PF
Snipes Creek	◒	◒	○	◒	◒ [I]	◒ ph	○ 2	——	● PF
Spring Creek	◒	●	○	◒	● [I]	◒ ph	○ [g] 2	●	● PF
Corral Canyon Creek	◒	◒	○	◒	◒	◒ ph	○ [g] 0	——	——
Sulphur Creek Wasteway	●	◒ [h]	○	◒	● [I]	◒ nutrients	● 8	——	——
Moxee Drain	◒	◒	○	●	●	◒ nutrients	● 15	●	——
Granger Drain	●	◒ [h]	○	◒	● [I]	◒ nutrients	● 13	●	——

[a] Primary sediment concern is upper watershed spawning gravels, particularly Northfork.
[b] Fecal coliform concerns in developed areas along lower reach due to septic tanks.
[c] Water temperatures reach 80^0 F.
[d] USGS Ag index was only applied to South fork upstream of agricultural areas.
[e] High seasonal sediment load during runoff events.
[f] Dissolved oxygen concentrations below state standards as measured by USFS below Tieton Dam.
[g] Possibly due to lack of data reporting to DOE.
[h] Sediment loads are being reduced through local efforts in response to TMDL program.
[I] Improvements noted in recent years in response to TMDL and other efforts.
[J] Temperature criteria are compared to numeric criteria and not to natural criteria.

RATING KEY

○ GOOD
◒ FAIR
● POOR

S-S 1990 Key

E Excellent
G Good
F Fair
P Poor

Table 2-14
Water Quality Condition Rating Matrix – Yakima River Reaches

Yakima River Mainstem	Pesticides	Sediment	Dissolved Oxygen	Temp.	Fecal Coliform	Other	1998 303d List	USGS Ag.b Index	Salmon/ Steelhead 1990
Keechelus Dam to Cle Elum River	○	○	◒	◒	○	○	○ 3	○	○ E
Cle Elum River to Wilson Creek	○	○ [c]	○	◒	○	○ metals	○ 5	○	○ E
Wilson Creek to Parker	○	◒ [e]	○	◒	○	○ metals	◒ 10	◒	○ G
Parker to Toppenish Creek	◒ [d]	◒ [a, d]	◒	●	◒	◒	○ 4	◒	● P
Toppenish Creek to Mouth	● [d]	● [a, d]	◒	●	◒	◒ metals PH ammonia	● 30	◒	● F-P

[a] Progress being made through TMDL implementation.
[b] USGS NPAI Index rating based on table 8 site condition summary on NWQA in WRI report #96-4280
[c] Affected by high sediment loads from Teanaway River during winter/early spring runoffs.
[d] Inputs from agricultural drains impact Yakima River.
[e] Affected by sediment loads from Wilson/Cherry Creeks during spring/summer.

RATING KEY

○ GOOD
◒ FAIR
● POOR

Less data is available on ground water quality in the Yakima Basin, compared to surface water. In addition, ground water quality was deemed a lower priority focus by the Watershed Planning Unit, in comparison with surface water quality. Therefore, the information presented on ground water quality conditions in the Watershed Assessment is less detailed than the information on surface water quality.

2.9.1 Ground Water Quality Criteria and Parameters

The State's ground water criteria serve as a background baseline and as a reference to establish trends in water quality conditions. The State's regulations at WAC 173-200 establish the criteria for all ground water, based on the premise that it may be used for drinking water. In addition, the federal government has established National Primary Drinking Water Standards, which apply to water supplies delivered to the public by public water systems.

Key parameters relative to drinking water supplies include fecal indicator bacteria, nutrients such as nitrate and nitrite; and organic chemicals such as pesticides and industrial chemicals.

2.9.2 Ground Water Quality Conditions

The Watershed Assessment noted that ground water quality can be affected by a wide variety of activities which introduce pollutants into the subsurface. In recent decades many researchers and regulatory agencies across the U.S. have identified the categories of sources listed below:

- Natural contamination/dissolved salts and minerals (including arsenic and radon, which are the subject of current regulatory activity at the federal level).
- Point source contamination at the wellhead.
- Septic systems.
- Leaking underground storage tanks.
- Application of fertilizers or pesticides.
- Application of manure to agricultural lands or gardens.
- Chemical or fuel spills.
- Leaching from landfills.
- Burial or dumping of wastes.

Each of these sources is likely to be present in some degree within the Yakima River Basin. Sources that are highly site-specific may cause ground water degradation only in localized areas, while widely dispersed sources can have a wider impact.

As part of the Watershed Assessment, knowledgeable staff at public agencies were interviewed to provide a qualitative indication of ground water quality conditions and key issues in the Yakima Basin. Ground water quality problems such as elevated levels of nitrates occur in the Yakima Basin in locales where the following two conditions are present: 1.) there is relatively dense development that is not served by public sewer systems, and 2.) there is a shallow water table. In addition, elevated nitrate levels may occur in areas where irrigated agriculture is present in combination with a shallow water table. Particular areas where these concerns have been identified include the areas around Sunnyside, Grandview and Mabton. Problems generally have not been identified in the upper portions of the Yakima watershed (YRB Planning Unit, 2001).

Kittitas County staff indicated there have been problems with bacteria in various parts of the County. Yakima County staff indicated they do not actively track ground water quality. Benton County staff indicated concerns similar to those expressed above by Ecology and DOH.

Based on interviews conducted with local, state and federal agency staff, it appears that ground water quality monitoring is not occurring on a regional basis within the Yakima River Basin. Where localized problems have been identified, monitoring activities have sometimes been implemented. In the absence of more comprehensive, long-term monitoring data, trends are unlikely to be quantifiable. In addition, if certain parameters have received little attention, they may pose a threat to drinking water supplies that goes undetected. This may be a limitation for watershed planning in terms of determining safe and reliable water supply for municipal and domestic purposes.

Large and medium-sized public water systems in the Yakima Basin generally have the ability to monitor, manage and protect the quality of their ground water supplies. However, small water systems and individual households relying on their own wells for drinking water are likely to be more susceptible to threats from ground water contamination. In addition, shallow and/or unprotected ground water supplies are more susceptible to ground water contamination than deep ground water supplies (EES 2002d).

2.10 Responsibilities for Water Resource Management

A variety of local, state and federal government organizations have authorities and responsibilities for water resource management in the Yakima River Basin. Table 2-15 lists some of these organizations, and briefly summarizes selected roles in water management. This table is not intended to be comprehensive list; but provides a basic summary for purposes of understanding material in this Watershed Plan.

Additional government organizations are also involved in Yakima Basin water resources and are referenced elsewhere in this plan. For a full list of acronyms and abbreviations, see the List of Acronyms and Abbreviations contained in this plan document. In addition, there are many private-sector organizations that use and manage land and water resources in the Yakima Basin.

Table 2-15
Role of Selected Government Organizations in Water Management

Organization	Role in Water Management
Local Level	
County governments (Benton, Kittitas, Yakima)	Growth management. Land use and development. Floodplain management. Critical areas ordinances. May own/operate water and sewer systems. Stormwater management. Many other responsibilities.
City governments	Growth management. Often own/operate water and sewer systems. Stormwater management. Regulate land use and development in city.
Public water systems	Deliver water to public.
Irrigation districts	Divert water and deliver to individual landowners/farmers. Manage diversions, conveyance, return flows.
Conservation districts	Assist farmers with a variety of programs.
Health districts	Public health. Designated by counties.
Tri-County Water Resources Agency (TCWRA)	Lead agency for development of watershed plan.
State Level	
Dept. of Ecology	Administer water rights and water quality programs. Many other programs related to water and land resources. Permitting.
Dept. of Fish and Wildlife (DFW)	Administer fish and wildlife programs.
Dept. of Health (DOH)	Regulate public water systems. Many other health-related programs.
Dept. of Agriculture	Administer agriculture programs.
Conservation Commission	Umbrella agency for local conservation districts (see above).
Dept. of Natural Resources (DNR)	Manage state forest, range and aquatic lands. Permitting.
Tribal Level	
Yakama Nation	Govern tribal members. Management of land and water resources & other activities on Reservation. Fishing rights on and off Reservation.
Federal Level	
Bureau of Reclamation (USBR)	Manage Yakima Irrigation Project. Many related responsibilities.
Bureau of Indian Affairs (BIA)	Federal trust responsibility for tribes. Manage Wapato Irrigation Project.
National Marine Fisheries Service (NMFS)	Implement Endangered Species Act, for anadromous fish
U.S. Fish and Wildlife Service (USFWS)	Implement Endangered Species Act, for resident fish. Many other fish and wildlife programs.
Environmental Protection Agency (EPA)	Federal oversight of water quality control programs. Many other environmental protection programs.
U.S. Dept. of Agriculture (USDA)	Federal administration of agriculture programs, including those designed to protect water quality and improve habitat.
Natural Resources Conservation Service (NRCS)	Assist farmers with a variety of programs.
U.S. Geological Survey (USGS)	Perform technical studies of water resources, and water quality. Including current study of groundwater; and National Water Quality Assessment (NAWQA).
Bonneville Power Administration (BPA)	Operate federal hydropower projects on Columbia River system. Administer federal funds for fish and wildlife enhancement.
Northwest Power Planning Council	Balance hydropower and fish production in Columbia River system.

Section II

Water Supply and Flow Management

Section II of this Watershed Plan presents management alternatives related to water supply and flow management. These topics are grouped together because the physical features and water-resource infrastructure of the Yakima Basin require that flow and supply be managed together. This is particularly true for surface water, but also has some bearing on ground water management. This section contains two chapters. Chapter 3 presents four alternatives for managing surface water resources, focusing on the mainstem Yakima/Naches system operated by the U.S. Bureau of Reclamation. Chapter 4 presents four alternatives for managing ground water resources. In each chapter, a preferred alternative is selected. The Planning Unit recommends these preferred alternatives for implementation.

Chapter 3

Management of Surface Water Resources

Chapter 3
Management of Surface Water Resources

This chapter discusses management of surface waters of the Yakima River and Naches River systems. This mainstem system is managed by the U.S. Bureau of Reclamation (USBR), through its system of storage reservoirs, to provide water supplies for various purposes. Most of the water consumed in the Basin comes from this system. The mainstem system is also a key element in supporting the Basin's fisheries resources.

In general, this Watershed Plan does not provide in-depth discussion of management of surface waters in the tributaries of the Yakima River. While the tributaries are important, each tributary has its own needs, issues and involved parties. The Planning Unit recognizes that significant issues with regard to water supply, instream flow, habitat, and water quality still remain to be resolved in the tributaries, and that funding will be needed to carry out this work. In order to be effective and responsive to local needs, planning carried out in the tributaries should involve the local residents and landowners.

This chapter addresses management of surface water resources for water supply and flow management objectives. Management of surface water *quality* is addressed separately, in Section 5 of this Watershed Plan.

The discussion in this chapter builds on information and analysis presented in Section 3 of the Watershed Assessment, as well as several technical memoranda developed in the watershed planning process. Technical memoranda with specific application to this chapter include:

Table 3-1
List of Technical Memoranda Related to Surface Water Management[1]

Voluntary Water Transfers as a Strategy for Meeting Planning Objectives (January 2002)
Water Use Efficiency in the Agricultural Sector (February 2002)
Reliability of Surface Water Supply for Irrigation, Yakima Project Water Users (January 2002)
Storage Strategies (January 2002)
Water Supply Needs for Instream Flows (January 2002)
Municipal, Domestic and Industrial Water Needs and Supply Strategies (January 2002)
Potential Effects of Climate Variability and Change (February 2002)
Water Reuse Opportunities in the Yakima Basin (draft June 2002)
Wymer Dam and Reservoir Project Review (draft November 2002)
Wymer Dam Kittitas Valley Supply Alternative (draft November 2002)
Hydrologic Modeling of Surface Water Alternatives (draft November 2002)

[1] For a complete list of all supporting documents developed for the watershed planning process, see Table 1-1.

Chapter 1.4 listed the seven substantive goals defined by the Yakima River Basin Watershed Planning Unit. Four of these goals are directly related to management of surface water resources. These four goals are:

- **Improve the reliability of surface water supply for irrigation use;**
- **Provide for growth in municipal, rural domestic and industrial demand;**
- **Improve instream flows for all uses with emphasis on improving fish habitat; and,**
- **Maintain economic prosperity by providing an adequate water supply for all uses.**

The evaluation of surface water management alternatives presented in this section discusses application to all four of these goals.

3.1 Key Surface Water Management Issues and Needs

A number of key issues are involved in managing surface waters of the Yakima Basin. These issues have been explored in various technical memoranda prepared during the planning process, and are also summarized in Section 2 of this Watershed Plan. Two of the key issues that will be discussed in this Section include:

- Reliability, particularly for proratable users of surface water from the Yakima Irrigation Project. For more information, see Section 2.4.1. Periodic droughts affect these users, and substantially reduce the Basin's economic output. The Basin has minimal carryover storage capacity, and is therefore particularly vulnerable to droughts that extend for longer than one year (e.g. 1992-94).
- Instream flow. A variety of legal requirements exist related to instream flows in the Basin. At some times and places, flows are less than desired, for purposes of fish habitat. At other times and places, they can be too high, as during irrigation season when high flows are needed to convey water from reservoirs in the Upper Yakima River and Naches River system, to water users in the Lower Basin.

As a rough approximation, needs for additional water supplies to meet Planning Unit objectives have been defined as:

- An additional 375,000 AF in dry years for irrigated agriculture. The 375,000 AF will meet a goal set in 1998 by the Yakima Watershed Council and confirmed by the Planning Unit to supply at least 70% of proratable irrigation entitlements during a dry year. For further information see Technical Memorandum on reliability (MWG, 2002c).

- Adequate water to meet instream flow objectives. Several alternative objectives have been defined for purposes of the planning effort. These include: meeting target flows at Parker under YRBWEP, providing increased flows in the Upper Yakima River below Keechelus Dam, sufficient to maintain flows above 200 cfs during all seasons; and eliminating the “flip flop” operations that provide increased flows on the Tieton River in the late summer and early fall. The quantity of water needed varies, and is addressed through the hydrologic modeling effort discussed below.
- 80,000 AF for municipal, industrial and domestic supply to meet projected growth in demand through year 2050 (EES, 2002c). Although the future M&I demand will likely be met through a combination of surface and groundwater withdrawals, the total amount is addressed in the surface water alternatives for comparison purposes. This approach provides conservative results, in assessing the benefits to reliability and stream flows; and also allows for potential “offsets” of ground water withdrawals by releases from the Project reservoirs.

The irrigated agriculture and instream flow need exists today; the municipal need reflects a projected need through the year 2050. There is an overlap in the quantities needed for these three purposes, since return flows from irrigation practices (canal seepage and on-farm application of water) and wastewater treatment provide a source of supply for downstream users and instream flow needs. The hydrologic modeling effort described in Section 3.5 accounts for this overlap by accounting for both diversions and return flows. In brief, the modeling approach assigned needs for irrigated agriculture, instream flows, and municipal purposes to specific locations in the Basin. The modeling approach was then used to analyze the ability of the various surface water management alternatives to meet those needs.

At the outset of the watershed planning process, the Initiating Governments (TCWRA) determined that the plan would not involve recommending minimum instream flows be adopted into State law. The primary reason was that target flows established by the U.S. Congress under YRBWEP were already in place for the mainstem system, and are used in operating the Bureau of Reclamation facilities.

This decision was revisited periodically during the planning process. In response to the availability of new funding ($300,000) for setting instream flows in year 2001, the TCWRA and Planning Unit again considered this issue. It was deemed that the amount of funding available and the time frame required by the State (completion concurrent with completion of this Watershed Plan) were inadequate to enter into this arena. The original decision was therefore confirmed.

3.2 General Techniques for Managing Surface Water Resources

Over the course of the planning process, the Planning Unit reviewed a number of strategies for managing surface water resources of the Yakima River Basin. Full documentation of this review is contained in the respective technical memoranda listed in Table 3-1. A brief summary of these strategies is provided below.

- ***Storage in surface reservoirs:*** The U.S. Bureau of Reclamation (USBR) operates five storage reservoirs in the Yakima Basin. These reservoirs are used to provide water to users holding entitlements, and are also managed to meet stream flow objectives identified under various legal obligations. The planning process reviewed past and current proposals to either enlarge existing reservoirs, replace existing reservoirs or build new, off-stream reservoirs. None of these proposals involve new sites that would block the Yakima River, its tributaries, or any perennial creeks[1]. For further information on projects reviewed, see Section 3.3 and the technical memorandum entitled "Storage Strategies" (MWG 2002d).
- ***Aquifer storage and recovery (ASR):*** This technique would involve "skimming" surface water flows during periods of high runoff and storing the water in a natural underground aquifer. In order for this technique to work, suitable geologic conditions must be present, and the water must be available during times of high runoff. Because this technique involves skimming and storage of surface water, it is discussed in this section instead of in the section on ground water.
- ***Water-use efficiency measures:*** These measures involve capital improvements and operational changes that allow water users to meet their needs while using less water. The techniques used can be very different from one sector of activity to another. For example, the water-use efficiency measures applicable to irrigation districts are very different from those applicable to municipal water systems.

  The planning process focused primarily on water-use efficiency measures by irrigation districts, as these measures have been studied in depth, offer potentially large reductions in diversions, and are authorized under YRBWEP. For more information, see the technical memorandum entitled "Water-use Efficiency in the Agricultural Sector" (MWG 2002e). One important finding of the technical memorandum is that the irrigation district efficiency projects provide only limited benefits in terms of water supply reliability. This is because they reduce return flows from irrigation district drains at the same time as they reduce diversions at district headgates. Since downstream irrigators rely on the return flows to meet their needs, additional water must be released from reservoir storage to compensate for the decrease in return flows. Therefore, while many water-use efficiency measures in the agricultural sector cause changes in the timing or location of flows, they offer a relatively minor opportunity to reduce the total quantity of water needed for irrigation supply.

[1] Some proposals would involve construction of a reservoir in a dry side valley, which may inundate an ephemeral creek that flows only for short periods following precipitation events.

This effect is illustrated in the hydrologic modeling results described in Section 3.5, below.

While in-depth analysis has not been performed with regard to on-farm water-use efficiency measures and municipal water conservation programs, the Planning Unit notes that water-use efficiency measures can also be applied in these areas. The larger municipal water systems throughout the Yakima Valley have conservation programs that comply with State standards. The efficiency of on-farm water use has improved substantially in recent decades. These improvements vary among crop types, due to the different needs of different types of crops, as well as the associated economics and return on investment. There has been a transition from gravity irrigation (i.e. rill or furrow) to sprinkler systems, starting with perennial fruit and hops and now progressing to row crops. For fruit and hops crops, pressurized systems now include microspray technology. While hay crops in the Kittitas Valley are still watered primarily with flood irrigation, the efficiency of water use in this area has also improved due to more precise monitoring of soil moisture and crop needs, improved scheduling and measurement of water deliveries and use at the farm level, and extensive training programs. Widespread use of PAM, which is intended to bind soil particles, reducing erosion and sediment loading, also requires more attention to the quantity and timing of water application, thereby improving efficiency. A number of state and federal programs have provided millions of dollars in funding for these on-farm efficiency improvements, together with support and technical assistance from conservation districts and irrigation districts.

- ***Voluntary transfers of water rights:*** Water rights can be leased or sold, on a voluntary basis, by willing sellers to willing buyers. The Planning Unit reviewed opportunities for water rights transfers, in a technical memorandum entitled "Voluntary Water Transfers as a Strategy for Meeting Planning Objectives" (EES, 2002e). With respect to conditions in the Yakima River Basin, this review indicated that transfers can provide significant opportunities for meeting stream flow objectives and municipal needs. However, transfers offer only limited ability to meet Planning Unit objectives with regard to reliability of water supplies for irrigated agriculture.

- ***Reuse of municipal wastewater:*** Municipal wastewater can be treated to meet acceptable standards for reuse. Reuse applications include irrigation of crops; irrigation of turf in parks, golf courses, etc.; and use in industrial facilities. The Planning Unit reviewed opportunities for wastewater reuse, in a technical memorandum entitled "Water Reuse Opportunities in the Yakima Basin" (EES, 2002f). Reuse of municipal wastewater offers some ability to extend municipal supplies as growth occurs. However, there are significant limitations on this strategy, as applied within the Yakima River Basin. In particular, return flows of treated effluent to the Yakima River are relied on by downstream users, and contributes to stream flows. In addition, this strategy is relatively costly, compared with alternate sources of municipal supply, such as ground water.

- ***New allocations.*** Water rights involving surface waters of the Yakima River Basin are addressed in the ongoing general adjudication. Therefore, new allocations of surface water are not identified as a means for meeting the Basin's needs. For further information, see the Watershed Assessment document, Section 3. However, it is possible that new entitlements for federal water could be identified in concert with enhancement of storage capacity in the basin. In addition, potential for new allocation of *ground water* is covered in Section 4, which discusses ground water management.

3.3 Specific Storage and Efficiency Projects Identified

During the planning process, the Planning Unit identified a number of surface water storage and efficiency projects related to the mainstem Yakima River system. These projects are described in two technical memoranda: "Storage Strategies" (MWG 2002d) and "Water Use Efficiency in the Agricultural Sector" (MWG 2002e). All but one of the storage projects were proposed in various reports developed by USBR over the past 20 years. The Black Rock reservoir project has been reviewed in an ongoing effort led by Benton County. The Wymer Project has also been examined more intensively, under the watershed planning process. The water-use efficiency projects all involve improvements of irrigation district facilities, and were generally developed in irrigation district water conservation plans under YRBWEP.

A brief discussion of each project is provided below. Maps showing the storage project sites and the irrigation districts are presented in Exhibits 3-1 and 3-2. For further information, refer to the technical memoranda.

3.3.1 Storage Projects Identified

Five storage projects are considered in this plan, with respect to meeting the Planning Unit's objectives for the mainstem Yakima River system. These are:

- ***Wymer Dam and Reservoir:*** This would be a new off-stream dam and reservoir constructed in Lmuma Creek Canyon, adjacent to the Yakima River in the Yakima River Canyon area between Ellensburg and Selah. Water to fill this reservoir would be pumped out of the Yakima River during high flow periods. A small portion of the water would come from intermittent flows in the Lmuma Creek canyon. When stored water is needed, it would be released into the Yakima River and flow downstream to serve Project water users downstream of this point. This would reduce the need to release water from reservoirs higher in the system. The reservoir's capacity would be approximately 142,000 acre feet. Since the quantity of water needed from the Yakima River to fill the reservoir is not available in dry years, the reservoir could be depleted in the first year of a multi-year drought. Further information on this project is provided in MWG, 2002f.

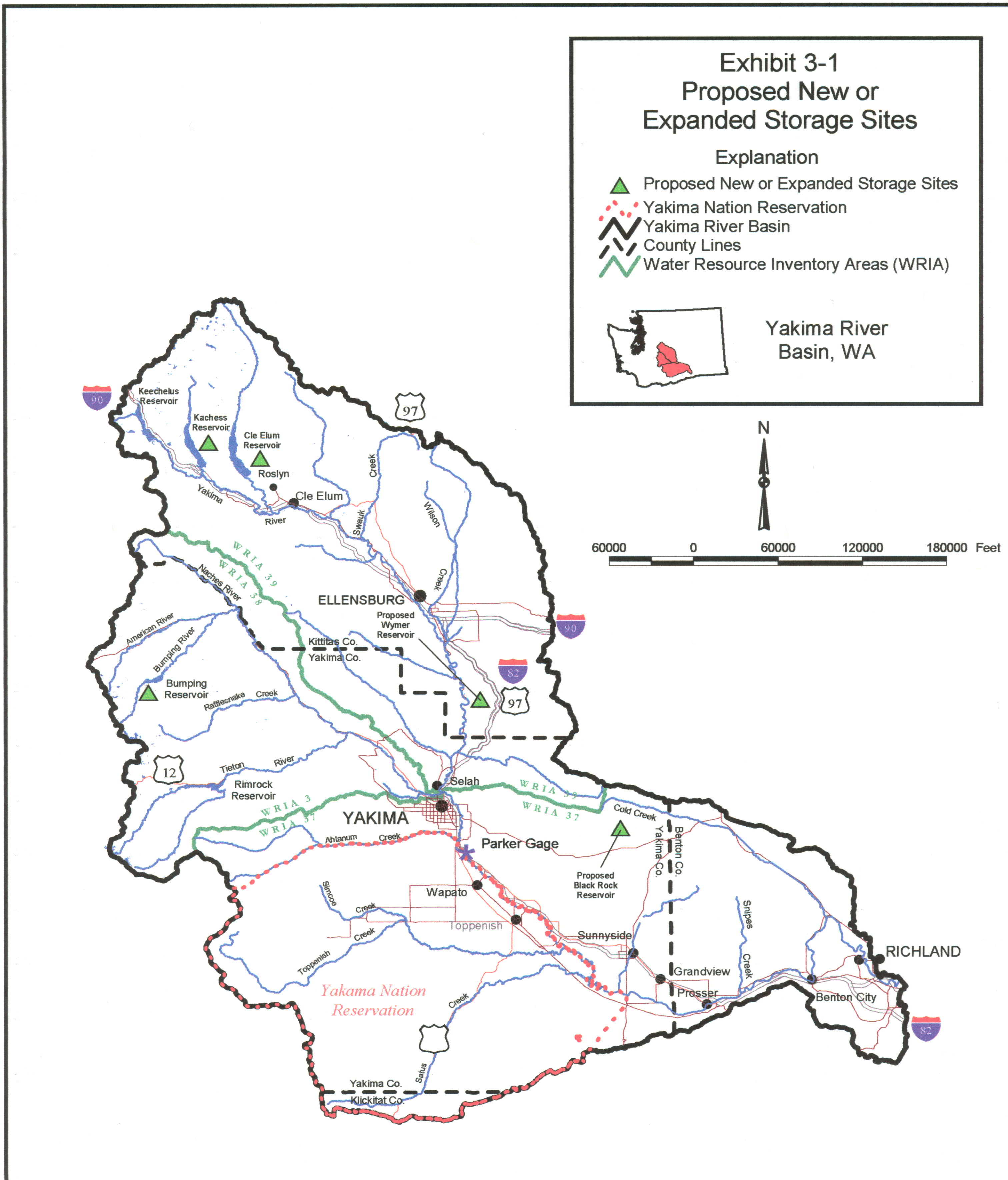


Exhibit 3-1
Proposed New or
Expanded Storage Sites
Explanation
Proposed New or Expanded Storage Sites
Yakima Nation Reservation
Yakima River Basin
County Lines
Water Resource Inventory Areas (WRIA)
Yakima River
Basin, WA
N
60000
0
60000
120000
180000
Feet
90
97
Keechelus
Reservoir
Kachess
Reservoir
Cle Elum
Reservoir
Roslyn
Cle Elum
Yakima
River
Creek
Swauk
Wilson
Creek
WRIA 39
WRIA 38
Naches River
ELLENSBURG
Proposed
Wymer
Reservoir
90
American River
Bumping River
Kittitas Co.
Yakima Co.
82
Bumping
Reservoir
Rattlesnake
Creek
97
12
Tieton
River
Rimrock
Reservoir
Selah
WRIA 39
WRIA 37
WRIA 3
WRIA 37
YAKIMA
Cold Creek
Ahtanum
Creek
Parker Gage
Yakima Co.
Benton Co.
Proposed
Black Rock
Reservoir
Simcoe
Creek
Wapato
Toppenish
Creek
Toppenish
Sunnyside
Snipes
Creek
RICHLAND
Grandview
Prosser
Benton City
Yakama Nation
Reservation
Creek
82
Satus
Yakima Co.
Klickitat Co.

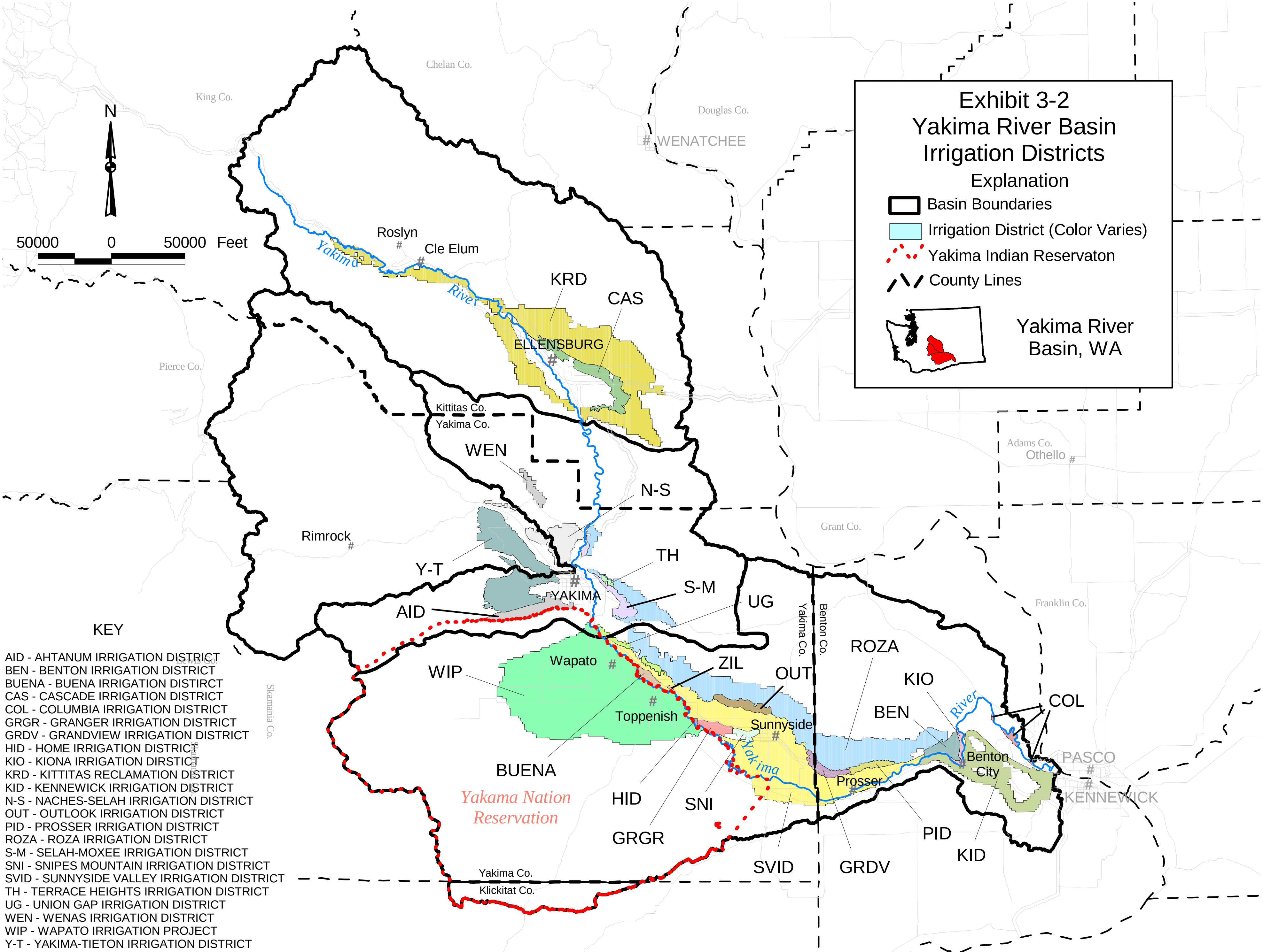


Exhibit 3-2
Yakima River Basin
Irrigation Districts
Explanation
Basin Boundaries
Irrigation District (Color Varies)
Yakima Indian Reservaton
County Lines
Yakima River
Basin, WA
N
50000
0
50000
Feet
Chelan Co.
King Co.
Douglas Co.
WENATCHEE
Pierce Co.
Kittitas Co.
Yakima Co.
Adams Co.
Othello
Grant Co.
Franklin Co.
Benton Co.
Yakima Co.
Klickitat Co.
Skamania Co.
Roslyn
Cle Elum
Yakima
River
KRD
CAS
ELLENSBURG
WEN
N-S
Rimrock
Y-T
TH
S-M
YAKIMA
AID
UG
ROZA
WIP
Wapato
ZIL
OUT
KIO
COL
BEN
Toppenish
Sunnyside
Benton
City
PASCO
BUENA
Yakama Nation
Reservation
HID
SNI
Yak ima
Prosser
KENNEWICK
GRGR
PID
SVID
GRDV
KID
River
KEY
AID - AHTANUM IRRIGATION DISTRICT
BEN - BENTON IRRIGATION DISTRICT
BUENA - BUENA IRRIGATION DISTRICT
CAS - CASCADE IRRIGATION DISTRICT
COL - COLUMBIA IRRIGATION DISTRICT
GRGR - GRANGER IRRIGATION DISTRICT
GRDV - GRANDVIEW IRRIGATION DISTRICT
HID - HOME IRRIGATION DISTRICT
KIO - KIONA IRRIGATION DIRSTICT
KRD - KITTITAS RECLAMATION DISTRICT
KID - KENNEWICK IRRIGATION DISTRICT
N-S - NACHES-SELAH IRRIGATION DISTRICT
OUT - OUTLOOK IRRIGATION DISTRICT
PID - PROSSER IRRIGATION DISTRICT
ROZA - ROZA IRRIGATION DISTRICT
S-M - SELAH-MOXEE IRRIGATION DISTRICT
SNI - SNIPES MOUNTAIN IRRIGATION DISTRICT
SVID - SUNNYSIDE VALLEY IRRIGATION DISTRICT
TH - TERRACE HEIGHTS IRRIGATION DISTRICT
UG - UNION GAP IRRIGATION DISTRICT
WEN - WENAS IRRIGATION DISTRICT
WIP - WAPATO IRRIGATION PROJECT
Y-T - YAKIMA-TIETON IRRIGATION DISTRICT
ZIL - ZILLAH IRRIGATION DISTRICT

- ***Bumping Lake Enlargement:*** Bumping Lake is an existing storage reservoir located on the Bumping River 17 miles upstream of its confluence with the Naches River. It was built prior to 1933. It is the smallest of the five main reservoirs in the Basin, with a capacity of 33,700 acre feet. The project would involve construction of a new dam, approximately one mile downstream of the existing dam, and creating a larger reservoir with a capacity of 400,000 acre feet. The reservoir would be operated in conjunction with other reservoirs as part of the Yakima Irrigation Project. Since the Bumping River is not capable of filling the reservoir in a single year, only a portion of this capacity would be available annually.
- ***Kachess Lake Augmentation:*** This project would involve diverting water from two small creeks (Silver and Cabin Creeks) in the vicinity of Kachess Lake in order to increase the supply available for storage in the Lake. Kachess Lake cannot be fully filled in water-short years, and the additional supply could be stored for use later in the irrigation season. The project would require construction of diversion works on the two creeks, and construction of pipelines from the Creeks to the Lake. The maximum diversion would be 200 cfs from Cabin Creek and 50 cfs from Silver Creek. The creeks would be diverted only during periods when flows meet certain minimum thresholds (e.g. 50 cfs in Cabin Creek and 10 cfs in Silver Creek).
- ***Cle Elum Lake Enlargement**:* Cle Elum Lake is the largest of the Yakima Project Reservoirs, with a storage capacity of 436,900 acre-feet. This is the main source of water for Yakima Project Users in the lower Yakima River Basin. This project would modify the outlet gates from the reservoir to provide an additional three feet of elevation for the reservoir pool, adding 14,600 acre-feet of storage capacity.
- ***Black Rock Dam and Reservoir:*** This would be a new off-stream dam and reservoir constructed in Black Rock Canyon, 20 miles east of the City of Yakima. In its largest proposed configuration, the reservoir would have a capacity of 1,700,000 acre-feet, making it the largest of the Basin's storage facilities. Water for this reservoir would be pumped from the Columbia River above Priest Rapids Dam and lifted over the divide into the Yakima Basin. Water would be released into the Roza Canal. This water would be used to offset selected diversions from the Yakima River. This project could deliver 500,000 acre-feet of water per year to the Yakima Basin to offset irrigation withdrawals, allowing extra water to remain in headwaters reservoirs. Much of the offset water could be used to improve stream flows in the Yakima River, while the remainder could be used for water supply purposes. Alternative configurations of this project are also being explored, such as a project with a capacity of 860,000 acre-feet capable of delivering 250,000 acre-feet per year. Further information on

the Black Rock project is provided in Washington Infrastructure Services et al., 2002, and other documents. The Black Rock studies have been supported, in part, with grant funding under the State watershed planning program.

Additional storage projects have also been proposed for the Yakima Basin, at various times. However, the five projects listed above were reviewed in greater detail for purposes of this Watershed Plan, and are included in the hydrologic modeling effort described in Section 3.5.

3.3.2 Irrigation District Efficiency Projects Identified

Under YRBWEP a number of irrigation districts have developed water conservation plans, resulting in a suite of recommended projects for each district. The Districts involved include:

Kittitas Reclamation District	South Naches Irrigation District
Roza Irrigation District	Naches-Selah Irrigation District
Sunnyside Valley Irrigation District/Board of Joint Control	Yakima-Tieton Irrigation District
Selah-Moxee Irrigation District	Benton Irrigation District
Ahtanum Irrigation District	Columbia Irrigation District
Union Gap Irrigation District/Fowler Ditch Company	Kennewick Irrigation District
Outlook Irrigation District	

The irrigation district projects vary from district to district, but generally include elements such as lining canals and laterals, or replacing them with pressurized piping; tailwater or drainage pump-back systems; canal automation and reregulation reservoirs; and improved measurement and accounting of flows. In general, these projects offer some benefits for stream flow, but do not greatly improve water supply reliability on a basin-wide basis.

In the case of the Columbia and Kennewick Irrigation Districts, their proposal also includes a pump exchange where diversions of water from the Yakima River would be eliminated and replaced by a diversion from the Columbia River.

3.3.3 Costs of Individual Projects

For purposes of comparison, capital costs of individual projects from various studies have been compiled and reviewed. In addition, annual operations and maintenance (O&M) costs were identified and expressed as a present value. This allows projects with substantial O&M costs to be compared on an even footing with projects whose primary costs are up-front capital costs.

For purposes of this analysis only "new" O&M costs were considered. This simplifies the analysis, because some of the projects reviewed involve modifications to existing facilities that already have O&M costs, while other projects would impose new O&M costs. Storage projects that are already in place were assumed to have no new O&M costs. Water-use efficiency projects were likewise assumed to have no new O&M costs, since they largely concern existing irrigation district facilities. While this is not true in all cases, it simplifies the review and provides suitable results for this broad, planning-level comparison. In addition, it provides a ready means of comparing costs of the three "action" alternatives with the "no-action" alternative, as discussed in Section 3.4.

The O&M costs include two components. First, the cost of all O&M activities apart from pumping water into the reservoirs is presented. For some projects, this value was estimated in available studies. For projects where the available studies did not provide an estimate of O&M costs, O&M was estimated using a standard factor of 0.1% of capital costs, suggested by USBR staff contacted during the planning process. Pumping costs were also included in the total estimate of O&M. Two of the storage projects, Wymer Reservoir and Black Rock Reservoir, require water to be pumped from a mainstem river into the reservoir for storage. Some of the pumping costs can be recovered, since power can be generated and sold when water is released from the reservoirs. The net of power costs associated with pumping, and revenue produced from power generation is included in the O&M costs for these two projects.

Three of the efficiency projects (Kennewick Irrigation District, Columbia Irrigation District, and Benton Irrigation District) also involve significant pumping costs, above and beyond current O&M costs.

In this section, these costs are presented on a project-by-project basis. In Section 3.6, these costs are combined into the various surface water management alternatives considered.

Table 3-2 updates all project costs (capital and O&M) to year 2002, using a standard index that accounts for inflation in the construction industry. Table 3-3 calculates the present value of annual O&M costs over a 50-year period. This is necessary to allow for comparisons among projects with capital costs only, and projects with a combination of capital costs and new O&M costs. The discount rate of 5.875 percent used in this calculation was obtained from USBR staff, and is the value used for all projects analyzed by the Bureau nation-wide in Fiscal Year 2003. Table 3-4 then provides the total cost of each project, calculated as the sum of capital and O&M costs. This total cost is used as the measure of project cost in all of the remaining cost tables presented in this chapter.

Table 3-2
Project Costs Updated to 2002 (1) (2)

Project	Study Year	Capital Cost in Study Year	Add'l O&M Cost in Study Year (3)	Escalation Factor (4)	Capital Cost in 2002 Dollars	O&M Cost in 2002 Dollars
Storage Projects						
Wymer Dam and Reservoir	2002	$411,215,000	$3,514,000	1.00	$411,215,000	$3,514,000
Bumping Lake Enlargement	1985	$144,205,000	$157,000	1.65	$238,426,000	$260,000
Kachess Lake Augmentation	1995	$12,200,000	$0	1.31	$15,955,000	$0
Cle Elum Lake Enlargement	2000	$16,687,100	$0	1.06	$17,633,000	$0
Black Rock Reservoir (large)	2001	$1,886,000,000	$19,166,000	1.03	$1,944,466,000	$19,760,000
Black Rock Reservoir (small)	2001	$1,057,000,000	$18,337,000	1.03	$1,089,767,000	$18,905,000
Water-Use Efficiency Projects (5)						
Kittittas Recl. Dist., Alt. I	1999	$36,910,641	$0	1.09	$40,236,000	$0
Roza ID, Preferred Measures	1998	$61,488,000	$0	1.12	$68,893,000	$0
SVID/BJC, First Tier, Option 1	2000	$59,950,900	$0	1.06	$63,349,000	$0
Selah-Moxee ID, Alt. I,	1995	$20,472,000	$0	1.31	$26,773,000	$0
Ahtanum ID, Alt. 2	1996	$5,856,000	$0	1.27	$7,416,000	$0
Union Gap ID/Fowler Ditch Co., Alt. 1	1999	$30,555,450	$0	1.09	$33,309,000	$0
Outlook ID, Preferred Alt., Six Phases	1995	$736,000	$0	1.31	$963,000	$0
South Naches ID, Alt. 3	1994	$5,400,000	$0	1.34	$7,233,000	$0
Naches-Selah ID, Alt. 2	1995	$15,880,000	$0	1.31	$20,768,000	$0
Yakima-Tieton ID, First Tier	2000	$290,000	$0	1.06	$306,000	$0
Benton ID, Program 6	2000	$13,326,000	$177,000	1.06	$14,081,000	$187,000
Columbia ID, Three Recommended Projects	1996	$12,902,000	$1,250,000	1.27	$16,340,000	$1,583,000
Kennewick ID, First Tier	1999	$54,275,600	$2,855,000	1.09	$59,166,000	$3,112,000

(1) Costs adjusted for inflation between June of study year and May 2002, using ENR Construction Cost Index (CCI).
(2) Sources: MWG, 2002d; MWG, 2002e; and Washington Infrastructure Services Inc. et al., 2002.
(3) For existing storage projects, and irrigation district efficiency projects, it is assumed that O&M costs associated with the improvements will be similar to O&M costs for existing facilities. Therefore, the additional cost is shown to be zero. This provides for an appropriate comparison with the "No-Action" Alternative. For new projects, costs are either derived from available studies, or were assumed to be 0.1% of capital cost. For those projects that involve pumping water (Wymer and Black Rock storage projects; and Kennewick I.D. pump-exchange efficiency project) the O&M estimate also includes an estimate of energy costs, from the applicable study.
(4) Escalation factor is ratio of ENR Construction Cost Index (CCI) in May 2002, to CCI in June in the year costs were originally estimated (i.e. the "study year" shown).
(5) Some of the efficiency projects have had features and costs recently updated, but these should not affect overall results of this review.

Table 3-3
Present Value of O&M Costs Over 50 Years
(2002 dollars)

Project	Annual O&M (Add'l to Existing Conditions) (1)	Present Value at discount rate of 5.875% (2)
Storage Projects		
Wymer Dam and Reservoir	$3,514,000	$56,368,000
Bumping Lake Enlargement	$260,000	$4,171,000
Kachess Lake Augmentation	$0	$0
Cle Elum Lake Enlargement	$0	$0
Black Rock Reservoir (large) 2	$19,760,000	$316,971,000
Black Rock Reservoir (small)	$18,905,000	$303,256,000
Water-Use Efficiency Projects (3)		
Benton ID, Program 6	$187,000	$3,000,000
Columbia ID, Three Recommended Projects	$1,583,000	$25,393,000
Kennewick ID, First Tier	$3,112,000	$49,920,000
All other efficiency projects from Table 3-2	$0	$0

1 O&M costs from Table 3-2
2 Discount rate used by USBR in Fiscal Year 2003
(3) Those districts listed have energy costs for pump-exchange.

Table 3-4
Project Cost Comparison
(All Costs in 2002 Dollars)

	Capital Cost	O&M Costs Additional to No-Action (Present Value) (1)	Total Cost (Present Value)
Storage Projects			
Wymer Dam and Reservoir	$411,215,000	$56,368,000	$467,583,000
Bumping Lake Enlargement	$238,426,000	$4,171,000	$242,597,000
Kachess Lake Augmentation	$15,955,000	$0	$15,955,000
Cle Elum Lake Enlargement	$17,633,000	$0	$17,633,000
Black Rock Reservoir (large) 2	$1,944,466,000	$316,971,000	$2,261,437,000
Black Rock Reservoir (small)	$1,089,767,000	$303,256,000	$1,393,023,000
Water-Use Efficiency Projects			
Kittitas Recl. Dist., Alternative I	$40,236,000	$0	$40,236,000
Roza ID, Preferred Measures	$68,893,000	$0	$68,893,000
SVID/BJC, First Tier, Option 1	$63,349,000	$0	$63,349,000
Selah-Moxee ID, Alt. I, Modified	$26,773,000	$0	$26,773,000
Ahtanum ID, Alt. 2	$7,416,000	$0	$7,416,000
Union Gap ID/Fowler Ditch Co., Alt. 1	$33,309,000	$0	$33,309,000
Outlook ID, Preferred Alt., Six Phases	$963,000	$0	$963,000
South Naches ID, Alt. 3	$7,233,000	$0	$7,233,000
Naches-Selah ID, Alt. 2	$20,768,000	$0	$20,768,000
Yakima-Tieton ID, First Tier	$306,000	$0	$306,000
Benton ID, Program 6 (2)	$14,081,000	$3,000,000	$17,081,000
Columbia ID, Three Recommended Projects (2)	$16,340,000	$25,393,000	$41,733,000
Kennewick ID, First Tier (2)	$59,166,000	$49,920,000	$109,086,000

(1) From Table 3-3.
(2) O&M for this efficiency project is primarily new power costs.

Table 3-5 offers another means of comparing project costs, that takes into account the yield of the various projects. The maximum yield of each project is presented, and costs per acre-foot of yield are calculated. In addition, since one of the key objectives of the Planning Unit is to improve reliability of water supply in dry years, the yield of the various projects over a sequence of three dry years was calculated. This is similar to conditions that occurred in 1992-94. The total cost of each project is divided by the average annual yield over the three year period. This “normalized” cost can be used as a measure of cost-effectiveness in comparing projects.

Table 3-5
Cost Effectiveness of Storage and Efficiency Projects
(All Costs in 2002 Dollars)

	Total Cost (Capital and O&M, present value)	Maximum Yield (1) (AFY)	Cost per AFY of Maximum Yield	Average Dry Year Yield (2) (AFY)	Cost per AFY in Dry Years
Storage Projects					
Wymer Dam and Reservoir (3)	$467,583,000	142,000	$3,300	58,000	$8,100
Bumping Lake Enlargement (4)	$242,597,000	400,000	$600	133,000	$1,800
Kachess Lake Augmentation	$15,955,000	5,400	$3,000	10,700	$1,500
Cle Elum Lake Enlargement	$17,633,000	15,000	$1,200	15,000	$1,200
Black Rock Reservoir (large)	$2,261,437,000	1,700,000	$1,300	500,000	$4,500
Black Rock Reservoir (small)	$1,393,023,000	860,000	$1,600	250,000	$5,600
Water-Use Efficiency Projects (5) (6) (7)					
KRD, Roza, SVID only	$172,478,000	160,000	$1,100	70,000	$2,500
All projects above Parker	$269,246,000	202,000	$1,300	83,000	$3,200
KID and Columbia Only (8)	$150,819,000	261,000	$600	248,000	$600
All projects below Parker	$167,900,000	274,000	$600	261,000	$600

(1) For storage projects, yield if the full volume available from storage were released in a single year.
(2) Average annual yield over a three-year dry period comparable to 1992-94.
(3) Dry year yields for Wymer were obtained from hydrologic modeling results.
(4) Dry year yields for Bumping are conservative estimates based on use of storage volume over a three-year period. Additional modeling would be needed to confirm Bumping results.
(5) Maximum yield for water use efficiency projects based on average to wet conditions. These results generated by averaging results modeled for years 1991, 1995 and 1996. Dry year yields from average of results modeled for years 1992-94. Dry year yield for projects below Parker (pump-exchange project) estimated based on diversion records from 1992-94
(6) Projects grouped to facilitate comparisons in alternatives analysis later in this Chapter.
(7) The "yield" from efficiency projects mainly benefits instream flow, but has less effect on water supply reliability. See text for further discussion.
(8) Yield included from these two projects is reduction in diversions from Yakima River.

3.4 Definition of Four Surface Water Management Alternatives

The Yakima Basin Watershed Planning Unit has identified three “action” alternatives, for review in the watershed planning process. These alternatives combine different sets of actions as discussed above into packages that can be used to meet the needs identified in Section 3.3. In addition, this Plan identifies a “no-action” alternative for purposes of comparison.

This planning approach is designed to enable the Planning Unit to make broad comparisons leading to a recommended strategy for the Yakima River Basin. In order to do this, the alternatives identify representative projects that could be used to carry out each strategy. The specific projects are useful in illustrating the relationship among the alternatives; however, each alternative could be specified to include a different mix of projects than the specific projects discussed here. ***The Planning Unit does not intend that the Watershed Plan recommendations be used as the final selection of specific projects for construction.*** Instead, the Planning Unit notes that further work is needed by appropriate project sponsors regarding feasibility, permitting, cost, funding sources, and other factors. The Plan recommendations are intended to set broad priorities for surface water management strategies to meet the planning objectives in the Basins, such as weighing the merits of a storage strategy, compared with a non-storage strategy.

The following alternatives are defined for purposes of the Watershed Plan. Maps displaying potential storage sites discussed, and showing irrigation districts where efficiency improvements would be undertaken, are presented in Exhibits 3-1 and 3-2.

Alternative I-1: Major Storage Enhancement, with Targeted Improvements in Water-use Efficiency and Additional Actions

- Storage Element: Construct one or more new reservoirs within the Basin, with combined capacity to meet the Planning objectives[2], minus the amount to be contributed by water-use efficiency and/or transfers (see below). A single project, Black Rock Reservoir in its largest proposed configuration, could fully meet the Planning Unit objectives. An alternative approach to providing a major storage enhancement would be to meet the needs using a combination of several projects, such as building both Wymer Reservoir and the Bumping Lake Enlargement, accompanied by smaller projects such as the modifications discussed at Kachess and Cle Elum Lakes. Stored water will be used for multiple purposes, including agricultural water supply reliability, municipal water supply and flow management. Stored water should not be used to expand irrigation beyond those lands already entitled to water from the Yakima Irrigation Project. These various storage projects have been described in the technical memorandum on storage prepared during the planning process (MWG 2002d); and in a report on the Black Rock Project (Washington Infrastructure Services, 2002).
- Water-use Efficiency Element: Irrigation Districts implement a targeted set of efficiency projects under Yakima River Basin Water Enhancement Project (YRBWEP). For this alternative it is assumed that only a small number of Districts will implement these projects. For modeling purposes, an illustrative set of three Districts' projects was used above Parker (KRD, Roza, and Sunnyside). Projects and flows below Parker were not modeled. However, the KID and Columbia ID pump-exchange project was also included in the cost analysis for this alternative, since these projects offer significant benefits for instream flow, and have a relatively low cost per acre-foot of flow improvement.

  Agricultural irrigators outside the purview of YRBWEP will be encouraged to implement efficiency measures as well.

  Municipal water suppliers, self-supplied commercial/industrial users, residents using ditches/canals for landscape irrigation, and/or residents with individual household wells will also be encouraged to implement efficiency measures. Washington Department of Health (DOH) has guidelines and requirements with respect to municipal conservation.

[2] 70% reliability in dry years and achieve improvements in stream flow.

- Water Reuse Element: Develop projects to reclaim and reuse municipal and/or industrial wastewater, where cost-effective compared with alternate sources of supply.
- Water-Rights Transfers Element: Continue state and federal efforts to purchase and/or lease water for instream flows from willing participants. Transfers do not increase available water supply, but can provide increased flexibility in use of available supply. Continue local, state and federal efforts encouraging voluntary transfers among water users for irrigation, municipal supply, commercial/industrial activity, etc.

Alternative I-2: Medium Storage Enhancement, with Targeted Improvements in Water-use Efficiency and Additional Actions

- Storage Element: Enlarge existing reservoirs and/or construct one or more new reservoirs within the Basin, with combined capacity to yield approximately 50,000 to 150,000 acre feet during dry years. Stored water will be used for the same purposes as Alternative I-1. However, this will only meet a portion of the need identified by the Planning Unit. Candidate projects identified include Wymer Reservoir, or enlargement of Bumping Lake. This alternative provides less yield than the storage element under Alternative I-1.
  - Water-Use Efficiency Element: Same as Alternative I-1.
  - Water Reuse Element: Same as Alternative I-1.
  - Water-Rights Transfers Element: Same as Alternative I-1.

Alternative I-3: Reliance on Efficiency Improvements, Water Reuse and Voluntary Transfers, with No Storage Enhancement

- Water-Use Efficiency Element: More extensive water-use efficiency measures would be employed, in comparison with Alternatives I-1 and I-2. In this case, all of the water-use efficiency projects for irrigation districts under YRBWEP (see Table 3-2) would be carried out. Water use efficiency for irrigators outside YRBWEP, and for municipal systems, would be the same as for Alternatives I-1 and I-2.
  - Water-Rights Transfers Element: Same as Alternative I-2.
  - Water Reuse Element: Same as Alternative I-2.
  - No storage element.

Alternative I-4: No Action

The No Action Alternative describes a condition in which water management will be limited to existing activities and facilities in the Yakima Basin. The purpose of the No-Action alternative is to explore how the defined objectives of the Planning Unit will be affected if the actions discussed in Alternatives I-1, I-2 and I-3 are not taken. Therefore, the No-Action Alternative:

- Assumes no new surface storage will be constructed in the Yakima Basin (although repairs to Keechelus Dam will be completed as currently planned, restoring the reservoir to full capacity).
- Explores the results if the water-use efficiency projects planned under YRBWEP were not implemented.
- Assumes that municipal reuse projects would not be constructed in the Basin.
- Assumes that recent activity involving voluntary transfers of water rights will continue to occur at approximately the same levels as in the past five years.

3.5 Hydrologic Modeling Study

Hydrologic modeling was performed to compare the effectiveness of the Alternatives in meeting water supply and instream flow needs. A technical memorandum titled "Hydrologic Modeling of Surface Water Alternatives" (MWG, 2002a) provides a detailed description of the methodology and findings. The hydrologic modeling was performed by the USBR. Assistance in interpretation of alternatives was provided to the USBR and a summary of model output were provided by Montgomery Water Group (MWG). This section provides a brief summary of the methodology used in the modeling study.

Hydrologic modeling was performed by the USBR using the RiverWare model, which represents multi-purpose components of a river system containing reservoirs. The University of Colorado Center for Advanced Decision Support for Water Environmental Systems (CADSWES) developed the RiverWare software. Functional requirements for the RiverWare software were developed through a cooperative effort with individual employees of the USBR and Tennessee Valley Authority. USBR Upper Columbia Area Office personnel developed the Yakima River Basin Planning and Operations Model using the RiverWare software. Various offices of the USBR are developing models using RiverWare to perform operations studies of large and small river and reservoir systems in the West. The model represents natural runoff; storage in Yakima Project reservoirs; releases from the reservoirs; surface water diversions by Yakima Project water users (irrigation entities and municipal and industrial users); and return flow from canal and lateral seepage, municipal wastewater treatment plants and irrigated fields.

The RiverWare model simulated the operations of the Yakima Project to the downstream boundary of the model at Sunnyside Dam (Yakima River at Parker). The model can be extended further downstream but time limitations for this project did not allow it for this Plan.

The period of 1991-1996 was used in the modeling, as it represents a range of hydrologic conditions, including a 3-year drought between 1992 and 1994. That drought period represents the worst combination of drought years on record for the Yakima Project.

The inputs to the model included runoff from the 1991-1996 time period, irrigation demands that represent average demands for irrigators, M&I needs for current and future conditions and flow targets used by the USBR for instream needs. The change in hydrologic conditions was modeled by changing the irrigation demands (e.g., for water conservation projects), simulating the effects of storage enhancement, and changing the target flows in various reaches of the Yakima River.

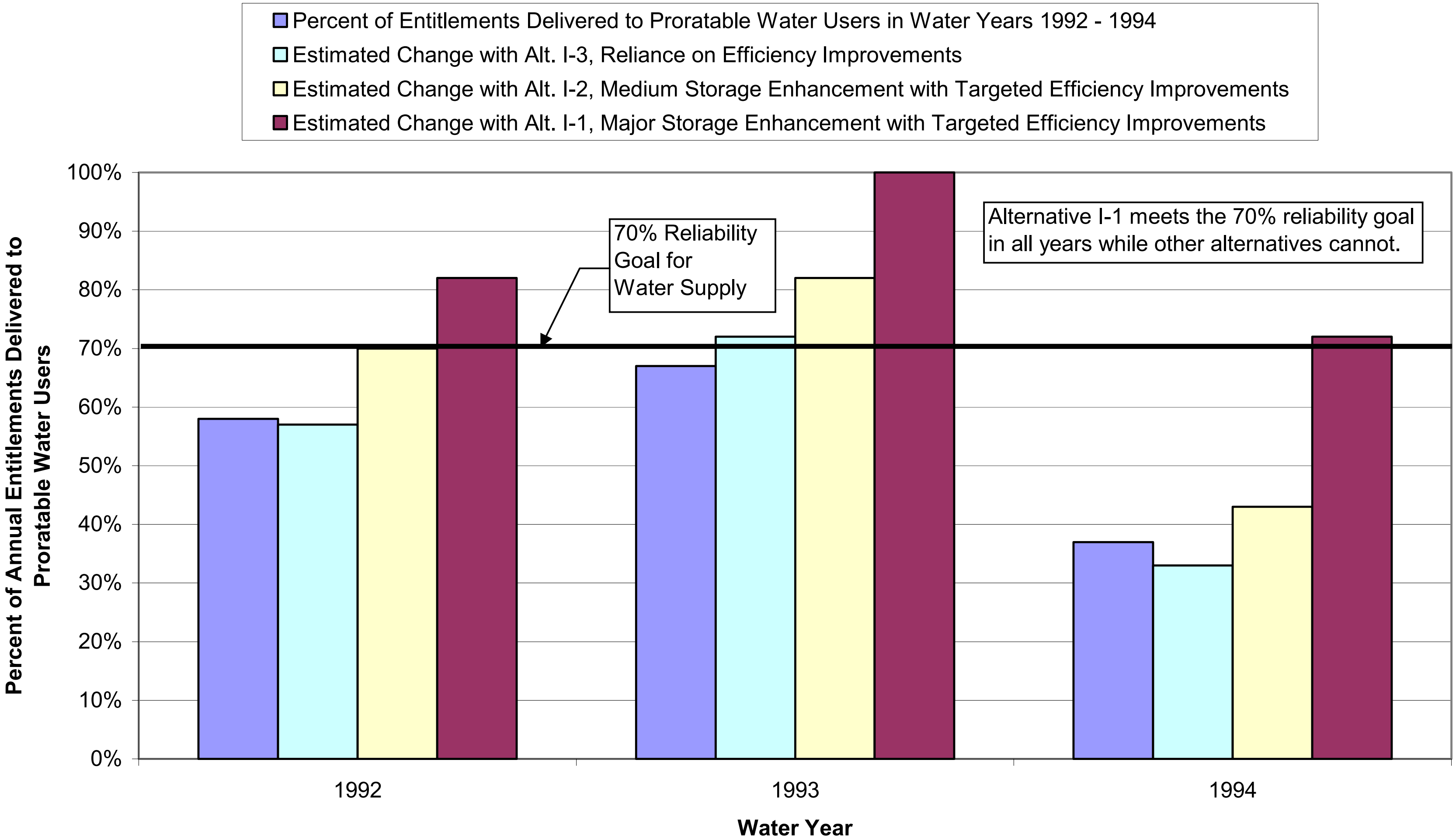
3.5.1 Hydrologic Modeling Results

Brief discussions of the results of the hydrologic modeling performed for each Alternative are included below. Graphs illustrating the changes in water supply and streamflow are provided. Graphs were prepared for the Alternatives that illustrate the following:

- Comparison of percent of entitlements that could be delivered to proratable water users, assuming that stored and conserved water is used first to improve stream flows in the Upper Yakima River, and second for reliability improvements (Exhibit 3-3).
- Effect on stream flow at four different locations, assuming that stored and conserved water is used first to improve stream flows in the Upper Yakima River, and second for reliability improvements. The three locations displayed are the Yakima River downstream of Keechelus Reservoir (Exhibit 3-4); the Yakima River at the Umtanum Gauge (Exhibit 3-5); and the Yakima River at Parker (Exhibit 3-6); and the Tieton River below Rimrock Reservoir (Exhibit 3-7).
- Effect on stream flow at two different locations, assuming that stored and conserved water is used first to eliminate the “flip flop” in Yakima Project operations, and second for reliability improvements. The two locations displayed are the Tieton River below Rimrock Reservoir (Exhibit 3-8); and the Yakima River at the Umtanum Gauge (Exhibit 3-9).

In each of the graphs, the model results are compared to the No Action Alternative. However, for purposes of clarity in the graphs, some alternatives are not displayed, where their results are similar to other alternatives.

Exhibit 3-3
Comparison of Four Alternatives by Percent of Annual Entitlements Delivered to Proratable Water Users



Notes: Scenario displayed includes meeting increased flow targets of 200 cfs in the Upper Yakima River.
For purposes of presentation, modeling results for Alt. I-1 are shown only for the Yakima Basin storage projects (Wymer, Bumping, Cle Elum, Kachess projects).

Exhibit 3-4
Yakima River Below Keechelus Reservoir
Comparison of Monthly Average Streamflow From Alternatives Using Conserved/Stored Water to Increase Streamflow in the Upper Yakima River

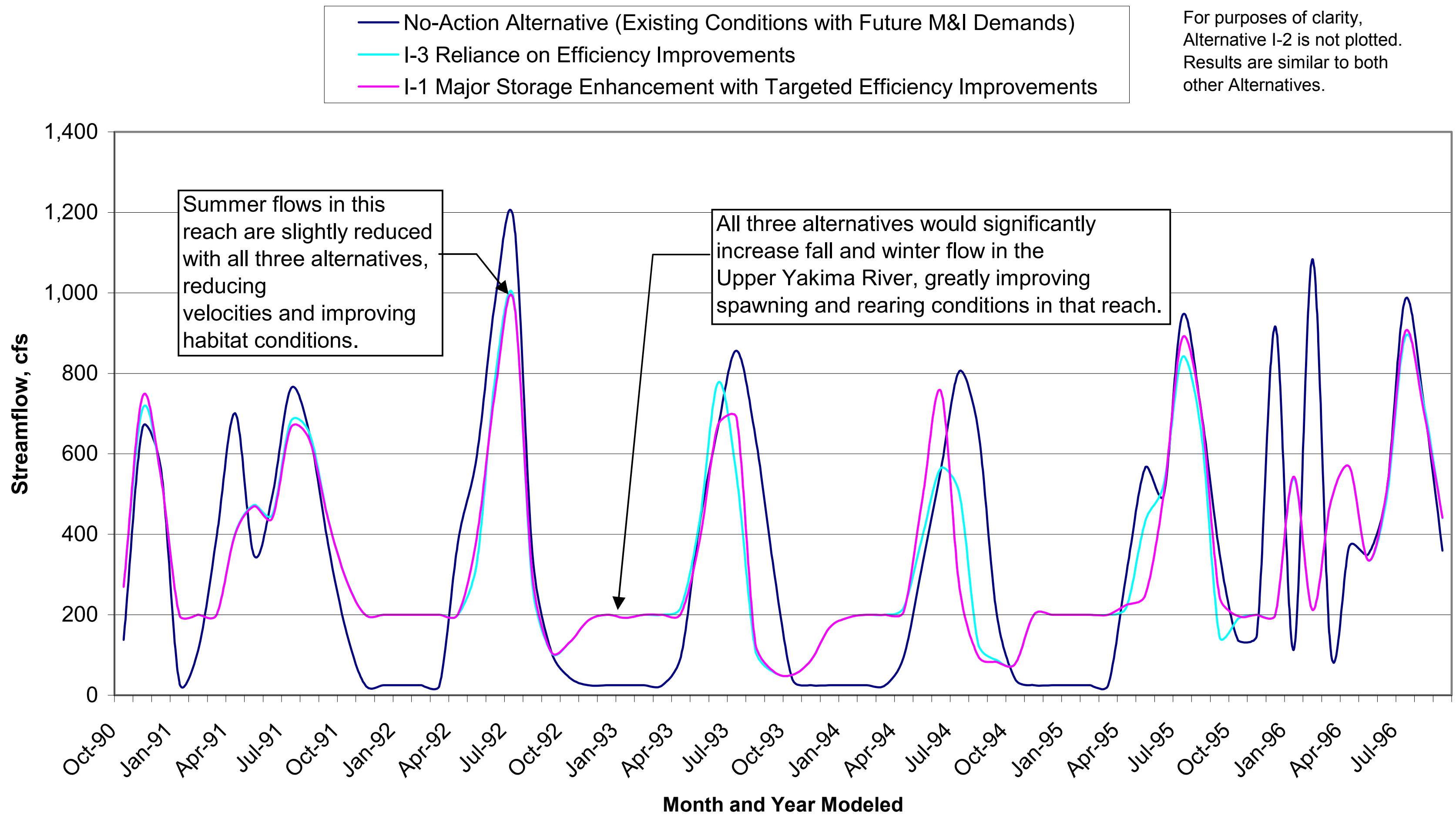


Exhibit 3-5
Yakima River at Umtanum
Comparison of Monthly Average Streamflow From Alternatives Using Conserved/Stored Water to Increase Streamflow in the Upper Yakima River

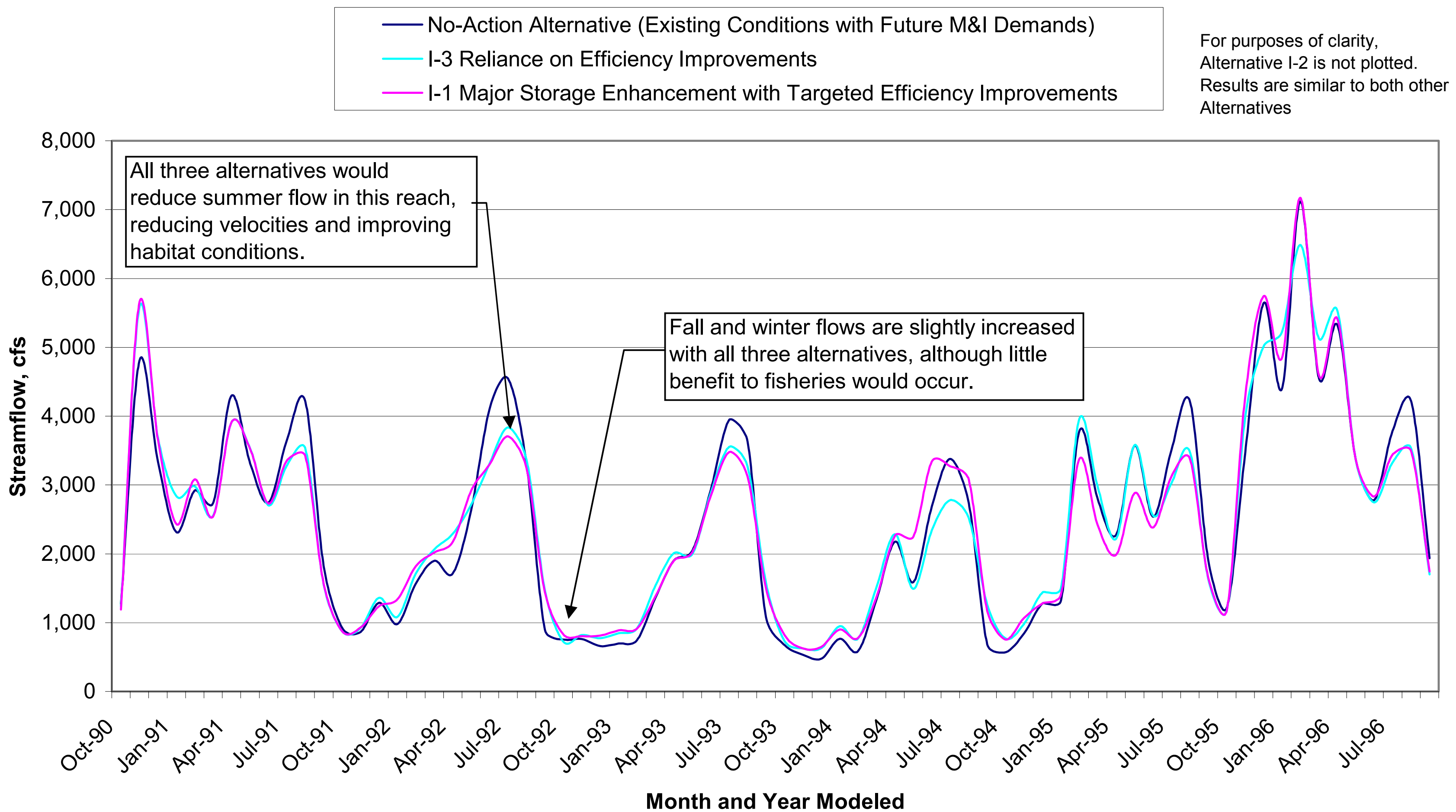


Exhibit 3-6
Yakima River at Parker
Comparison of Monthly Average Streamflow From Alternatives Using Conserved/Stored Water to Increase Streamflow in the Upper Yakima River

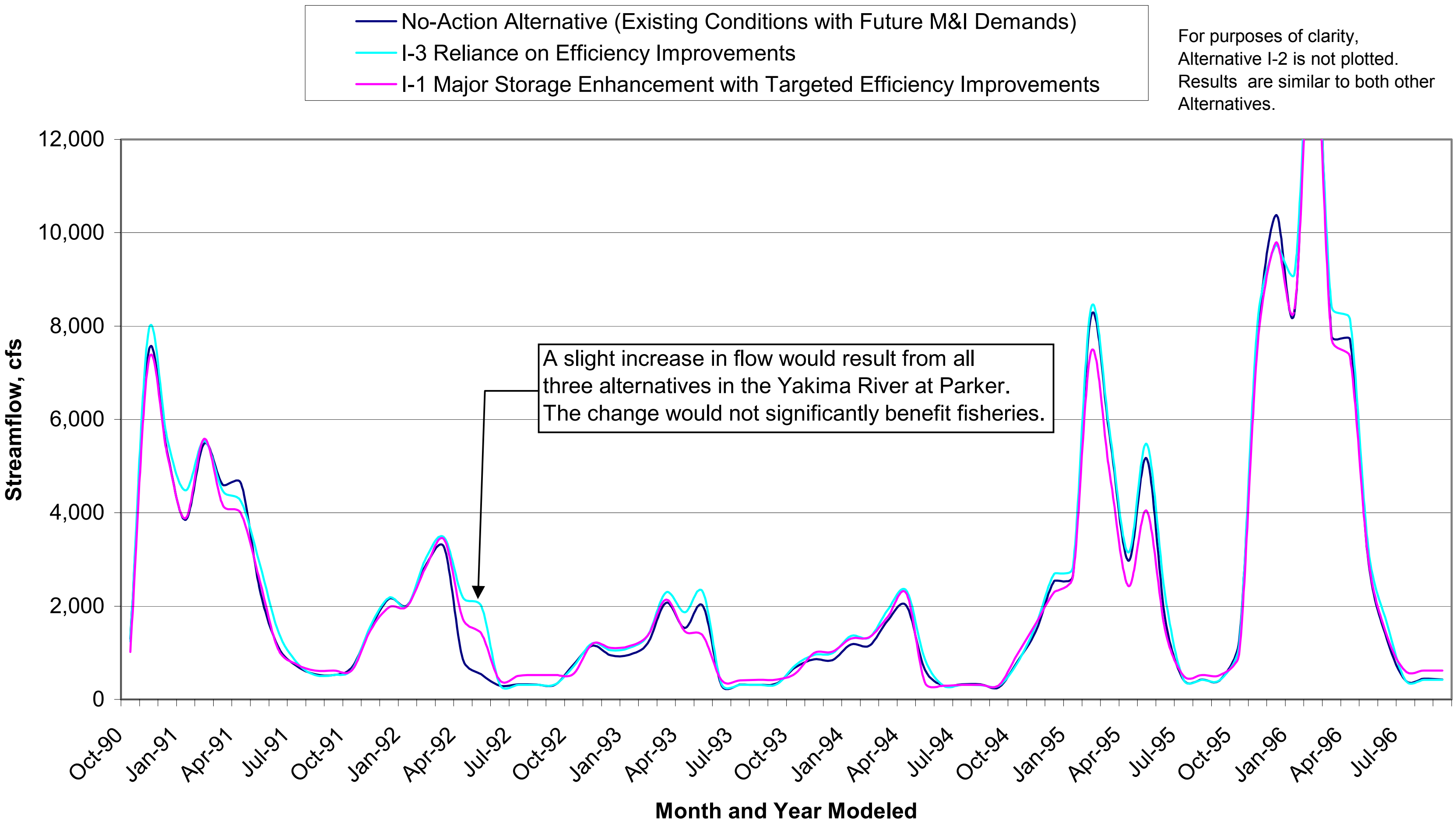


Exhibit 3-7
Tieton River Below Rimrock Reservoir
Comparison of Monthly Average Streamflow From Alternatives Using Conserved/Stored Water to Increase Streamflow in the Upper Yakima River

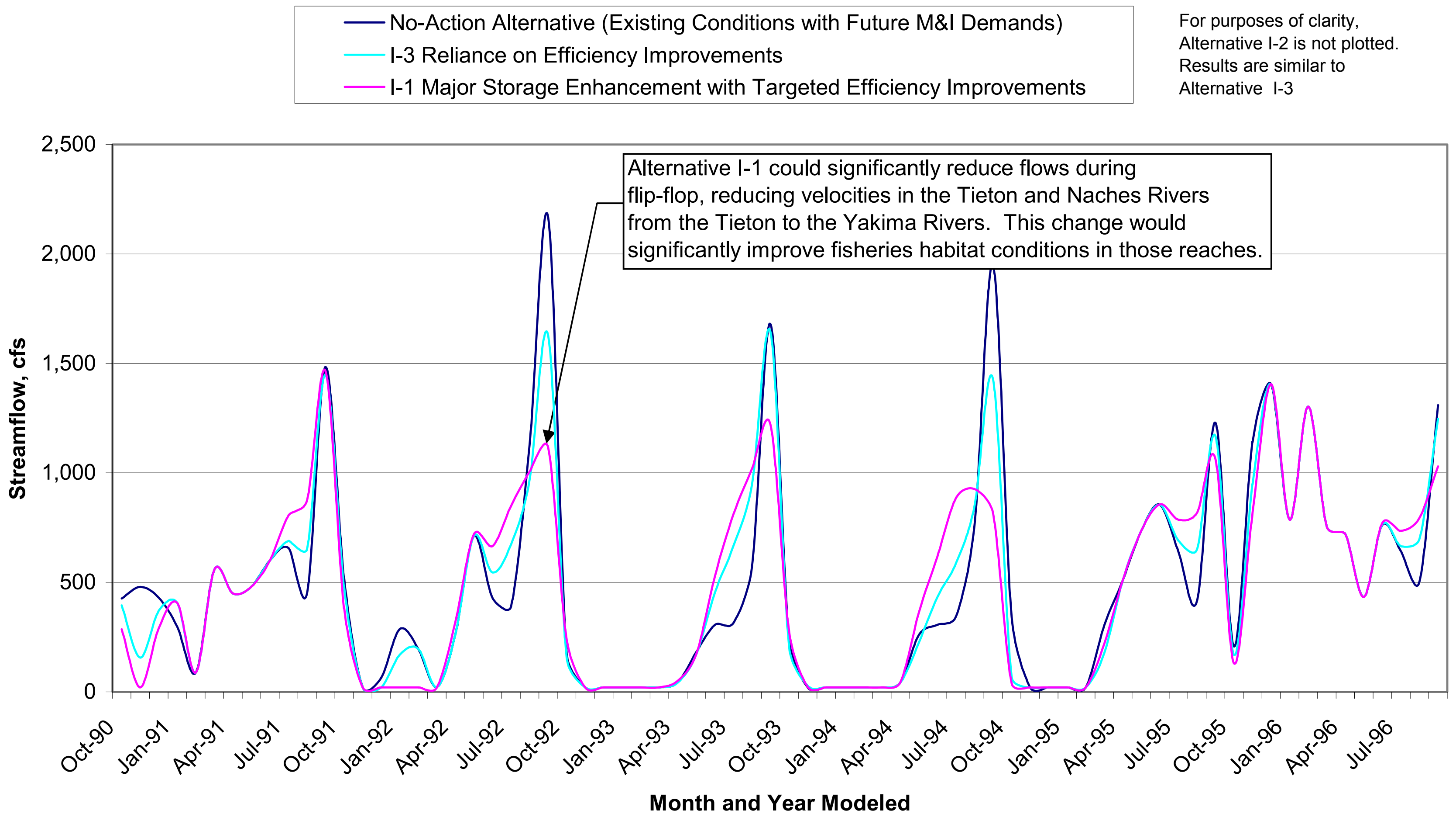


Exhibit 3-8
Tieton River below Rimrock Reservoir
Comparison of Monthly Average Streamflow from Alternatives Using Conserved/Stored Water to Eliminate Flip-Flop

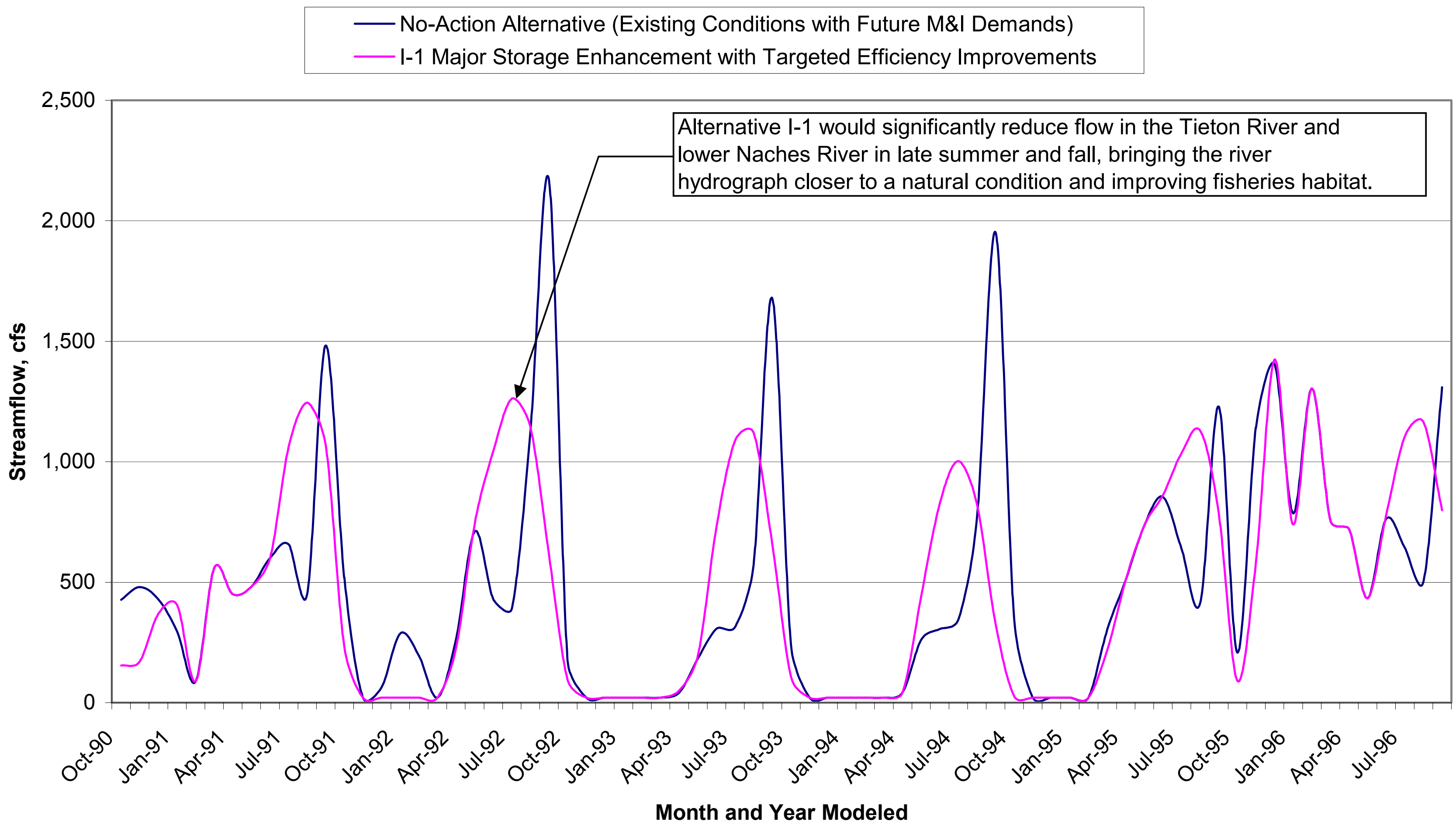
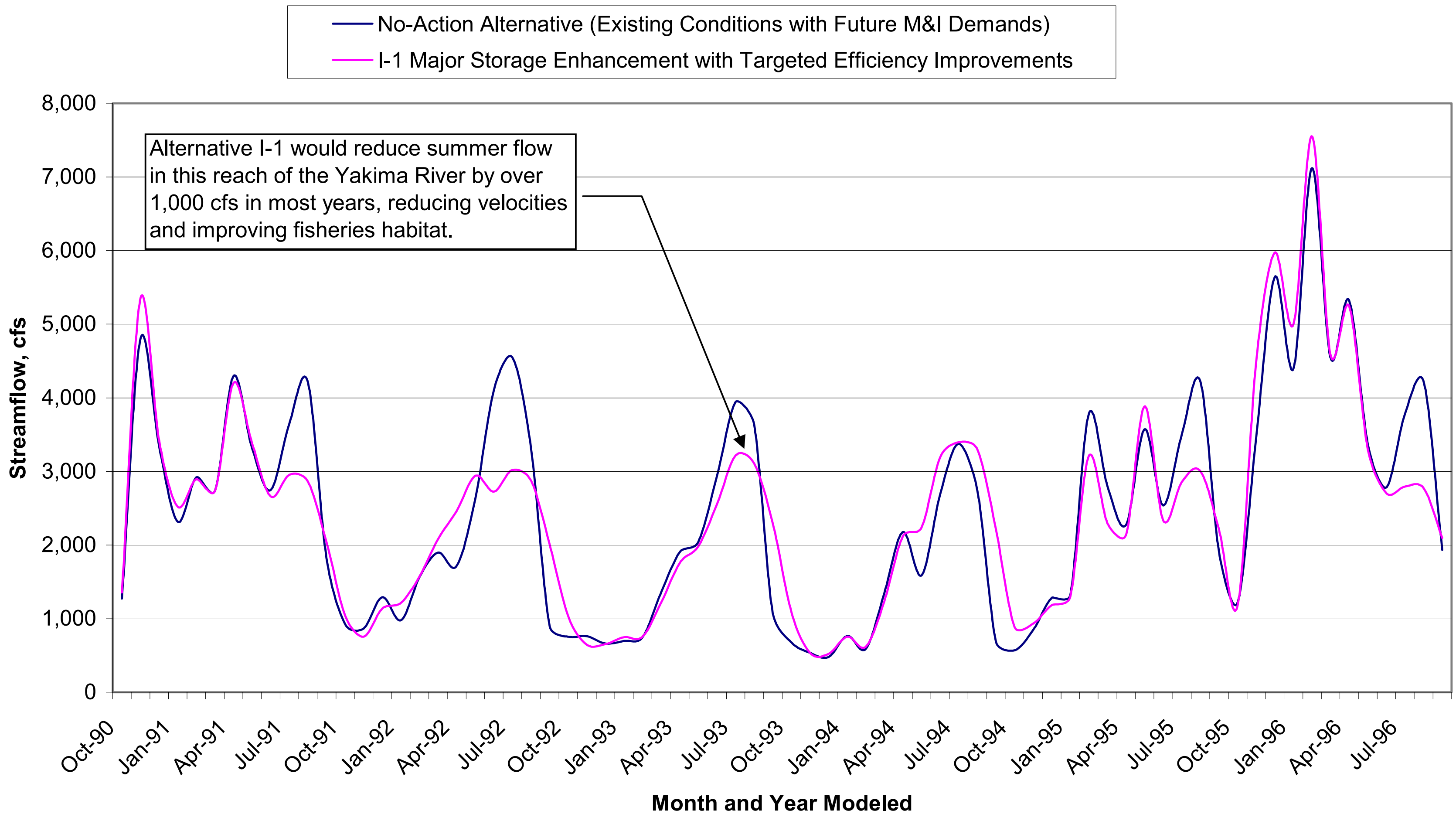


Exhibit 3-9
Yakima River at Umtanum
Comparison of Monthly Average Streamflow from Alternatives Using Conserved/Stored Water to Eliminate Flip-Flop



It should be noted that Alternative I-1 (Major Storage Enhancement) includes different combinations of projects involved (see Section 3.4). In the graphs, the results shown are for the scenario involving construction of Wymer Reservoir, enlargement of Bumping Lake, and modifications at Kachess and Cle Elum Lakes. These provide a "conservative" view of Alternative I-1, since the Black Rock Alternative would provide benefits greater than those shown in the graphs.

For more complete results, refer to the technical memorandum on hydrologic modeling (MWG, 2002a).

3.5.2 Results of Modeling No Action Alternative

The no action alternative describes the existing streamflow, reservoir storage, diversions and operations of the Yakima Project with future municipal and industrial (M&I) demands imposed. The future M&I demands are included solely to permit comparisons of the No-Action Alternative with the three action alternatives. This does not mean that current entitlements would be changed under the No-Action Alternative.

The modeling was performed with future predicted M&I demands to illustrate the effect of water use required to meet growth needs in the Yakima River Basin. Although the future M&I demand will likely be met through a combination of surface and groundwater withdrawals, the total of the two demands was represented in the model as surface water withdrawals as discussed with the Water Supply Workgroup. This approach provides conservative results, in assessing the benefits to reliability and stream flows; and also allows for potential "offsets" of ground water withdrawals by releases from the Project reservoirs (again, the purpose of modeling these features is solely to allow comparison with the action alternatives). The estimated additional M&I water use in 2050 for the upper Yakima River Basin is 12,929 acre-feet/year (AFY), from Middle Yakima 21,941 AFY and Naches 13,792 AFY. The demands were distributed such that two-thirds of those demands were applied to the irrigation season in the hydrologic model.

3.5.3 Results of Modeling Alternative I-1 (Major Storage Enhancement)

Alternative I-1 uses water from a large reservoir or reservoirs to improve the reliability of water supply for irrigation and to improve flow conditions for fisheries. Two scenarios are described with differing uses of the increased water supply that would be made available. The first is to increase Yakima River flow below Keechelus Dam. A minimum flow of 200 cfs was imposed on that reach. Water available after meeting those targets is used to improve the reliability of water supply. The second scenario uses water from the reservoir(s) to eliminate Flip Flop and Mini Flip Flop. Additional M & I use representing potential future demands for both surface and groundwater are also applied to water demands represented in each of the scenarios.

The effect on reliability for proratable water users is presented in Exhibit 3-3. The results of the modeling indicate Alternative I-1 will provide a very reliable water supply to Yakima Project water users for the scenario of providing 200 cfs flow in the upper Yakima River below Keechelus Reservoir. A full water supply is provided in all but severe drought years such as 1994. Even then, the proration level exceeds the 70% reliability goals of the Watershed Planning Unit.

Alternative I-1 also provides the opportunity to improve streamflow conditions in other reaches of the Yakima and Naches River system. Flow hydrographs are presented in Exhibits 3-4 to 3-7 for the Upper Yakima River, Yakima River at Umtanum, Yakima River at Parker and the Tieton River below Rimrock Reservoir for the scenario of providing 200 cfs flow in the Upper Yakima River. Flow conditions during fall and winter are significantly improved in the Upper Yakima River as 200 cfs is provided after the irrigation season (Exhibit 3-4). There is also a benefit during summer, as peak flows resulting from Keechelus Reservoir releases are slightly reduced. Flow conditions in the Yakima River at Umtanum are also improved by reducing peak flows during summer, and slightly increasing fall and winter flows (Exhibit 3-5). A slight increase in flow will also result in the Yakima River at Parker (Exhibit 3-6). A reduction in reservoir releases from Rimrock Lake during the flip-flop period significantly reduces peak flows in most years in the Tieton River and the Naches River downstream of its confluence with the Tieton River (Exhibit 3-7).

For the second scenario of eliminating flip-flop, flow changes are significant throughout the Yakima and Naches River system except at Parker Dam. Flow hydrographs are presented in Exhibits 3-8 and 3-9 for two locations: the Tieton River below Rimrock Reservoir and the Yakima River at Umtanum. Improvements in streamflow conditions for fisheries would occur by reducing peak flows in summer along the Yakima River and substantially reducing the discharge from Rimrock Reservoir to the Tieton River that occurs in early September during flip-flop operations. Streamflow in the Yakima River at Umtanum is reduced by over 1,000 cfs (approximately 25%) during the summertime during most years. In the Yakima River at Parker (not displayed in the graphs), it appears summer flows are increased in most years but little other change is apparent.

3.5.4 Results of Modeling Alternative I-2 (Medium Storage Enhancement)

The model predicts the reliability of water supply for proratable water users would change by approximately 6% to 15% in dry years such as the 1992 to 1994 time period (see Exhibit 3-3), if the water saved through storage and efficiency improvements is used to improve the reliability of water supply and to increase instream flow in the Upper Yakima River. The improvement in reliability is smallest in 1994 because it is the third year of a drought and the reservoir could not refill to supply sufficient water for three consecutive years of drought. Under this alternative, a reduction in streamflow of approximately 500 cfs (10-12%) is predicted for the Yakima River at Umtanum during most years in the summertime, and also in the Tieton River below Rimrock Reservoir for most years during flip-flop operations. A slight increase in flow at Parker during summer months would also result for most years. For purposes of clarity, flow results for Alternative I-2 are not plotted on the exhibits, since the results fall between Alternatives I-1 and I-3.

3.5.5 Results of Modeling Alternative I-3 (Reliance on Efficiency, Reuse, and Transfers)

The results of this Alternative are plotted in Exhibits 3-3 through 3-9. Under this alternative, water saved through efficiency improvements would be used to meet Planning Unit objectives, without any enhancement to the Basin's storage capacity. The model predicts the reliability of water supply for proratable water users would change by approximately -4% in 1994, +5% in 1993 and –1% in 1992 (see Exhibit 3-2). Flow conditions in the upper Yakima River would be improved in the fall and winter by releasing more water from Keechelus Reservoir. Summer flows would also be improved by reducing peak flow (Exhibit 3-3). Flow conditions in the Yakima River at Umtanum would improve in the summer, as peak flows would be reduced (Exhibit 3-4). A slight increase in flow of the Yakima River at Parker would also result (Exhibit 3-5). A reduction in reservoir releases from Rimrock Lake during the flip flop period would reduce peak flows in the Tieton River and in the Naches River downstream of the confluence with the Tieton River (Exhibit 3-7). The magnitude of this reduction varies from year to year.

3.6 Cost Comparisons

In this section, the costs of individual projects from Section 3.3 are combined into the various alternatives. Both total cost and cost per acre-foot of yield per year were calculated. Results are presented in Tables 3-6 and 3-7. Since costs vary substantially depending on the specific projects included in each alternative, the tables are broken down into sub-alternatives.

Alternative I-1 (Major Storage Enhancement)

- Sub-alternative I-1A: Storage enhancement involving waters of the Yakima Basin only (Wymer Reservoir, Bumping Lake Enlargement, and modifications to Kachess and Cle Elum Lakes);
- Sub-alternative I-1B: Storage enhancement involving importation of water from the Columbia River into the Yakima Basin (Black Rock Reservoir)

Alternative I-2 (Medium Storage Enhancement)

- Sub-alternative I-2A: Wymer Reservoir

- ❑ Sub-alternative I-2B: Enlargement of Bumping Lake

Alternative I-3 (Reliance on Efficiency, Transfers and Reuse with No Storage Enhancement)

As shown in Table 3-6, the total costs range from $437 million for Alternative I-3 (Reliance on Efficiency Improvements) to $2.58 billion for Alternative I-1B (Major Storage Enhancement, using Black Rock Reservoir). Costs for the other alternatives fall between these values.

Cost per acre-foot of the different alternatives varies, depending on whether maximum yield or dry-year yield is considered. For example, cost per acre-foot in dry years ranges from $1,300 for both Alternative I-2B and I-3 to $3,200 for Alternative I-1B.

Table 3-6
Comparative Cost of Three Action Alternatives (1) (2)
(All Costs in 2002 Dollars)

Projects	Total Cost, Alt. I-1A	Total Cost, Alt. I-1B	Total Cost, Alt. I-2A	Total Cost, Alt. I-2B	Total Cost, Alt. I-3 (3)
Storage Projects					
Wymer Reservoir	$467,583,000	N/A	$467,583,000	N/A	N/A
Bumping Lake Enlargement	$242,597,000	N/A	N/A	$242,597,000	N/A
Kachess Lake Augmentation	$15,955,000	N/A	N/A	N/A	N/A
Cle Elum Lake Enlargement	$17,633,000	N/A	N/A	N/A	N/A
Black Rock Reservoir[3]	N/A	$2,261,437,000	N/A	N/A	N/A
Water-Use Efficiency Projects					
Kittittas Recl. Dist., Alternative	$40,236,000	$40,236,000	$40,236,000	$40,236,000	$40,236,000
Roza ID,	$68,893,000	$68,893,000	$68,893,000	$68,893,000	$68,893,000
SVID/BJC	$63,349,000	$63,349,000	$63,349,000	$63,349,000	$63,349,000
Selah-Moxee ID	N/A	N/A	N/A	N/A	$26,773,000
Ahtanum ID	N/A	N/A	N/A	N/A	$7,416,000
Union Gap ID/Fowler Ditch Co.	N/A	N/A	N/A	N/A	$33,309,000
Outlook ID	N/A	N/A	N/A	N/A	$963,000
South Naches ID	N/A	N/A	N/A	N/A	$7,233,000
Naches-Selah ID	N/A	N/A	N/A	N/A	$20,768,000
Yakima-Tieton ID	N/A	N/A	N/A	N/A	$306,000
Benton ID	N/A	N/A	N/A	N/A	$17,081,000
Columbia ID	$41,733,000	$41,733,000	$41,733,000	$41,733,000	$41,733,000
Kennewick ID	$109,086,000	$109,086,000	$109,086,000	$109,086,000	$109,086,000
Total	**$1,067,065,000**	**$2,584,734,000**	**$790,880,000**	**$565,894,000**	**$437,146,000**

[1] Alternatives:
I-1A: Major storage enhancement using in-basin waters, plus targeted efficiency and other actions.
I-1B Major storage enhancement using water from out of basin (Black Rock project), plus targeted efficiency and other actions.
I-2A Medium storage enhancement, using Wymer project, plus targeted efficiency and other actions.
I-2B Medium storage enhancement, using Bumping project, plus targeted efficiency and other actions.
I-3 Reliance on efficiency improvements, water reuse and voluntary transfers, with no storage enhancement.

[2] Does not include cost of water rights transfers, municipal reuse, and municipal conservation.

[3] Large version of Black Rock project

Table 3-7
Cost Effectiveness of Three Action Alternatives
(2002 dollars)

Alternative (1)	Total Cost (2)	Maximum Yield (AFY) (3)	Cost per AFY of Maximum Yield	Average Dry Year Yield (3) (AFY)	Cost per AFY in Dry Years
I-1A	$1,067,065,000	983,400	$1,100	534,700	$2,000
I-1B	$2,584,734,000	2,121,000	$1,200	818,000	$3,200
I-2A	$790,880,000	563,000	$1,400	376,000	$2,100
I-2B	$565,894,000	821,000	$700	451,000	$1,300
I-3	$437,146,000	476,000	$900	344,000	$1,300

[1] Alternatives:
I-1A: Major storage enhancement using in-basin waters, plus targeted efficiency and other actions.
I-1B Major storage enhancement using out-of-basin water (Black Rock), plus targeted efficiency and other actions.
I-2A Medium storage enhancement, using Wymer project, plus targeted efficiency and other actions.
I-2B Medium storage enhancement, using Bumping project, plus targeted efficiency and other actions.
I-3 Reliance on efficiency improvements, water reuse and voluntary transfers, with no storage enhancement.

[2] From Table 3-6

[3] Sum of projects from Table 3-5, selected and grouped for each alternative

3.7 Overall Comparison of Surface Water Management Alternatives

The four surface water management alternatives were compared using a consistent set of criteria, to determine which alternative should be recommended. The criteria used in this evaluation are listed in Table 3-8. These criteria are adapted from the Guide to Watershed Planning and Management (EES, 1998).

Table 3-8
Criteria for Evaluating Alternatives

Effectiveness Criteria	Feasibility Criteria
Overall Effectiveness. Among the alternatives considered, which are most effective at meeting Planning Unit objectives? (see Section 1.4).	*Legal authority*. Do the implementing organizations have the authority to implement the proposed solution? If not, can ordinances or rules be adopted to provide that authority?
Cost-effectiveness. Which alternatives deliver the highest benefits for each dollar invested?	*Approvals/permits*. What approvals or permits will be required? Are those approvals or permits likely to be granted?
Flexibility over time. Which solutions offer the ability to be readily modified over time, in response to changing conditions and improved information?	*Cost and Funding Sources*. How expensive is each alternative, and who will bear the cost? Will funding sources be available, both in the short-term and long-term?
Environmental Impacts. What kinds of environmental impacts are expected, and how severe are these impacts?	*Integration with related programs*. How will each solution fit in with related programs and plans?

Key findings from the evaluation are summarized below. The full evaluation is presented in greater detail in Appendix 3-A.

3.8 Key Findings for Alternative I-1: Major Storage Enhancement, with Targeted Improvements in Water-use Efficiency and Additional Actions

Alternative I-1 is the most effective alternative in meeting the objectives defined by the Planning Unit. It is very effective in improving reliability of surface water supply. Its effectiveness in this regard is much greater than all other alternatives considered in this Plan. As shown in Exhibit 3-3, Alternative I-1 could increase reliability to proratable users by approximately 35 percent in very dry years such as 1994, while simultaneously meeting increased targets for stream flow. This alternative is the only one that meets the Planning Unit goal of delivering at least 70 percent of entitlements to proratable users in dry years. The improved reliability would lead to substantial economic benefits. Economic benefits to the Yakima Basin are estimated to range from $16 million to $30 million on an average annual basis. In dry years this effect would be considerably magnified, ranging from $112 million to $244 million.

Alternative I-1 would also provide significant improvements in flexibility for management of stream flows in the mainstem system. This increased flexibility could be used to improve habitat conditions for listed fish species, as well as other benefits. The exact improvements depend on how the water is used in system operations, and choices about which reaches could be targeted for improved stream flow. Representative results are illustrated in Exhibits 3-4 to 3-9.

Alternative I-1 could provide sufficient supply to serve projected growth in demand in the municipal and industrial sector through year 2050. Water could be used either for direct supply of M&I needs; or to offset any effects of ground water pumping on stream flows.

However, Alternative I-1 is much more costly than the remaining alternatives. The cost, expressed as a present value in 2002 dollars (including both capital and O&M costs) is estimated to be on the order of $1.07 billion to $2.58 billion, depending on the mix of projects involved.

The environmental impacts of this alternative would be greater than the other alternatives, due to the magnitude of the storage improvements needed. It should be noted, however, that even though Alternative I-1 focuses on storage improvements, it would have minimal impact on fish passage in the Yakima Basin, and would allow improvements in stream flows for listed fish species. This is due to the specific characteristics of the various projects described for this alternative. In addition, the stored water is intended to improve reliability, but not to expand irrigated lands beyond those lands with existing entitlements. Further information on environmental impacts is presented below, in Section 3.12.

This alternative would be more complex in terms of gaining needed permits and approvals. For example, one version of this alternative (sub-alternative I-1A) would involve construction or modification of four reservoir sites, each requiring extensive permitting and approvals. The other version (sub-alternative I-1B) would involve construction of Black Rock Reservoir, and would require approvals to withdraw water from the Columbia River, for use in the Yakima River Basin. These needs will likely create increased costs, complexity and delays for this alternative, in comparison with the remaining "action" alternatives.

3.9 Key Findings for Alternative I-2: Medium Storage Enhancement, with Targeted Improvements in Water-use Efficiency and Additional Actions

Alternative I-2 would improve reliability of surface water supply, but not as much as Alternative I-1. Modeling results simulating years 1992-96, for example, show that the improvement in reliability to proratable users would be on the order of 6 to 15 percent. These improvements could be obtained while simultaneously meeting increased stream flow targets. In some dry years, the reliability objective of at least 70 percent of entitlements delivered to proratable users could not be met. Economic benefits would be lower than for Alternative I-1. These benefits have not been estimated, but would likely be less than the low end of the range reported for Alternative I-1, above (i.e. less than $16 million on an average annual basis; and less than $112 million in dry years).

Alternative I-2 could improve the flexibility of the Yakima Project reservoir system by providing storage and releases closer to the largest demands in the Basin. However, the volume of storage is not sufficient to provide a large degree of flexibility over a long period of time during drought years.

This alternative could not eliminate the "flip-flop." However, the hydrologic modeling results show the impacts of the flip-flop on stream flows could be slightly reduced.

Alternative I-1 could provide sufficient supply to serve projected growth in demand in the municipal and industrial sector through year 2050. Water could be used either for direct supply of M&I needs; or to offset any effects of ground water pumping on stream flows. However, because Alternative I-2 provides less yield, and does not fully meet the 70 percent reliability objective, use of water for this purpose could conflict with the reliability or flow objectives in some dry years.

Alternative I-2 could be completed at a cost substantially less than that of Alternative I-1. The cost is estimated to range from $566 million to $791 million, depending on the specific projects involved. This cost is expressed as a present value in 2002 dollars including both capital and O&M costs.

The environmental impacts of Alternative I-2 would be intermediate between the other two "action" alternatives. The main impacts would be due to construction of one major reservoir in the Basin. Further information on environmental impacts is presented below, in Section 3.12.

Approvals and permitting would be relatively complex, but less so than Alternative I-1. For example, Alternative I-2 does not include the Black Rock Project, and would therefore not involve use of water from the Columbia River. With respect to waters of the Yakima River Basin, Alternative I-2 would involve only one storage site, instead of four, thereby reducing permitting complexity.

3.10 Key Findings for Alternative I-3: Reliance on Efficiency Improvements, Water Reuse and Voluntary Transfers, with No Storage Enhancement

Alternative I-3 is the only "action" alternative that does not involve construction or improvement of water storage facilities (other than minor reregulation reservoirs associated with irrigation district efficiency projects). Because of this, Alternative I-3 is less costly than the other alternatives, and would involve fewer and less complex permitting issues.

Alternative I-3 is less effective in meeting Planning Unit objectives. It would improve reliability of water supply slightly, but not as much as Alternatives I-1 or I-2. In dry years such as the 1992-96 period, reliability would slightly decrease or be increased by only 5 percent (see Exhibit 3-3) if the water saved through efficiency improvements is first used to increase instream flow in the upper Yakima River and then be used to improve the reliability of water supply for proratable water users.

Alternative I-3 would provide improvements in stream flows in the mainstem system. These results are displayed in Exhibits 3-4 to 3-7. Unlike Alternative I-1, this alternative would not allow elimination of the "flip-flop" in Yakima Project operations.

Those municipal and industrial users with proratable entitlements (e.g. City of Yakima) would benefit slightly from the reliability improvements discussed above. However, this alternative would not provide a source of supply to meet demands associated with growth in the municipal and industrial sector to year 2050.

Alternative I-3 is the least costly of the "action" alternatives, but still would require a substantial investment of $437 million.

Other elements of this alternative include expanded use of voluntary transfers, additional conservation in the municipal sector, and construction of facilities to reclaim and reuse municipal wastewater. These activities were reviewed in several technical memoranda prepared during the planning process (EES, 2002c, 2002e, and 2002f).

To the extent that municipal and industrial entities undertake water conservation programs, these can help extend existing water supplies as communities grow. However, it is unlikely that water conservation can fully offset growth in municipal demand, estimated to be 41 percent between years 2000 and 2050. Moreover, because urban uses of water are relatively small compared with irrigation uses in the Yakima Basin, this method offers only marginal benefits in the overall context of Yakima Basin needs.

Voluntary transfers of water rights could potentially be an important source of water to serve municipal growth, in areas where circumstances permit. Voluntary transfers can also be an effective means of improving stream flows in some locations. However, voluntary transfers offer little ability to improve reliability of water supply for agriculture at the basin-wide scale.

Reuse of municipal wastewater offers some ability to extend municipal supplies as growth occurs. However, there are significant limitations on this strategy. In particular, return flows to the Yakima River are relied on by downstream users, so reuse projects that reduce return flows from cities may be problematic. In addition, reuse of municipal wastewater is relatively costly, compared with other alternatives such as ground water production.

Alternative I-3 would have fewer environmental impacts than the other two "action" alternatives. The primary impacts would be effects on shallow ground water levels in areas where irrigation district efficiency projects are undertaken. This could affect both wetlands used by fish and wildlife, and local owners of shallow wells.

3.11 Key Findings for Alternative I-4: No- Action

The No-Action alternative offers no improvement over current conditions, in terms of meeting the Planning Unit objectives. Under this alternative, agricultural producers relying on proratable supplies from the Yakima Project would continue to experience substantial losses during drought years, substantially reducing the Basin's economic output and employment in those years. Management of stream flows in the mainstem Yakima River and Naches system would continue as under current conditions. Communities experiencing growth will face considerable difficulty in obtaining new water supplies, unless ground water supplies are made available (see Section 4).

The No-Action Alternative, by its nature, does not impose new costs or require any additional funding sources. However, all existing programs currently operating in the Yakima Basin require ongoing funding, including the USBR's Yakima Project operations; the Department of Ecology's water rights administration activities; Water Conservancy Boards; municipal water and wastewater systems, etc.

3.12 Preliminary Review of Environmental Impacts

Appendix 3-B provides a preliminary review of the environmental impacts of the various alternatives. This preliminary review is intended to provide an initial overview of the various environmental impacts, based on readily available information. It does not constitute a complete Environmental Impact Statement (EIS) under the State Environmental Policy Act (SEPA). However, in performing this review, the intent of the Planning Unit is to identify the most significant types of environmental impacts associated with each alternative.

The results of the preliminary environmental review are summarized in Table 3-9.

The Planning Unit notes that further review of environmental impacts, and potentially identification of environmental mitigation elements, will likely be needed as various individual projects are pursued. In particular, any major project such as a new reservoir, will require an EIS to be prepared by the lead agency for that project.

3.13 Recommended Alternative(s)

Alternative I-1, Major Storage Enhancement with Targeted Improvements in Water-use Efficiency and Additional Actions, is the only alternative than can meet the defined objectives of the Planning Unit. This Alternative offers opportunities for significant improvement of reliability for water users, as well as improved stream flows throughout the mainstem system. For this reason, the Planning Unit recommends this Alternative for implementation.

The Planning Unit believes the potential environmental impacts associated with Alternative I-1 are reasonable, in comparison with the benefits. This is due in large part to the availability of storage sites that are either offstream, or involve enlargement of existing facilities.

It is recognized that Alternative I-1 will be costly in financial terms. However, the Planning Unit believes that these investments in the basin's infrastructure will provide significant, long-term benefits for both the regional economy and endangered fish.

As noted in Section 3.4, the Planning Unit does not intend to recommend specific project sites in this Watershed Plan. Several projects appear potentially worthy of further review to establish their feasibility and determine whether they can be funded. Selection of specific projects will be handled in other forums, as appropriate information is obtained and analyzed.

Table 3-9
Summary Environmental Review of Surface Water Management Alternatives

I-1 **Major Storage Enhancement, with Targeted Improvements in Water-use Efficiency and Additional Actions**	**I-2** **Medium Storage Enhancement, with Targeted Improvements in Water-use Efficiency and Additional Actions**	**I-3** **Reliance on Efficiency Improvements, Water Reuse and Voluntary Transfers, with No Storage Enhancement**	**I-4** **No Action**
***Representative Projects*:** Black Rock Reservoir (large version); OR Combination of four projects: Wymer Reservoir, enlargement of Bumping Reservoir, modification of Kachess Lake and enlargement of Cle Elum Lake. PLUS: conservation plans of selected irrigation districts; some municipal reuse projects; market-based transfers and some trust acquisitions from voluntary sellers	***Representative Projects*:** Wymer Reservoir; OR Enlargement of Bumping Reservoir; PLUS: conservation plans of selected irrigation districts; some municipal reuse projects; market-based transfers and some trust acquisitions from voluntary sellers	***Representative Projects*:** Conservation plans of all irrigation districts under YRBWEP; some municipal reuse projects; market-based transfers and trust acquisitions from voluntary sellers	***Representative Projects*:** No Projects.
High Environmental Impacts (vary depending on projects selected): ***A. If Black Rock Selected:*** • Inundation of farmland, disturbed lands, and some shrub-steppe habitat. • Condemnation of private land. • Disturbance of land from roads, pipelines, pumping station. • Short-term impacts on water quality from construction activity	***High Environmental Impacts (vary depending on projects selected)*** • National forest and other federal land, state park facilities, utilities, & roads. • Condemnation of private land. • Bumping Lake project affects federal wilderness lands • Fish and wildlife habitat, including wetlands, from land inundation, earth moving, easements, pipelines, & road construction. • Short-term impacts on water quality from construction activity	***High Environmental Impacts*** • None identified ***Low Environmental Impacts:*** • Disturbance or loss of wetlands/other riparian habitat from efficiency improvements in Irrigation Districts. • Lowered water tables in these same areas, affecting owners of shallow wells. ***No Environmental Impacts:*** • Efficiency projects do not impede fish migration.	***Environmental Impacts:*** • Status quo

Table 3-9 (cont.)
Summary Environmental Review of Surface Water Management Alternatives

I-1 **Major Storage Enhancement, with Targeted Improvements in Water-use Efficiency and Additional Actions**	**I-2** **Medium Storage Enhancement, with Targeted Improvements in Water-use Efficiency and Additional Actions**	**I-3** **Reliance on Efficiency Improvements, Water Reuse and Voluntary Transfers, with No Storage Enhancement**	**I-4** **No Action**
High Environmental Impacts (cont.) ***B. If Combination of four other projects selected:*** • National forest and other federal land, state park facilities, utilities, & roads. • Condemnation of private land. • Inundation and disturbance of federal wilderness lands • Disturbance of fish and wildlife habitat, including wetlands, from land inundation, earth moving, easements, pipelines, & road construction. • Short-term impacts on water quality during construction. ***Low Environmental Impacts (also vary depending on projects selected)*** • If Kachess project selected, may impede fish migration in Silver and Cabin creeks. • If Black Rock project selected, slight reduction in Columbia River flows, but limited to high flow periods. • If "flip-flop" eliminated or reduced, reduced whitewater recreation on Tieton River (but benefits to fish). • Disturbance or loss of wetlands/other riparian habitat from efficiency improvements in Irrigation Districts. • Potential disturbance of archeological sites or cultural resources. ***No Environmental Impacts*** • No expansion of irrigated lands, beyond those lands with existing entitlements.	***Low Environmental Impacts (also vary depending on projects selected)*** • Some reduction in flows for whitewater recreation on Tieton River. • Disturbance or loss of wetlands/other riparian habitat from efficiency improvements in Irrigation Districts. • Archeological sites or cultural resources ***No Environmental Impacts:*** • Neither of these storage enhancement projects include physical barriers to fish migration. • No expansion of irrigated lands, beyond those lands with existing entitlements.	***(see previous page)***	***(see previous page)***

Table 3-9 (cont.)
Summary Environmental Review of Surface Water Management Alternatives

I-1 Major Storage Enhancement, with Targeted Improvements in Water-use Efficiency and Additional Actions	I-2 Medium Storage Enhancement, with Targeted Improvements in Water-use Efficiency and Additional Actions	I-3 Reliance on Efficiency Improvements, Water Reuse and Voluntary Transfers, with No Storage Enhancement	I-4 No Action
Environmental Benefits: • Substantial improved water management flexibility for stream flows. • Efficiency projects may offer water quality benefits	***Environmental Benefits:*** • Improved water management flexibility for stream flows (less than for Alternative I-1). • Efficiency projects may offer water quality benefits	***Environmental Benefits:*** • Improved stream flow conditions, but more limited than potential improvements from Alternatives I-1 and I-2. • Efficiency projects may offer water quality benefits	***Environmental Benefits:*** • Status Quo
Insufficient information to characterize: • Effects on reservoir fisheries from storage enhancement. • Effects on water quality, groundwater, and riparian habitat from lining canals. • Effects on water quality and groundwater from introduction of out-of-basin water and/or enhancement of existing reservoirs. • Changes to fish habitat, spawning suitability, potential indirect effects on migration behavior. • If Black Rock project selected, effects on Columbia River system.	***Insufficient information to characterize:*** • If Bumping Lake project selected, effects on reservoir fisheries from storage enhancement. • Effects on water quality, groundwater, and riparian habitat from lining canals. • Effects on water quality and groundwater from storage enhancement. • Changes to fish habitat, spawning suitability, potential indirect effects on migration behavior.	***Insufficient information to characterize:*** • Effects on water quality, groundwater, and riparian habitat from lining canals.	***Insufficient information to characterize:*** Not Applicable

3.14 Other Surface Water Projects

In addition to the surface water management projects discussed in the context of the three "action" alternatives, there are a other initiatives under way in the Yakima Basin that are closely related to the objectives of the Watershed Plan. These activities are not included in the alternatives, because the alternatives were designed to show major distinctions between overall strategies that impact the basin as a whole. Nonetheless, these projects warrant discussion, and should be viewed as important elements within local areas of the Yakima Basin. Therefore these projects are described below, and have also been discussed in the various technical memoranda prepared during the Planning process.

- *City of Yakima ASR.* This project would involve storing water underground for use in dry years. For more information, see information prepared for City of Yakima. Some of this information was developed using a state grant under the watershed planning program.
- *Pine Hollow Reservoir Project.* This project has been proposed by the Ahtanum Irrigation District, and would be located west of the City of Yakima and north of Ahtanum Creek in Pine Hollow Canyon. Water would be diverted from the North Fork of Ahtanum Creek in the winter and early spring. The water would be used to provide irrigation water to both Ahtanum Irrigation District and Wapato Irrigation Project (Yakama Nation Reservation) users and increase flows in Ahtanum Creek.
- *Possible source substitution involving tributaries in Kittitas Valley.* Many landowners within Kittitas Reclamation District (KRD) obtain water from both KRD deliveries and from their own diversions of tributary creeks. These creeks include Big Creek, Little Creek, Taneum Creek, and Manastash Creek. If additional water were available from KRD, these landowners could potentially meet a larger share of their needs from KRD, reducing the need for tributary diversions. This could improve flow in the creeks, with benefits for fish habitat. KRD has completed a study to determine the cost and feasibility of water-use efficiency projects on KRD laterals. Reduced leakage from the laterals could potentially provide the additional supply needed to reduce diversions from one or more of the tributary creeks listed above.

The Planning Unit encourages continued development of solutions such as these that can contribute to the overall objectives for the Watershed Plan, as defined in Section 1.4.

3.15 Implementation Considerations for Surface Water Management

The preferred alternative would involve a range of activities involving agricultural and municipal water use, by a variety of public and private entities. In the agricultural sector, Alternative I-1 involves construction of one or more storage reservoirs in the Yakima Basin, continued implementation of irrigation district efficiency improvements under YRBWEP, and ongoing improvements to on-farm water use efficiency. In the municipal sector, this alternative would involve ongoing attention to water use efficiency in the municipal and industrial sector, and periodic review of the need and benefits associated with reuse of municipal wastewater. This alternative also involves voluntary transfers of water rights, by both public and private water users. The implementation framework outlined in Chapter 8 of this Watershed Plan envisions that different actions will involve different implementing organizations, as appropriate.

The preferred alternative includes enhancement of the Basin's water storage capacity as a central feature of the Watershed Plan. The water storage would likely be planned, designed, constructed and operated by the USBR. Implementation would involve further feasibility studies and design work, solicitation of funding from the federal government and other sources, permitting activities, project-level environmental review, and consultation under the endangered species act. Each of these steps requires extensive activity, over a multi-year time frame. This will likely be a very challenging process, due to the magnitude of the financial commitments required, complexity involved in balancing instream and out-of-stream objectives, and the many different perspectives on these issues. Along the way there will be key decisions, such as how the storage improvements and existing storage facilities should be managed to ensure the instream flow objectives are met. Other organizations would need to be involved in supporting and carrying out this process, including irrigation districts, state agencies such as the Ecology and DFW, and citizens with an interest in these projects.

The municipal elements of Alternative I-1 are less defined at this time. In general, each city and town in the Yakima Basin has jurisdiction over the nature and intensity of water conservation programs, as well as any decisions regarding wastewater treatment and reuse. Therefore, the city and town governments are both the decision-makers and the implementing authorities for these components of the Watershed Plan.

With regard to water use efficiency measures, the Planning Unit recognizes that State law regarding relinquishment of water rights (Chapter 90.14 RCW) can provide a disincentive to public and private water users considering efficiency measures. The Planning Unit urges the Legislature as well as public and private water users in the Yakima Basin work to find a solution to this issue.

The transfers element of Alternative I-1 is "de-centralized," in that it relies on market forces and the judgment of individual water rights holders.

Chapter 8 discusses the role of a "Coordination Agency" in monitoring and supporting the implementation process. This Coordination Agency could be instrumental in assisting with Alternative I-1. For further information, see Chapter 8.

Chapter 4

Management of Ground Water Resources

Chapter 4
Management of Ground Water Resources

Ground water is an important resource in the Yakima River Basin. It is used for municipal water supply, agricultural irrigation, domestic water supply, stock watering, industry and other uses (see Chapter 2). All except two of the Basin's cities and towns rely exclusively on ground water for public water supply. Ground water and surface water resources may be interconnected in some locations, which gives rise to management challenges. This chapter identifies alternatives for managing the ground water resources of the Yakima Basin, and evaluates these alternatives using criteria similar to those used for surface water alternatives in Chapter 3a.

This chapter does not discuss ground water quality. For information on management of ground water quality, see Chapter 6 of this watershed plan. This chapter does not discuss Aquifer Storage and Recovery (ASR). However, ASR is discussed in Section 3. It is covered under Chapter 3 because it involves diverting surface water for storage in an aquifer. Therefore, it can be considered as a surface water management strategy.

As discussed in the Watershed Assessment, the U.S. Bureau of Reclamation (USBR), Washington State Department of Ecology (Ecology), and the Yakima Nation signed a Memorandum of Agreement (MOA) to fund and oversee a study of the ground water resources of the Yakima River Basin. The U.S. Geological Survey (USGS) has been contracted to perform the lead role in conducting the study, which is intended to gather additional data on hydrogeologic characteristics of the Yakima Basin, and to develop a numerical model of interactions between aquifers, and between ground water and surface water. The USGS study is expected to be completed in approximately 2007. The information provided by this modeling effort is expected to assist in making ground water management decisions in the Yakima Basin.

As discussed in the Watershed Assessment, available data is inadequate to understand important relationships among aquifers, and between ground water and surface water. It is anticipated that completion of the USGS modeling study will substantially improve the current understanding and predictive capabilities with respect to impacts from proposed uses of ground water. The Watershed Planning Unit recognizes that detailed planning for ground water would be premature pending completion of the study. Therefore, the alternatives presented in this chapter are general in nature. Moreover, evaluation of these alternatives is necessarily qualitative, since quantitative data is lacking at this time. The purpose of the discussion of ground water management alternatives presented in this chapter is to lay the conceptual foundation for future decision-making, that will occur after the USGS modeling effort is complete. For this reason, the discussion of ground water management alternatives presented in Chapter 4 is less detailed than the discussion of surface water management alternatives found in Chapter 3 of this Watershed Plan.

Chapter 2.5 of this Watershed Plan provides a brief summary of information on ground water resources of the Basin. Further technical information is provided in Section 4 of the Watershed Assessment document (YRB Planning Unit, 2001). Additional information is provided in a technical memorandum titled “Issues Related to Management of Ground Water Supplies” (EES, 2002b). These materials are considered to be an integral part of this plan document, by reference.

Chapter 1.4 listed the seven substantive goals defined by the Yakima Basin Watershed Planning Unit. Five of these goals are related to management of ground water supplies. These five goals are:

- Improve the reliability of surface water supply for irrigation use;
- Provide for growth in municipal, rural domestic and industrial demand;
- Improve instream flows for all uses with emphasis on improving fish habitat;
- Protect, improve and sustain ground water quantity and pumping levels of aquifers for the benefit of current and future use; and,
- Maintain economic prosperity by providing an adequate water supply for all uses;

The evaluation of ground water management alternatives presented in this chapter discusses application to all five of these goals.

4.1 Key Ground Water Management Issues

A number of interrelated issues must be considered when discussing ground water management strategies in the Yakima Basin. Key ground water management issues in the Yakima Basin were identified in the technical memorandum referenced above (EES 2002b) and are summarized as follows:

- ***Inadequate Data on Local/Regional Ground Water Systems.*** Key data gaps exist with respect to ground water rights, extent of use from different aquifers, exempt wells, unauthorized withdrawals, and areas with long-term declines in water levels. However, it should be noted that the USGS study discussed above and Ecology’s amended water measurement rule are anticipated to improve the availability of certain types of ground water data over time[1].

[1] It should be noted that the USGS study will not address all of the data gaps identified by the Planning Unit, with regard to water rights and uses.

- ***Availability of New Ground Water Rights.*** No new ground water rights have been issued for a number of years, and Ecology has imposed a temporary restriction on issuance of new rights pending completion of the USGS study described above.

- ***Ground Water/Surface Water Exchange.*** The relationships between surface and ground water, and the time periods involved in their interaction, are important in managing water resources in the Yakima Basin. Pumping ground water from some aquifers at particular locations may reduce flows in nearby surface waters. This reduction in flow may affect fish and other aquatic resources or potentially impair senior water rights. In other cases, pumping ground waters may have little effect on surface waters or may have effects that are delayed in time for locations far from the well. These effects can be very difficult to quantify.

- ***Potential Declines in Ground Water Levels Due to Effects of Agricultural Water-Use Efficiency Measures.*** Management of surface waters can affect ground water supplies. Where surface water is diverted and applied to irrigated lands, the resulting infiltration often provides an important mechanism for local recharge and elevated water tables. Where water-use efficiency measures are implemented, ground water recharge may be reduced, and aquifer levels lowered. These effects can cause problems for local ground water users, particularly those reliant on shallow wells. This can also dry up wetlands that are important for fish and wildlife.

- ***Potential Long-Term Declines in Water Levels Due to Withdrawals.*** Many areas of the eastern Washington have experienced long-term declines in water levels due to the effects of ground water withdrawals. Similar overdraft might also be occurring in the Yakima Basin. Although USGS and Ecology have collected data in some areas, long-term water level monitoring data is not currently available on a basin-wide basis to determine long-term trends in ground water levels.

- ***Inadequate Legal/Policy Framework for Aquifer Storage and Recovery.*** Artificial recharge is being used as a water-resource management technique in various locations in the U.S. However, no full-scale artificial recharge projects are currently under way in the State of Washington. This is partially due to the policy issues involved (e.g., level of treatment required, use of water by other users, water rights needed).

- ***Unaccounted for Water Use by Exempt Wells.*** Certain types of ground water use are exempted from the requirement to obtain a water right for withdrawal of ground water[2]. Approximately 40 percent of the Yakima Basin population relies upon individual household wells for their domestic water supply (see Table 2-1), most of which are "exempt wells." Exempt wells represent an

[2] For further information on exempt wells, see the Watershed Assessment document, Section 4.3.3.

unaccounted-for withdrawal of water from the basin which could potentially adversely impact other nearby water resources.

- ***Relationship with Surface Water Supplies.*** Some irrigators and cities use ground water as a backup source of supply, in dry years when surface water deliveries are inadequate to meet their needs. Solutions that improve surface reliability may reduce this need for ground water (also see Chapter 3). If new surface water supplies are not developed, then ground water becomes a more critical resource for the Basin.

- ***Unauthorized Withdrawals of Ground Water.*** Illegal uses of ground water (e.g., water use without a valid permit from Ecology, violation of the conditions of a water right, or water use from an "exempt well" that exceeds conditions of the exemption) may also be occurring in the basin. These unauthorized withdrawals could adversely impact other nearby water resources. Enforcement against illegal water uses could potentially free up water for other purposes that are legally authorized.

- ***Proliferation of Small Public Water Systems.*** As development occurs within urban growth areas, new homes may be served by small public water systems or may hook up to a larger municipal system. Proliferation of small systems can make it harder to manage withdrawals to protect the ground water resource, and may also make achievement of public health standards more challenging.

4.2 Applicable Ground Water Management Actions

Potential ground water management actions were reviewed in the Technical Memorandum titled "Issues Related to Management of Ground Water Supplies" (EES 2002b). These actions were identified through review of ground water management programs in other areas (Odessa Ground Water Management Subarea, Washington; Palouse Basin Aquifer, Washington/Idaho; and Edwards Aquifer, Texas). The following is a brief summary of potential actions that could be implemented to achieve the objectives discussed above. Some combination of these actions can be incorporated in any of the action alternatives discussed later, in Section 4.3.

- ***Establish a Data System to Assess Water Level Trends and Ground Water Usage Patterns.*** Sound data is the basis of an effective ground water management program. Establishment of a data system should include elements such as selecting aquifers for data collection; identifying suitable wells for monitoring, collecting data; establishing parameters of interest with regard to water usage; determining frequency of data collection; linkage to available ground water models; and establishing a framework and protocol for data verification, storage, access, and analysis. This system can be tailored for use with the ground water model under development by USGS. Water usage data reported to Ecology under Chapter 173-173 WAC, as recently amended, can be used as well.

- ***Develop Long-Term Criteria for Managing Ground Water Levels.*** As part of a comprehensive program to manage ground water, criteria can be developed to serve as targets and/or triggers for management actions in response to potential declines in water levels or production capacity identified as part of ongoing and future monitoring.
- ***Implement Water Use Efficiency Measures.*** Implementation of water-use efficiency measures for agricultural, municipal, domestic and industrial uses can contribute to effective management of withdrawals. For further information, see related technical memoranda produced for the watershed planning unit (EES EES 2002b and 2002c; MWG 2002d) and Guide to Watershed Planning and Management, Addendum No. 1 (EES 2001).
- ***Conjunctive Use with Surface Water Resources.*** Ground and surface waters are both used in many areas, often in combination to meet the demand of individual or group users. Managing these resources conjunctively can be used as a tool to optimize overall surface water/ground water system effects.
- ***Limitations on New Allocations.*** In areas where new allocations of ground water would cause undesired effects, these allocations could be issued with stringent conditions attached, or prohibited altogether.
- ***Water Rights Transfers Among Willing Parties.*** Water rights can be transferred on a voluntary basis through lease, sale, or other arrangements to achieve multiple benefits. Benefits are highly dependent on the specific conditions of each transfer. Transfers from ground to surface water, or vice versa, may also offer benefits in some locales.
- ***Retire Ground Water Rights on a Voluntary Basis or through Relinquishment.*** Where ground water is no longer used or needed, associated water rights can be retired, providing greater certainty to remaining users. Ground water rights could be retired through voluntary transfers or through the relinquishment provision in the State Water Code (Chapter 90.14 RCW).
- ***Public Education and Outreach.*** Ground water occurrence and movement within the larger hydraulic cycle is not generally well understood by the public or by some water users. Improved understanding could aid in achieving desired outcomes and improve support for ground water actions.

All of these measures have potential applications in the Yakima River Basin. However, at this time, a detailed ground water management plan is not specified, pending completion of the USGS study as described in the outset of this section.

4.3 Ground Water Management Alternatives

This section identifies alternatives for managing the ground water resources of the Yakima Basin, and evaluates these alternatives using criteria similar to those used for surface water alternatives in Chapter 3a. The ground water alternatives are identified as:

- Alternative II-1: Utilize Ground Water as a Key Resource in Meeting Water Supply Needs;
- Alternative II-2: Limit New Ground Water Development to Selected Uses;
- Alternative II-3: Prohibit New Withdrawals of Ground Water; and,
- Alternative II-4: No Action

It is important to remember these alternatives are being developed here at a general, conceptual level. Full analysis of these options will be deferred to coordinate with the completion of the USGS study of the Basin's ground water resources. However, the basis for future management options is being presented here as a means for establishing a preliminary assessment of future decision tradeoffs. The range of possible options at this time extends from expanded use to prohibition of any new use. Potential future details of these options are discussed as part of the individual alternatives outlined below.

Alternative II-1: Utilize Ground Water as a Key Resource in Meeting Water Supply Needs

Under this alternative, ground water would be viewed as a key resource to assist in meeting the Yakima Basin's water requirements for agriculture, stock watering, municipal supply, commercial and industrial needs, individual household supply, and/or other uses. Existing ground water supplies would continue to be used under the conditions of applicable water rights. In addition, new supplies would be developed to assist in meeting new or growing demands related to all purposes of use.

Management techniques would be used to manage water levels and prevent long-term declines in water levels. This includes data collection and management, attention to water-use efficiency by all users, enforcement action against unauthorized uses, use of voluntary water rights transfers, and avoidance of pumping practices that would deplete aquifers over the long term. Where applicable, surface and ground water supplies may be used conjunctively to enhance reliability and minimize impacts on stream flows.

Exempt wells as defined in the State Ground Water Code (Chapter 90.44 RCW) would continue to be installed as one means of providing ground water for users that qualify for the exemption. This element of alternative II-1 is similar to the "No-Action" Alternative described below.

Due to Ecology's obligations under the ground water MOA, this alternative could not be fully developed or implemented until the USGS study is completed. At this time, Ecology has prohibited issuance of new water rights until that time.

Alternative II-2: Limit New Ground Water Development to Selected Uses

Under this alternative issuance of new water rights for ground water withdrawals would be more limited than under Alternative II-1. In those areas or aquifers where further ground water development must be limited due to factors such as declining water levels or impacts on surface stream flows, proposed ground water uses would be subject to more stringent conditions in terms of issuing new water rights. A formal set of criteria will be developed for issuance of new water rights in these aquifers. These criteria may be different from one area to another, depending on local circumstances in different parts of the Yakima Basin. The criteria will take into account factors in different areas, as appropriate, such as the quantity of water needed for different types of uses; the quality of water needed; and the availability of alternate supplies (e.g. surface water – see Section 3).

In areas where supplies needed for agricultural irrigation can be met from surface water sources such as the Yakima Irrigation Project, the Planning Unit identifies a preference for ensuring that other uses, including but not limited to municipal, industrial, and domestic uses, can be met from ground water. This is because water needed for these purposes must be of high quality; treatment to meet state and federal drinking water standards is typically more costly for surface water than for ground water; and the quantities required are typically small in comparison with agricultural needs. Agricultural uses, due to the large quantities of water needed, should generally be met by surface water supplies where possible. However, this preference will need to be subjected to further analysis and review prior to implementation; and the full range of potential uses should be considered.[3] In addition, the specific mechanisms for defining which aquifers should be subject to this limitation will need to be developed. It should be noted that this preference is closely linked to the alternatives discussed in Section 3. If water supplies for agricultural irrigation can be made more reliable through storage enhancement, then irrigation users can meet their needs from surface water supplies, rather than developing backup ground water supplies.

Conditions for water users in tributary subbasins without access to Yakima Irrigation Project Water are different, and this alternative acknowledges this difference. The criteria that may be applied in these areas will need to be developed

[3] For example, the Watershed Assessment identified stock watering, dairies, protection of crops from frost, and environmental uses as other existing uses of ground water in the Yakima Basin at this time. See Section 4.2 of Watershed Assessment.

locally, to fit local needs and circumstances. In general, municipal supplies will not be the focus in these areas, since the main municipal centers of the Yakima Basin are located along the mainstem Yakima River rather than the tributaries. Without access to water from the mainstem, ground water remains a critical resource to meet the needs of agricultural irrigation in these areas, both as a primary and supplemental source of supply. The Planning Unit does not define any preferences or criteria for these areas at this time, but recommends that criteria for managing issuance of new ground water rights be developed locally, to allow for new development of ground water while protecting the resource.

As with the other alternatives, existing ground water uses would continue under the conditions of applicable water rights. Voluntary transfers may be pursued to "retire" some existing rights, where this would either protect ground water levels from declining or could serve as a means for improving stream flows in waters that are hydraulically connected to an aquifer.

It should be noted that the State Water Code at Chapter 90.03.290 already restricts ground water permits to those meeting four tests (water must be available, there must be no detriment or injury to existing rights, water use must be beneficial, and the water use must be in the public interest). Alternative II-2 would impose additional restrictions on issuance of new ground water rights in the Yakima Basin. The most likely means of implementing this approach would be adoption of rules by the Department of Ecology defining the criteria for issuance of new ground water rights. However, the Planning Unit does not envision a "blanket rule" that would treat the entire Yakima Basin as a single unit. Instead, any rules adopted to implement this alternative should specifically identify the areas where differing criteria will apply within the Basin, since this alternative indicates that criteria will be different for areas with access to Yakima Irrigation Project water; compared with subbasin tributaries.

Due to Ecology's obligations under the ground water MOA, this alternative could not be fully developed or implemented until the USGS study is completed.

Like Alternative II-1, management techniques would be used to manage ground water levels and prevent long-term declines in water levels. This includes data collection and management, attention to water use efficiency by all users, enforcement action against unauthorized uses, use of voluntary water rights transfers, and avoidance of pumping practices that would deplete aquifers over the long-term. Where applicable, surface and ground water supplies may be used conjunctively to enhance reliability and minimize impacts on stream flows.

Within urban growth areas, this alternative also includes a preference for reducing reliance on individual household wells ("exempt wells") or small public water systems for domestic water supply, by providing access to larger public water system supplies as new development occurs. The purpose of this is to improve the ability to manage the ground water resource. However, in order to supply these needs, the larger public water systems will need adequate water rights and sources of supply, either from ground water or surface water.

Within Urban Growth Nodes, or other areas of rural residential concentration, water supply for new development should be consolidated where feasible to avoid installation of new individual household wells for domestic uses. The methods for regulating such consolidated systems by local governments should be standardized. A system of approving and regulating small community systems should be developed and implemented by local governments. The purpose of consolidating supply and streamlining small system approval is to more easily monitor withdrawals and subsequent uses from aquifers.

Alternative II-3: Prohibit New Withdrawals of Ground Water

Under this alternative, development of new ground water supplies in the Basin would be prohibited (perhaps with an exemption for emergency situations based on stringent criteria to be defined). Existing ground water uses would continue under the conditions of applicable water rights, but voluntary transfers may be pursued to "retire" some existing rights. New or growing demands for water would either go unmet, or would be met by surface water supplies.

As with Alternative II-2, this alternative includes reducing reliance on exempt wells, particularly with regard to new urban and suburban development, by providing access to alternate public water system supplies. However, in order to do this, public water systems will need adequate water rights and sources of supply, either from ground or surface water (see surface water alternatives in Chapter 3a).

With respect to issuance of new water rights, this alternative is similar to the current "moratorium" on issuance of new water rights under the ground water MOA. However, unlike the MOA, this situation would extend the moratorium permanently. Since it is not inconsistent with the MOA, it could be implemented prior to completion of the USGS study.

This alternative would also involve management techniques to prevent ground water decline, as for Alternatives II-1 and II-2. This includes data collection and management, attention to efficiency, and other activities, as discussed previously.

Alternative II-4: No Action

The No Action Alternative describes a condition in which existing activities, programs, and trends in the Yakima Basin continue in the absence of Alternatives II-1, II-2 and II-3. With regard to ground water supplies, this will include the temporary moratorium on issuance of new ground water rights, as per the ground water MOA. Under the No-Action alternative there is uncertainty as to what will happen with ground water rights after the USGS study is completed, since future actions depend on results of the study.

As with Alternative II-1, the No-Action alternative will assume that some water users, including new residential developments, will rely on exempt wells for their water supply, consistent with recent practices and trends in the Basin.

The No-Action alternative will assume that no new activity will occur to prevent declines in aquifer levels, since these activities are not in place at this time, and there are no new initiatives under way to address ground water decline.

4.4 Alternatives Evaluation

The four ground water management alternatives described in Section 4.3 were evaluated by the Planning Unit. Because of the many uncertainties surrounding ground water at this time, this evaluation is general and qualitative in nature. The eight criteria used in this comparison are identical to those used in the review of surface water management alternatives (see Table 3-7 in Chapter 3).

The evaluation according to these criteria is contained in the tables in Appendix 4-A. There is one table for each of the criteria listed. Table 4-1 summarizes the results of the evaluation. For further detail, refer to the Appendix.

4.5 Recommended Alternative(s)

The Planning Unit recommends Alternative II-2 as the preferred alternative. However, the Planning Unit notes that Alternative II-2 alone cannot meet the Planning Unit's objectives with regard to water supply and economic prosperity. Therefore, this recommendation is made with the recognition that enhancement of surface water storage is also needed (See Chapter 3).

The primary criterion used in selecting Alternative II-2 was "Overall Effectiveness" (see Table 4-1 and Appendix 4-A). Many members of the Planning Unit feel that it would be unacceptable to prohibit new uses of ground water in the Basin (Alternative II-3), given the many needs for water supply. At the same time, the Planning Unit recognizes that ground water resources must be carefully managed to avoid depletion, and to minimize potential impacts on stream flows in those areas where hydraulic continuity is significant. Alternative II-1 could potentially cause undesirable impacts to both ground and surface water resources that are not consistent with the Planning Unit's objectives. The preferred Alternative II-2 strikes an appropriate balance between the need for water supply and the need to protect the Basin's ground water resources for long-term, sustainable uses.

Table 4-1
Alternatives Evaluation Summary

Evaluation Criteria	Alternative II-1 Key Resource	Alternative II-2 Selected Uses	Alternative II- 3 Prohibit New Withdrawals	Alternative II-4 No Action
Effectiveness[(1)]				
Overall Effectiveness	Effective in meeting municipal, domestic and industrial needs. Can contribute to improving reliability of irrigation. May have negative impacts on stream flow in some areas. Declines in water levels may occur.	Main benefits for municipal, domestic and industrial. Could offer limited benefits to reliability for irrigation in some locales. Criteria could be designed to protect both stream flows and ground water levels.	Would limit growth and development in water-short communities, compromising economic opportunities. No improvement in reliability. Could help protect stream flows, where hydraulic continuity is significant. Would help limit declines in water levels.	Depends on whether future decisions permit new use of ground water.
Cost-Effectiveness	Financial costs generally borne by each water user. Cost effectiveness of overall ground water management program cannot be determined at this time.	Similar considerations as Alternative II-1.	Financial cost low or zero; but cost of lost economic opportunities is high.	Depends on future decisions.
Flexibility Over Time	Use of ground water in conjunction with surface water could improve flexibility.	Improved flexibility primarily for municipal, domestic and industrial users.	Little flexibility, since new uses of ground water prohibited.	Depends on future decisions.
Environmental Impacts	Increased ground water use could impact regional aquifer systems and local base flows at some places and times. Could potentially impact stream temperatures at some places and times.	Criteria used for this alternative could be designed to minimize impacts.	Status quo, since new withdrawals would not be permitted.	Effects depend on future decisions.
Feasibility[(2)]				
Legal Authority	Ecology has authority to issue permits. Federal F&W agencies may have authority to override. Yakama Nation may have legal standing.	Rule-making by Ecology may be needed to apply this alternative.	Rule-making by Ecology may be needed to close Basin to further appropriations.	Ecology has authority to continue regulation of ground water withdrawals, subject to terms of MOA with USBR and YN.
Approvals/ Permits	Permit applications handled case by case, by Ecology.	Same as Alternative II-1.	No new permits would be issued.	Permitting depends on future decisions.
Cost and Funding Sources	Cost usually borne by individual user. Generally not prohibitive. Cost of improved management and data may be significant.	Similar to Alternative II-1. May be costs associated with legal challenges.	No capital or operational costs. May be costs associated with legal challenges.	Depends on future decisions.
Integration with Related Programs	Compatible with existing programs to administer water rights. Improved data and management may require additional staffing.	Generally, same as Alternative II-1.	Compatible with water rights program and fish recovery programs. May not be compatible with local land use and economic development programs.	Depends on future decisions.

Notes:
(1) Qualitative ranking of perceived effectiveness from 1 to 10, with 10 being the most effective. See Tables 1 through 5 for discussion of qualitative rankings.
(2) Qualitative ranking of perceived feasibility from 1 to 10, with 10 being the most feasible. See Tables 6 through 11 for discussion of qualitative rankings.

The Planning Unit also emphasizes the need for improved data and regional scale management of ground water resources. Modern, scientific management of this resource requires sustained collection of high-quality data on water levels in different aquifers, as well as information on water usage. In addition, it is important that individual water users use ground water as efficiently as possible.

At this time, Alternative II-2 has been developed only at a conceptual level, for purposes of guiding policy decisions. Considerable work remains to be done before this Alternative is ready for implementation. In particular:

- A framework is needed for analyzing particular aquifers to determine whether they are susceptible to depletion and whether they are hydraulically connected to the Basin's surface waters. For those aquifers that do not have either of these conditions, new development of ground water should be allowed greater latitude, than for aquifers that do have these conditions.
- Criteria for prioritizing water uses will need further development. The Planning Unit has expressed a general preference to reserve water for certain uses, but provisions must be made to ensure other, valid uses are provided for in some way (e.g. through access to surface water, and sufficient storage capacity to meet surface water needs).
- Specific procedures will need to be developed for Ecology to process permit applications for use of ground water, consistent with this Alternative. This may include adoption of a rule to implement this Alternative.
- A framework to provide for long-term data collection and management is needed, to improve the ability to monitor and manage the ground water resource.

4.6 Implementation Considerations for Ground Water Management

4.6.1 Available Administrative Programs

Existing ground water management programs that could be used to implement the recommended alternative in the Yakima Basin were identified in the Technical Memorandum titled "Issues Related to Management of Ground Water Supplies" (EES 2002b). These programs were identified by reviewing existing State programs and case studies for the Odessa Ground Water Management Subarea, Palouse Basin Aquifer, and Edwards Aquifer.

The Planning Unit recommends the following approach for managing ground water resources in the Yakima Basin:

1. Continue to rely upon Ecology's water resources program, which is currently the only administrative system in place for managing ground water allocations and related quantity issues in the Yakima River Basin. Rule-making may be needed to implement the preferred alternative

discussed above. However, the USGS study should be completed (i.e., in 2007), and further details of the management program developed, prior to rule-making.

2. With regard to continued uses of water under existing ground water rights, rely upon ground water management decisions made by individual members of the water user community, within the framework of State water law. If appropriate, provide new voluntary forums for assisting water users make decisions and identify alternative approaches to meeting their needs.
3. Use agreements among local governments and State agencies to adopt and implement an independent ground water management program (as done for the Palouse Basin Aquifer – see technical memorandum). The watershed planning framework under Chapter 90.82 RCW would provide an appropriate foundation for this approach, if coupled with agreements among local governments and State agencies.

With regard to water use efficiency measures, the Planning Unit recognizes that state law regarding relinquishment of water rights (Chapter 90.14 RCW) can provide a disincentive to public and private water users considering efficiency measures. The Planning Unit urges the Legislature as well as public and private water users in the Yakima Basin work to find a solution to this issue.

4.6.2 Implementation Roles and Responsibilities

Under the preferred alternative, Ecology would process applications for new water rights, in the context of a new rule to be adopted to implement Alternative II-2. Other activities would involve establishment of an improved ground water management framework, with improved water level monitoring capabilities, and coordination of pumping practices affecting aquifers subject to depletion, or streamflows in areas where aquifers are hydraulically connected to surface waters. The Coordinating Agency discussed in Chapter 8 could provide an effective means of developing this data collection and management framework, including partnerships with Ecology, USGS, or other organizations as appropriate. Promotion of water-use efficiency measures by municipal users, self-supplied industries, and agricultural users could also be coordinated by the Coordination Agency.

4.6.3 Potential Sources of Funding

The degree to which any new program can be implemented will depend largely on the amount of funding available. The implementing agency should initiate attempts to obtain long-term sources of funding immediately. Potential sources of funding for ground water management include:

- Federal grants from EPA and United States Department of Agriculture
- Cooperative agreements with federal agencies (e.g., USGS) in which the federal government funds a portion of the project
- Washington State funding programs, such as Public Works Trust Fund, State Revolving Fund for Drinking Water, etc.
- New fees applied to water users in various categories, as appropriate (e.g. customers of public water systems; agricultural users of ground water; industrial users; owners of individual household wells, etc.)
- Property tax or other local taxes
- Water rate surcharges adopted by public water systems benefiting from program
- Other state or local appropriations

Where funding is derived from targeted fees or taxes, care must be taken to ensure that principles of fairness and equity are addressed, and that the public supports these activities.

4.6.4 Implementation Priorities

It is recognized that funding may not be available to implement all actions included in the recommended alternative(s). In addition, full implementation of the recommended alternative will not be possible until completion of the ground water MOA study conducted by USGS. However, a number of independent actions could be pursued independently in the interim, in a scaled-back program. The actions could be prioritized by the Planning Unit based on relative importance, cost, and staffing availability. Potential interim actions include:

- Cooperative agreements
- Improved data collection (e.g., water levels)
- Voluntary transfers of water rights
- Water use efficiency measures
- Public education and outreach

For further information on implementation of this Watershed Plan, see Chapter 8.

Section III

Environmental Enhancement (Non-Flow Elements)

Section III of this Watershed Plan describes environmental enhancement actions that are not related to flow management. (Management of stream flows is covered separately in Section II because of the close relationship between flow and water supply.) This section includes three chapters addressing surface water quality, ground water quality, and fish habitat conditions, respectively. This section does not define "alternatives" as in Section II. This is because the various actions described for improvement of water quality and fish habitat generally are not mutually exclusive. Instead, a comprehensive environmental enhancement program can consist of many inter-related actions, which are listed here. The ability to carry out these actions depends largely on the availability of funding, staffing, and other resources.

Chapter 5

Surface Water Quality Strategy

Chapter 5
Surface Water Quality Strategy

Chapter 2 of this Watershed Plan contains a brief summary of surface water quality conditions in the Yakima River Basin, based on more extensive information presented in the Watershed Assessment (YRB Planning Unit, 2001). This Chapter presents a recommended strategy for improving and protecting surface water quality in the Basin. The surface water quality strategy consists of a structured set of goals, objectives and actions, as described in the following sections.

Management of surface water quality presents a significant challenge, due to the number and variety of activities that affect water quality, in all areas of the Basin. This is reflected in the range of objectives and actions described in this chapter. The Planning Unit has not attempted to define requirements for any agency, local government, or private sector organization. Instead, this Chapter lists a range of actions that would contribute to improving and protecting water quality, and identifies priorities. In addition, this chapter summarizes, in broad qualitative terms, the resources that may be needed to implement the various actions listed. A detailed analysis of costs and benefits has not been undertaken. It is assumed that implementing agencies will review costs and benefits as per their normal procedures in evaluating potential water quality activities.

It is recommended that this Surface Water Quality Strategy be used by state agencies, local governments and private sector organizations as they propose and fund projects and programs to improve water quality. Many of these organizations contributed to development of this Watershed Plan.

It is acknowledged that many organizations are already engaged in carrying out actions included in the strategy, and the Planning Unit recommends these efforts be continued and expanded wherever possible. In particular, the Planning Unit recognizes the Total Maximum Daily Load (TMDL) process currently being implemented by the Washington State Department of Ecology (Ecology). It is anticipated that the TMDL process will be an important vehicle for reducing loading to surface waters of the Yakima Basin over the next 10 to 20 years.

This Chapter was developed initially as a Technical Memorandum (Bain & Associates, 2002b), under the oversight of EES and the Water Quality Work Group of the Planning Unit. The water quality strategy builds on information summarized in the Watershed Assessment document. The Watershed Assessment, in turn, relied on numerous previous studies, including a number of reports from the U.S. Geological Survey's (USGS) National Water Quality Assessment (NAWQA) study of the Yakima River Basin, other studies, and ongoing monitoring data compiled by various federal, state and local agencies. Readers should consult the Watershed

Assessment for more detailed information on water quality conditions, previous studies conducted in the Basin, and the causes and sources of water quality impairment in the Yakima River Basin.

5.1 Water Quality Goals

The water quality strategy includes an overall goal and six supporting categorical goals. Under each categorical goal there is a set of specific objectives to implement the goals. The goals, objectives and related rationale are described below.

The overall goal of this strategy is: ***Protect and improve water quality consistent with the needs of aquatic life, public/private water supplies, recreation, and other uses.***

Under this overall goal, the six categorical goals are described as follows:

1. ***Reduce non-point source pollution:*** This goal stresses non-point source[1] pollution reduction and prevention. Best management practices as well as other approaches are identified.

2. ***Support/maintain point source programs:*** This goal calls for support and maintenance of point source[2] pollution controls. It is recognized that point sources are currently being regulated through the National Pollutant Discharge Elimination System (NPDES) permit program managed by Ecology under the provisions of the federal Clean Water Act and State law.

3. ***Improve interagency coordination of water quality programs:*** This goal addresses a need for improved coordination among local, state and federal agencies involved in management of surface water quality. An interagency committee formerly performed this function in the Yakima Watershed, but has been disbanded. Leadership is needed to reestablish an effective interagency coordinating forum.

4. ***Improve watershed-wide information base:*** This goal seeks to improve and broaden the base of basin-wide information on surface water quality conditions and causes of impairment. This goal is important for site-specific problem definition as well as for evaluation of the effectiveness of project actions. The nature of local problems and cause-effect relationships also need to be better understood.

5. ***Ensure water quality standards reflect natural regional conditions:*** This goal is important as a guiding principle for regulatory agency consideration given concerns over local applicability of certain water quality criteria such as those

[1] Point sources are discharges to surface water that occur at a single, defined point, such as a pipe from a municipal or industrial wastewater treatment plant. Non-point sources are diffuse activities that deposit contaminants on the ground surface that can be carried into surface waters through runoff.
[2] See previous footnote.

associated with current water temperature standards and background levels associated with turbidity criteria. Water quality standards, when set, reviewed and enforced, should consider geographic conditions and natural background conditions. Warm summer air temperatures on the eastern slopes of the Cascades may account for the large number of 303(d) listings for temperature in the Yakima Basin. Local public support for water quality efforts is based on locally relevant rationale. The process of setting TMDLs associated with 303(d) listings provides an opportunity to revisit local conditions. In addition, water quality standards in some areas of the Basin have already been adjusted to account for natural conditions.

6. ***Minimize water resource management impacts on water quality:*** This goal focuses on water quality impacts of the Yakima Basin's system of storage reservoirs, diversions, and return flows and their effect on hydrology. Stream flow affects water quality through dilution, aeration and velocity effects. Management of the river system's hydrology can affect water temperatures through diminished flow, but also potentially can be used to enhance some aspects of water quality (e.g. temperature) through carefully managed reservoir releases.

In addition to the substantive goals listed above, the Planning Unit notes that improving public awareness of water quality conditions, sources of impairment, and progress in improving water quality is an important component of the overall water quality strategy.

5.2 Objectives and Actions

5.2.1 Summary of Objectives, Actions and Priorities

The Surface Water Quality Strategy includes ten specific objectives that support the categorical goals listed above. In addition, a set of actions was identified under each objective. Some of these actions were then identified as priorities by the Planning Unit, as discussed further, below. Table 5-1 summarizes the entire Surface Water Quality Strategy, including goals, objectives, and actions.

As shown in Table 5-1, five actions are identified as priorities for implementation. These priorities were defined by the Water Quality work group, based on the following criteria:

- ❑ Addresses a major cause of impairment, or provides improved foundation for other actions;
- ❑ Adequately addressed by existing programs;
- ❑ Cost-effective;
- ❑ Funding available;

- Supported by stakeholders and public; and,
- Watershed Plan provides suitable vehicle for advancing the action.

Appendix 5-A provides further information on how these criteria were applied to identify the priorities shown in Table 5-1.

Discussions of each objective and proposed actions for water quality improvement are provided in the following pages. Each objective statement is followed by its purpose, rationale, relationships to goals, and other objectives and a list of proposed actions. In general, the purposes, rationale, etc. for these actions were developed based on review of water quality information (see references), interviews with knowledgeable persons, discussion among the Water Quality Subgroup, and professional judgment of the author of this technical memorandum.

The proposed actions are also summarized in tables that identify potential implementing agencies, as well as a brief qualitative assessment of potential resources needed for implementation, based on professional judgment of the author. The tables also provide a qualitative assessment of whether benefits would be short or long-term in nature. These tables are intended to serve as a preliminary step in considering implementation needs, and do not represent a commitment on the part of any agency or the private sector. Implementation issues will need consideration in detail during development of the Yakima River Basin Watershed Plan.

Many of the actions identified are already being implemented to some degree by various organizations. Where this is the case, the intent is to emphasize extending these activities to more areas, obtaining additional funding to expand implementation, and to involve more landowners and agencies.

The Planning Unit recognizes that other objectives and actions to improve and protect surface water quality may be identified in the future. The process for implementing this Watershed Plan needs to be flexible to allow new actions to be identified and included over time.

Table 5-1
Surface Water Quality Strategy

	High Priority Actions
GOAL 1: REDUCE NON-POINT SOURCE POLLUTION	
• **Objective 1: Prevent/mitigate forest practices impacts**	
▪ Action 1A: Improve Forest Road/Trail Management	
▪ Action 1B: Improve Timber Harvest Management	
▪ Action 1C: Other Watershed Actions	
• **Objective 2: Prevent/mitigate agriculture impacts**	
▪ Action 2A: Improve Irrigation Management	✓
▪ Action 2B: Improve Cropland Management	✓
▪ Action 2C: Reduce Impacts of Agricultural Chemicals	
▪ Action 2D: Address Livestock Impacts	✓
▪ Action 2E: Control Other Agricultural Impacts	
• **Objective 3: Prevent/mitigate stormwater impacts on water quality**	
▪ Action 3A: Plan/Implement Municipal Stormwater Runoff Controls	
▪ Action 3B: Plan/Implement Industrial Stormwater Runoff Controls	
• **Objective 4: Prevent/mitigate resource extraction impacts**	
▪ Action 4A: Control Impacts of Gravel Mining	
• **Objective 5: Prevent/mitigate recreation impacts**	
▪ Action 5A: Improve Recreational Use Management	
GOAL 2: SUPPORT/MAINTAIN POINT SOURCE PROGRAMS	
• **Objective 6: Maintain/improve compliance with discharge permits**	
▪ Action 6A: Upgrade Wastewater Facilities	
▪ Action 6B: Accommodate Service Area Growth	
GOAL 3: IMPROVE INTERAGENCY COORDINATION OF WATER QUALITY PROGRAMS	
• **Objective 7: Improve interagency coordination**	
▪ Action 7A: Improve Interagency Coordination	✓
GOAL 4: IMPROVE WATERSHED-WIDE INFORMATION BASE	
• **Objective 8: Improve understanding of problems and solutions**	
▪ Action 8A: Improve Cause-Effect Understanding	✓
▪ Action 8B: Improve Problem/Solution Definition	
▪ Action 8C: Expand Monitoring Activities	✓
GOAL 5: ENSURE WATER QUALITY STANDARDS REFLECT NATURAL REGIONAL CONDITIONS	
• **Objective 9: Ensure water quality standards reflect natural regional conditions**	
▪ Action 9A: Refine Water Temperature Criteria	
▪ Action 9B: Define Background Turbidity Levels	
GOAL 6: MINIMIZE WATER RESOURCE MANAGEMENT IMPACTS ON WATER QUALITY WHILE SUPPORTING LOCAL WATER USES	
• **Objective 10: Minimize water resource impacts on water quality**	
▪ Action 10A: Improve Surface Water Resource Project Operations	
▪ Action 10B: Assess Groundwater Impacts on Surface Water	

5.2.2 Detailed Description of Objectives and Actions

Objective 1: Prevent/Mitigate Forest Practices Impacts

Purpose: Support and encourage use of forest practice activities to protect and enhance water quality.

Rationale: Activities on forested lands can have significant impacts on water quality, particularly as related to soil erosion and water temperature. Forest practice-related activities including timber harvest and road maintenance can alter hydrology with attendant impacts on streams, particularly in the headwaters of the watershed. Protection of forested headwater drainages is critical as a source of high quality water for downstream reaches, which support a variety of beneficial uses.[3]

Relationship to Goals and Objectives: Objective 1 is the most closely linked with the protection aspect of the overarching water quality goal and to the categorical goal for prevention of non-point pollution. This objective also supports specific habitat protection goals designed to prevent degradation of important headwaters.

Proposed Actions: Actions identified under Objective 1 are intended to support the USFS, national forest plans and forest practice rules under the Forest Practices Board consistent with recommendations of the USFS and DNR watershed assessments (see References) and supporting activities. These sources have identified numerous actions to protect and improve water quality. Action categories addressing water quality include:

- ❑ ***Action 1A.*** Improve Forest Road/Trail Management. Numerous projects, plans and programs on federal and state/private forest lands are associated with forest roads and trails. These range from impact assessments, design modifications, and road density reduction programs to decommissioning of specific roads, trails or stream crossings. Examples of potential projects and programs under Action 1A include:
  - [*]*Management of Forest Roads*
  - Design of Forest Roads/Culverts
  - Construction Practices for Forest Roads
  - Erosion Control for Forest Roads
  - Decommissioning of Forest Roads/Trails
  - Road Fill Evaluation
  - Road Density Evaluation.

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[3] High quality water is generally associated with the forested headwaters of the Yakima Basin as shown on NAWQA reports and USFS watershed assessments.
[*] Italics denote high priority action.

- ❑ ***Action 1B.*** Improve Timber Harvest Management. Harvest-related actions include evaluations associated with pre-harvest plans and related criteria (e.g., riparian buffers) and mitigation of past logging impacts. Action categories addressing water quality include:

  - Evaluations of Unstable Slopes
  - Timber Harvest Management Plans
  - Riparian Canopy Closure Improvements
  - Road and Timber Harvest Buffers
  - Restoration of Riparian Recreation Areas
  - Soil Compaction Mitigation.

- ❑ ***Action 1C.*** Other Watershed Actions. There are a number of types of water quality-related actions which are more general in nature or which do not fit into the previously identified action groups. These include:

  - Watershed Assessments
  - Evaluations of Water Temperature Impacts from Forest Management Practices
  - Coordinated Resource Management Plans
  - Water Quality Monitoring.

***Screening Considerations*:** Control of non-point pollution within the forested areas of the watershed receives high priority because of the importance of these headwaters (i.e., influence on downstream reaches, habitat refugia). Many of the kinds of actions identified are protective/preventive in nature but there are also mitigation or restoration needs, which are very important in selected subbasins (e.g., Teanaway River drainage) where water quality impairment (e.g., erosion/turbidity) is an issue. Forest Service, DNR and private timber company watershed assessments outline management needs and prescriptions for recovery in specific subbasins. Obstacles to implementation of some actions exist due mainly to increasing recreational use pressures and the economics of timber harvest. The actions identified are mainly associated with on-going maintenance and good land stewardship.

The Forest and Fish Report, developed for the State Forest Practices Board and the Governor's Salmon Recovery Office in the late 1990s, outlined a proposal for new forest practices rules, statutes and programs to protect salmon habitat on now federal lands in Washington. Ongoing federal Forest Service activities and the new state forest practice rules based on Forest and Fish Report recommendations include numerous elements which are directly linked to water quality protection and others which are more closely associated with habitat management.

Table 5-2 summarizes the action categories in terms of potential agency and landowner involvement, resource needs and short term/long term benefits.

Most of the actions under Objective 1 require more time to take effect as revegetation and other watershed healing processes are involved and many different projects may be phased over a large area.

Table 5-2
Considerations for Implementation of Objective 1

Action	Potential Involvement(1)	Resources and Costs (2)	Benefits	
			Short-Term	Long-Term
1A Forest Road/Trail Management	USFS, DNR, Landowners	High		✓
1B Timber Harvest Management	USFS, DNR, Landowners	High		✓
1C Other Watershed Activities	USFS, DNR, Landowners	High	✓	✓

(1) See List of Acronyms at beginning of document.
(2) Low – less than $100,000, Medium between $100,000 and $500,000, High greater than $500,000.

Objective 2: Prevent/Mitigate Agricultural Impacts

Purpose: Emphasize control of non-point pollution from agricultural sources to protect and improve water quality throughout the watershed.

Rationale: Non-point pollution from agricultural activities is a particular problem in the Yakima River watershed[4]. Sources are varied, ranging from irrigation return flow and agricultural chemicals to confined animal feeding operations and dairies. Many of the surface waters in the lower reaches of tributaries are in violation of water quality standards, reflecting past pesticide use and other practices. Other problems include turbidity and water temperature. Ongoing efforts by the Department of Ecology (Ecology) working with Conservation Districts, NRCS, Irrigation Districts and local water users to reduce non-point source impacts through TMDL programs are successfully addressing some of these problems. As efforts continue, additional improvements will be realized.

Relationship to Goals and Objectives: Objective 2 closely linked to the overall water quality goal and categorical goal #1, which addresses non-point pollution source control. Certain point sources are also addressed (e.g., confined animal feeding operations). Other objectives that are closely linked include those emphasizing coordination of water quality projects and monitoring.

[4] For example, the USGS NAWQA studies concluded that agricultural related factors were a major cause of impaired conditions in lower reaches of numerous tributaries and the lower mainstem river area.

Proposed Actions: Actions identified under Objective 2 are categorical in nature reflecting the diversity of agricultural activities. These categorical action groups relate to irrigation, agricultural chemicals, animal confinement and other miscellaneous topics. Action categories and identified project types addressing water quality are listed below:

- ***Action 2A.*** Improve Irrigation Water Management. The following activities and other action needs are suggested for improvement of irrigation water management to benefit water quality. It is recognized that progress is being made on many of these actions already in the Yakima Basin. Examples of types of actions under action 2A include:
  - Irrigation District system improvements
  - *[*]Irrigation Scheduling and Management*
  - *On-farm Irrigation System Upgrades/Conversions*
  - Polymer Use for Tailwater Quality
  - On-Farm Sediment Ponds
  - Off-Farm Sediment Ponds
  - Tailwater Pump Back Systems
  - Silt removal from canals and laterals
  - Canal weed control impacts
  - Consider water quality impacts in routine operations and maintenance actions on irrigation drains

- ***Action 2B.*** Improve Cropland Management. Tillage, residue management, and other practices have water quality consequences for both irrigated and dry land farming. Examples of types of actions are listed below:
  - In-Furrow Residue Placement
  - *[*]Row Crop Erosion Control*
  - Tillage Management.

- ***Action 2C.*** Reduce Impacts of Agricultural Chemicals. Agricultural chemicals used in the watershed include pesticides for control of weeds, insects, other plant and animal pests; fertilizers such as nitrates, ammonium compounds and phosphates; and special chemicals for enhancement of crop quality or environmental factors (e.g., polymers for erosion control). Polymer use has improved water quality and received significant support, but refinements are needed to achieve proper dosages for particular sites[5]. Some past practices (e.g., DDT use outlawed in 1970s but applied on agricultural crops, forests, and in urban areas) have

[*] Italics denote high-priority action.
[*] Italics denote high priority action.
[5] Kittitas County Conservation District, Row Crop Erosion Control Study, 1999.

left accumulated residues in soils and aquatic life. Actions that could help understand and reduce impacts of agricultural chemicals are:

- Split Fertilizer Applications
- Soil Fertility Testing
- Pesticide Application Training
- Pesticide Licensing Programs
- *Row Crop Soil Erosion Controls*
- *On-farm Irrigation Water Management*
- Deep Percolation Evaluations
- Aerial Spraying Accuracy Evaluations
- Polymer Use Evaluations and Education
- Wind Criteria for Pesticide Application
- Roadside spraying evaluations
- *Aquatic weed control evaluations*
- Spray buffers from water body

- ❑ ***Action 2D.*** Address Livestock Impacts. Activities associated with confined animal feeding operations (CAFOs), dairies, ranching, and small holdings (hobby farms) have water quality impacts. While these activities occur mainly in areas designated for agricultural production, they may occur on a smaller scale in rural residential areas as well. CAFOs and dairies are regulated through state permits and these address discharges from permitted facilities. Less intensively used lands such as pastures are managed more on a voluntary basis with input from advisory agencies such as the Washington State University Cooperative Extension (WSUCE). Some aspects of ranching and general animal confinement are more controlled to discourage animals from accessing tributary streams. There has been considerable attention in recent years to reducing water quality impacts of large animals on the region's waterways. Existing permit programs and voluntary measures to address water quality concerns offer means of making progress on this issue. Examples of more specific actions are listed below, some of which are ongoing:

- *Maintain Technical/Financial Support to CAFOs*
- National Pollutant Discharge Elimination System (NPDES) Permitting of CAFOs.
- Maintain Dairy Permit Programs
- Voluntary Fencing of Streams
- Voluntary Buffer Strips near Streams
- Small Landowner Assistance Programs
- Application of Public Land Grazing Programs
- Out of Stream Water Source Developments

- [*] *Manure Management*
- Support Conservation District Efforts regarding Dairies
- Support Ecology TMDL Efforts

- ❑ ***Potential Impacts of Wildlife and Wildlife Management.*** In addition to livestock impacts discussed above, some Planning Unit members have suggested that wildlife may also impact water quality in the Yakima River Basin. The Water Quality Work Group acknowledges these effects are likely present. However, the Work Group did not identify any studies that specifically address impacts from wildlife, or suggest mitigation is necessary. Therefore, this Surface Water Quality Strategy does not include actions to address the effects of wildlife or wildlife management activities.

- ❑ ***Action 2E.*** Control Other Agricultural Impacts. There are impacts of agricultural-related activities that are not covered under the previous action groups. Needs also include educational and water quality monitoring activities as well as impacts of agribusiness operations and irrigation canal maintenance. Examples of other agricultural-related project actions include:

  - Pesticide Residue Monitoring in Aquatic Life
  - Agricultural Soil Monitoring for Pesticides
  - *Educational and Assistance Programs for Small Farms/Ranches*
  - Educational Tours/Demonstration for Commercial Growers

***Screening Considerations*:** Based on studies reviewed in the Watershed Assessment (e.g. Section 5.2.4 of Assessment document), agricultural land uses are strongly correlated with water quality impairment in the Yakima River watershed. Water quality is generally excellent in the headwaters and deteriorates significantly within intensively farmed areas of the Yakima Valley. With the exception of temperature criteria violations, most water quality standards violations in the Yakima basin are mainly associated with agricultural sources of non-point pollution.

Table 5-3 summarizes the actions identified with Objective 2 along with proposed agency involvement, potential resource needs and a qualitative determination of whether the benefits are short or long term in nature.

[*] Italics denote high priority action.

Table 5-3
Considerations for Implementation of Objective 2

Action	Potential Involvement(1)	Resources and Costs (2)	Benefits	
			Short-Term	Long-Term
2A Irrigation Management	CD, WSU, ID, USDA, Landowners	High	✓	✓
2B Improve Cropland Management	CD, WSU, ID, USDA, Landowners	Low	✓	✓
2C Impacts of Agricultural Chemicals	CD, Ecology, ID, WDOA, Landowners	High	✓	✓
2D Animal Confinement Impacts	CD, Ecology, USDA, Landowners	Medium	✓	✓
2E Other Agricultural Impacts	ID, CD, WSU, WDOA, USGS	Medium	✓	✓

(1) See List of Acronyms at beginning of document.
(2) Low – less than $100,000, Medium between $100,000 and $500,000, High greater than $500,000.

Objective 3: Prevent/Mitigate Stormwater Impacts

Purpose: Control municipal/industrial stormwater run-off impacts through implementation of approved management plans.

Rationale: Stormwater runoff from developed/urban areas and industrial sites contains pollutants that require management to avoid adverse impacts to receiving waters. State and regional guidelines exist (e.g., western Washington stormwater guidelines) which identify appropriate stormwater management practices. Stormwater ordinances have been adopted by county governments and other municipalities in the Yakima basin, which identify water quality control approaches such as use of retention basins and bioswales. Although some municipalities have adopted ordinances, guidelines tailored to the Central Washington region are not available at this time[6].

Relationship to Goals and Objectives: Objective 3 is related to the overall water quality goal and categorical goals #1 and #2, which deal with non-point and point source controls respectively. Aspects of Objective 3 also encourage development of regional water quality control guidelines that are consistent with Categorical Goal #5 which emphasizes consideration of regional conditions.

Proposed Actions: Actions identified with Objective 3 are primarily associated with municipal/industrial stormwater planning and related implementation. Only one action group accordingly is proposed under Objective 3.

[6] The Washington State Department of Ecology has begun planning to develop a stormwater management manual for Eastern Washington, which should help to meet this need.

- ❑ ***Action 3A.*** Plan/Implement Municipal Stormwater Runoff Controls. Actions identified for improvement of municipal stormwater runoff control plans and related implementation are listed below:
  - *[*]Municipal Stormwater Ordinances*
  - Regional Stormwater Runoff Control Guidelines
  - Municipal Stormwater Control Plans
  - Regional Stormwater Impact Assessments.
- ❑ ***Action 3B.*** Plan/Implement Industrial Stormwater Runoff Control. Actions identified for control of industrial stormwater are listed below:
  - Industrial Stormwater Ordinances
  - Regional Industrial Stormwater Guidelines
  - Industrial Stormwater Control Plans
  - Regional Stormwater Impact Assessments

Screening Considerations: Stormwater runoff management is needed in the Yakima Basin but is considered of lesser priority in most of the watershed than topics covered by objectives 1 or 2. Potential stormwater impacts from larger municipalities such as the cities of Yakima, Richland, Ellensburg, Prosser, and Sunnyside may be significant, particularly from storms that may increase pollutant loads during times of lower river flow. Work is needed on stormwater controls in most of the region's cities. Regional guidelines appropriate to the local climate should be made available for municipalities and for industrial runoff control design (see previous footnote). See Table 5-4 for other considerations. Benefits are primarily long-term, as stormwater plans will require time for development and implementation.

Table 5-4
Considerations for Implementation of Objective 3

Action	Potential Involvement[1]	Resources and Costs	Benefits	
			Short-Term	Long-Term
3A Municipal Stormwater Control	CNTY, CITY, Ecology	Medium		✓
3B Industrial Stormwater Control	CNTY, CITY, Ecology, IND	Low		✓

(1) See List of Acronyms at beginning of document.
(2) Low – less than $100,000, Medium between $100,000 and $500,000, High greater than $500,000.

Objective 4: Prevent/Mitigate Resource Extraction Impacts

Purpose: Control water quality impacts from mining and extraction of gravel, and/or other natural resources.

[*] Italics denote high priority action.

Rationale: Gravel mining activities have affected water quality in the Yakima Basin. There are major gravel extraction operations currently near the Yakima River mainstem. Gravel quarries operate under Ecology discharge permits and there are studies planned to evaluate effects of gravel quarry operations, including effects of varying locations on the floodplain, because of water quality and fish habitat concerns. Other natural resources extraction, such as coal mining, gold mining, and natural gas exploration has occurred in the watershed. However, the Water Quality Subgroup has not identified information that would indicate serious concerns from these activities, at this time.

Relationship to Goals and Objectives: Control of resource extraction impacts is consistent with the overall water quality goal.

Proposed Action: Actions proposed under Objective 4 are grouped in one category.

- ❑ ***Action 4A.*** Evaluate Gravel Extraction Operations. There is a variety of concerns regarding gravel quarry operations, particularly within flood plain areas. Specific actions identified are listed below:
  - *[*] *Gravel Quarry Relocation Studies*
  - *Gravel Extraction Impact Evaluations*
  - Gravel Extraction Permit Assessment
  - *Gravel Quarry Relocation Assistance*

***Screening Considerations*:** Objective 4 has highly localized impacts, which are important to water quality and fish habitat. Because these impacts are localized, they are considered a lower priority in the context of the overall Yakima Basin. Channel restoration activities will require time for healing. There are economic impacts associated with major changes in gravel extraction, which need to be considered along with possible benefits of restoration, relocation or other controls of gravel operations.

Table 5-5
Considerations for Implementation of Objective 4

Action	Potential Involvement(1)	Resources and Costs (2)	Benefits	
			Short-Term	Long-Term
4A Evaluate Gravel Extraction Operations	Ecology, IND, DFW, Land owners, CNTY, DNR	High	✓	✓

(1) See List of Acronyms at beginning of document.
(2) Low – less than $100,000, Medium between $100,000 and $500,000, High greater than $500,000.

[*] Italics denote high priority action.

Objective 5: Prevent/Mitigate Recreation Impacts

Purpose: Control or relocate recreational activities and restore damaged recreational sites where water quality impacts occur.

Rationale: Recreational uses can degrade water quality particularly where activities are near or within water bodies. Campgrounds in riparian areas that are intensively used result in soil compaction and alter runoff rates causing soil erosion. Stream crossings by recreational vehicles (e.g., ORVs) can be protected by hardening or relocated to less sensitive sites. Roads and trails to accommodate recreational use can contribute to erosion problems by concentrating runoff or because of design deficiencies, particularly in areas with a dense network of roads and trails.

Relationship to Goals and Objectives: Objective 5 is closely allied with objective 1 (forest practices) as both involve forest-oriented activities with many similar impacts associated with forest roads, compaction and soil erosion. Objective 5 mainly supports the overall goal and categorical goal #1.

Proposed Actions: The kinds of actions required to address Objective 5 are similar to some of those identified for timber harvest-related activities under forest practices. These are described under objective 1. Forest roads and trails are also used for recreation access but are not addressed under objective 5 as these are covered under objective 1. Proposed action for objective 5 is described below:

- ❑ ***Action 5A.*** Improve Recreational Use Management. Recreation activities can increase pressures on forested environments. Recreation management for water quality protection typically requires a wide variety of considerations ranging from mitigation of past damage to careful management of on-going activities such as campgrounds near streams. Action categories under recreation management include:

    - [*]*Off Road Vehicle Controls*
    - Stream Crossing Mitigation
    - Soil Compaction Mitigation
    - Campground Management/Facilities
    - *Recreational Use Evaluations*
    - Camping/ORV Use Evaluations
    - Snowmobile Use Mitigation

***Screening Considerations*:** Based on watershed assessments conducted in forested areas and the author's experience, recreational use impacts vary widely and are generally most significant near waterways, particularly where

[*] Italics denote high priority action.

activities are within riparian corridors. Priorities for mitigation will vary depending on the project and its locations. Prevention-related priorities are generally high in order to guide future planning for campgrounds and their access. Stream crossings and other more direct impact zones should generally be prioritized higher than upland projects involving diffuse recreation unless impacts on water quality are particularly compelling. Campground sanitation problems (facility projects) should receive high priority. Obstacles to implementation are expected especially where controls are needed to reduce intensity of recreational use in sensitive riparian areas and pristine uplands. Recreational use pressures are intensifying in the forested region so conflicts are likely when access is restricted. Rationale for water quality protection will need to be strong and communicated to the public in order to ensure support. Benefits are mainly long-term, as healing processes (e.g., revegetation) require time.

Table 5-6
Considerations for Implementation of Objective 5

Action	Potential Involvement[1]	Resources and Costs [2]	Benefits	
			Short-Term	Long-Term
5A Recreational Use Management	USFS, DNR	High		✓

[1] See List of Acronyms at beginning of document.
[2] Low – less than \$100,000, Medium between \$100,000 and \$500,000, High greater than \$500,000.

Objective 6: Support/Maintain Point Source Pollution Control Programs

Purpose: Continue to stress point source pollution controls as an ongoing need.

Rationale: Considerable progress has been made in the abatement of point source pollution sources through construction and operation of wastewater treatment plants and other facilities. Permit programs have been refined and treatment technologies have advanced since the 1960s when the nation began to focus on cleanup- of municipal and industrial wastewater. Effective laws are in place and major progress has been achieved. Needs will generally consist of expanding facilities to meet the needs of population growth and replace aging facilities, or to address new regulatory requirements and technological advances in the future. These needs can generally be addressed within the framework of the existing NPDES permitting process, including provisions for expansion to serve growth, upgrading and maintenance of facilities to meet regulatory requirements, and continued monitoring of effluents and receiving waters.

Proposed Actions: Actions identified under Objective 6 include facility improvements on an as-needed basis. These are described below:

- ***Action 6A.*** Upgrade Wastewater Facilities. There are numerous municipal and industrial wastewater treatment plants which discharge to the Yakima River or its tributaries. There are also areas which will need to be sewered as growth continues. The kinds of project actions needed include:
  - Address Pollutant Loading Impacts in Permit Process
  - Existing Municipal Treatment Plant Enlargements
  - *[*] *Existing Municipal Treatment Plant Upgrades*
  - Development of New Municipal Wastewater Facilities
  - Enlargement/Upgrading of Industrial Wastewater Facilities
  - Development of New Industrial Wastewater Facilities
  - Effluent Outfall Improvements
  - Effluent Reclamation/Reuse Facilities (e.g., spray fields)
  - Pumping Station and other Collection System Upgrades.

- ***Action 6B.*** Accommodate Service Area Growth. As required in State rules, municipal facilities need to accommodate incorporation of new areas and growth to protect both ground and surface waters. Actions needed include facility service expansion and regulations as listed below:
  - Sewer and Water Extensions to Serve Growth
  - Hookup Ordinances
  - Septic System Density Limitations
  - Water Well Density Limitations
  - *Sewer Areas of Growth near Municipalities*

***Screening Considerations*:** Point source pollution controls require continued vigilance and periodic upgrading to provide enlargements to accommodate growth and stricter effluent quality requirements such as ammonia and chlorine limits. Although this objective is important, the Water Quality Subgroup has assigned it a slightly lower priority than the non-point source controls that relate to forestry and agriculture in the Yakima watershed. Obstacles to implementation for objective 6 needs are generally financial.

Table 5-7
Considerations for Implementation of Objective 6

Action	Potential Involvement[1]	Resources and Costs [2]	Benefits	
			Short-Term	Long-Term
6A Upgrade Wastewater Facilities	CITY, IND, Ecology	High	✓	✓
6B Accommodate Service Area Growth	CITY, CNTY, IND, Ecology	High	✓	✓

[1] See List of Acronyms at beginning of document.
[2] Low – less than $100,000, Medium between $100,000 and $500,000, High greater than $500,000.

[*] Italics denote high priority action.

Objective 7: Improve Interagency Coordination

Purpose: Coordinate water quality improvement and monitoring projects.

Rationale: The Yakima River drainage covers a large area with many jurisdictions that need to coordinate programs and projects to meet watershed water quality goals. In the recent past, an Interagency Council (IAC) reviewed and coordinated these activities. The IAC later became involved with prioritization of proposed salmon habitat restoration projects and controversy resulted that caused the group to disband. A similar interagency council is needed to coordinate water quality and habitat projects. This organization should be carefully structured to provide broad interagency involvement. Prioritization of grant applications and other proposed projects can now be accomplished by others such as lead entity groups established specifically for this purpose.

Relationship to Goals and Objectives: Objective 7 relates directly to categorical goal #3, and also supports all of the other goals and objectives.

Proposed Actions: Objective 7 is relatively narrow in its focus and requires but one type of action.

- ❑ ***Action 7A.*** Improve Interagency Coordination. The main focus of the proposed action is to reestablish a coordinating council covering the watershed, which would have the following characteristics and functions:
  - Multiagency Participation
  - Forum for Coordination of Water-quality Projects
  - [*]*Coordination of Water Quality Monitoring Plans*
  - Water Quality Data Sharing
  - [*]*Forum for Discussion of Water Quality Topics*
  - Forum for Discussion of Habitat Topics
  - Forum for Discussion of Water Resource Projects
  - Forum to Facilitate Interagency Collaboration
  - Forum to Compare Local Government Guidelines/Regulations
  - Upgrade Data Exchange

***Screening Considerations*:** The purpose of Objective 7 is particularly important as a formal intergovernmental coordination forum is lacking in the watershed. Some type of forum is needed that brings agency staffs together to disclose plans, share data and find ways to have consistent guidelines and approaches to water quality (and habitat) improvement and monitoring projects. The coordinating groups would logically involve federal, state and tribal agencies per the previous IAC, but could include an expanded group of

[*] Italics denote high priority action.
[*] Italics denote high priority action.

local entities including irrigation and timber entities, county governments and municipal governments. Leadership could potentially rotate among federal, state, and local agencies to maintain balance.

Table 5-8
Considerations for Implementation of Objective 7

Action	Potential Involvement (1)	Resources and Costs (2)	Benefits	
			Short-Term	Long-Term
7A Improve Interagency Coordination	All involved agencies	Low	✓	✓

(1) See List of Acronyms at beginning of document.
(2) Low – less than $100,000, Medium between $100,000 and $500,000, High greater than $500,000.

Objective 8: Improve Understanding of Watershed Problems and Solutions

Purpose: Improve understanding of causal mechanisms, problems and effectiveness of solutions.

Rationale: Information is key to understanding of watershed problems, their causes and effects of enhancement activities. Monitoring is one component of this information need but there is also a need for better understanding of complex interrelationships between water quality and habitat factors and effects concerned with fish/aquatic life protection and other uses. Research is needed. Monitoring data are needed. Understanding will rely on these data and results of adaptive management programs designed to determine whether desired project outcomes are being realized. These informational processes are needed as feedback to guide future water quality (and habitat) improvement projects.

Proposed Actions: There are numerous types of actions identified under this objective. These are discussed separately below:

- ***Action 8A.*** Improve Cause-Effect Understanding. There is a myriad of complex interrelationships involved in aquatic systems. These will require research and patience to help environmental managers determine which types of projects/actions work best and which theories are valid. Examples of research needs for water quality are discussed at length in a separate technical memorandum prepared for the Water Quality Subgroup. Some additional topics include:

  - Groundwater-Surface Water Interactions
  - [*]*Climate and Water Temperature Interactions*
  - Flow and Water Quality Interactions

[*] Italics denote high priority action.

- Water Quality Effects on Movements of Migrant Spawners
- Riparian Shade Effects on Temperature
- Turbidity Causes from Miscellaneous Sources
- In-River Sedimentation Processes
- Pesticide Decay in Aquatic Life/Sediments
- Pesticide Decay in Soils
- Pesticide Contamination Pathways
- Effectiveness of Polyacrylimides
- Effectiveness of Best Management Practices
- Fertilizer Losses/Uptake
- Effects of Reservoir Releases on Turbidity
- Effects of Reservoir Releases on Temperature.

❑ ***Action 8B.*** Improve Problem/Solution Definition. Definition of site-specific local needs and problems and the characterization of outcomes of projects is important and requires more information. Examples of needs are listed below:

- Detailed Geographic Breakdown of Specific Needs
- Stream Reach Assessments of Water Quality
- Prioritization of Problems within Reaches
- Assessment of Tributary Water Quality on Mainstem
- Determination of Specific Project Outcomes
- Adaptive Management Guidance

❑ ***Action 8C.*** Expand Monitoring Activities. Water quality and other related habitat monitoring will need to be evaluated and expanded/upgraded to ensure both data integrity and geographical coverage. This aspect of Objective 8 is closely linked to the monitoring coordination elements of Objective 7. More specific actions include:

- Broaden Monitoring to cover entire geographic area
- Expand tributary monitoring outside of forest areas
- Organize mainstem river monitoring
- Broaden topics covered in monitoring information base
- Upgrade data exchange network.

Table 5-9
Considerations for Implementation of Objective 8

Action	Potential Involvement[1]	Resources and Costs [2]	Benefits	
			Short-Term	Long-Term
8A Cause-Effect Understanding	CD, USBR, Ecology, DFW, USGS, USFS, DNR	High		✓
8B Problem/Solution Definition	CD, USBR, Ecology, DFW, USGS, USFS, DNR	Medium		✓
8C Monitoring Activities	Ecology, USGS, CD, DFW, USFS, DNR	Medium	✓	✓

(1) See List of Acronyms at beginning of document.
(2) Low – less than $100,000, Medium between $100,000 and $500,000, High greater than $500,000.

Objective 9: Ensure Water Quality Standards Reflect Natural Regional Conditions

Purpose: Water quality standards criteria need to be attainable considering natural regional conditions such as climate and geology.

Rationale: Criteria used in water quality standards should protect designated uses while reflecting what is naturally attainable in the region considering climactic and geologic factors. Certain criteria such as turbidity are strongly influenced by natural processes (e.g., hydrology, soil erodibility) and reference background levels, which are to be used to determine compliance. Other criteria such as water temperature are linked closely to climatic driven factors such as air temperatures, presence or absence of vegetative shade cover, groundwater/surface water interactions and seasonal streamflows. There are also factors caused by human activity (e.g., removal of trees near waterways) that influence stream temperatures. Background levels for turbidity and temperature need to be better defined in the Yakima watershed.

Relationship to Goals and Objectives: Objective 9 is directly related to categorical goal #5.

Proposed Actions: There are specific actions associated with Objective 9 that are intended to provide information to standard setting agencies.

- ❑ ***Action 9A.*** Refine Water Temperature Criteria. Information is needed to better relate observed water temperatures to natural background conditions and associated temperature influencing factors to determine standards compliance and to model temperature. Example project actions are:
  - Historic Riparian Vegetative Cover Maps

- Simulations of Groundwater – Surface Water Interaction
- [*]*Water Temperature Modeling*
- *Climatic Change Evaluations re Water Temperature*
- Rationale for Special Temperature Standards
- Natural Bull Trout Distributions
- Timing/Seasonality of Temperature Criteria
- Diurnal Duration of Elevated Temperatures
- Critical Life Stage Timing by Geographic Area
- Refugia Locations and Migration Linkages
- Cold Water Source Evaluations
- Assessments of Human Related Effects

❑ ***Action 9B.*** Define Background Turbidity Levels. More information is needed to set background levels of turbidity as a basis for determining compliance with current standards. Examples of needs are:

- Soil Erodibility/Erosion Risk Mapping Associated with Turbidity
- *Turbidity Resulting from Natural Runoff from Undisturbed Wilderness Areas*
- Turbidity Levels Associated with Various Storm Frequencies
- Effects of Reservoirs on Background Turbidity
- Turbidity Measurements during Snow Melt Events
- Turbidity Measurements from Rainfall Events
- Duration of Turbidity Levels Following Events
- Diurnal Fluctuations in Background Turbidity.[7]

Screening Considerations: The information needed to meet needs of Objective 9 are expected to be used to develop rationale for water quality standards that are currently under review. Accordingly, there are near-term needs for comments to agencies reviewing criteria. Information developed will also be useful as rationale in public forums when questions arise concerning attainability or relevancy of certain criteria. Criteria debates are ongoing for temperature and concerns have been expressed as related to TMDL goals for turbidity in the upper Yakima River watershed.

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[*] Italics denote high priority action.

[7] The Kittitas County Conservation District observed diurnal changes in turbidity in the mainstem Yakima River during snow melt runoff events reflecting the flow pulses that occur when nighttime freezing arrests snow melt and day time warming speeds up melting and associated erosion. Monitoring results could be affected if diurnal patterns are not recognized during such events.

Table 5-10
Considerations for Implementation of Objective 9

Action	Potential Involvement [(1)]	Resources and Costs [(1)]	Benefits	
			Short-Term	Long-Term
9A Refine Water Temperature Criteria	Ecology, USFS, USGS, CD	Medium	✓	✓
9B Define Background Turbidity Levels	Ecology, ID, CD, USGS	Medium	✓	✓

(1) See List of Acronyms at beginning of document.
(2) Low – less than $100,000, Medium between $100,000 and $500,000, High greater than $500,000.

Objective 10: Minimize water resource impacts on water quality

Purpose: Design and operate surface and groundwater management activities to minimize water quality impacts and improve water quality.

Rationale: Water quantity affects water quality. Surface water storage reservoirs and groundwater extraction can affect local water quality. Flow in surface waters is affected by water resource project operations including reservoir storage and release, canals and drains, (operational spills) and pumping from shallow aquifers near creeks. Opportunities exist for utilizing water resource projects and programs as a means to enhance in-stream flows and related water quality conditions while supporting water uses.

Proposed Project Actions: The types of actions envisioned under objective 10 vary among the kinds of water resource project elements involved. Projects may rely on reservoir releases, reservoir outlet modifications, wheeling water down canals, canal releases, or shallow groundwater modification involving pumping or infiltration/recharge.

- ❑ ***Action 10A.*** Improve Surface Water Resource Project Operations. Examples of water resource project facility use in water quality control include deliberate releases for water supply that alter water quality through dilution effects and stratification in reservoirs as surface warming and due to water density differences. Example actions are listed below:

- *[*] Flow Augmentation from Storage Releases*[8]
- Flow Augmentation from Canal Releases
- Multilevel Outlets for Storage Reservoirs
- Impact Evaluations of Reservoir Warming and Cooling
- Flow-Quality Relationship Studies.

❑ ***Action 10B.*** Assess Groundwater Impacts on Surface Water. There are interactions between shallow groundwater and surface water in the watershed that affect water quality (e.g., ongoing studies by Jack Stanford for USBR). Groundwater seepage and exchanges between surface and subsurface flows along the mainstem and in tributaries have water quality impacts. Assessment actions are listed below:

- Evaluate seepage to Streams in Agricultural Areas
- *[*] Evaluate Impacts of Pumping from Shallow Groundwater*
- *Evaluate Shallow Aquifer Storage Benefits to Mainstem Hyporheic Zone*
- Consider Recharge of Shallow Groundwater with Return Flow
- Evaluate Cooling Effects of Percolation from Cropland Irrigation

Screening Considerations*:* There are extensive water resource management operations within the Yakima River watershed. Natural hydrographs are altered as result of storage reservoir operations, diversions and return flow accretions.[9] Impacts result that, can be mitigated by well-designed projects or operations. Multiple uses of existing water resource infrastructure can benefit water quality. Past federal laws have encouraged flow augmentation from storage for water quality benefit and multilevel reservoir outlet structures for downstream water quality enhancement. Federal projects (e.g., USBR reservoirs) have been funded in part because of anticipated water quality benefits.[10] Recent studies in the watershed (e.g., KRD) have identified modified canal conveyance operations for instream flow enhancement, which also will benefit water quality in flow depleted reaches (e.g., Big Creek). Shallow groundwater builds up in alluvial valleys due to irrigation activities (e.g., Kittitas Valley) and resulting drainage augments low river flow during the latter part of the irrigation and in early autumn. Groundwater storage facilitates cooling as accretions drain into surface water. Management of present and future water resources to benefit all uses

[*] Italics denote high priority action.
[8] A federal law passed in the mid 1960s actually required federal reservoir projects be evaluated for flow augmentation benefits for water quality control.
[*] Italics denote high priority action.
[9] The "normative" hydrograph is discussed in numerous recent publications authored by USBR, SOAC, and the Independent Scientific Group (e.g., *Looking for Common Ground* – a report to the NWPPC, February 1999.)
[10] Examples of federal water resource projects evaluated in the 1960s for water quality control benefits include the USBR New Melones Project and USBR proposals to route water from the Eel River through Clear Lake California.

is a major challenge. The Yakima River watershed plan potentially can help integrate water resource operations with water quality management.

Another consideration is effects of impaired ground water on surface water quality. The Water Quality Work Group acknowledges this may have an impact on surface water in some locales. However, review of studies on water quality in the Yakima River Basin, have not identified this as a significant issue at this time. Therefore, no actions are included to address impaired ground water in the context of improving surface water quality. Protection and enhancement of ground water quality is discussed separately, in another technical memorandum prepared for the Watershed Planning Unit.

Table 5-11
Considerations for Implementation of Objective 10

Action	Potential Involvement(1)	Resources and Costs (2)	Benefits	
			Short-Term	Long-Term
10A Improve Surface Water Resource Project Operations	ID, Landowners	High	✓	✓
10B Assess Groundwater Impacts on Surface Water	USBR, USGS	High	✓	✓

(1) See List of Acronyms at beginning of document.
(2) Low – less than $100,000, Medium between $100,000 and $500,000, High greater than $500,000

5.3 Addressing 303(d) Listings

Many waterways within the Yakima Basin have been listed by Ecology for water quality standards violations under Section 303(d) of the federal Water Quality Act (WQA). Major efforts are underway to achieve water quality standards compliance through development and implementation of TMDLs (water cleanup plans) led by the Department of Ecology.[11] TMDL programs are being coordinated to clean up water bodies on the 303(d) list. Parameters addressed include sediments and associated pesticides and fecal coliform in agricultural drains and wasteways draining to the lower Yakima River. Similar efforts are being planned for selected Kittitas Valley drainages (e.g., Cherry Creek). Other TMDL plans have been developed to address water temperature for the Teanaway River drainage. Many local organizations in the Yakima Basin are involved with TMDL planning and implementation.

[11] TMDL activities in the lower Yakima watershed include Granger Drain, Sulphur Creek Wasteway, Spring and Snipes Creeks, other TMDL activities in the watershed are in the planning phase for the Teanaway River and the upper Yakima River area.

TMDL work summaries and needs are provided as Appendix C to the technical memorandum on surface water quality (Bain & Associates, 2002b). This material groups TMDL efforts and other ways to address 303(d) listed water bodies. Ongoing work by the USFS and Ecology is discussed.

Several TMDL program implementation topics have emerged that warrant emphasis in the water quality strategy for the Yakima Basin Watershed Plan. These include the following concepts:

- TMDL prioritization is encouraged to include consideration of water quality strategies that emphasize enhancement of mainstem migration corridors, particularly in the lower reaches of the Yakima River system. TMDL priorities should be developed for 1998 303(d) listed water temperature violations considering ongoing evaluations of criteria and standards compliance evaluations.
- Comprehensive water quality monitoring programs are encouraged to measure effects of TMDL implementation activities and to provide baseline information for compliance determinations considering ongoing water quality standards compliance evaluations.
- When Ecology plans to conduct a TMDL they should try to address all of the 303(d) listings in a particular subbasin including related monitoring and assessment activities, public outreach and implementation programs. Ongoing efforts by Ecology to group parameters to be addressed simultaneously should be encouraged.
- Ecology needs to schedule their TMDL assessments sufficiently ahead of time so that grants to local agencies for monitoring activities can be times and coordinated to address TMDL needs. For example, if Ecology plans to assess monitoring data for a particular basin in 2007 they would like to have two years of monitoring data by a local agency in advance, then Ecology needs to identify their intent four years earlier, i.e. by 2003.

Local agencies, such as county conservation districts should continue to be included in future TMDL efforts and tasked with the public outreach effort and water quality monitoring responsibilities.

5.4 Surface Water Quality Monitoring

The Water Quality Work Group of the Planning Unit identified water quality monitoring as an important issues requiring coordination in a long-term framework. This section presents this framework, addressing monitoring by irrigation districts, conservation districts, State, Tribal, and Federal agencies, and private sector organizations. The principal goals of the monitoring plan are to: (1) understand water quality conditions and changes in the status of critical parameters over time (status and trends); (2) determine whether conditions meet established criteria, reference levels, or standards (compliance); and, (3) assess the effectiveness of changes in resource management (evaluation of implementation actions). The monitoring plan is described more fully in a Technical Memorandum prepared by McKenzie Consulting (2001a).

This plan provides reviews of current, ongoing monitoring activities and suggestions for monitoring actions to be done on a regular basis or as special studies to fill important data gaps. The plan describes seven principles of long-term monitoring that are important for such a plan to be successful. A program for coordinating and implementing the monitoring plan also is presented. There are also recommendations for establishing a mechanism to ensure the continued, coordinated implementation of this plan and reevaluation of the plan after a five year time period.

This monitoring plan is divided into three geographic sections, with monitoring activities for specific parameters described under each of the geographic sections. These sections include:

- Forested streams for discharge, temperature, and sediment;
- Nonforested tributaries and drains to the Naches and Yakima Rivers for discharge, temperature, turbidity and sediment, nutrients, dissolved oxygen and pH, and indicator bacteria; and,
- Mainstem Naches and Yakima Rivers for discharge, temperature, turbidity and sediment, nutrients, dissolved oxygen and pH, and indicator bacteria.

The last part of the plan addresses biological sampling for invertebrates and algae and sampling for toxic organic compounds and trace element.

The cost to do all recommended monitoring activities is estimated to be between \$900,000 and \$1,500,000 per year. This includes \$80,000 to \$200,000 as capital expenditures, which would need to be added every 10 to 15 years. It is further estimated that it will cost an additional \$500,000 to \$800,000 per year to bring the current monitoring activities up to the recommended levels, including the capital expenditures listed above. One of the uncertainties in this estimate is assuming how the revisions to State standards and guidance from EPA will affect monitoring activities.

The monitoring plan does not accommodate all aspects of data collection and management in the Yakima River Basin. Many of the priorities, responsibilities, and data requirements of the individual land-and water-management agencies are unique to those agencies and organizations and are properly carried out within their own programs. Rather, this monitoring program is intended to provide a structure to supply data at the basin level. The data collected will likely not be sufficient to answer all questions about the effect of management actions, or the combined effects of multiple management actions, on water quality. It should, however, provide indications of changing conditions over time, allowing additional investigations to be done to determine causes or define the extent of those changes. This monitoring plan does not take into account the Interim Comprehensive Basin Operating Plan being prepared under direction from the Department of Interior, which was not available at the time the monitoring plan was developed.

Funding is an obvious constraint for most organizations. It will be the task of the combined organizations involved in coordinated monitoring to develop appropriate funding strategies for monitoring to supplement current programs.

5.4.1 Elements of the Surface Water Quality Monitoring Plan

The Surface Water Quality Monitoring Plan is summarized in Table 5-12.

Table 5-12
Summary(1) of Surface Water Monitoring Plan

I.	Monitoring of Streams on Forested Lands
	A. Stream Discharge
	B. Water Temperature
	C. Sediment
II.	Monitoring of Non-forested Tributaries and Drains to the Naches and Yakima Rivers
	A. Stream Discharge
	B. Water Temperature
	C. Turbidity and Sediment
	D. Nutrients
	E. Dissolved Oxygen (DO) and pH
	F. Indicator Bacteria
III.	Monitoring of Mainstem Naches and Yakima River
	A. Stream Discharge
	B. Water Temperature
	C. Turbidity and Sediment
	D. Nutrients
	E. Dissolved Oxygen (DO) and pH
	F. Indicator Bacteria
IV.	Additional Monitoring Warranting Consideration
	A. Invertebrates and Algae
	B. Toxic Substances

(1.) For full details of monitoring plan, see McKenzie Consulting, 2001a.

5.4.2 Principles of Long-Term Monitoring

For a monitoring program to be successful, it must be both focused and relevant to regional and local issues and needs. The following principles are defined, to assist in focusing monitoring efforts[12].

[12] The principles are modified from those established for the Middle and Upper Deschutes River Basin, Oregon (Anderson, 2000) and the Lower Columbia River Estuary Program (1999).

1. *Monitoring is focused on the development of data that will provide information on status and trends in the Yakima River Basin.*
2. *A variety of special research studies will be needed, both in the short term and over the long term, to fill key data gaps.*
3. *Commitment to development of an integrated plan utilizing ongoing programs will be necessary.*
4. *Establishment of a mechanism for coordinating basin-wide monitoring will be necessary.*
5. *A strategy for management of data is necessary to ensure access to essential information.*
6. *A periodic assessment of monitoring data and reevaluation of the monitoring plan will be required to ensure success of the plan.*
7. *Successful monitoring will require active participation of key entities and individuals.*

More extensive discussion of these principles is included in the technical memorandum (McKenzie Consulting, 2001a).

5.4.3 Recent Monitoring Activities

Critical to preparing any monitoring plan is having information on current and recent monitoring activities. To aid in preparing this monitoring plan, an Excel spreadsheet titled Recent Monitoring Activities, has been prepared. This spreadsheet includes the following: (1) name assigned to each site by the agency or organization operating the site; (2) location as Township, Range, Section and/or as latitude and longitude (if known); (3) parameters collected; (4) frequency of collection and period of operation (if known); (5) agency operation the site; (6) monitoring objectives for the site; (7) source of funds to operate the site; (8) information on what agency or individual manages the data base and are the data likely to be available over the next 10 years (if known); and, (9) quality assurance comments concerning the data (if known). The spreadsheet includes a list of about 500 sites that are currently active or have had stream discharge or water quality data collected in the past ten years. The spreadsheet has been divided into three geographic subbasins, Upper Yakima River (upstream of Naches River), Naches and Mid Yakima (Naches River Basin plus Yakima River Basin from confluence of Naches River to the Gap at Union Gap, and Lower Yakima (downstream of the Gap at Union Gap. One or more of these files can be requested from the TCWRA at tricountywater@co.yakima.wa.us or by calling the TCWRA at (509) 574-2650.

5.4.4 Improving Coordination of Monitoring Efforts

The existing monitoring programs being conducted by individual organizations appear relatively sound, providing a good structure around which to base more comprehensive and coordinated monitoring. However, for almost all issues identified, there is a need to inventory existing data within and across agencies and organizations and to assess the suitability of available data for analysis at a basin scale, to complete data analysis, and to communicate the results of those analyses.

There are certain steps that can be taken to enhance the likelihood of success in meeting the goals for basin monitoring. These steps include increasing integration of current monitoring efforts among agencies, filling data gaps, and communicating available data and information. This section provides six recommendations related to these needs.

Recommendation 1: *Establish a mechanism for coordinating the long-term execution of the Yakima Basin monitoring plan, and track major changes in management or land use in the basin in relation to the monitoring.* A process for coordination and discussion of monitoring issues is critical to the long-term success of the basin-wide monitoring plan including multiple agencies. Potential candidates to coordinate this effort include Ecology, TCWRA, the United States Bureau of Reclamation (USBR) or a combination of the three agencies. It is estimated to take 1 to 2 person months per year to initially implement and to continue management of this effort.

Recommendation 2: *Periodically review progress for the basin monitoring plan, with annual and 5-year intervals, to determine if monitoring elements are being carried out, evaluate monitoring data and results, and modify the design and priorities of the monitoring as needed.* If monitoring is to remain viable, it must be flexible enough to adapt to changes in basin priorities or other aspects of water-quality management. It is impossible to anticipate all of the issues and other questions that monitoring may be asked to help answer in coming years. Periodic planned reevaluation of the monitoring effort is therefore suggested, at two different time scales: (1) Annual reviews would be used to assess and communicate the quantity of data collected and any immediate findings such as emergence of new issues or violations of water-quality standards. (2) Every fifth year the reassessment would include a more substantial analysis of data by the participating organizations. It is critical that this review includes prioritization of the questions that are most important for the monitoring plan to address. It is estimated to take 1 to 2 person months per year of effort to implement and to continue management of this effort.

Recommendation 3*: Establish common protocols that enable data comparison among agencies and that are consistent with objectives for data collection.* The use of common, clearly defined protocols for sample collection, processing, and laboratory analysis is important wherever possible to ensure the comparability of data collected by different organizations or over time within an individual organization. The goal is to be able to collate all the data into one data set when needed to answer particular questions. It is estimated to take 0.5 to 1 person month per year to implement and to continue management of this effort.

Recommendation 4: *Develop quality assurance plans for all monitoring projects.* Quality assurance (QA) plans are critical to the success of any monitoring program. Sufficient quality control (QC) data, and the assessment of those data, can allow the comparison and collation of data among agencies and over time, whereas inadequate QC data can prevent such comparison and collation. As part of the implementation of the monitoring plan, an important task for each component of the plan, based on the principles outlined previously, would be the development of a detailed QA plan. The goal of all QA programs is to provide environmental data, using multiple sampling crews and analytical laboratories, with quantifiable bias, variability, and representativeness. It is estimated to take 0.5 to 1 person month per year to implement and to continue management of this effort.

Recommendation 5: *Establish a data management strategy that allows data and developed databases to be shared easily among agencies and other interested parties and to provide information regarding the type and quantity of data collected.* In order for monitoring data to be used to assess status and trends, management effectiveness, and the monitoring plan itself, those data will need to be available to all who are interested. Issues requiring discussion will include system locations, operation and maintenance, system compatibility, database design (for example, centralized or dispersed), and data accessibility. It is estimated to take 1 to 3 person months per year to implement and to continue management of this effort.

Recommendation 6: *Make information, reports, and other products available to other agencies and the public.* One of the measures of success of the monitoring program will be the degree to which data collected and the findings or information resulting from these data, are used. Users of data can include the data-collection agencies themselves, other organizations involved in the monitoring plan, managers in the region, and the public. Water managers and the public are most likely to use interpretations resulting from the monitoring plan rather than raw data. Including these end users as part of the data-collection and interpretive process increases the relevance of the monitoring program and the likelihood of its continued support by the involved organizations and the public alike.[13] It is estimated to take 0.5 to 1.5 person months per year to implement and to continue management of this effort.

5.5 Surface Water Quality Research Needs

An additional technical memorandum was developed (McKenzie, 2001b) to identify research needed to improve and maintain surface water quality conditions in the Yakima River Basin. Research projects are needed to identify causes and solutions to water temperature, bacteria, pH and dissolved oxygen conditions where stream reaches in the basin are on the 303 (d) list for 1998. The numbers of 303(d) listings for water temperature, bacteria, pH and dissolved oxygen are 78, 18, 5 and 9 respectively. Assessments or identification of causes and solutions are needed for most of the 303(d) listings by 2013, 12 years from now. The research projects also address watershed health by quantifying the physical and primary productivity and time of travel of the Naches and Yakima Rivers. This memorandum is a complement to the Water Quality Monitoring Plan that has objectives of spatial and temporal variability, trends, compliance with State standards and effectiveness of management actions.

Each research project is organized to provide a list of potential questions that should be addressed, potential methods of analysis, data set needed, and a monitoring program to collect the data. Listed below are the six research projects addressed, the portions of the basin streams they will be needed on, a priority assigned to each one, and an estimated cost. Priority 1 is indicated when many to most streams need this research and the research will need to be done in the next 12 years. Priority 2 is indicated when there are some streams that need this research and the research will need to be done in the next 12 years. Priority 3 is indicated when this research would help quantify the hydrology of the basin but the work in not critical to completing assessments and/or Total Maximum Daily Load (TMDL) in the basin. Cost estimates are for the Yakima River Basin over the next 12 years.

The suggested research projects are shown in Table 5-13.

[13] This suggestion is differentiated from Recommendation 5 by its emphasis on results and analysis in order to provide information to the public. Recommendation 5 is more oriented towards the mechanics of making monitoring data available among agencies or other researchers for the purposes of analysis.

Table 5-13
Suggested Surface Water Quality Research Projects

I. Mainstem Naches and Yakima Rivers and Tributaries and Drains
  A. Quantify water temperatures resulting from natural conditions
    1. Priority 1;
    2. Cost is estimated to be $700,000 to $1,500,000 depending on the number of subbasins or reaches;
    3. Projects are needed for 56 forested stream reaches which are on the 303(d) list of 1998;
    4. Projects are needed on 22 nonforested stream reaches which are on the 303(d) list of 1998 and will likely be needed on most tributaries, drains, and mainstem reaches;
  B. Quantify indicator bacteria sources
    1. Priority 1.5;
    2. Cost is estimated to be $300,000 to $500,000 depending on the number of subbasins or reaches;
    3. Projects are needed on 18 nonforested stream reaches listed on the 303(d) list of 1998 and will likely be needed on many other reaches when the 2002 list is available;
  C. Quantify low dissolved oxygen concentrations and causes
    1. Priority 2;
    2. Cost is estimated to be $300,000 to $500,000 depending on the number of subbasins or reaches;
    3. Projects are needed on 5 nonforested stream reaches listed on the 303(d) list for 1998 and will likely be needed on several other reaches in the valley when dissolved oxygen data are available for early morning hours;
  D. Determine nutrient criteria to control primary productivity
    1. Priority 1;
    2. Cost is estimated to be $400,000 to $1,000,000 depending on the number of subbasins or reaches;
    3. Projects are needed on most to all nonforested stream reaches receiving agricultural and urban runoff in the valley floor;
    4. Projects are needed on selected forest streams where grazing and timber harvest has added nutrients to streams

II. Mainstem Naches and Yakima Rivers Only:
  A. Quantify physical and primary productivity characteristics
    1. Priority 1.5
    2. Cost is $125,000 to $175,000 depending on the amount of participation provided by interested agencies;
    3. Projects are needed for Yakima River and desirable Naches River;
  B. Quantify time of travel
    1. Priority 3;
    2. Cost is $75,000 to $125,000 depending on the number of reaches and number of discharge levels included;
    3. Projects are needed for Yakima River and desirable for Naches River

Chapter 6

Management of Ground Water Quality

Chapter 6
Management of Ground Water Quality

As discussed in Chapter 2, many communities in the Yakima River Basin rely upon ground water for municipal and domestic water supplies. The Planning Unit's Watershed Assessment characterized overall water quality conditions of ground water supplies used for these purposes. Working with the Water Quality Work Group, EES reviewed ground water quality protection programs developed in other areas, as well as management procedures under State law. Findings were documented in a technical memorandum. A set of actions was identified to accomplish the goal of protecting ground water from contamination in the Yakima Basin. This chapter presents those actions. For more detailed background information, see the technical memorandum (EES 2002d).

6.1 Goals for Ground Water Quality Protection

The results of the Watershed Assessment indicated that large and medium-sized public water systems in the Yakima Basin have the ability to adequately manage and protect the quality of their ground water supplies. However, small water systems and individual households that rely on ground water supplies for drinking water were found to be more susceptible to ground water contamination. In addition, shallow and/or unprotected ground water supplies were found to be more susceptible to ground water contamination than deep ground water supplies. Thus, the Planning Unit narrowed the overall goal of protecting ground water from contamination to a specific emphasis on unprotected ground water supplies located outside the service areas of large water systems. This emphasis enables limited resources to be allocated to those ground water users facing the greatest risk of contamination. The goal of the ground water quality strategy can therefore be stated as:

- *Protect ground water quality for public water supply purposes, with an emphasis on unprotected ground water supplies located outside the service areas of large water systems.*

Under this overall goal, three specific management goals were developed:

- Prevent future impacts to clean ground water supplies;
- Prevent further degradation of currently impacted ground water supplies; and,
- Clean up impacted ground water supplies.

In the context of this chapter of the Watershed Plan, an "unprotected" ground water supply means an unconfined aquifer, an aquifer located less than 100 feet below ground surface, or an aquifer penetrated by improperly sealed wells. "Outside the service areas of large water systems" includes both populated areas where most residences are served by private household wells and areas that are served by a public water system with less than 500 service connections. "Ground water supplies" refers to both existing drinking water sources and aquifers that could be used for a drinking water supply in the future. The term "clean" water is used to mean potable water that has contaminant concentrations consistent with background levels. The term "impacted" water is used to mean water with contaminant concentrations elevated above background levels. These definitions are not absolute, but are intended to provide general guidance.

The Planning Unit recognizes that shallow, unprotected supplies in areas served by larger water systems may also be impacted by land use, industrial activities, storage of petroleum products and chemicals, and other factors. While these areas are not covered in detail here, this does not indicate a lack of concern that these supplies also be protected and cleaned up where necessary. The Planning Unit anticipates that these types of conditions will continue to be addressed by existing federal, State and local ground water quality protection and cleanup programs.

The Planning Unit also recognizes that in some areas, impacted ground water may discharge to surface water, causing impairment of the natural environment. Although the Watershed Assessment did not identify this as a significant concern for the Yakima Basin, it is noted that protection of ground water for public water supply purposes also will generally result in improved protection of the natural environment as well.

6.2 Ground Water Quality Strategy

Management objectives and actions were developed for ground water quality protection in the Yakima Basin based on needs identified in Section 5.3 of the Watershed Assessment, the review and evaluation of existing programs documented in the Technical Memorandum (EES 2002d), and input from the Planning Unit's Water Quality Work Group.

Six management objectives were developed to accomplish the three management goals listed above. These objectives are:

1. Improve public understanding and awareness of issues related to drinking water quality;
2. Assess susceptibility of ground water supplies to contamination on a regional basis;
3. Improve ability to detect and monitor impacts to ground water supplies;
4. Improve local Wellhead Protection Programs;
5. Minimize impacts of land use activities on ground water supplies by implementing technical management strategies; and,
6. Clean up sources of ground water contamination.

Together, these objectives provide a comprehensive approach to achieving the management goals.

It is recognized that funding may not be available to implement all actions recommended in this Chapter. However, many of the six objectives could be pursued independently, in a scaled-back program. The objectives can be prioritized based on relative importance, cost, staffing availability, and the sequential relationship of some objectives. It is recommended that Objectives 1 and 2 be given the highest priority. Accomplishing the public education objective (Objective 1) will provide broad support for the remaining actions. The risk assessment objective (Objective 2) is a foundation for all subsequent strategies since it will reveal which locations are most susceptible to ground water contamination.

It is recommended that Objectives 3 and 4 have a slightly lower priority than Objectives 1 and 2. The local implementing agency has the ability to make improvements to ground water monitoring (Objective 3) and wellhead protection (Objective 4) activities; however, existing state and federal programs are already addressing these objectives to a certain extent.

If a more limited program is undertaken, it should be recognized that Objectives 5 and 6 will likely prove the most complex and expensive to carry out. While preventing ground water contamination from land use activities (Objective 5) is critical, it may be expensive and difficult to implement this objective effectively. Likewise, taking actions to clean up contaminant sources (Objective 6) is anticipated to be expensive and difficult to implement. In addition, existing state and federal programs already exist for cleaning up most contaminant sources.

A discussion of each recommended objective is presented below. Specific actions developed for each objective and implementation considerations for each objective are also discussed. Tables showing proposed agency involvement for completing each objective are included. These tables also contain planning-level assessments of staff resources, implementation cost, and a characterization of benefits as either short-term, long-term, or both.

6.2.1 Objective 1: Improve Public Understanding and Awareness of Issues Related to Drinking Water Quality

Purpose: Enable the public to make educated decisions about actions that can protect ground water quality.

Rationale: Educating the public about the importance of ground water quality will over time raise awareness and improve practices. An aware public will likely be able to facilitate more change in terms of ground water protection than local government agencies. In addition, broad public support will be necessary to successfully implement technical management strategies.

Relationship to Other Objectives: In general, this objective is tied to all other objectives since broad public support will be necessary.

Proposed Actions

Action 1A. Provide outlets for ground water protection information. The public should have easy access to relevant information about ground water supplies and water quality. Region-specific information about the ground water resource, risk assessment activities, monitoring programs, wellhead protection activities, technical management strategies, and clean up efforts should be provided to the public. Information about existing national programs for private homeowners such as "Home-A-Syst/Farm-A-Syst" (WSU Cooperative Extension 2001) and United States Department of Agriculture's Environmental Quality Incentives Program (National Resources Conservation Service 2001) should also be provided to the public. Information should be available to the public in a variety of mediums such as compact disk, web site, flyers, workshops, community fairs, etc.

Although this action is focused on areas outside the service areas of larger water purveyors, there may be opportunities to link with outreach and education programs of the larger water purveyors in each community.

Action 1B. Develop a mass media campaign for ground water protection. Advertisements and public service announcements in print, radio, and television can reach a broad audience. A mass media campaign is often the most effective way of raising awareness about a particular issue such as drinking water.

Action 1C. Develop a ground water protection program for schools. Classroom education will influence a large portion of the community and will establish a long-term legacy. The program could include class presentations, class exercises, and field trips and should be integrated into existing science or environmental education programs.

Action 1D. Conduct periodic public opinion surveys related to ground water protection efforts. Surveys would provide an indicator of the apparent effectiveness of ground water protection strategies. Surveys would also provide valuable feedback about which strategies the public supports.

Considerations for Objective 1

- ❑ Public education programs require expertise often unavailable in the existing staff resources of the anticipated implementing agencies.
- ❑ A long-term commitment of resources will be required to develop a successful public education program.

- While a mass media campaign can quickly improve the public's name-recognition of a particular issue, it is not an effective means of educating the public about complex or technical ideas.

Table 6-1
Agency Involvement and Resource Needs for Objective 1

Action	Proposed Agency Involvement (1)	Staff Resources Required (2)	Initial Implementation Cost (3)	Short-term Benefit	Long-term Benefit
1A. Provide outlets for ground water protection information	• *County health department* • WSU Cooperative Extension • Conservation districts	Medium	Medium	✓	✓
1B. Develop a mass media campaign for ground water protection	• *County health department* • WSU Cooperative Extension • Conservation districts	High	Medium	✓	
1C. Develop a ground water protection program for schools	• *County health department* • WSU Cooperative Extension • Conservation districts	High	Medium	✓	✓
1D. Conduct periodic public opinion surveys related to ground water protection efforts	• *County health department* • WSU Cooperative Extension • Conservation districts	Medium	Medium	✓	

(1) The agency proposed for a lead role is shown in italics. Other listed agencies may provide additional support with data and/or resources. Interagency agreements may be a vehicle for promoting cooperation.
(2) Staffing estimated only for agency proposed for lead role. Low = Need ¼ to ¾ fulltime equivalent (FTE) to implement. Medium = Need 1-2 FTE to implement. High = Need > 2 FTE and/or contracted services to implement. Staffing estimates are relative, and would likely be reduced if multiple actions are implemented simultaneously.
(3) In general, Low = Less than $50,000 per county. Medium = Between $50,000 and $250,000. High = Greater than $250,000.

6.2.2 Objective 2: Assess Susceptibility of Ground Water Supplies to Contamination on a Regional Basis

Purpose: Identify unprotected ground water supplies located outside the service areas of large water purveyors "at risk" of becoming impacted in order to guide subsequent management strategies.

Rationale: It is not feasible or cost effective to implement management strategies that protect all unprotected ground water supplies outside the service areas of large water purveyors. Rather, management strategies should focus resources primarily on a subset of this population – supplies that are already impacted and supplies "at risk" of becoming impacted in the future. The risk assessment procedures described in this section will be used to rank ground water supplies in terms of relative susceptibility to contamination.

Relationship to Other Objectives: The risk assessment described in Objective 2 is intended to guide the selection and implementation of subsequent management strategies under Objectives 3, 4, and 5.

Proposed Actions

Action 2A. Conduct Level I Risk Assessment. This preliminary assessment is intended as a relatively quick and cost-effective way to determine general areas that are susceptible to ground water contamination. Land use and hydrogeologic screening criteria could be applied to a ground water quality database to rank the susceptibility of all ground water supplies. Land use and hydrogeologic screening criteria that could be used to delineate "at risk" supplies include:

- Presence of Washington Department of Ecology (Ecology) or United States Environmental Protection Agency (EPA) regulated facilities and sites
- Presence of domestic on-site septic systems (i.e., unsewered areas)
- Presence of land application of untreated, non-domestic wastewater
- Presence of concentrated animal feeding operations
- Presence of agricultural operations requiring frequent fertilizer and pesticide application
- Presence of stormwater dry wells above some specified threshold density
- Presence of mining activities
- Presence of wells above some specified threshold density
- Presence of shallow wells (e.g., less than 100 feet below ground surface)
- Presence of unconfined, shallow aquifers (such as alluvial aquifers or perhaps aquifers in the Upper Ellensburg Formation) in which a shallow well could be completed
- Presence of regional aquifer recharge area
- Presence of water quality monitoring exceedances
- Presence of source designated as "ground water under the influence of surface water"

A ground water quality database could be built with data obtained from the Washington Department of Health (DOH), Ecology, county governments, and other agencies. The Geographic Information System (GIS) database developed for the Kittitas County Groundwater Survey (Bain, April 1999) is a relevant local example of the type of database that needs to be built. The ground water quality database should be maintained at the local level with a single data management system as described in Action 2C. The technical memorandum (EES 2002d, Table 2) describes potential sources of data for a ground water quality database and how the data might be incorporated into a single data management system.

Action 2B. Conduct Level II Risk Assessment (if necessary). This follow-up assessment is intended as a comprehensive approach to more accurately rank susceptibility to contamination in the event that the Level I Risk Assessment is not sufficient. Additional data would be acquired and added to the ground water quality database developed for the Level I Risk Assessment in Action 2A. The technical memorandum (EES, 2002d, Table 3) describes additional sources of data that could be added to the ground water quality database. Essentially the same land use screening criteria that were used to screen the database in the Level I Risk Assessment would be applied to the expanded database for the Level II Risk Assessment. Additional hydrogeologic screening criteria that could be added for the Level II Risk Assessment include:

- Well screen or perforations located in more than one aquifer
- Absence of significant confining layers above aquifer
- Age of well (e.g., wells completed prior to early 1970s when requirements to submit Water Well Reports were implemented)
- Absence of adequate surface seal on well
- Relative distance of well downgradient from contaminant source

The improved accuracy of the Level II Risk Assessment would be based on significant improvements in the quality of data in the database and improvements in hydrogeologic screening criteria.

Action 2C. Evaluate existing data management system and improve system if necessary. A considerable amount of potentially useful ground water quality data can be easily acquired from a variety of sources to build the database described in Actions 2A and 2B. Unfortunately, this data is often provided in incompatible formats. For instance, DOH and Ecology currently maintain GIS databases with locations of wells and regulated facilities and sites, respectively. However, other water quality data is currently only available in tab-delimited text files, Microsoft Access databases, or paper files. Thus, a local data management system is needed in order to store, link, manipulate, and present data acquired from a variety of sources. GIS software such as ArcInfo is capable of providing the database and mapping tools needed to complete the risk assessment described in this objective. Other data management systems such as AutoCAD may have sufficient database and mapping capabilities as well.

Action 2D. Produce regional maps showing results of risk assessment. Areas with "at risk" ground water supplies and potential sources of contamination should be highlighted at a minimum. These maps can be used as graphical tools to select management strategies and locations for strategy implementation. The mapping products can also be used by local agencies, water purveyors, and facility/site operators for planning activities and as a public education tool.

Considerations for Objective 2

- In some areas, selected elements of Objective 2 may already be addressed by existing critical areas ordinances.

- The accuracy of some data will be compromised due to inherent inaccuracies and inconsistencies in the data source. For instance, the accuracy of a well location on a Water Well Report (e.g., well log) is to be limited by the restraints of the Public Land Survey System (e.g., locations typically delineated according to ¼ Section or ¼ ¼ Section of a given Township and Range). Field mapping using Global Positioning Systems (GPS) may be necessary if precise locations are needed.
- It will be difficult to establish uniform hydrogeologic and land use ranking criteria that apply to all ground water supplies. For instance, it will be difficult to qualitatively or quantitatively assess the relative potential for contamination from different land use activities.
- The tendency when working with a large database is to summarize the data record (as done in the 1999 Kittitas County Groundwater Survey by Bain). Actually ranking the susceptibility of ground water supplies and then prioritizing management strategies based on that ranking will be a much more difficult process.
- A considerable amount of work would be required to compile all the data suggested for a Level II Risk Assessment. If the Level II Risk Assessment is not completed due to budget constraints, some of the data for the Level II Risk Assessment could still be gathered for use in the Level I Risk Assessment (e.g., gather well completion data from Water Well Reports as done by Bain, April 1999).
- Technical map products may be misunderstood by some public audiences.

Table 6-2
Agency Involvement and Resource Needs for Objective 2

Action	Proposed Agency Involvement (1)	Staff Resources Required (2)	Initial Implementation Cost (3)	Short-term Benefit	Long-term Benefit
2A. Conduct Level I Risk Assessment	• *County health department* • County planning department • Ecology • DOH • Local water purveyors	Medium	Low	✓	
2B. Conduct Level II Risk Assessment (if necessary)	• *County health department* • County planning department • Ecology • DOH • Local water purveyors	High	Medium to High	✓	✓
2C. Evaluate existing data management system and improve if necessary	• *County health department*	Low to Medium	Low	✓	✓
2D. Produce regional maps showing results of risk assessment	• *County health department* • County planning department • Local water purveyors	Low	Low	✓	

(1) The agency proposed for a lead role is shown in italics. Other listed agencies may provide additional support with data and/or resources. Interagency agreements may be a vehicle for promoting cooperation.
(2) Staffing estimated only for agency proposed for lead role. Low = Need ¼ to ¾ fulltime equivalent (FTE) to implement. Medium = Need 1-2 FTE to implement. High = Need > 2 FTE and/or contracted services to implement. Staffing estimates are relative, and would likely be reduced if multiple actions are implemented simultaneously.
(3) In general, Low = Less than $50,000 per county. Medium = Between $50,000 and $250,000. High = Greater than $250,000.

6.2.3 Objective 3: Improve Ability to Detect and Monitor Impacts to Ground Water Supplies

Purpose: Identify impacted ground water supplies located outside the service areas of large water purveyors.

Rationale: Locations with impacted ground water supplies should be identified in order to select and guide subsequent management strategies in conjunction with the risk assessment (Objective 2). Three separate monitoring approaches (initial baseline assessment, long-term monitoring to detect impacted supplies, and long-term performance monitoring) have been recommended to provide the technical data needed to accomplish this objective.

Relationship to Other Objectives: Selection of sampling locations to identify impacted ground water supplies should be based in part on the results of the risk assessment (Objective 2). Water quality monitoring data obtained during this objective should be added to the ground water quality database described in Objective 2. Improvements to local wellhead protection activities

(Objective 4) should be highly encouraged in locations where impacted supplies are detected. Application of Objectives 5 and 6 should be based in part on the results of the baseline water quality assessment.

Proposed Actions

Action 3A. Evaluate the availability and usefulness of existing ground water quality monitoring data. This evaluation should review the data sources discussed below to determine whether new monitoring programs need to be established or if this objective can be accomplished with existing monitoring programs. Group A and Group B Public Water Systems (PWSs) are required to conduct water quality monitoring of all production sources. Some Ecology regulated facilities and sites are required to collect site-specific data from monitoring wells. Ground water quality data can also be obtained from regional monitoring events that have been conducted in the Yakima Basin. For instance, ground water monitoring surveys conducted by Bain (April 1999) and Ecology (April 1997) could be used as initial baseline assessments of nitrate and pesticide impacts in the Kittitas Valley. In addition, the United States Geological Survey (USGS) is in the process of collecting water quality monitoring data from a number of wells throughout the Yakima Basin. Finally, efforts by Ecology's Environmental Assessment Program to implement a statewide ground water monitoring program should be reviewed. The Environmental Assessment Program is scheduled to propose strategies for program implementation in 2002.

Action 3B. Establish or facilitate short-term monitoring approach to determine baseline conditions of ground water supplies. If an existing baseline ground water quality assessment (e.g., USGS Yakima Basin study) is not available for the areas and parameters of interest, then the implementing agency should consider implementing a short-term monitoring program. This monitoring program would consist of a one-time monitoring event with a large number of monitoring locations across the basin. Selected sampling locations should include wells in areas designated "at risk" by the risk assessment as well as "clean" wells. Private household wells could be included in the baseline assessment by implementing a program for providing financial assistance to owners of private wells. Monitoring locations could be tested for bacteria, nitrate, pesticides (e.g., synthetic organic compounds regulated by the Safe Drinking Water Act), and/or any other identified contaminants of concern (e.g., iron and manganese in the Kittitas Valley). Well completion details (e.g., presence of surface seal, casing diameter, exact well location) should be verified and field parameters (e.g., temperature, pH, specific conductivity) should be monitored to the greatest extent practicable during sampling. The local implementing agency may want to rely upon technical expertise provided by DOH, Ecology, and USGS in completing this monitoring approach.

Action 3C. Establish or facilitate long-term monitoring approach to detect impacted ground water supplies. The implementing agency will most likely need to establish a new long-term monitoring program and/or compile monitoring data from a variety of existing programs (e.g., data collected from Group A PWSs, Group B PWSs, Ecology regulated facilities/sites, USGS Yakima Basin study, etc.) in order to satisfy this objective. A long-term monitoring program would consist of periodic monitoring events at a reduced number of monitoring locations used in the baseline ground water quality assessment. Selected long-term monitoring locations should specifically target areas identified as "at-risk" in the risk assessment. All monitoring locations could be tested for an expanded list of contaminants beyond bacteria, nitrate, and pesticides, if necessary. If possible, water levels should be measured and recorded during the long-term monitoring program for use in determining regional ground water gradients. The local implementing agency may want to rely upon technical expertise provided by DOH, Ecology, and USGS in completing this monitoring approach.

Action 3D. Establish or facilitate long-term monitoring approach to evaluate the performance of implemented management strategies. Before implementing this action, the local implementing agency should understand that it is often extremely difficult to draw accurate performance conclusions from long-term monitoring data. This action will be technically similar to Action 3C, but the monitoring results will be used for a different application. While some of the same long-term monitoring locations may be used to satisfy both actions, additional long-term monitoring locations will likely be necessary to conduct the performance evaluations. All implemented technical management strategies should be represented with long-term monitoring locations in the proximity of the implementation area. Ideally, each implementation area could be evaluated with monitoring results from upgradient and downgradient monitoring locations. For instance, historical water quality data collected from an upgradient well and a downgradient well could be used to evaluate the effectiveness of extending a sewer line to a previously unsewered residential area. Each monitoring location would only need to be tested for the specific contaminant targeted by the management strategy (e.g., testing for nitrate in areas where sewer lines are being extended to replace on-site septic systems). Again, water levels should be measured and recorded for use in determining local ground water gradients. The local implementing agency may want to rely upon technical expertise provided by DOH, Ecology, and USGS in completing this monitoring approach.

Action 3E. Analyze data collected during monitoring programs. Potential analysis techniques could include statistical descriptions of data record, comparisons with maximum contaminant levels, trend analysis, hypothesis testing, determination of three-dimensional distribution of contaminants, and correlation of land use activities with impacted ground water supplies. Linking ground water monitoring data with other attributes in the data management system described in Objective 2 will facilitate analysis and presentation of ground water monitoring data.

Considerations for Objective 3

- The overall effectiveness of the ground water monitoring programs will be directly proportional to the quality of data analysis. Collecting a large amount of data is useless if the data is not properly analyzed. For instance, a thorough hypothesis testing and trend analysis should be periodically conducted to draw conclusions from the data record.
- Will need continued availability of staff resources and funding to keep the long-term monitoring program going (i.e., Actions 3C and 3D).
- Inconsistent protocols can greatly impact the usefulness of the monitoring program. For instance, a change in laboratory analytical method can make it difficult to compare sample results within the same data record. Therefore, uniform procedures should be established for field sampling procedures, laboratory analysis, quality assurance/quality control methods, monitoring frequency, and recordkeeping.
- Long-term monitoring locations should be selected with great care. Monitoring locations in which access may be an issue over the course of the monitoring program (e.g., homeowner selling property) should be avoided. Well completion information should be available for each well selected as a long-term monitoring location. In other words, hydrogeologic information about the well such as the location of the well screen, characteristics of the surface seal, and the type of aquifer tapped should be known.

Table 6-3
Agency Involvement and Resource Needs for Objective 3

Action	Proposed Agency Involvement (1)	Staff Resources Required (2)	Initial Implementation Cost (3)	Short-term Benefit	Long-term Benefit
3A. Evaluate the availability and usefulness of existing ground water quality monitoring data	• *County health department* • DOH • Ecology • USGS	Low to Medium	Low	✓	✓
3B. Establish or facilitate short-term monitoring approach to determine baseline conditions of ground water supplies	• *County health department* • Local water purveyors DOH • Ecology • USGS	Medium to High	High	✓	✓
3C. Establish or facilitate long-term monitoring approach to detect impacted ground water supplies	• *County health department* • Local water purveyors DOH • Ecology • USGS	Medium to High	Medium		✓
3D. Establish or facilitate long-term monitoring approach to evaluate the performance of implemented management strategies	• *County health department* • Local water purveyors DOH • Ecology • USGS	Medium to High	Medium		✓
3E. Analyze data collected during monitoring programs	• *County health department* • DOH • Ecology • USGS	High	Low	✓	✓

(1) The agency proposed for a lead role is shown in italics. Other listed agencies may provide additional support with data and/or resources. Interagency agreements may be a vehicle for promoting cooperation.
(2) Staffing estimated only for agency proposed for lead role. Low = Need ¼ to ¾ fulltime equivalent (FTE) to implement. Medium = Need 1-2 FTE to implement. High = Need > 2 FTE and/or contracted services to implement. Staffing estimates are relative, and would likely be reduced if multiple actions are implemented simultaneously.
(3) In general, Low = Less than $50,000 per county. Medium = Between $50,000 and $250,000. High = Greater than $250,000.

6.2.4 Objective 4: Improve Local Wellhead Protection Programs

Purpose: Improve management of unprotected ground water sources located outside the service areas of large water purveyors.

Rationale: Local water purveyors have the greatest ability to assess, protect and manage their own ground water sources. Unfortunately, many small water systems lack the resources to complete a formal wellhead protection program or initiate wellhead protection activities. Technical and/or financial assistance could be provided to these small systems to complete formal or informal wellhead protection activities. Assistance should be concentrated in areas with ground water supplies that are already impacted or "at risk" of becoming impacted in the future.

Relationship to Other Objectives: Wellhead protection area delineations and contaminant inventories completed by local water purveyors could be added to the ground water quality database used for the risk assessment (Objective 2). Assistance to local water purveyors should be targeted in areas identified as "at risk" in Objective 2 and impacted supplies identified in Objective 3.

Proposed Actions

Action 4A. Enforce Wellhead Protection Program requirements for all Group A PWSs. The majority of Group A PWSs in the Yakima Basin have established acceptable Wellhead Protection Programs. However, a number of Group A PWSs have not established a Wellhead Protection Program at all. Other Group A PWSs have submitted Wellhead Protection Program documentation to DOH, but have not established or maintained adequate wellhead protection area delineations, contaminant inventories, or management programs. DOH should require compliance for all Group A PWSs and provide additional technical and/or financial assistance, if necessary. Enforcement actions and assistance should be focused in areas with supplies that are impacted or "at risk" of becoming impacted in the future.

Action 4B. Facilitate use of a computer model for delineating select Group A PWS wellhead protection areas. The USGS is in the process of developing a numerical ground water transport model for the Yakima Basin in accordance with the Memorandum of Agreement between the Bureau of Reclamation, Ecology, and the Yakama Nation. This regional model could be used to delineate accurate wellhead protection areas (e.g., capture zones) around Group A PWS ground water supplies that are impacted or "at risk" of becoming impacted in the future. Determining accurate capture zones around an "at risk" or impacted ground water supply would enable a water purveyor to more precisely pinpoint where management strategies should be implemented. Thus, the implementing agency should work with the USGS to evaluate applicability of the USGS computer model for this purpose. This activity should also be coordinated with DOH activities to map wellhead protection areas using Geographic Information Systems (GIS) including web access.

Action 4C. County health districts can encourage Group B PWSs to voluntarily establish a Wellhead Protection Program. Group B PWSs are not required to do any wellhead protection planning under current regulations. However, most Group B PWSs would benefit from going through the process of establishing a simplified Wellhead Protection Program. Existing wellhead protection regulations and guidance documents for Group A PWSs could be distilled into an easy-to-use guide for Group B PWSs. The guide would essentially be an informational packet with suggestions for establishing wellhead protection area delineations, contaminant inventories, and simple management programs. This guide could be mass-mailed to all Group B PWSs. Additional technical and/or financial assistance could be offered to Group B PWSs in areas with "at risk" or impacted ground water supplies.

Considerations for Objective 4

- ❑ 100 percent compliance of Group A PWSs with wellhead protection regulations may not be attainable.
- ❑ Group A PWSs and local government agencies may not have the technical staff to use computer models to generate more accurate wellhead protection area delineations. This may require reliance on USGS staff or contracted services.
- ❑ Ability of DOH to carry out actions such as 4A is contingent on availability of staff and other resources.
- ❑ Many local water purveyors lack the technical background to accurately identify potential sources of contamination.
- ❑ Many Group B PWSs will not perform wellhead protection activities even if technical and financial assistance is provided.
- ❑ Wellhead protection literature and informational packets may be misunderstood by some public audiences.

Table 6-4
Agency Involvement and Resource Needs for Objective 4

Action	Proposed Agency Involvement (1)	Staff Resources Required (2)	Initial Implementation Cost (3)	Short-term Benefit	Long-term Benefit
4A. Enforce Wellhead Protection Program requirements for all Group A PWSs	• *DOH* • Local water purveyors	Low	Low to Medium	✓	
4B. Facilitate use of a computer model for delineating select Group A PWS wellhead protection areas	• *DOH* • Local water purveyors • USGS	High	High	✓	✓
4C. Encourage Group B PWSs to voluntarily establish a Wellhead Protection Program	• *County health department* • Local water purveyors • WSU Cooperative Extension • DOH	Low to Medium	Medium	✓	✓

(1) The agency proposed for a lead role is shown in italics. Other listed agencies may provide additional support with data and/or resources. Interagency agreements may be a vehicle for promoting cooperation.
(2) Staffing estimated only for agency proposed for lead role. Low = Need ¼ to ¾ fulltime equivalent (FTE) to implement. Medium = Need 1-2 FTE to implement. High = Need > 2 FTE and/or contracted services to implement. Staffing estimates are relative, and would likely be reduced if multiple actions are implemented simultaneously.
(3) In general, Low = Less than $50,000 per county. Medium = Between $50,000 and $250,000. High = Greater than $250,000.

6.2.5 Objective 5: Minimize Impacts of Land Use Activities on Ground Water Supplies by Implementing Technical Management Strategies

Purpose: Prevent degradation of unprotected ground water supplies outside the service areas of large water purveyors by various land use activities.

Rationale: A variety of land use activities can act together as non-point sources to impact ground water supplies. It is more efficient and cost-effective method to prevent land use activities from impacting ground water supplies than attempt to clean up ground water supplies after they have been impacted.

Relationship to Other Objectives: The type of management strategies that need to be implemented and the locations where the strategies need to be implemented should be based on the risk assessment (Objective 2) and monitoring programs (Objective 3).

Proposed Actions

Action 5A. Identify land use activities and contaminants to be addressed with technical management strategies. Land use activities and contaminants of concern in the Yakima Basin will depend on region-specific ground water quality results obtained during the risk assessment (Objective 2) and monitoring program (Objective 3). For example, it might be determined that the following land use activities are associated with "at risk" and impacted ground water supplies: on-site wastewater disposal, animal feeding operations, agricultural operations, and chemical storage and handling operations. Likewise, data might suggest that pesticide impacts are more prevalent than nitrate impacts, or vice versa. Please note that this action is similar to a portion of Action 3E.

Action 5B. Select and implement technical management strategies. The local implementing agency will be responsible for final selection and implementation of management strategies based upon input from local and state agencies, stakeholders, interest groups, and the general public. Examples of specific management strategies that might be selected and implemented in the Yakima Basin include:

- ❑ Establish guidelines to limit septic system densities in new developments.
- ❑ Extend sewer lines from urban centers to nearby areas with septic systems.
- ❑ Provide technical and financial assistance to expanding wastewater collection and treatment facilities.
- ❑ Develop operations and maintenance program for on-site septic systems.

- Review existing guidelines for land application of wastewater effluent and consider whether more stringent requirements are needed including rules and regulations if applicable.
- Review existing guidelines prohibiting on-site disposal of non-domestic wastewater from commercial and industrial facilities, and consider whether more stringent requirements are needed, including rules and regulations, if applicable.
- Review existing design and operation standards for chemical storage and handling operations, and consider whether more stringent requirements are needed, including rules and regulations, if applicable.
- Promote implementation of BMPs for fertilizer application, pesticide application, irrigation management practices, and manure handling (e.g., Field Operations Technical Guide; and Ecology and WSU, April 1995).
- Review existing guidelines for siting of concentrated animal feeding operations, and consider whether more stringent requirements are needed, including rules and regulations, if applicable.
- Provide technical and financial assistance to agricultural and animal feeding operations for ground water quality improvement projects.
- Maintain local household hazardous waste collection and disposal programs; and, State producer pesticide collection (WSDA).
- Support research on contaminant fate and transport issues in the Yakima Basin.

Considerations for Objective 5

- In some areas, some aspects of this objective may be addressed already, under existing critical areas ordinances.
- It may be difficult to discern from the results of the risk assessment and monitoring program which land use activities and contaminants need to be addressed.
- Selection and implementation of technical management strategies do not guarantee adequate protection of ground water supplies from contamination.
- Management strategies should not be applied uniformly to all locations. Some locations and land uses may require site-specific strategies.

Table 6-5
Agency Involvement and Resource Needs for Objective 5

Action	Proposed Agency Involvement (1)	Staff Resources Required (2)	Initial Implementation Cost (3)	Short-term Benefit	Long-term Benefit
5A. Identify land use activities and contaminants to be addressed with technical management strategies	• *County health department* • Conservation districts • Ecology • WSDA • NRCS	Medium	Low	✓	
5B. Select and implement technical management strategies	• *County health department* • Conservation districts • Ecology • WSDA • NRCS	High	High	✓	✓

(1) The agency proposed for a lead role is shown in italics. Other listed agencies may provide additional support with data and/or resources. Interagency agreements may be a vehicle for promoting cooperation.
(2) Staffing estimated only for agency proposed for lead role. Low = Need ¼ to ¾ fulltime equivalent (FTE) to implement. Medium = Need 1-2 FTE to implement. High = Need > 2 FTE and/or contracted services to implement. Staffing estimates are relative, and would likely be reduced if multiple actions are implemented simultaneously.
(3) In general, Low = Less than $50,000 per county. Medium = Between $50,000 and $250,000. High = Greater than $250,000.

6.2.6 Objective 6: Clean Up Sources of Ground Water Contamination

Purpose: Restore impacted, unprotected ground water supplies outside the service areas of large water purveyors for potential use as a drinking water source.

Rationale: While prevention is the most effective way of protecting clean ground water supplies, a significant number of unprotected ground water supplies may already be impacted. These impacted ground water supplies cannot be safely used as an existing or future source of supply. Impacted ground water supplies should be cleaned up where feasible such that the ground water can be used as a drinking water source.

Relationship to Other Objectives: Some impacted ground water supplies may be identified by the long-term monitoring program (Objective 3).

Proposed Actions

Action 6A. Evaluate the need for greater involvement as a stakeholder in clean up actions at Ecology regulated facilities and sites. Remediation activities at Ecology regulated facilities and sites are already reviewed and approved by Ecology. While most remediation activities are required to restore impacted ground water to acceptable drinking water levels, Ecology occasionally allows ground water contaminants to be left in place at concentrations significantly above maximum contaminant levels (MCLs). Ecology should notify the local implementing agency about sites in the Yakima Basin in which proposed remediation actions will not restore impacted ground water to concentrations below MCLs. Then the local implementing agency could get more involved as an active participant in the public notification process to ensure that remediation actions are sufficient to protect existing and future ground water supplies. The local implementing agency can identify geographic locations of many currently regulated sites and facilities at the Ecology facility/site database web site (http://www.ecy.wa.gov/services/as/iss/fsweb/fshome.html). A number of geographic searches can be conducted with this database including latitude/longitude, city, zip code, and county searches.

Action 6B. Evaluate the need for independent clean up actions. Some land use activities that have contributed to ground water contamination cannot be easily assigned to responsible parties. Examples of contaminant sources that may not be fully addressed by Ecology clean up programs include septic systems, animal feeding operations, agricultural operations, chemical storage facilities under a certain size threshold, etc. The local implementing agency should investigate the potential for providing technical and/or financial assistance to remove or remediate sources of contamination and downgradient impacts associated with these land use activities.

Considerations for Objective 6

- ❑ It may be difficult to stay up-to-date with the status of all remediation activities in the county or basin unless significant resources are earmarked for this task.
- ❑ It may be extremely difficult in most cases to identify specific land use activities that have contributed to ground water contamination and need to be cleaned up. A strong link between an impacted ground water supply and a land use activity would need to be firmly established (see Objective 3).

Table 6-6
Agency Involvement and Resource Needs for Objective 6

Action	Proposed Agency Involvement(1)	Staff Resources Required(2)	Initial Implementation Cost(3)	Short-term Benefit	Long-term Benefit
6A. Evaluate the need for greater involvement as a stakeholder in clean up actions at Ecology regulated facilities and sites	• *County health department* • Ecology • Local water purveyors	Medium	Low		✓
6B. Evaluate the need for independent clean up actions	• *County health department* • Ecology • WSDA • USGS	High	High	✓	✓

(1) The agency proposed for a lead role is shown in italics. Other listed agencies may provide additional support with data and/or resources. Interagency agreements may be a vehicle for promoting cooperation.
(2) Staffing estimated only for agency proposed for lead role. Low = Need ¼ to ¾ fulltime equivalent (FTE) to implement. Medium = Need 1-2 FTE to implement. High = Need > 2 FTE and/or contracted services to implement. Staffing estimates are relative, and would likely be reduced if multiple actions are implemented simultaneously.
(3) In general, Low = Less than $50,000 per county. Medium = Between $50,000 and $250,000. High = Greater than $250,000.

6.3 Implementation Considerations

Although management goals, objectives, and actions have been developed for the Yakima Basin as part of this watershed planning effort, local organizations will be responsible for establishing actual programs to protect ground water from contamination. A brief overview of some preliminary issues that will need consideration by local organizations when implementing the Watershed Plan are presented below.

6.3.1 Roles and Responsibilities

The role and responsibilities of each participant in a given ground water quality protection program needs to be defined from the beginning. A lead agency with broad local authority, such as the board of county commissioners, should be designated. Local government agencies able to provide resources and support staff, such as the county health department and county planning department, should be delineated. The amount of resources and support available from state agencies, such as DOH and Ecology, should be gauged. Likewise, the degree to which cities and local water purveyors are able to participate in the protection program should be established.

The local agency that implements the Watershed Plan will need to accept the management goals and objectives, as presented herein or modify the goals and objectives to satisfy new criteria. Development of specific management strategies and actions can be accomplished later by local committees. However, it should be decided in the beginning if independent ground water protection programs are going to be developed or if the framework for an existing program such as the GWMA Program will be used.

6.3.2 Potential Sources of Funding

The degree to which the Watershed Plan can be implemented will depend largely on the amount of funding available. The implementing agency should initiate attempts to obtain long-term sources of funding immediately. Potential sources of funding for ground water protection activities include:

- Federal grants from EPA and United States Department of Agriculture
- Cooperative agreements with federal agencies (e.g., USGS) in which the federal government funds a portion of the project
- Clean Water Act Section 319 Non-point Source Fund
- Centennial Clean Water Fund
- Washington State Revolving Fund
- Washington State Water Pollution Control Fund
- Grants from the Washington Conservation Commission
- Tax septic system and/or water use
- User fees on drinking water systems

- Property tax or other local taxes
- Plan review fees and permit fees
- Water rate surcharges adopted by public water systems benefiting from program
- Other state or local appropriations

Where funding is derived from targeted fees or taxes, care must be taken to ensure that principles of fairness and equity are addressed.

6.3.3 General Management Considerations

A number of common-sense suggestions should be considered for successful implementation of a Yakima Basin ground water protection program. The following suggestions were modified from lessons learned from implemented ground water protection programs for the Spokane Valley/Rathdrum Prairie Aquifer (Idaho DEQ 1999):

- Effective leadership and a clear understanding of roles and responsibilities will benefit implemented objectives and actions.
- Successful programs will require cooperation, communication, and information exchange between local water purveyors, cities, counties, and state government agencies.
- Key leadership and staff positions should be stable over a long-term period (e.g., need staff with institutional memory to sustain programs since local planners and elected officials are continually changing).
- Successful implementation of most strategies requires sustained commitment of dedicated technical staff.
- Long-term success will depend on the ability to integrate management programs into core local government responsibilities (such as wellhead protection, land use planning, permitting septic systems).
- An effective methodology is needed for monitoring the performance of implemented objectives and actions.
- The public should be involved throughout the adoption and implementation process.
- Short-term successes should be promoted to boost the success of the entire program.

Chapter 7

Fish Habitat Enhancement

Chapter 7
Fish Habitat Enhancement

As described in Chapter 2, a Watershed Assessment was completed for the basin in 2001, including an assessment of habitat conditions. The assessment provides historical information on habitat impacts, identifies species of concern, and describes habitat factors used to assess current habitat conditions in the basin, including both tributaries and the Yakima River mainstem. The assessment also identifies habitat information needs and includes a summary of local, state and federal regulatory and non-regulatory programs. Habitat-related information from the Assessment is summarized in Section 2.7 of this Watershed Plan. For more detailed information, see the Assessment document (YRB Planning Unit, 2001).

Based on the results of the Assessment, the Habitat Work Group of the Yakima River Basin Watershed Planning Unit developed a habitat enhancement strategy for the basin, which is documented in a technical memorandum (Bain, 2002a). The strategy is summarized in this Chapter. It provides a prioritized approach for habitat enhancement, along with a list of actions for consideration by local governments, state agencies, and other organizations as they propose and fund habitat-related projects and programs. The habitat enhancement section does not contain binding requirements for any organization. However, it presents recommended management goals, objectives and actions. Where possible, relative resources needed to implement different aspects of the strategy have been identified. It is acknowledged that many organizations are already engaged in carrying out actions included in the strategy, and the Planning Unit recommends these efforts be continued and expanded.

It is expected that the recommended approaches and priorities outlined in this section will be a primary input and information consideration for local and state agencies with implementation responsibilities and by the Yakima Basin Lead Entity for allocating state salmon recovery funding. Chapter 90.82.100 RCW of Washington State law describes the relationship between the watershed planning activities and habitat restoration (enhancement) activities under the State's Salmon Recovery Act:

> Planning established under this section [habitat] shall be integrated with strategies developed under other processes to respond to potential and actual listings of salmon and other fish species as being threatened or endangered under the federal endangered species act…. Where habitat restoration activities are being developed under [ESHB 2496], such activities shall be relied on as the primary nonregulatory habitat component for fish habitat under [the Watershed Management Act].

This Chapter of the Watershed Plan, combined with the habitat assessment, the Washington Conservation Commission's Limiting Factors Analysis (2001) and other planning efforts underway in the basin, provide the foundation for developing a salmon recovery plan and funding salmon recovery projects through the Yakima Lead Entity and state Salmon Recovery Board (ESHB 2496) process. It also provides direction for regulatory and management actions that can be implemented by local and state agencies to protect and enhance habitat.

It is also anticipated that this Chapter will be used an foundational information for state and local agency requests made to other funding agencies, such as the Bonneville Power Administration/Northwest Power Planning Council for program and project funding in the basin.

7.1 Management Framework for Fish Habitat Protection and Enhancement

A recommended management framework is provided in this Chapter to help guide fish habitat protection and enhancement in the Yakima River watershed. This management framework builds upon information provided in the full technical memorandum (Bain 2001a) and summarized in Chapter 2.7 of this Plan. The management framework includes an overarching goal, guiding principles, objectives and proposed actions to help guide more detailed planning and implementation of specific habitat enhancement projects or programs.

Overarching Goal: Protect and enhance aquatic habitats in the Yakima River and tributaries to achieve a healthy system for anadromous salmonids and other native fish.

Guiding Principles:

1. Protect existing high-quality habitats and connecting migration corridors.
2. Protect and enhance habitats that are damaged but still functional.
3. Improve water quality consistent with the needs of designated beneficial uses and regulatory requirements.
4. Protect significantly damaged habitats from further degradation.

These guiding principles emphasize several approaches for protection and enhancement of habitats. Definitions of habitat condition are provided with these policies which distinguish properly functioning condition (PFC) from generally suitable habitats based on biological assessments. Guiding principles are listed to provide a conceptual framework for prioritization of needs and evaluation of proposed strategies and actions to protect and enhance aquatic habitats.

Protection of existing high-quality functioning habitats and connecting migration corridors is the first priority. Protection is essentially local and state government planning, regulation and code enforcement, and management responsibilities.

Protection must be uniformly effective, and equitable throughout the watershed. Accordingly, although the mechanisms and devices employed to protect habitat functions may differ according to the habitat conditions in each subbasin or river reach, within any and all reaches they must be sufficient to protect the achieved level of function. An essential part of watershed enhancement and protection is the application of state and federal funds/programs to enhance dysfunctional habitat elements, including obtaining from willing landowners such things as conservation easements, land trusts, fee simple purchases, etc. of high quality habitats that are threatened, or of extraordinary importance.

Guiding Principle 1 emphasizes protection and connection of existing high quality habitats. This principle has its foundation in the watershed level protection maxim "protect the best, then restore and reconnect the rest." (Pacific Rivers Council, 1996) This maxim reflects a major shift in strategy for habitat enhancement suggested over previous efforts in the Pacific Northwest that focused on treatment of symptoms at sites that represented worst cases of degradation, which subsequently failed to reverse declines in fish production (Frissel, 1993). The importance of protection of healthier watersheds (refugia) is stressed in many recent technical documents (e.g., watershed planning guides, peer reviewed papers and habitat enhancement strategies). These documents stress protection of relatively healthy areas and connection with ecosystem processes that provide refuge areas and sustain a diversity and abundance of native fishes.[1] (Bradbury, 1995; Pierce County and Puyallup River Watershed Council, 2000)

Guiding Principle 2 is protection and enhancement of habitats that are damaged but still functional, and is next priority. For these areas, existing local and state regulatory functions must prevent further degradation through permit review and code enforcement while privately or publicly funded management and enhancement programs are applied to restore and enhance degraded habitat functions to levels that will sustain salmonid lifecycles. Enhancement of at-risk habitats is likely to be more cost-effective than attempting to restore degraded or historically poor habitat.

Protection and enhancement is also necessary on downstream low elevation reaches and associated floodplains to increase productivity. Although existing high-quality habitats generally are found at higher elevations in the watershed, valuable spawning and rearing habitat is found in the floodplain areas of the Yakima River Mainstem and lower reaches of the Naches River. The first line of protection in such areas is local land use designations/densities appropriate to the hazards/sensitivities of the resource, followed by local and state development standards and code enforcement that protect habitat, including water quality. Enhancements of habitat elements are to be accomplished through funded programs with voluntary participation of landowners. In Guiding Principle 2 it is

[1] Refuge areas sometimes referred to as refugia, focal habitats aquatic diversity areas of Key Watersheds are relatively undisturbed headwater areas that foster spawning and rearing for remnant populations of sensitive fishes and other organisms. These areas are usually assigned very high priority for protection or enhancement.

also recognized that habitats that are more than slightly damaged should be restored with high priority when these act as a bottleneck to fish production.

Guiding Principle 2 stresses enhancement of "at risk" habitats over non-functioning, degraded habitats. This concept is consistent with recent salmon enhancement and watershed planning guidance and technical papers published by respected environmental organizations, universities, and resource management agencies (Pacific Rivers Council, 1996; Frissel, 1992; USDI, 1998; NMFS, 1996). Examples of statements from referenced documents are provided below which pertain to the concepts expressed in Guiding Principle 2.

> ***Pacific Rivers Council***: The Pacific Rivers Council's overall theme of restoration is "First Protect the Best – Then Restore the Rest." The Pacific Rivers Council Guide stresses needs to maintain critical habitats as refuges from disturbance and warns that past efforts that emphasized restoration of severely degraded habitats failed and deflected efforts from programs that protected critical refuge areas and minimized correction of root causes of habitat deterioration and fish population decline (1996).
>
> ***Frissel, C.A., Oregon State University***: "Restoration should be focused where a minimal investment can secure the maintenance of the largest amount of high-quality habitat and diverse aquatic biota… A small investment in a watershed that still retains much of its natural integrity can secure far more critical resources, and far better safeguard the future of sensitive fish species, than a very expensive effort in a watershed that has already suffered severe and long-standing degradation (1993)."
>
> ***US Department of Interior and Agriculture***: By concentrating on the "at risk" systems, enhancement activities can save many riparian-wetland areas from degrading to a non-functioning condition. Once a system is non-functional, the effort, cost and time required for recovery is dramatically increased. Enhancement of non-functional systems should be reserved for those situations where the riparian-wetland has reached a point where recovery is possible, when efforts are not at the expense of "at risk" systems, or when unique opportunities exist (1998).
>
> ***National Marine Fisheries***: "Strategies should place a high priority on existing highly productive, or potentially highly producing areas within watershed of listed or at risk ESUs (sometimes labeled "core areas"). These areas need to identified and given a high level of protection from potentially damaging activities. "Protection should focus on maintaining essential functions of the mainstem and tributary spawning and rearing areas, and conditions in the migration corridors that allow for safe passage, both upstream and downstream of adults and juveniles (1996)."

Guiding Principle 3 is an overarching goal for water quality, an essential habitat component. This water quality principle recognizes the need to protect in and out of stream beneficial uses. Compliance with water quality laws and regulation is also recognized as a basic tenet of the watershed plan.

Guiding Principle 4 is an anti-degradation goal. Non-functional habitats should be protected from further damage, and enhanced where easily done. For example, with protection from further degradation, highly degraded habitats can improve over time through natural healing processes. Opportunities for enhancing highly degraded reaches are anticipated to become a higher priority as salmon recovery programs progress.

Objectives:

The following objectives were developed considering one or more aspects of the four Guiding Principles. These more specific strategic elements deal with subparts of the principles and more detailed approaches that are considered in the development of tactics or actions. The first five objectives (Group 1) are organized in terms of priority and oriented toward protection and enhancement actions, while the Group 2 objectives are more programmatic in nature, dealing with improving the information base, performance measurement and standards, and are not listed in order of priority.

The eight objectives are listed below with their narrative statements:

Group 1 – Prioritized Protection and Enhancement Objectives

- ***Objective 1:*** Protect Existing High Quality Aquatic Environments
- ***Objective 2:*** Protect and Enhance Fish Migration Corridors
- ***Objective 3:*** Enhance Downstream Reaches and Connect Associated Floodplains In Tributary and Mainstem Reaches to Benefit Fish Production
- ***Objective 4:*** Prioritize Enhancement of Damaged Aquatic Habitats that are Still Functional
- ***Objective 5:*** Protect Existing Habitat Conditions from Further Degradation

Group 2 - Programmatic Objectives (Not Listed in Order of Priority)

- ***Objective:*** Improve Watershed Wide Information Base
- ***Objective:*** Focus on Habitat Condition To Measure the Effectiveness of Habitat Enhancement Actions
- ***Objective:*** Ensure Water Quality and Habitat Standards Reflect Natural Regional Conditions

7.2 Integration of Management Framework with Prioritization of Tributaries and Mainstem River Reaches

The comparative analysis findings from Section 2.7.4 were combined with the management framework outlined in Section 7.1 for the mainstem river reaches and tributary subbasins. Fish distribution information has also been added. The results are displayed in Table 7-1.

7.2.1 Mainstem River Reach Prioritization

Prioritization of mainstem river reaches was strongly influenced by the second part of Guiding Principle 1 which stresses protection of connecting migration corridors as well as the enhancement aspects of Guiding Principle 2 relative to damaged but still functioning habitats. The mainstem river is degraded in its lower reaches but functions as the major migration corridor for salmonids and is also important spawning areas for fall Chinook and reintroduced Coho populations. Further review of EDT analysis results for spring Chinook show upper mainstem Yakima River reaches are highly rated for both preservation and enhancement potential. These upriver reaches are considered the most productive areas in the basin, particularly for spring Chinook.

Accordingly, all five mainstem Yakima River reaches and the Naches River were assigned high priority for both protection and enhancement as reflected in Table 7-1. Needs of the individual reaches vary as illustrated in the habitat and water quality condition qualitative assessment summaries in Tables 2-11 and 2-12 (See Chapter 2). However, all mainstem river reaches and the Naches River are considered to have equal priority even though details concerning enhancement approaches will differ significantly between the lower and uppermost sections of the river.

7.2.2 Tributary Stream Prioritization

Considerations influencing prioritization approaches for the 31 tributary streams were based on the four Guiding Principles and the information from Tables 2-11 and 2-12 referenced above.

Table 7-1
Fish Habitat Protection and Enhancement Priority Groups

Guiding Principle	Priority Group*	Rationale, Strategy and Response	Stream Name	Known Fish Distribution
Protect the best	1	Preserve existing high quality habitat with specific enhancements directed at fish passage and access concerns Highest Priority for Preservation	Yakima River: Sections 1 & 2	 Chinook, steelhead
	1	Preserve existing high quality habitat with specific enhancements directed at fish access/migration concerns. Highest Priority for Preservation.	American R. Rattlesnake Cr Cle Elum R. Umtanum Cr.	Chinook, bull trout Chinook, steelhead bull trout Chinook Steelhead
Protect and Enhance Damaged but Still Functional Habitat	2	Protect and enhance as migratory route to all spawning and rearing areas of the basin, and for spawning and rearing for fall Chinook and Coho.	Yakima River Sections 3 & 4 Section 5	 Chinook, Coho, steelhead Chinook
	2	Restore at risk sections in lower reaches of each tributary due to barriers, riparian degradation or flow issues. Highest priority for enhancement.	Kachess R Bumping R Gold Creek Naches R Big Cr. Little Naches R Tieton R. Taneum Cr	Bull trout Chinook, steelhead Bull trout Steelhead, Chinook, bull trout Insufficient data Chinook, steelhead Insufficient data Steelhead
	3	Restore larger reaches of each tributary due to habitat problems mainly associated with compromised riparian conditions, low flows and watershed erosion impacts. Medium priority for enhancement	Cowiche Cr. Wide Hollow Cr. Cabin Cr. Swauk Cr Ahtanum Cr	Insufficient data Coho Insufficient data Steelhead Coho, steelhead, bull trout

Table 7-1 (cont.)
Fish Habitat Protection and Enhancement Priority Groups

Guiding Principle	Priority Group*	Rationale, Strategy and Response	Stream Name	Known Fish Distribution
Improve Water Quality for Regulatory Requirements and to Provide Access to Upstream Habitats	4	Restore lower reach degraded habitat conditions mainly associated with water quality, loss of riparian function; barriers and flow. Higher quality habitat in upper reaches need connectivity for fish migration. Priority should be reviewed where projects improve connectivity.	Teanaway R. Manastash Cr Corral Canyon Cr Wilson Cr	Steelhead, Chinook bull trout Insufficient data Coho Insufficient data
Protect Significantly Degraded Habitat from Further Degradation	5	Protect seriously degraded habitat mainly associated with false attraction flows, water quality, degraded channels and riparian areas. Near-term priority for water quality enhancement and protection to stop continued degradation. Habitat enhancement priority increases over time as progress is made on higher priority water bodies.	Spring-Snipes Cr Wenas Cr Reecer Cr Lmuma Cr	Coho, Chinook Insufficient data Insufficient data Insufficient data
None: Wasteways, Drains, Intermittent Streams or Other Severely Degraded Systems	6	Near-term priority for water quality enhancement and protection to stop continued degradation. Enhance possible rearing habitat near the confluence. These streams may cause high mortality and may be unsuitable habitat for certain life stages. Sediment and pesticide load reduction to protect Yakima River mainstem water quality. False attraction flow problems exist. Habitat enhancement priority increases over time as progress is made on higher priority water bodies.	Cherry Cr Sulphur Cr Wasteway Granger Drain Moxee Drain Burbank Cr Selah Cr	Insufficient data Insufficient data Insufficient data Insufficient data Insufficient data Insufficient data

* Prioritized in accordance with the goals and objectives established by the Planning Unit and information contained in the Watershed Assessment Report (January 2001)

Guiding Principle 1 stresses protection of high quality habitats. Streams that fell in this category are best suited for protection. The best tributary habitats were identified through the watershed assessment process and ranked in further evaluations of habitat condition and water quality as described earlier in this memorandum. In general, the best tributaries drained wilderness areas or other protected lands. These included the American River and Rattlesnake Creek in the Naches drainage and the Cle Elum River and Umtanum Creek in the upper Yakima River areas of Kittitas County.

Guiding Principle 2 stresses protection and enhancement of damaged reaches that are still functional. Enhancement activities should concentrate on "at risk" systems and not emphasize enhancement of highly-degraded systems until such systems have reached a point where recovery is possible. These and other rationale for Guiding Principles 1 and 2 are described earlier in this memorandum.

Guiding Principle 3 pertains to water quality and recognizes the need to protect beneficial uses that include in-stream and diversionary uses. Other considerations affecting prioritization of project actions include potential impacts on productivity within other reaches. For example, a project may help improve fish passage to higher quality habitats upstream or mitigate water quality problems affecting downstream habitats. Such situations where connectivity is enhanced may justify elevating priority of a "group 4" stream as indicated in Table 7-1.

Guiding Principle 4 is an anti-degradation goal to ensure that highly-degraded habitats are not further degraded. Over time, these habitats may slowly recover naturally if protected from further degradation. Future opportunities for enhancement of these lower priority areas will be identified as higher priority reaches are addressed.

Each of the 31 tributaries were generally categorized into groups 1 - 6 under the four guiding principles, based upon the qualitative assessment information provided in Tables 2-11 and 2-12, and professional judgment.

Priority groupings ranged from 1 (Extraordinary), 2 (Excellent), 3 (Good), 4 (Fair), 5 (Poor) to 6 (Special Problem Areas). Highest priority for protection (Guiding Principle 1) was assigned to the Group 1 streams, highest priority for enhancement (Guiding Principle 2) was assigned to the Groups 2 and 3 streams respectively. Streams ranked Group 4 or below were considered significantly degraded to differing degrees, particularly in their lower reaches. However, some of the Group 4 streams have high-quality habitat in upstream reaches and if water quality could be improved, access to these upstream reaches may be possible (Guiding Principle 3). Minimal near term enhancement potential was assigned to the Priority 5 and 6 streams except for water quality enhancement needs mainly associated with rearing opportunities near creek mouths and TMDL implementation designed to improve mainstem Yakima River water quality. Habitat enhancement priority for Group 5 and 6 water bodies should increase over time as progress is made on higher priority water bodies. Additional assessment of habitat enhancement opportunities for both Group 5 and 6 streams may be warranted, in conjunction with resource agencies.

Additionally, fish distribution information in tributary streams, based on published reports (Hockersmith, 1995; Pearsons, et al. 1998; Haring, 2001) has been included to supplement habitat-ranking information provided in Table 7-1 (see above). This information was not included in the quantitative habitat ranking approach as the focus of the evaluation was on habitat conditions and not current fish species distribution. The fish distribution and habitat information are complementary, and are intended to allow individuals to make informed judgments about prioritizing salmon recovery projects in the large and diverse geography of the Yakima River basin.

"Known fish distribution," as defined for the purposes of this report, only includes streams that have been identified in published reports as currently supporting salmon, steelhead, or bull trout use at all life-stages. It must be pointed out that historically the extent of such support within the Basin was larger than at present, and that currently nearly all tributary streams in the Yakima Basin, including some intermittent streams, are capable of supporting, and many do support, some life stages of salmonids for part of their life-cycle during certain times of the year. In addition, all tributaries and many intermittent streams can support resident fish, such as rainbow or cutthroat trout, minnows, suckers, lamprey, and other important components of the ecosystem such as aquatic insects. For project ranking, the Habitat priority rankings need to be considered in conjunction with known fish distribution (species, life stages, ESA listed, LHFA, etc.), so that the cumulative outcome of recovery projects provides a balanced supply of sufficient habitats for all the life stages of a species' expanding population with its use range.

If a tributary supported all life stages (spawning, incubation, rearing, migration) of an indicator species (bull trout, steelhead, salmon) then the species inhabiting the stream was identified in the Known Fish Distribution column of Table 7-1. Because salmon or trout successfully use these streams during all life stages, this data can provide additional guidance for salmonid recovery prioritization. However, it is important to note and consider that many streams provide important habitat for less than all life stages. For example, there are many off-channel habitat areas that only provide rearing habitat, which has been determined to be a limiting factor in the Yakima

Basin. Ahtanum and Cabin Creek are both Category 3 streams, although these two streams are very different in terms of fish use. Ahtanum Creek currently supports Coho salmon, steelhead, and bull trout, while none of these species are known to occur in Cabin Creek.

Alternatively, a stream may have high quality habitat but also have an impassable barrier culvert near the mouth, blocking fish access to the stream. In that case, sole reliance on fish distribution information would lead to the erroneous conclusion the stream did not have the potential to produce fish.

Another reason for providing fish distribution information is because ESA listed species are present in the Basin. Improving habitat in streams that support listed species is a priority from the standpoint of complying with ESA regulations. Both bull trout and steelhead are listed under ESA as "threatened" in the Basin.

Finally, there are numerous smaller tributary streams that were not rated or ranked in this process. The habitat condition and prioritization of such waterways needs to be evaluated when project actions are proposed and preferably earlier, as suggested under the Group 2 Objective – Improve Watershed Wide Information Base, activities involving habitat assessments. Examples of streams that are expected to require assessments include Amon Creek, Dry Creek, Little Creek, Nile Creek, Mabton Drain and Tucker Creek. These examples cover a wide range of habitats scattered throughout the basin. New information and special problems may justify more attention for certain waterways. For example, significant fish utilization of Amon Creek (Benton County) has recently been reported which indicates there will be needs to assess impacts of emerging land development pressures in this watershed (DFW, 2001). Tucker Creek (Kittitas County) has a fish passage problem through a highway culvert that justifies prioritization to remove a bottleneck. Future assessments of habitat will help refine and expand the prioritization of geographical sub-areas and identify bottlenecks and opportunities to enhance fish production.

The tiered approach to prioritization is consistent with guiding principles described in the Habitat Protection and Enhancement Management framework and reflects similar geographically-oriented approaches described for other watersheds and in published guidelines and technical papers[2,] (PRC, 1996; Frissell, 1993). Priorities can and should be modified over time as new information on habitat conditions and additional fish distribution information becomes available.

[2] Hood Canal Coordinating Council – Salmon Recovery Strategy for Hood Canal and the Eastern Strait of Juan de Fuca, Version 9-2000. This watershed-oriented strategy prepared with contributions from tribes. State DFW, DNR, USSFWS, USFS, numerous local organizations including 4 salmon recovery groups has a 5-tiered geographic approach linked to salmon species and listings. Strategy stresses protection of high quality habitat over restoration and stresses restoration of self-sustaining natural functions over engineered solutions.

7.2.3 Strategies

Different conceptual strategies for protection and enhancement are associated with the different priority groups. These are necessarily directed to broader issues which are associated with causes of habitat problems, feasibility of enhancement approaches, determination as to where actions are most needed and desires for long-term benefits for targeted species. The strategies are not focused on tactics, (the myriad of specific actions to implement objectives) other than a need to be realistic as to whether tactics are possible or feasible. Habitat protection and enhancement strategies are emphasized for the first four priority groups as shown in Table 7-1. Lower ranked streams are managed to avoid doing harm downstream (e.g., water quality impacts, false attraction of fish) except for possibilities of site-specific rearing opportunities near creek mouths.

7.2.4 Goal Achievement

The Habitat management framework stresses protection and enhancement in order to achieve a level of properly functioning habitat in prioritized water bodies that is consistent with increased fish production. Numerical goals have not been established, although NMFS recently issued "possible" interim abundance and productivity targets for steelhead for the Basin, as provided in Table 7-2 (Lohn 2002).

Table 7-2
Middle Columbia Steelhead Evolutionary Significant Unit (ESU)
Yakima River Basin

Satus/Toppenish	2,400
Naches	3,400
Mainstem (Wapato to Roza)	1,800
Mainstem (above Roza)	2,900[3]

Improved habitat condition for a significant area of the watershed is intended to serve as a surrogate goal until numerical goals are established. As numerical goals are established as part of future recovery plans under the Endangered Species Act, the salmon recovery goal can be expressed as a proportion of the historic production of the affected species. The extent of properly functioning habitat needed for goal achievement could then be estimated based on production potential of watershed reaches or proportionality considering historic fish production statistics.

It appears reasonable as an initial strategy to have watershed areas that are well protected for salmonids while a portion of the watershed has more emphasis placed on mitigation of water quality impacts affecting down

[3] Northwest Power Planning Council smolt capacity reduced by 50% to reflect shared production potential with resident form.

gradient areas (e.g., mainstem reaches) or correction of bottlenecks blocking access to upstream habitats. In special problem areas where fish may be harmed near term (due to false attraction), protection could extend to exclusion of fish using physical barriers or management of flows or other appropriate management actions where false attraction flows have potential for luring spawning fish into inhospitable habitats. False attraction flows will need to be addressed to reduce or prevent spawning in unsuitable spawning habitat. Managing spill that attract fish into inhospitable habitats still needs to occur because the extent and magnitude of this problem regarding mortality, bottlenecks, or pre-spawn delays that result in poor spawning success is still unknown. It is anticipated that these approaches may change over time as goals, objectives and strategies are reviewed and updated to incorporate new information.

Increased fish production may be a measure of improved habitat conditions or may be due to other factors outside of the Yakima Basin. Watershed goals for ESA recovery plans will probably integrate fish population parameters into habitat enhancement strategies considering limiting factors. The Conservation Commission Limiting Habitat Factors Analysis has identified specific habitat limiting factors as related to different species. Important factors include in-stream flow and water quality in the lower reaches of the system (especially water temperature). Rearing habitat has emerged as a major need through much of the system, particularly along the mainstem. Loss of rearing habitat is linked to a variety of factors affecting side channel/off channel access and suitability. Floodplain function and riparian zone management issues are important as related to woody debris, pool formation, channel complexity, shade and other elements that shape aquatic environments.

Thus, achievement of the overarching habitat goal can be attained through a combination of protection and enhancement efforts. This goal, which is focused on achievement of a healthy system for anadromous and other native fishes, sets a standard of quality or excellence for the watershed.

Limitations of Prioritized Approach and Management Framework

There are limitations to this prioritized approach and management framework for habitat protection and enhancement within the basin. It should not be viewed as a comprehensive habitat enhancement strategy that details a prescribed and sequential set of actions or projects which will result in the most efficient (in terms of funding and time) improvements in habitat or salmonid populations. In order for such a strategy to be formulated, there are still scientific/technical and policy steps that should be undertaken to improve the chance of success for a protection and enhancement strategy. These technical and policy steps, and the formulation of such an integrated strategy, are anticipated to be completed through other efforts, such as the 2496 salmon recovery planning process, or specific ESA compliance strategies for addressing potential take activities for steelhead and bull trout.

The additional scientific/technical steps yet to be completed include more detailed assessments of salmonid populations and their ability to respond to habitat improvements. These assessments would include the management status of each stock in the watershed (i.e. listed under ESA, hatchery stock managed for maximum harvest, wild stock managed for maximum harvest, hatchery stock managed for supplementation of wild fish or re-introduction, etc.), the current size of the population, potential population size (based on historic records or amount of available habitat), population trends, spatial distribution, and fecundity or productivity of the population. Technical information would include the resources available in the basin for natural[4] and managed[5] re-introduction of stocks into areas where they have been extirpated, or supplementation of stocks that are declining in population or at critically low levels. This information would include the status and capacity of existing hatchery, rearing, or fish transportation facilities or equipment, the availability of populations suitable (i.e. closely related to those which formerly existed in the basin or a given stream) for use as a brood stock for re-introduction, and changes in fish management which may have to occur in order to allow the stock to recover.

Policy steps include deciding which are the highest priority species or stocks to concentrate on – those listed under ESA, other stocks with critically low population levels, stocks which are currently productive for harvest, stocks which were historically very large and have good potential for recovery, stocks showing rapid decline, or stocks which provide genetic resources for re-establishment of other populations, etc. – and other policy questions such as funding, existing land uses in the project areas, etc.

Completing these steps will allow for individual projects or actions to be evaluated for effectiveness and cost efficiency in achieving more specific goals within the basin. It is anticipated that more detailed strategies and tactics for achieving the goals (i.e. proposed projects and their sequence) will be developed, implemented and monitored to meet the objectives for species recovery within the Yakima Basin.

Watershed actions (protection and enhancement) should stress benefit-cost approaches to achieve the most potential fish production/protection for given monetary or resource costs or economic impacts. The geographic areas with highest potential and priority should be stressed. Temptations to spread enhancement burdens more evenly across jurisdiction should be avoided in

[4] Natural: Re-introduction occurs on its own and without human intervention.
[5] Managed: Re-introduction occurs with human intervention.

the interest of maximizing production and minimizing the cost and economic impact. Effective watershed coordination will be needed to better assure that science has as strong a role as possible in the program and project prioritization process. Setting numerical fish production goals may be considered in the future as habitat conditions improve to the point where fish species are de-listed from ESA, and further discussions of providing habitat capacity to sustain harvestable sport and commercial fisheries could be considered.

Migratory fish are dependent on downstream conditions generally outside of the purview of the Yakima Basin jurisdiction. Harvest, hatchery programs, fish passage structures, predators, ocean conditions and other factors affect fish runs. The Yakima River watershed habitat enhancement effort for anadromous fish will likely need to be based on good faith of others assuming "if we build it (protect and enhance habitat), they will come."

7.3 Recommended Actions

Recommended actions have been identified based upon the Group 1 and 2 objectives. In this section, each objective is listed followed by an explanation of a) purpose, b) rationale, and c) suggested actions.

Each objective and resulting actions have been evaluated to determine likely agency and private sector involvement in implementation actions, general resource commitments needed and anticipated benefits and has been summarized in table format. The resource commitments were rated as minor, moderate or major considering aggregate of staff resources or monetary requirements. Some resource commitments, such as Medium listed for county updates of critical areas ordinances, are identified in more than one table. These are not to be considered additive, but have been duplicated for reader convenience. Benefits were assessed on a similar scale for short-term as well as longer-term impacts. Short-term impacts reflect such factors as lag time for benefits to be realized (e.g., land management ordinance development, revegetation programs for LWD recruitment programs) versus more rapid effects such as barrier removal or woody debris placement. Impacts categorizations are necessarily subjective and are intended only to provide a perspective for relative comparison of identified actions. In some cases, implementation considerations are also provided in narrative after a table.

Potential obstacles exist which can be barriers to implementation. Obvious barriers include availability of funding sources and staff resources. The funding barrier is considered common to realizing all identified objectives. Other obstacles more unique to particular objectives are identified where these are known or suspected.

7.3.1 Group 1 Objectives

Objective 1: Protect Existing High Quality Environments

Purpose: To protect the best existing habitats recognizing these provide both refuge and production of native genetic stocks.

Rationale: Protection of existing high quality aquatic environments is one of the most essential components of this strategy. Protection implies careful land use in the watershed as well as implementation of in-channel measures to assure connectivity with downstream migratory corridors. The existing high quality aquatic habitats generally drain high elevation forested lands and some of the best of these are within designated wilderness areas. The protection of existing high quality environments (refugia) does not lead directly to significantly enhanced fish production but provides safer havens for locally threatened genetic stocks during stressful times (e.g., dry years). Objectives that stress fish production at lower elevations address fish production quantities, while this objective stresses qualitative aspects (e.g., gene pool) and provides insurance and resiliency for threatened/at-risk species and other species.

Proposed Actions: Actions identified with Objective 1 are directed at higher elevation forested areas where environmental and state forest impacts of development are minimal (e.g., designated Wilderness Areas and National and State Forest lands) and to other downstream reaches including major migration corridors, spawning and rearing areas affected by floodplain management.

Action 1A - Road/Trail Impact Management. Proposed forest road and trail related actions are listed below for forested headwater. Most of these lands are under public ownership.

- ❑ Road redesign/obliteration
- ❑ Culvert redesign/improvement
- ❑ Reduce road/trail densities
- ❑ Trail redesign/obliteration
- ❑ Harden stream crossings

Numerous specific road and trail improvements and road/trail density reduction programs are identified in watershed assessments prepared by USFS, DNR and private timber companies.

Action 1B - Watershed Headwaters Protection and Projects. A variety of other actions including stricter land use ordinances and enhancement projects have been identified for protection of headwater areas. Revision, implementation and enforcement of land use ordinances are needed to protect natural ecological systems within streams and riparian areas. County governments can focus resources on protection of all key habitat areas with special emphasis on headwater refugia connecting migration corridors and spawning/rearing habitats.

Projects will also be needed to enhance habitat and reduce habitat damage risks. The US Forest Service (USFS) and the State Department of Natural Resources (DNR) have identified numerous actions applicable to the headwater areas they manage. Most of these are designed to correct recreational impacts at selected upland sites or in riparian areas where timber harvest has occurred. Some relatively pristine areas have natural impediments to fish passage (e.g., American River Canyon) where needs for improvements have been identified in watershed assessments. Some lands have been logged near streams in these more pristine headwater areas. Remedial activities have also been identified in watershed assessments which address soil compaction (e.g., yarding sites) and revegetation needs, especially where timber has been removed near waterways. Large woody debris is needed at some sites because of past timber harvest activities. Actions include:

- ❑ Development Standards
- ❑ Revised Critical Area Ordinances
- ❑ Revised Shoreline Management Ordinances
- ❑ Enforcement Activities
- ❑ Volunteer Programs
- ❑ Riparian Area Revegetation
- ❑ Large Woody Debris Projects
- ❑ Stream Channel Improvements
- ❑ Soil Compaction Remediation
- ❑ Dispersed Recreation Management
- ❑ Off-Road Vehicle Control

Table 7-3
Implementation of Objective 1

Action	Proposed Agency Involvement [1]	Initial Implementation Resources [2]	Benefits	
			Short-Term	Long-Term
1A Road/Trail Impact Management	USFS DNR PTC	Medium		X
1B Watershed Headwaters Protection and Projects	USFS DNR PTC CNTY	Medium	X	X

(1) See List of Acronyms at beginning of document.
(2) Low – less than $100,000, Medium between $100,000 and $500,000, High greater than $500,000.

Implementation Considerations:

Potential obstacles to implementation of Objective 1 include:

- Remote nature of impact areas which need to be addressed as regards access and limited periods of time when improvements can be made due to snow pack and other climatic factors.
- Dispersed nature of the remedial measures required which prolong the implementation period and related pre-project planning and design.
- Economic impacts of reduced recreation and development potential.
- Political/ideological resistance due to conflicting ideas regarding enhancement goals in the Basin.
- Landowner resistance often arises due to financial limitations, but can often be alleviated through public education and outreach as well as financial incentives and compensation.

Objective 2: Protect and Enhance Anadromous Fish Migration Corridors

Purpose: This objective seeks to assure connectivity between the Yakima River mouth, tributaries and upper mainstem spawning areas.

Rationale: Protection of migratory fish species requires that spawning and rearing habitats are accessible and that suitable habitat condition exists along the migration corridor. Quality habitat conditions are necessary not only for adults moving upstream to spawn, and for rearing and migrating juveniles as they move downstream. The juvenile life stage requires suitable habitat away from the main river.

Proposed Actions: Migration corridor protection and enhancement actions include remedies dealing with flow, land use management, water quality, floodplain and riparian function, fish passage barriers and screening. Anadromous fish migration corridors are primarily affected by land development in floodplains, streamflows, water quality deficiencies, passage barriers and diversions. Streamflows may be too low, too high, too variable or have false attraction characteristics that confuse fish seeking spawning grounds. Poor water quality associated with low stream flow may have direct impacts affecting fish survival (e.g., lethal dissolved oxygen) or more subtle influences affecting growth or enhancing predator populations (e.g., temperature) or possibly reducing predator impacts (turbidity). Actions considered under this objective are identified in the following paragraphs.

Action 2A - Flow Related Actions. Actions considered important for migration corridors are primarily linked to flow and false attraction concerns. High flows and fluctuating flows are considered important for other life stages (e.g., egg, emerging fry, rearing of juveniles). Flow related actions identified for migration corridors include:

- Target Flow Development (e.g. minimum, maximum, pulsed flow)

- Flow Augmentation (e.g. water purchased, leased, or placed in trust from willing sellers)
- Stream Flow Enhancement Evaluation
- Increase Flow for Dewatered/Low Flow Reaches
- Management of False Attraction Flows
- Management and Evaluation of False Attraction Flow Impacts
- Channel Reconfiguration

Flow augmentation is currently being addressed in several parts of the basin, particularly where stream flows have been judged to be unacceptably low during critical times such as the fall migration period. These include the Teanaway River and Taneum Creek where enhancement programs are being implemented with the involvement of the Kittitas Reclamation District and others. Dry or seriously dewatered reaches exist in a number of subbasins, which need to be evaluated to determine feasibility of dry season stream flow enhancement. These include Ahtanum Creek, Manastash Creek and Wenas Creek. Some areas have been identified where rewatering or augmentation of flow-depleted streams through canal releases is probably feasible (i.e., Big Creek). These kinds of solutions involve complex water rights negotiations involving storage and natural flow priority dates. Other simple solutions may involve purchases, leases or the placement of water rights in trust from willing sellers.

False attraction flows are a complex issue that is interwoven with flow augmentation actions in some areas and with tailwater and canal operational spills in others. False attractions concerns will impact some flow related solutions, particularly those involving substitution of storage water for creek diversions. Some false attraction flow problems may justify physical exclusion of migratory fish from affected agricultural waterways (e.g., drains and wasteways), but only if the waterways are determined to be totally artificial. At present, fish are only excluded from canals and farm irrigation supplies by screening of diversions. Ultimately, operational spills will need to be controlled or eliminated to fully deal with false attraction. Eliminating the false attraction flows will also address associated migration delays that increase prespawning mortality.

Action 2B - Water Quality Actions. Problems affecting migratory fish passage that are associated with water quality are primarily in lower reaches of the mainstem Yakima River. Most of these migration related problems relate to water temperature. For example, the reach below Toppenish Creek to the river mouth experiences serious thermal pollution problems. Many water quality standards violations occur in the lower river. Agricultural return waters that have contributed sediment and associated pesticides and fertilizers to the lower mainstem are being improved through application of best management practices and ongoing TMDL efforts. Water quality related actions identified with adult fish passage, egg development and juvenile rearing in downstream reaches are:

- ❑ Continued TMDL Implementation
- ❑ Temperature Reduction Programs
- ❑ Pesticide Management Efforts
- ❑ Soil Erosion Controls
- ❑ Irrigation Water Management
- ❑ Nutrient Management
- ❑ Fertilizer Management
- ❑ Comply with Discharge Permits
- ❑ Address other 303d List Needs
- ❑ Monitor Water Quality
- ❑ Coordinate Water Quality Efforts
- ❑ Educate Water Users and Public re: Water Quality Needs and BMPs

The TMDL programs that are being implemented affect the Granger Drain and the Sulphur Creek Wasteway, while other improvement programs are associated with the Moxee Drain and activities within the Yakama Nation that impact tributaries such as the Marion Drains, Satus Creek and Toppenish Creek. Water temperature reductions require a variety of programs involving flow augmentation, shading of stream banks (where feasible) and agricultural practices that discourage tailwater warming and recharge to encourage cooler groundwater accretions to the drainage channels. Coordination of temperature controls will be needed along with extensive evaluations of what is possible and practical considering regional climate variations. This work will need to consider new and emerging water quality criteria approaches that differ from traditional single maximum temperature standards. Source controls of pesticides will need to continue with special emphasis on pesticides known to be present in the regions agricultural soils (e.g., DDT). Soil erosion controls will be stressed along with other non-point pollution clean-up efforts that encourage fertilizer management with attendant reductions in nitrate and phosphate into surface and ground waters. These fertilizer management approaches will continue to be linked with irrigation water management and soil conservation efforts.

Action 2C - Physical Passage Barrier Mitigation. These are major structures (i.e., diversion dams) within the mainstem of the Yakima and Naches River and numerous smaller structures, which can block fish passage in many of the lowland tributaries (e.g., Ahtanum Creek, Cowiche Creek, Wilson Creek). The diversion dams along the mainstem reaches have fish passage facilities, which are generally acceptable. Passage barriers exist at the major storage reservoirs (e.g., Cle Elum, Kachess, Keechelus, Rimrock, Bumping). Passage facilities are deficient at various locations when flows are low, particularly within lower reaches of tributary streams (e.g., Ahtanum Creek, Cowiche Creek). Diversion screening is an issue in many smaller tributaries (e.g., Wilson Creek, Cherry Creek, Reecer Creek, Swauk Creek, Ahtanum Creek, Wenas Creek, Snipes Creek, Spring Creek, Corral Creek). Screening facilities have been constructed for most mainstem diversions along the Yakima and Naches Rivers and in the Teanaway River system. Actions considered to improve fish passage along migratory corridors are:

- Evaluation of Culverts and Other Fish Passage Barriers
- Fish Screening Projects
- Fish Passage Facilities
- Fish Passage Structure Evaluations for Storage Reservoirs
- Efficiency Studies of Existing Fish Passage Structures
- False Attraction Flow Management
- Evaluations of Bull Trout Migration
- Channel Enhancement
- Barrier Removal

Tributary fish passage improvements and screens are actions that are needed to improve migration success. There are screening and fish passage projects being planned currently under Yakama Nation programs (e.g., Wilson Creek) and under a recent grant award from BPA to a consortium of Yakima Basin local, state and federal agencies (e.g., KCCD, KCWP, DFW, USBR).[6] Fish passage facilities are being evaluated under the Yakima Enhancement Projects for Cle Elum Reservoir. Additionally, the U.S. Bureau of Reclamation (USBR) is beginning an appraisal study on fish passage in 2002 for all five USBR dams, with a more detailed feasibility study scheduled for 2004. Existing fish passage structures will profit from periodic operational reviews to assure fish passage is efficient under all flow regimes. Fish exclusion is a controversial subject, which needs to be addressed in view of concerns over upstream migrants wandering into inhospitable reaches (e.g., Sulfur Creek Wasteway) where successful spawning is unlikely under present conditions. There are complex problems affecting bull trout migration from storage reservoirs during drawdown periods, which need to be carefully evaluated and corrected.

Action 2D - Regulate Land Uses Near Streams. Updating, coordinating and standardizing land use plans and ordinances to protect migratory corridors at the local, state, and federal level needs to occur so that there is uniformity of desired outcomes regarding land management in the basin. Existing state regulations and local ordinances such as hydraulic permitting requirements, other state permits, local zoning, shoreline management plans, flood hazard

[6] The BPA grant will cover a variety of projects including canal stream crossings and screening projects. The Kittitas County Conservation District (KCCD) and a group of canal companies and districts known as the Kittitas County Water Purveyors (KCWP) have obtained this grant in a joint project involving the State Department of Fish and Wildlife and the US Bureau of Reclamation.

management plans and critical areas ordinances are in place to regulate land use near streams. Some of the habitat aspects of flood hazard plans (e.g., Kittitas County) include alternatives to traditional flood control structures (e.g., rock barbs, drop structures) that can enhance fish habitat; riparian corridors are also mentioned as means to slow and store flood waters. County flood hazard plans (e.g., Benton County) also provide information on loss of fish habitat and identify specific spawning grounds and possible solutions to address lost habitat. However, coverage varies among documents developed within the three counties partly due to the different time frames; Shoreline plans are generally 20-30 years old whereas county flood hazard management plans were prepared within the past five years. Even the newer flood-related plans differ significantly. The Kittitas County flood hazard management plan briefly addresses habitat-related floodplain issues while the Benton County flood hazard management plan is more comprehensive on habitat issues. Changes to land use regulations in the basin should be implemented such that they remain consistent with the Yakima River watershed enhancement objectives. Specific actions implemented to regulate land use near streams need also to be consistent with existing regulations and watershed enhancement objectives. These actions include:

- Flood Hazard Planning/Coordination
- Uniform Regulations for Development
- Building Standards Uniformity
- Floodplain Filling Ordinance Amendments
- Reassessment of Floodplain Uses/Densities
- Reassessment of Floodway and Floodplain Mapping
- Density Bonuses/Transfers, Clustering Provisions
- Review Critical Areas Ordinances
- Wetlands Banking
- Review Shoreline Management Plans
- Conservation Easements
- Open Space/Tax Exemptions
- Financial Incentives for Habitat Development and Increasing Habitat Functions
- Regional HPA Approvals
- Regulation Enforcement
- Voluntary Remediation
- Financial Incentives (Grants and Cost-Share)
- Best Management Practices (e.g. improve livestock grazing management to minimize riparian impacts)
- Watershed-Wide Coordination Forum
- Watershed-Wide Water Management

The above actions require local planning agencies (counties, cities and state agencies) to carefully review their plans and policies considering habitat protection needs and their ESA implications. New or updated regulations will probably result from this process in part to achieve more consistency between jurisdictions. Plans, policies, guidelines and standards will need to be coordinated and revised with a view to achieving uniform outcomes and watershed-based goals throughout the basin. Agencies such as DOE and NRCS should be encouraged to support financial incentives (grants, cost-share programs) and encourage voluntary programs involving buffer strips, fencing and riparian area habitat protection.

A watershed focus is particularly important for the Yakima River system given the interdependencies of land use and habitat impacts. The upper-forested areas are a major source of clean water. This clean water needs to be protected as it moves through the system. Reservoir operations and land use activities (particularly within the agricultural and urbanized areas) influence the quality and flow regimes as well as in channel and riparian habitats important to aquatic life. The basin deserves coordinated water resource management that enhances habitat quality. Coordination should be effected through existing institutions (agencies and private entities). Management may need to consider special watershed forums such as exist elsewhere in the world for major river systems (e.g., Ohio River, Thomas River, Ruhr River).

Table 7-4
Implementation of Objective 2

Action	Proposed Agency Involvement(1)	Initial Implementation Resources(2)	Benefits	
			Short-Term	Long-Term
2A Flow Related Actions	USBR, Ecology, WDFW, SOAC	High	X	X
2B Water Quality Actions	Ecology, CD, ID, PPO,	High	X	X
2C Passage Barrier Improvements	USBR, PPO, ID, WDFW	High	X	X
2D Regulate Land Uses	CNTY, CITY Ecology, NRCS, USFS, DNR	Medium		X

(1) See List of Acronyms at beginning of document.
(2) Low – less than $100,000, Medium between $100,000 and $500,000, High greater than $500,000.

Implementation Considerations: Potential obstacles to implementation are many because many of the proposed actions require changes to intra- and inter-jurisdiction/agency coordination and implementation of existing land regulations and water management, especially as they relate to floodplains, stream flows and barriers. It is also necessary that responsible regulatory entities consistently apply and enforce regulations, which in turn requires funding, public outreach, and education. Water quality actions have more continuity with ongoing programs such as TMDL efforts in the lower Yakima

River areas. However, water temperature reductions will require significant resources and criteria influencing water temperature management are currently in a state of flux. Target flows do not yet exist and consensus on these is likely to require considerable time and study. Screening is expensive but appears to be receiving more funding support (e.g., recent BPA grant).

Land use in the floodplain and riparian area has impact on side channel rearing (i.e., access to old floodway channels) and riparian shade along river banks. Generally, large trees are discouraged in levee banks and most armored reaches have few trees that can contribute to woody debris as they fall on the wrong side of the dike. Off-channel rearing, natural hyporheic function, sediment storage and other floodplain functions are probably the more compelling reasons for regulating and restoring this zone. Rearing habitat enhancement will require a combination of stricter floodplain regulation and site-specific enhancement projects such as those identified under Objective 3 (Action 3B) to ensure properly functioning floodplain conditions exist in the Basin.

Objective 3: Enhance Downstream Reaches and Connect Associated Floodplains in Tributary and Mainstem Reaches

Purpose: Maximize fish propagation and rearing in mainstem reaches, which are known to provide a high percentage of the anadromous fish production in the basin.

Rationale: Although existing high quality habitats generally are found at higher elevations in the watershed, valuable spawning and rearing habitat is found for salmon (e.g., spring chinook) at lower elevations. Fish production evaluations have identified the upper Yakima River mainstem and the Naches River mainstem as highly productive reaches with a significant proportion of the fish production potential in the Yakima Watershed. These studies include the BPA subbasin plan and related evaluations carried out by the Yakama Nation using the Ecosystem Diagnosis and Treatment model. Mainstem Yakima River reaches between Ellensburg and Keechelus Dam were among the most productive for spring chinook; high productivity was also associated with the Naches River. it stresses enhancement of migration corridors (Guiding Principle 1) which are generally damaged in the lower reaches and to floodplain connectivity, an important factor for rearing juveniles. Water quality improvements are also an important fish migration consideration, particularly in the lower reaches of the mainstem. These lower mainstem areas are important for migrating chinook and coho salmon and steelhead and important for fall chinook spawning.

Proposed Actions: Actions identified under Objective 3 are numerous and varied. Categories of actions include in-stream flow management, floodplain and other off-channel connectivity efforts, water quality enhancement, riparian corridor improvements, in-channel complexity enhancement and other activities involving predator management, spawning substrates and fish passage. These necessarily include some actions identified for other objectives.

Action 3A - Improve In-Stream Flow Management. Improvement of in-stream flow regimes is an identified need for many parts of the Yakima Basin. Solutions involve a variety of actions that are highly specific to individual river reaches and selected tributaries. Possible actions include:

- ❑ Flow Augmentation in the Naches River (Wapatox Powerplant Reach), Lower Teanaway River, Lower Taneum Creek, and Lower Big Creek
- ❑ Flow Fluctuation Management below Storage Dams
- ❑ Evaluation of Flow Management Options for Lower Manastash Creek, Lower Wenas Creek, and Tieton River
- ❑ Flow Augmentation for Lower Ahtanum Creek, Lower Yakima River (Chandler Powerplant Reach), and below Prosser.
- ❑ Purchase, Lease or Place Water Rights in Trust (Willing Seller)
- ❑ Evaluate Hydrograph Alterations (and Mitigate)
- ❑ Evaluation of Instream Flow as Related to Floodplain Function

Some of these actions are being worked on by others (e.g., Kittitas Reclamation District re: flow augmentation of Manastash and Taneum Creeks) or are identified in action lists proposed by others (e.g., Yakima Basin Water Investment Action Agenda re: Wapatox Power Plant buyout). Some reflect needs identified by regulatory agencies (e.g., DOE 303d lists). Some require side channel storage in tributaries that will require careful study and may be costly relative to fish benefits (e.g., Manastash Creek, Wenas Creek) whereas others appear to have more cost effective solutions (e.g., Big Creek, Taneum Creek flow augmentation and water leases). Water may need to be obtained from purchase of water rights from willing sellers in some cases. In others, storage water may be transferred in canals and released at appropriate locations in tributaries without adverse flow impacts to the mainstem during the irrigation season. Water right issues such as priority dates of natural flow vs. storage water will need to be resolved.

Action 3B - Improve Off-Channel Connectivity. Juvenile fish rearing habitat is an identified limiting habitat factor, particularly along the mainstem Yakima River and lower Naches River where highways and levees restrict floodplain access. Actions to improve off-channel connectivity include:

- ❑ Evaluate site specific access problems along highways, dikes and railroads

- Reconnect floodplain channels (e.g., dike breaching or with culverts)
- Develop access to gravel quarries along the mainstem
- Enhance off channel rearing habitat near mouths of creeks in canyon areas
- Regulate floodplain land uses.

Culverts along highways are correctable, critical areas and shorelines ordinances and plans can be updated, and floodplains can be reconnected in certain areas. Concerns exist regarding flood control and enhancing rearing opportunity in the Yakima canyon.

Opportunities exist to carry out these actions but there are geographic limitations for each. There are specific highway culverts that block access to tributaries (e.g., Tucker Creek) which are correctable. Regulations within floodways should be reviewed considering ESA listings as shoreline management plans, critical areas ordinance and some of the county flood hazard plans predate listings. Reconnection of floodway areas may involve relocation of levees to protect property or buy out programs. Gravel quarry access has been accomplished for some areas where ponds are very near the river (e.g., Gladmar Park near Thorp) but more complexity is needed for these lakes to provide refuge for juveniles. Rearing opportunities may exist in the Yakima Canyon and can be improved with enhancement projects on Lmuma Creek and other tributaries, which flow into this highly channelized reach.

Action 3C - Water Quality Enhancement. The focus of water quality improvements for this objective is related to the quality of lower elevation reaches such as the lower Yakima River mainstem where water quality can be a limiting factor for fish production. Needed actions pertain to several water quality factors as identified below:

- Water Temperature Improvements in Lower Mainstem Reach
- Turbidity/Sediment Controls in Lower Mainstem Reach
- Pesticide Controls for Mainstem Reaches

The improvements needed are inter-related in that turbidity/sediment controls such as are being implemented under ongoing TMDL programs for several drains and wasteways (e.g., Moxee Drain, Granger Drain, Sulphur Creek Wasteway) and Spring and Snipes Creeks are reducing volume of warm tailwater discharges and reducing pesticide loadings associated with sediments. Actions under this category are ongoing and expected to continue to be needed for the foreseeable future.

Action 3D - Riparian Area Improvements. Improvements along riparian areas are important to help lower summer water temperatures, decrease bank erosion, increase channel stability, and decrease channel migration and increase instream structure all of which help natural habitat development. Activity under this category affect actions dealing with water quality and action dealing with large, woody debris and pool/riffle development (Action Category 3E). Possible actions for riparian area improvements in lower elevation reaches include:

- ❑ Road and Culvert Redesign/Relocations
- ❑ Livestock Fencing and Other Grazing Management Programs
- ❑ Riparian Buffer Management (e.g. revegetation and fencing programs)
- ❑ Revegetation Programs
- ❑ Timber Harvest Management in Riparian Zones
- ❑ Protecting Springs
- ❑ Protecting and enhancing Hyporheic Functions
- ❑ Streambank Stabilization

Many of these actions are being implemented through regulation of forest practices and voluntary actions by landowners with frontage on major waterways. This category necessarily involves numerous site specific actions by diverse private property owners and public land managers.

Action 3E - In-Channel Complexity Actions. Enhancement of in-stream complexity involves a variety of processes some of which are covered in previously described action categories (e.g., off-channel connectivity efforts and riparian corridor improvements). A fundamental aspect of channel complexity involves establishment of pools and riffles usually accomplished naturally by presence of large rocks and large woody debris (LWD). Highly channelized reaches of the river exist where complexity is diminished because of sustained high stream flows, reduction of woody debris recruitment due to past timber harvest in riparian areas and the presence of dams, highways and levees. LWD recruitment implies a need for a natural supply as well as the flow regime to distribute it. Barriers are a related concern when LWD cannot move down river (e.g., Prosser Dam). Possible in-channel complexity actions include:

- ❑ Engineered Log Jams
- ❑ Root Wads and Other LWD Project
- ❑ Encouragement of Braided Channels
- ❑ Rock Barb Installation
- ❑ Channel Condition Enhancement
- ❑ Pool Development
- ❑ Riparian Area Buffer Evaluations
- ❑ Evaluations of LWD Recruitment and Transport

Opportunities for in-channel complexity enhancement are limited in some of the river reaches due to high flows through highly channelized reaches;

however, lower mainstem areas may offer significant opportunities where flows are lower. For example, old oxbows may be reconnected and woody debris could be relocated into areas which historically would have had large trees washed down from the upper watershed. Woody debris projects would necessarily be better suited for these off-channel areas where high velocity flows are less likely to occur. Highways and levees block off vegetated riparian areas reducing LWD recruitment. These barriers need to be evaluated to determine if mitigation is warranted.

Action 3F - Other Improvements. Downstream reaches are generally warmer and experience more significant predation problems (e.g., small mouth bass and catfish and the native Northern Pikeminnow). Other concerns include accumulations of sediment in lower mainstem areas which reduce the spawning potential for species utilizing the lower reaches (e.g., Fall chinook). As TMDL efforts reduce sediment sources it may be feasible to enhance spawning through establishment or enhancement of spawning areas (in-channel or off-channel). Other concerns arise over fish passage at structures or dams along the lower elevation reaches, particularly in selected tributaries (e.g., Ahtanum Creek, Wilson Creek). Passage projects and related fish screening at diversions are needed in a variety of waterways, some of which are particularly important during low flow periods. Possible actions include:

- ❑ Northern Pikeminnow Controls
- ❑ Exotic Species Control Programs
- ❑ Changes in Harvest Regulations
- ❑ In-channel Spawning Area Enhancement
- ❑ Off-channel Spawning Area Development

Table 7-5
Implementation of Objective 3

Action	Proposed Agency Involvement(1)	Initial Implementation Resources(2)	Benefits Short-Term	Benefits Long-Term
3A Improve In-Stream Flow Management	USBR, SOAC, DOE	High	X	X
3B Improve Off-Channel Connectivity	DOT, WDFW, CNTY, CD, PPO, Other	Medium	X	X
3C Water Quality Enhancement	DOE, EPA, CD, ID, PPO, USGS, USFS, DNR	High	X	X
3D Riparian Area Improvement	PPO, USFS, DNR, CD, WDFW, CNTY Other	Medium		X
3E In-Channel Complexity Actions	WDFW, CD, CNTY, Other	High	X	X
3F Other Improvements	WDFW, PPO, ID	High	X	X

(1) See List of Acronyms at beginning of document.
(2) Low – less than $100,000, Medium between $100,000 and $500,000, High greater than $500,000.

Implementation Considerations: Actions identified under Objective 3 include a wide variety of possible project categories and special programs some of which (e.g., instream flow) are identified under other objectives. Most of the actions under Objective 3 involve high resource commitments and have major long-term benefits. Some are less likely to have major short-term benefits because time is required for measures (such as revegetation) to take full effect.

Impediments to implementation include those cited for Objective 2 particularly as related to instream flow. Actions involving enhancement of floodplain connectivity are potentially controversial particularly where risks of flooding may increase or major highway relocation is involved. A better understanding of in-channel complexity may be required for enhancement in some areas as proposed actions may reduce channel capacity causing increased flood risk, particularly where LWD projects occur in developed areas.

Objective 4: Prioritize Enhancement of Degraded Aquatic Habitats that are Still Functional

Purpose: To enhance slightly degraded habitats that have a high probability of being productive.

Rationale: This objective is based on the premise that recovery is possible for slightly damaged or "at risk" systems whereas enhancement of non-functional or highly degraded habitats requires dramatically increased effort, cost and recovery time (USDA, USDI, 1998). Enhancement of highly-degraded systems should be reserved for those situations where a system has improved to a point where recovery is possible, whether through natural healing, (e.g., revegetation) pollution prevention or other intervention approaches. Enhancement is important where improvement of degraded habitats will have major beneficial effects for the system, i.e., outside of the immediate project area. These reasons are further explained in the rationale for Guiding Principle 1.

Proposed Actions: Enhance Damaged Habitats. This objective necessarily covers an extensive range of actions since habitat damage has many causes. These involve the same action categories identified with Objective 3 except these extend farther up the watershed beyond the main lowland migration corridors. Objective 4 enhancement also extends to bull trout habitat which in some areas is upstream from major storage reservoirs which currently block fish migration. Thus the categories of actions proposed are similar and have similar rationale, but the resources and benefits are somewhat different, particularly as related to enhancement of higher elevation water bodies which can include the placement of large woody debris and creating pool habitat in the main channel of smaller streams.

The summary table provides an overview of these actions with footnotes where activities are significantly different from those identified for Objective 3.

Table 7-6
Implementation of Objective 4

Action	Proposed Agency Involvement [(1)]	Initial Implementation Resources[(2)]	Benefits	
			Short-Term	Long-Term
4A Improve In-Stream Flow Management	USBR, SOAC	High	X	X
4B Improve Off-Channel Connectivity	DOT, CNTY, PPO, Other	High	X	X
4C Water Quality Enhancement	DOE, CD, ID, PPO	High		X
4D Riparian Area Improvement	PPO, USFS, DNR, CD, WDFW, CNTY, Other	High		X
4E In-Channel Complexity Actions	WDFW, CD, CNTY, Other	High	X	X
4D Other Improvements	WDFW, PPO, ID	High	X	X

(1) See List of Acronyms at beginning of document.
(2) Low – less than $100,000, Medium between $100,000 and $500,000, High greater than $500,000.

Implementation Considerations: The same actions identified in Objective 3 pertain to Objective 4. These are summarized in Table 4 and have essentially the same or high benefits to those under Objective 3. Differences are primarily related to scope as Objective 4 actions extend higher in the watershed and include actions for Bull Trout upstream of the major storage reservoirs. Accordingly, costs are significant and probably somewhat higher for Objective 4 than for Objective 3.

Obstacles to implementation are essentially the same as those previously identified under Objective 3 actions. Both Objectives 3 and 4 have actions that require major decisions or consensus on significant issues such as instream flow management, access to floodplains, riparian area improvements and in-channel projects potentially affecting flood flows.

Objective 5: Protect Existing Habitat Conditions from Further Degradation

Purpose: To prevent degradation of habitats in all waterways and prevent further unnatural alterations to hydrograph. Allow enhancement through natural processes and improve water quality.

Rationale: Damaged waterways should not be allowed to deteriorate further. This objective extends to in-stream and riparian habitats and the flow hydrograph. Natural healing processes will eventually improve some habitats providing future opportunities for more concerted habitat improvements.

Proposed Actions: Proposed actions include land use management, managing water use and improving water quality. For land use management, regulations, development standards and policies of agencies with land use regulation authority need to be upgraded to be consistent across the watershed and to address ESA listings of steelhead and bulltrout. Water use management can be evaluated to better understand how current management actions impact habitat. For water quality, continued emphasis is needed to manage non-point pollution while recognizing that some point source pollution issues remain to be addressed in the watershed plan implementation phases.

Action 5A - Regulate Land Uses. Refer to Action 2D.

Action 5B - Evaluate and Regulate Water Use Impacts. Water use is regulated by a variety of methods including water rights, water pollution control and water supply. Although the existing regulatory framework is extensive there are aspects of water management, which need to be better understood and require more informed guidance or regulation. These range from groundwater pumping impacts on hyporheic functions including nutrient and temperature implications for affected surface waters to hydrograph shifts, alterations or fluctuations that diverge from what is considered "normal" or desirable for fish. Impacts of some of these interactions are unclear and warrant further study. Actions include:

- ❑ Reservoir Storage Impacts on Water Quality
- ❑ Reservoir Release Impacts on Habitats
- ❑ Reservoir Level Fluctuation Impacts on Bull Trout Migration
- ❑ Regulation of Shallow Groundwater Pumping Impacts on Surface Water
- ❑ Regulation of Reservoir Release Impacts on Hydrograph

Action 5C - Improve Water Quality with a Focus on Non-Point Pollution. This includes the following actions:

- ❑ Prevent and Mitigate Forest Practices Impacts
- ❑ Prevent and Mitigate Agricultural Impacts
- ❑ Prevent and Mitigate Urban Development Impacts
- ❑ Prevent and Mitigate Resource Extraction Impacts
- ❑ Prevent and Mitigate Municipal/Industrial Impacts
- ❑ Prevent and Mitigate Recreational Impacts
- ❑ Prevent and Mitigate Transportation Impacts
- ❑ Prevent and Mitigate Water Resources Management Impacts
- ❑ Prevent and Mitigate Fish Management Impacts

All of the use-based impacts cited above have a non-point pollution aspect and some (i.e., municipal/industrial) have point source aspects as well (e.g., wastewater treatment facility discharges). The non-point pollution concerns vary widely among these use-based categories although some share specific water quality concerns such as soil erosion, a problem often associated with timber harvest, irrigation and urban development. Some of the uses have unique problems such as spills (transportation impact) or fish hatchery impacts, one of many fish management challenges. Some of these use-based concerns go beyond water quality yet affect habitat quality and threatened fish population. Highways and flood control levees affect stream corridors reducing floodplain functions and off-channel rearing. Water resource operations affect streamflows and fish passage both positively and negatively, and may create barriers. All of these use-based activities contribute to non-point pollution and/or habitat alteration. However, best management practices are identified to prevent or mitigate most of the known impacts.

Table 7-7
Implementation of Objective 5

Action	Proposed Agency Involvement[1]	Initial Implementation Resources[2]	Benefits	
			Short-Term	Long-Term
5A Regulate Land Use	CNTY, CITIES, DOE, NRCS, USFS, DNR	Medium		X
5B Evaluate/Regulate Water Use Impacts	DOE, USBR	High		X
5C Focus on Non-Point Pollution	TCWRA, WDFW, DOE, USFS, DNR, CD, WCC, CNTY	Medium	X	X

(1) See List of Acronyms at beginning of document.
(2) Low – less than $100,000, Medium between $100,000 and $500,000, High greater than $500,000.

7.3.2 Group 2 Objectives

The following three objectives have been identified for implementation, in concert with the Group 1 objectives. These objectives are different from the previous five objectives in that they more programmatic in nature, relating to improved information, performance measurement and performance standards. Also these objectives are not listed in order of priority.

Objective: Improve Watershed-Wide Information Base

Purpose: Improve understanding of causal mechanisms, problems and effectiveness of solutions. Ongoing habitat assessments are needed to improve information base on identified high quality and degraded habitats. This can strengthen the foundation for an adaptive management program where an expanding and refined information base supports improved habitat enhancement and protection activities, and evaluation of implementation results.

Rationale: Habitat condition definitions need to be better linked to watershed conditions considering the variety of ecosystems in the watershed. Criteria are unclear for some habitat factors (e.g., large woody debris) and would benefit from local habitat assessments by trained professionals that can better assess fish production potential of various streams and river reaches. Baseline conditions need to be better established for future reference. Some areas of the watershed have been surveyed (e.g., streams within US Forest Service jurisdiction) but others are less well understood. Different criteria pertaining to "properly functioning condition," (PFC) judgments need to be evaluated as part of local habitat assessment so agencies performing these assessments use similar approaches and criteria.[7]

Proposed Actions: The actions proposed under this objective include habitat assessments that involve evaluations of physical, biological and water quality conditions within streams and rivers and along their riparian corridors and adjacent floodplains. This objective includes monitoring activities to help define problems to determine cause and affect relationships and to evaluate success of watershed plan implementation.

Action: Assess Habitat Condition. This group of actions is focused on problem identification, causes and effects. Actions include:

- ❑ Survey Stream/River Reaches
- ❑ Habitat Assessments
- ❑ Identify Needs re Life Stages
- ❑ Evaluate Production Potential
- ❑ Assess and Verify Causal Mechanisms
- ❑ Project Effects of Enhancement
- ❑ Educate Public about Habitat Conditions

These actions are diagnostic in nature and are the kinds of assessments that are needed early in the implementation stage. The information gathered will help fine tune future implementation measures.

Action: Monitor Aquatic Habitats. This action group includes implementation of periodic monitoring activities covering water quality and habitat conditions. These activities include assessment of success of a variety of implementation measures as well as fulfilling more generalized monitoring needs to determine compliance with water quality standards, permit conditions or TMDL goals. Actions include:

- ❑ Water Quality Monitoring
- ❑ Habitat Condition Monitoring
- ❑ Fish Production Evaluations
- ❑ Fish Passage Facility Monitoring
- ❑ Spawning Surveys
- ❑ Waste Discharge Monitoring
- ❑ Evaluations of Project Success
- ❑ Inform Public of Habitat Quality

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[7] USFS watershed assessments in the Naches River Watershed have identified PFC criteria conflicts between National Forest Plan and NMFS PFC criteria.

Table 7-8
Implementation of Objective – Improve Information Base

Action	Proposed Agency Involvement [1]	Initial Implementation Resources[2]	Benefits	
			Short-Term	Long-Term
10A Habitat Assessment	WDFW, USBR, SOAC, WCC, CD, ID, USFS, DNR, USGS, DOE	Medium	X	X
10B Monitor Aquatic Habitats	WDFW, USBR, SOAC, WCC, CD, ID, USFS, DNR, USGS, DOE	Medium	X	X

(1) See List of Acronyms at beginning of document.
(2) Low – less than $100,000, Medium between $100,000 and $500,000, High greater than $500,000.

Implementation Considerations: This objective deals with information rather than on-the-ground improvements. However, the habitat related surveys identified are important to both prioritization of actions and to assessment of success or failure. The actions involve professional staff, primarily fishery biologists with agencies or private consultants/universities that may be involved through agency contracts. Although their role may be limited, local governments are also involved in this process through the State shoreline regulations. Table 7-XX above summarizes agency involvement resource heads and impacts.

Objective: Focus on Habitat Condition to Measure the Effectiveness of Habitat Enhancement Actions

Purpose: Evaluating results for habitat enhancement and protection are a primary focus for measuring effectiveness of local watershed actions rather than fish production or spawning escapement statistics.

Rationale: There are many factors which affect anadromous fish production in the Yakima River watershed that can not be addressed by local planning efforts.. These include ocean conditions, survival in the mainstem Columbia River and its estuary, and most harvest activities. Therefore, improvement in the design and prioritization of habitat actions is needed so that habitat conditions in the Yakima basin will be suitable for returning fish and their offspring during times when downstream conditions allow significant spawners to reach the Yakima River mouth. Population trends in fish production and spawner escapement, in and out of the basin, will be monitored by others. Trends will be helpful in assessing and validating the success of protection and enhancement efforts.

Proposed Actions: Objective 2 provides direction for the habitat enhancement management framework. This strategic component has several aspects as illustrated by specific actions discussed below.

Action: Focus on Habitat Condition. The actions listed under this part of the strategy provide guidelines for habitat enhancement. Actions under other objectives are designed to help organize and prioritize future planning, implementation, monitoring and adaptive management. The proposal actions under Objective 2 are:

- ❑ Evaluate Ways to Protect High Quality Habitat, Enhance "At Risk" Habitat, and Eliminate Habitat Bottlenecks
- ❑ Prioritize Most Cost Effective Actions
- ❑ Prioritize Mainstem Migration Corridors
- ❑ Improve Water Quality to Benefit Habitats
- ❑ Develop Adaptive Management Approaches Based on Accepted Monitoring Strategies/Methods
- ❑ Participate in Larger Regional Planning Efforts

Objective 2 actions provide information and guidance. All of the other objectives are affected by these efforts. Staff resources from various responsible agencies should be utilized in assessing fines, coordinating and directing the habitat enhancement effort. Accordingly resources needed for coordination and management of the watershed plan implementation phases are identified with the Focus on Habitat Condition Objective as shown in the summary table.

Screening Consideration: Objective 2 is designed to improve design and prioritization of implementation actions. It is a guidance-related objective that provides for analysis and evaluation of actions for preplanning and adaptive management. Resource commitments are primarily to staff selected agencies with lead roles.

Obstacles to Objective 2 are primarily related to budget appropriations and staff assignments but also include methodology limitations since understanding is not yet perfected for some aquatic habitat enhancement needs. Time will be required to translate new information and adaptive management into revised action programs.

Table 7-9
Implementation of Objective – Measure Habitat Condition

Action	Proposed Agency Involvement (1)	Initial Implementation Resources(2)	Benefits Short-Term	Long-Term
6A Focus on Habitat Condition	TCWA, WDFW, DOE, USFS, DNR, CD, WCC	Medium	X	X

(1) See List of Acronyms at beginning of document.
(2) Low – less than $100,000, Medium between $100,000 and $500,000, High greater than $500,000.

Objective: Ensure Water Quality and Habitat Standards Reflect Natural Regional Conditions

Purpose: This objective seeks to improve criteria and standards applied to the Yakima Basin in order to provide better evaluation and rationale for enhancement efforts

Rationale: This objective stresses that water quality criteria are consistent with natural conditions in the watershed, especially as related to climatological factors which affect streamflows and riparian vegetation. It is recognized that stream flow has been altered by water resource projects (e.g., storage reservoir releases and water supply diversions) and that riparian areas have been significantly altered by timber harvest, floodplain developments, reservoir releases, irrigation development and other factors. Natural factors such as climate, physical flow processes in the watershed and historical vegetative cover need to be considered in assessing natural background conditions as related to water quality conditions such as water temperature and turbidity as well as amounts of large woody debris and riparian shade.[8] Historic fish distributions need to be better understood considering historic hydrology (e.g., prior to irrigation development).

Proposed Actions: Actions identified under this objective are considered necessary for fine tuning the watershed planning and are useful in obtaining broader public support. The questions asked in this objective need to be addressed and the watershed planning phase provides a forum to encourage these actions. The actions themselves involve the regulatory and resource agencies that have responsibility for these topics.

Action: Improve Information and Criteria. Actions identified cover diverse topics all of which have been identified as information needs or criteria concerns. Criteria should be refined after analyzing new data and knowledge. Actions identified under this objective include:

- ❑ Evaluate Climate-Based Temperature Criteria
- ❑ Determine Background Turbidity Levels

[8] For example, the Lewis and Clark Journals from October 1805 report that there were essential no woody plants near the Yakima River mouth and that local tribes used salmon carcasses for fuel.

- ❑ Evaluate Historic Fish Distributions
- ❑ Resolve Woody Debris Criteria Differences
- ❑ Assess Natural Vegetation Distributions
- ❑ Reach Consensus on Target Flows
- ❑ Assess Food Web/Nutrient Needs
- ❑ Evaluate Sediment and Bedload Dynamics
- ❑ Determine Groundwater/Surface water Interactions

Many of these topics are research topics that should be encouraged by the watershed plan. The list of information needs is expected to grow as the planning proceeds.

Table 7-10
Implementation of Objective – Standards Reflect Natural Conditions

Action	Proposed Agency Involvement (1)	Initial Implementation Resources	Benefits	
			Short-Term	Long-Term
9A Improve Information and Criteria	DOE, WDFW, USFS, DNR, USBR, USGS, NCC, CD	Medium	X	X

(1) See List of Acronyms at beginning of document.
(2) Low – less than $100,000, Medium between $100,000 and $500,000, High greater than $500,000.

7.4 Implementation Framework for Habitat Strategy

As mentioned in the introduction, it is expected that the recommended approaches and priorities outlined in this Habitat Protection and Enhancement section of the Environmental Enhancement Program will be a primary input and information consideration for a) the Yakima Basin Lead Entity for allocating state salmon recovery funding and b) for local and state agencies with regulatory and non-regulatory implementation responsibilities.

7.4.1 Integrating Habitat Protection and Enhancement Framework with State and Federal Salmon Recovery Processes

This section, combined with the habitat assessment, the Washington Conservation Commission's Limiting Factors Analysis (2001) and other planning efforts underway in the basin, provide the foundation for habitat enhancement strategies in the Basin. It is anticipated that strategy implementation will occur in several different ways, including: a) planning and funding specific habitat projects through the Yakima Lead Entity and State Salmon Recovery Board (a.ka. ESHB 2496) process; b) developing ESA compliance strategies (Habitat Conservation Plans, Section 4(d) Programs; Section 7 consultation and biological assessments); c) NWPPC/BPA salmon recovery planning and implementation; and, d) regulatory and management actions to be implemented by local and State agencies. This section focuses on items (a) and (d): the state and local government responsibilities for habitat protection and enhancement.

Salmon Recovery Planning

A local Lead Entity for salmon recovery has been established in the Yakima Basin as prescribed in the State's Salmon Recovery Act (2496). A citizens' advisory committee and technical advisory committee have also been established under the Yakima Lead Entity. The citizens advisory committee reviews and recommends projects to the Lead Entity, which then forwards a prioritized list of recommended projects to the State's Salmon Recovery Fund Board (SRFB) for funding consideration. The technical advisory committee provides technical review on projects and provides this input to the citizens' advisory committee and the Lead Entity.

The SRFB has provided lead entities with guidance and criteria for project identification and prioritization, and developing habitat enhancement strategies (July 2001). This includes project eligibility criteria, eligible applicants, matching requirements and other criteria and guidance.

The Planning Unit recommends the Yakima Lead Entity add a criterion to those outlined by the SRFB that can give a project a higher local ranking if it is consistent with the protection and management framework outlined in this plan and any other regional plans the Yakima Lead Entity has identified as important. This is one way to more formally link the 2496 process with the watershed plan. Another possible way to strengthen this linkage is to add to the project application form a place for the project proponent to explain how the project is consistent with the Habitat Protection and Enhancement framework in the watershed plan.

The citizens committee, the technical advisory committee and the Yakima Lead Entity would then review and award points as appropriate to projects in light of the proposed implementation framework outlined in this plan and criteria from other plans, studies and methodologies, such as Ecosystem Diagnosis and Treatment, Limiting Habitat Factors Analysis and the Lead Entity Salmon Recovery Plan. For instance, higher priority might be given to a project that protects or enhances Group 1 or 2 water bodies from Table 7-1 (e.g. Rattlesnake Creek) over a Group 4 or 5 water body (e.g. Wilson Creek). It is recognized that there are other factors that are also considered in evaluating and ranking projects, such as overall project benefit, readiness to proceed, overall project cost, and level of matching funding. The implementation framework is intended to be used as a general guide and input to the project review and prioritization process.

7.4.2 Review and Update State and Local Regulatory and Non-Regulatory Programs as Appropriate

In addition to the Salmon Recovery process, State and local agencies should review the information provided in the Habitat framework to determine how to incorporate the guiding principles, objectives and actions into existing regulatory and non-regulatory responsibilities. Each regulatory and non-regulatory program has certain governing policies, plans and procedures that could be reviewed and updated where appropriate to ensure consistency with recommended habitat enhancement and protection actions.

Because the basin encompasses several different local government political boundaries, an important part of this review and update to programmatic documents will be to coordinate efforts between state and local government, and among local agencies. The goal is to have as much consistency as possible applied across the basin, regardless of which agency is administering a program.

A description of some of the primary regulatory programs to be reviewed and updated by local and state agencies is provided below. For additional information on local and state regulatory and non-regulatory programs involving habitat protection and enhancement, see Tables 6-44 and 6-45 in the Watershed Assessment document.

Local Programs

City and County governments should review comprehensive land use plans and zoning, critical areas ordinances, shoreline master programs, SEPA procedures, flood management programs, development standards, and stormwater management programs. A key point emphasized in the Habitat strategy is to ensure consistency in protective measures and standards for local government programs. A regional task force might be established for one or more topic areas, such as critical areas ordinances or shorelines master plans, to review and compare existing documents and make recommendations for improved consistency and protective measures.

An example of how the regional task force concept might work is where County Commissions authorize and direct Benton, Kittitas and Yakima County Planning Departments to lead a regional effort to establish common protection standards for fish and wildlife habitat areas and frequently flooded areas (Critical Areas), and Shoreline and Floodplain management programs. The county planning departments work with City planning agencies and the Yakima Regional Council of Governments (provides planning services for several smaller communities) to establish a task force(s) to address each program. The task force would scope out and define areas to be addressed consistent with the adopted plan and other relevant documents (e.g. state guidance on Best Available Science for critical areas) and develop common protection standards and protection approaches for jurisdictions to adopt into their individual ordinances, code and plans. A similar regional approach could be applied to stormwater management and other relevant programs.

For local government non-regulatory programs, the managers of these various programs within the basin (primarily managed and implemented by conservation districts) could meet to review how to apply the habitat strategy in pursuing additional funding for habitat enhancement and related programs (e.g. education), and whether a regional approach based upon the strategy might be able to leverage additional funding into the basin.

State Programs

Washington Department of Ecology should review relevant plans, policies and procedures for its regional responsibilities, including point and non-point source water quality programs/regulations, wetlands protection programs, water resources management actions and oversight of County and City shoreline master programs. As instream flow was not included as a formal planning component of the watershed plan, Ecology also has responsibility for setting instream flows in the basin, and will need to establish a path forward for determining where and how flows should be established in the basin. Defining a strategy for setting instream flows will require close coordination with USBR, and will also involve other federal agencies such as NMFS and USFW, and local water resource management agencies and water right holders. See Section 3 for additional information on this topic.

Washington Department of Fish and Wildlife would review its hydraulic permitting process and its other fish and habitat management and monitoring programs for consistency with the management framework, recognizing much of the protection and enhancement actions are already built into the agency’s policies and through oversight of federal regulatory agencies such as NMFS.

Washington Department of Natural Resources would review its policies and procedures for aquatic use permitting and forest practices management, as well as policies and procedures for managing agency land holdings within the basin.

The state caucus established to provide state agency input during watershed plan development is a logical forum for coordinating state agency regulatory and non-regulatory program reviews and recommending any suggested changes to make these programs more consistent with the habitat strategy.

Section IV

Implementation

Section IV of this Watershed Plan contains just one chapter, which addresses implementation of the actions previously described in Sections II and III.

Chapter 8

Implementation

Chapter 8 Implementation

The purpose of this section is to provide a summary, integrated road map for organizing efforts and implementing the actions and strategies recommended in individual chapters of the plan. Members of the Planning Unit expect that local and state agencies will review the plan and assume responsibility for recommended actions by incorporating these into agency work plans, and through establishing cooperative agreements where appropriate. It is hoped that federal agencies and the Yakama Nation will also consider the actions and objectives of this plan, and assist as appropriate.

The Planning Unit accepts that any strategies, actions, obligations or potential obligations assigned to local, state or federal agencies, and tribes if they participate in plan implementation in the future are directly associated with securing necessary funding, resources, and legislative authorizations where required, and are subject to applicable rules and regulations, the Administrative Procedures Act and SEPA and NEPA requirements.

It is also anticipated that this plan will help to better integrate and focus existing resources and lead to the dedication of additional state and federal resources within the Basin for recommended actions.

Information is organized into seven sections:

- 8.1 - Plan Adoption Process and Commitments for Implementation
- 8.2 - Overview of Implementation Framework
- 8.3 - Organizing and Coordinating Plan Implementation
- 8.4 - Implementing Resource Management Actions
- 8.5 - Future Data Needs And Adaptive Management
- 8.6 - Annual Plan Review and Future Plan Amendments, and,
- 8.7 - Public Involvement During Plan Implementation.

8.1 Plan Adoption Process and Commitments for Implementation

The purpose of this section is to summarize legal requirements for plan adoption and implementation, identify actions that may be subject to rule making before implementation can occur, and other commitments needed for plan adoption and successful implementation.

8.1.1 Legal Requirements for Watershed Plan Approval and Implementation

Plan Approval Requirements

Under the Watershed Management Act (Chapter 90.82.130 RCW) once technical assessments are completed and key management actions defined, the planning unit submits the watershed plan to each county with territory in the management area: Benton, Kittitas and Yakima Counties. The Board of County Commissioners for each county is then required to:

1) Provide public notice of and conduct at least one public hearing on the proposed watershed plan
2) After the public hearings in each county, the Boards of County Commissioners are required to hold a joint legislative session to either approve the plan, or return it to the planning unit with suggested revisions. The plan is approved by a majority vote of the County Commissioners of each county (i.e. two affirmative votes from Benton, two affirmative votes from Kittitas and two affirmative votes from Yakima County Commissioners).

If the plan is approved, the Counties and State agencies are required to implement plan obligations that they have formally accepted as obligations per RCW 90.82.130. See Section 8.2.2 for further discussion. If the plan is returned to the planning unit with suggested revisions, the planning unit can revise the plan and resubmit the revised plan to the counties. Each county must again hold a public hearing on the revised plan followed by the joint legislative session. If the plan is not approved, the planning process is terminated.

Adopting Plan Obligations

The Watershed Management Act defines "obligations" as "any action... that imposes upon a tribal government, county government, or state government, either: a fiscal impact; a redeployment of resources; or a change of existing policy." The watershed plan cannot create an obligation unless each of the governments obligated agrees, in a recorded vote.

When the watershed plan is approved, the statute requires each county and each state agency to undertake implementing actions for the obligations accepted.

When the watershed plan is approved, the statute requires each county and each state agency to undertake implementing actions for the obligations accepted.

- For state agencies, the Act requires that they "shall adopt by rule the obligations of both state and county governments and rules implementing the state obligations, the obligations on state agencies are binding upon adoption of the obligations into rules, and the agencies shall take other actions to fulfill their obligations as soon as possible" (Chapter 90.82.130 RCW);
- For counties, "the obligations are binding on the counties and the counties shall adopt any necessary implementing ordinances and take other actions to fulfill their obligations as soon as possible" (Chapter 90.82.130 RCW).

Other participants in the planning process such as cities, irrigation districts and conservation districts are not required by law to adopt plan actions by rule or ordinance. Additionally, many of the recommended plan actions for state, county or other agencies are non-regulatory. For these actions, other forms of commitments from implementing agencies may be needed. For example, cooperative agreements could be used. Section 8.1.3 identifies some recommended agreement approaches for securing commitment from all entities identified for plan implementation responsibilities.

8.1.2 Potential Obligations for State Agencies and Local Governments

The Planning Unit has expressed that voluntary, cooperative measures are preferred over regulatory enforcement approaches. Accordingly, only a few plan actions regulatory in nature have been identified for potential actions associated with state rules or county ordinances. Beyond these regulatory actions, other implementing actions have been identified for state and county agencies, including: a) concurrence with plan-assigned responsibilities, b) timely permit processing, c) increased enforcement of selected existing rules and d) funding support.

Suggested Actions to Address through New or Updated State Rules

- ***Aquifer Storage and Recovery:*** An Ecology rule is needed to establish how ASR projects are permitted statewide, addressing areas such as aquifer boundaries, protection of water rights, and ownership of water stored for recovery, recharge and recovery treatment requirements and environmental impacts. (Note: Ecology is currently developing a proposed rule, *Chapter 173-157 WAC - Underground Artificial Storage and Recovery,* to establish standards for review of ASR proposals and mitigation of any adverse impacts.)
- ***Revise Water Quality Standards to Reflect Local Conditions:*** An updated Ecology rule should be considered (Chapter 173-201A-030 WAC) to reflect recommended revisions to basin water quality standards. Water quality standards for parameters such as temperature, when set, reviewed and

enforced, should consider geographic conditions and natural background conditions. Warm summer air temperatures on the eastern slopes of the Cascades may account for the large number of 303(d) listings for temperature in the Yakima Basin. See Chapter 5 for additional information (Note: The process of setting TMDLs associated with 303(d) listings provides an opportunity to revisit local conditions. In addition, water quality standards in some areas of the Basin have already been adjusted to account for natural conditions.

- ***Ground water Management Strategy:*** The approach to ground water management recommended in Section 4 may require rule-making by Ecology in order to be implemented. This would likely occur after year 2007, when the USGS study of ground water resources of the Basin has been completed. See Chapter 4 for additional information.

With regard to water use efficiency measures, the Planning Unit recognizes that state law regarding relinquishment of water rights (Chapter 90.14 RCW) can provide a disincentive to public and private water users considering efficiency measures. The Planning Unit urges the Legislature as well as public and private water users in the Yakima Basin work to find a solution to this issue.

Suggested Actions to Address by New or Updated County Ordinances

- ***Stormwater Management:*** Review and update, as needed, county stormwater policies and regulations to implement surface water quality management recommendations provided in Chapter 5 (See Objective 3).
- ***Critical Areas:*** Review and update, as needed, critical areas policies and regulations for wetlands and fish and wildlife habitat conservation areas to reflect the Planning Unit's recommended fish habitat enhancement strategy in Chapter 7. It is recommended that update efforts be coordinated among the three Counties to achieve a consistent level of protection and performance requirements. Cities are also encouraged to review and update critical area policies and regulations.
- ***Shorelines and Floodplain Management:*** Review and update, as needed, shorelines and floodplain management policies and regulations to reflect the Planning Unit's recommended fish habitat enhancement strategy (Chapter 7). It is recommended that update efforts be coordinated among the three Counties. Cities are also encouraged to review and update, as needed, shorelines and floodplain management policies and regulations.
- ***Gravel Mining in Riparian Areas:*** Counties are encouraged to review regulations that allow for new or expanded mining operations in or next to riparian areas, consistent with the surface water quality recommendations outlined in Chapter 5 (see Objective 4).

8.1.3 General Commitments for Implementation

In addition to the recommended areas to be addressed by rule or ordinance, the Planning Unit seeks agency commitments for all other plan implementation responsibilities identified for state and local implementing agencies. The Planning Unit recognizes that many of the implementation actions included in this plan may need additional assessment and planning before implementation can proceed and responsibilities can be assumed, and that implementation is also subject to budgetary and staffing constraints. With this in mind, state agencies, county agencies, cities, irrigation districts, conservation districts are requested to do the following (Note – not all items listed are applicable to all agencies):

- Commitment to reviewing recommended plan actions in detail and develop detailed implementation plan for assigned actions, addressing areas such as land management; facility, budget, and human resources planning; operations and maintenance; regulatory (if applicable), training, management priorities and other applicable activities.
- Commitment to dedicate existing funding, staff and other resources where possible to implement assigned plan actions, and to pursue new funding sources for unfunded actions.
- Commitment to timely review and decisions on permit applications needed for recommended actions. It is understood this review may or may not result in a favorable decision for a given action. It is also understood that the decision process may be impacted by staffing and funding constraints. This applies to several state agencies (Ecology, DFW, DNR, WDOA and DOH), the three counties and to cities.
- Commitment to implement applicable rules and regulations and to consider recommended strategies and actions contained in the plan during rule writing and revision processes.
- Commitment to coordinate with other agencies where needed to implement a strategy and/or action.

Additionally, the Planning Unit recognizes that successful plan implementation is also contingent upon commitment from individual landowners to implement best management practices and capital improvements as appropriate. Therefore, the Planning Unit asks landowners to review their operations in light of the recommended plan actions, determine how these actions apply to current practices and system conditions, and work to make necessary improvements, seeking outside grant and loan funding from existing and new programs, as available. Landowners can access several programs that exist through conservation districts, irrigation districts, WSU Cooperative Extension and other agencies.

8.2 Overview of Implementation Framework

Implementation of this Watershed Plan will consist of many separate actions by various organizations, such as State agencies, county and city governments, irrigation districts, conservation districts, and others. Table 8-1 summarizes these actions, listed for a selected group of organizations that will have the greatest involvement in Plan implementation. The table identifies "lead" and/or "other" responsibilities for each organization. This table is not comprehensive, as there are other organizations with additional implementation involvement described later in this chapter.

It is recognized that many actions will be subject to budgetary and staffing constraints. However, in approving the Watershed Plan, all Planning Unit members and represented organizations agree to help seek and support funding to carry out each listed item, focusing first on the priority actions identified by each technical committee.

Coordination of these various actions will be an important aspect of the implementation process. In this Chapter it is proposed that a coordination agency (CA) be designated to coordinate implementation actions. This could be the existing Tri-County Water Resources Agency (TCWRA). However, it is also possible that another existing organization could play this role, or a new organization could be formed to carry out this responsibility. Funding for the Coordination Agency is an important issue, since there is currently no state or local funding source identified for this purpose. See Section 8.3.3 for further discussion on funding the CA.

A proposed schedule for implementation is provided in Exhibit 8-1. Further details on this schedule are provided later in this chapter.

Table 8-1*
Organizations With Primary Implementation Responsibilities

Implementing Organization	Subject	Actions
	Lead Responsibilities	
Coordination Agency		• **Intergovernmental Coordination and Communications** • **Pursue Additional Funding** • **Monitor Plan Implementation** • **Information Clearinghouse** • **Support Specific Strategies** • **Identify Issues/Barriers to be Addressed** • **Targeted Public Outreach** • **Prepare Annual Progress Report** • **Coordinate Watershed Plan Updates** • **Administrative Support**
	Lead Responsibilities	
Counties		• **Plan Adoption** • **Establish Coordination Agency and Water Resources Advisory Committee** • **Update land use regulations within jurisdictional area to protect habitat, improve off-channel connectivity, and improve management of riparian areas consistent with Habitat Strategy** • **Co-lead with Cities to support service expansion by public water systems within urban growth areas to replace exempt well use** • **Develop policies or regulations restricting installation of new individual household wells within urban growth nodes or other areas of rural residential concentration** • **Manage stormwater in unincorporated areas consistent with surface water quality strategy** • **Facilitate County Workshop(s) to develop more detailed habitat enhancement strategies at the county or subbasin level**
	Other Responsibilities	
	Management of Surface Water Resources	• Support design and construction of storage projects by providing seed funding, securing political support, seeking additional funding and processing permits in a timely manner
	Management of Ground Water Resources	• Track progress of USGS Study and provide input to its application and associated policy decisions • Work with other agencies to design and establish improved system for monitoring and managing aquifer water levels over the long term • Provide input to Ecology in establishing formal program for issuance of new ground water rights in Yakima Basin, consistent with Watershed Plan, Alternative II-2 (Selective Restrictions on New Ground Water Development)

(*Note: Not comprehensive, see Table 8-2.)

Table 8-1 (cont.)*
Organizations With Primary Implementation Responsibilities

Implementing Organization	Subject	Actions
Counties (cont.)		• Support process to define specific ground water management actions consistent with overall objectives of watershed plan. Address elements such as water-use efficiency, transfers, expanded service by public water systems within urban growth areas to replace exempt well use, etc. • Support the design and implementation of public education program to support actions above
	Surface Water Quality Strategy	• Support the design and implementation of public education program to reduce non-point source pollution • Identify projects and seek funding from water quality actions • Participate in Interagency Coordination Forum
	Management of Ground Water Quality	• See lead responsibilities
	Fish Habitat Enhancement	• See lead responsibilities • Identify projects and seek funding for habitat actions
Cities	**Lead Responsibilities**	
		• **Define specific ground water management actions consistent with overall objectives of watershed plan. Address elements such as water-use efficiency, transfers, expanded service by public water systems within urban growth areas to replace exempt well use, etc.** • **Manage wellhead protection areas** • **Cities periodically review reuse opportunities during utility plan updates projects** • **Manage stormwater in incorporated areas consistent with surface water quality strategy** • **Update land use regulations to improve off-channel connectivity, and improve management of riparian areas consistent with Habitat Strategy**
	Other Responsibilities	
	Management of Surface Water Resources	• See lead responsibilities above
	Management of Ground Water Resources	• Work with other water utilities to track progress of USGS Study and provide input to its application and associated policy decisions • Work with other water utilities to design and establish improved system for monitoring and managing aquifer water levels over the long term

(*Note: Not comprehensive, see Table 8-2.)

Table 8-1 (cont.)*
Organizations With Primary Implementation Responsibilities

Implementing Organization	Subject	Actions
Cities (cont.)		• Provide input to Ecology in establishing formal program for issuance of new ground water rights in Yakima Basin, consistent with Watershed Plan, Alternative II-2 (Selective Restrictions on New Ground Water Development)
		• Support the design and implementation of public education program to support actions above • Other – See lead responsibilities above
	Surface Water Quality Strategy	• Participate in interagency coordination
	Fish Habitat Enhancement	• See lead responsibilities above
Ecology	**Lead Responsibilities**	
		• **Process water right transfer/change applications in a timely manner (in cooperation with county water conservancy boards)** • **Track progress of USGS Study and provide input to its application and associated policy decisions. Support local governments in tracking this process** • **Work with local water users and affected groups to establish formal program for issuance of new ground water rights in Yakima Basin, consistent with Watershed Plan, Alternative II-2 (Selective Restrictions on New Ground Water Development)** • **Develop and implement TMDLs for water quality parameters** • **Refine water quality criteria for temperature** • **Seek funding for a study to better define background turbidity levels** • **Administer other permitting processes and programs consistent with water quality and habitat strategies** • **Work with responsible parties to clean up sources of groundwater contamination**
	Other Responsibilities	
	Management of Surface Water Resources	• Support design and construction of storage projects by providing seed funding, providing technical assistance and support, seeking additional state and federal funding and processing state permits in a timely manner • Assist with funding water reuse projects, as appropriate • Other – See lead responsibilities above
	Management of Ground Water Resources	• Work with local water purveyors to design and establish improved system for monitoring and managing aquifer water levels over the long term • Work with local water purveyors to design and implement public education program addressing ground water management to support actions above

(*Note: Not comprehensive, see Table 8-2.)

Table 8-1 (cont.)*
Organizations With Primary Implementation Responsibilities

Implementing Organization	Subject	Actions
Ecology (cont.)	Management of Ground Water Resources	• Other – See lead responsibilities above
	Surface Water Quality Strategy	• Improve Cause-Effect Understanding • Seek funding to expand monitoring activities
	Management of Groundwater Quality	• Participate in activities that improve ability to detect and monitor impacts to ground water supplies • Seek funding for program to minimize impacts of land use activities on ground water supplies by implementing technical management strategies • Other – See lead responsibilities above
	Fish Habitat Enhancement	• Purchase or lease water from willing sellers to enhance flows • Identify potential stream segments for setting instream flows (areas not regulated by USBR) • Monitor and evaluate USBR system operations on habitat and water quality
Irrigation Districts	**Lead Responsibilities**	
		• **Work with USBR to implement water use efficiency projects, including establish agreements, and design and construction** • **Identify projects and seek funding for habitat and water quality enhancement actions**
	Other Responsibilities	
	Management of Surface Water Resources	• Support design and construction of storage projects by providing seed funding, securing political support, seeking additional state and federal funding • Other – See lead responsibilities above
	Management of Ground Water Resources	• Track progress of USGS Study and provide input to its application and associated policy decisions • Work with other water purveyors to establish improved system for monitoring and managing aquifer water levels over the long term • Work with Ecology in establishing formal program for issuance of new ground water rights in Yakima Basin, consistent with Watershed Plan, Alternative II-2 (Selective Restrictions on New Ground Water Development) • Support design and implementation of public education program addressing ground water management to support actions above
	Surface Water Quality Strategy	• Work with individual landowners to improve irrigation and crop land management • Other – See lead responsibilities above
	Fish Habitat Enhancement	• See lead responsibilities above

(*Note: Not comprehensive, see Table 8-2.)

Table 8-1 (cont.)*
Organizations With Primary Implementation Responsibilities

Implementing Organization	Subject	Actions
Conservation Districts	**Lead Responsibilities**	
		• **Work with landowners to implement BMPs and projects that improve irrigation and cropland management, and reduce livestock impacts consistent with water quality and habitat strategies**
	Other Responsibilities	
	Surface Water Quality Strategy	• Participate in interagency coordination forum • Identify and support efforts to improve cause-effect understanding • Identify projects and seek funding for water quality enhancement actions • Support efforts to expand monitoring activities • Other – See lead responsibilities above
	Management of Ground Water Quality	• Support local ground water protection education programs
	Fish Habitat Enhancement	• See lead responsibilities above • Identify projects and seek funding for habitat enhancement actions
County Health Districts	**Lead Responsibilities**	
		• **Develop detailed county ground water quality management strategies**
	Other Responsibilities	
	Management of Ground Water Quality	• Improve public understanding and awareness of drinking water issues • Assess susceptibility of ground water supplies to contamination • Improve ability to detect and monitor impacts to ground water supplies • Encourage Group B systems to voluntarily establish a Wellhead Protection Program • Minimize impact of land use strategies on ground water supplies by implanting technical management strategies • Evaluate the need for greater involvement of stakeholders in cleanup actions at Ecology regulated facilities and sites
Local Water Purveyors	**Other Responsibilities**	
	Management of Ground Water Quality	• Assess susceptibility of ground water supplies to contamination • Improve ability to detect and monitor impacts to ground water supplies • Improve local Wellhead Protection Programs • Evaluate the need for greater involvement of stakeholders in cleanup actions at Ecology regulated facilities and sites

(*Note: Not comprehensive, see Table 8-2.)

Table 8-1 (cont.)*
Organizations With Primary Implementation Responsibilities

Implementing Organization	Subject	Actions
US Bureau of Reclamation	**Lead Responsibilities**	
		• **Seek authorization and funding from Congress to conduct feasibility studies, prepare environmental review, obtain permits (including ESA Section 7 consultation) and design and construct recommended storage project(s), consistent with recommended surface water strategy, Alternative I-1.** • **Review existing flow management regime, identify opportunities to enhance instream flows for fish and implement where possible** • **Continue working with irrigation districts to implement water use efficiency projects through agreements, funding and other actions**
	Other Responsibilities	
	Management of Surface Water Resources	• Other - See lead responsibilities above
	Surface Water Quality Strategy	• Participate in interagency coordination forum • Identify and support efforts to improve cause-effect understanding • Support efforts to expand monitoring activities
	Fish Habitat Enhancement	• See lead responsibilities above
Washington Department of Fish and Wildlife	**Lead Responsibilities**	
		• **Monitor aquatic habitat conditions** • **Improve watershed-wide information base by developing and updating data management tools (e.g. SHIAPP and EDT)** • **Consider surface water quality and habitat strategies in administer permitting processes and programs.** • **Identify projects and seek funding for habitat enhancement actions**
	Other Responsibilities	
	Surface Water Quality Strategy	• Participate in interagency coordination forum
	Fish Habitat Enhancement	• Assist in identifying areas to enhance flows and support instream flow enhancement efforts • Support efforts to improve habitat conditions • See lead responsibilities above

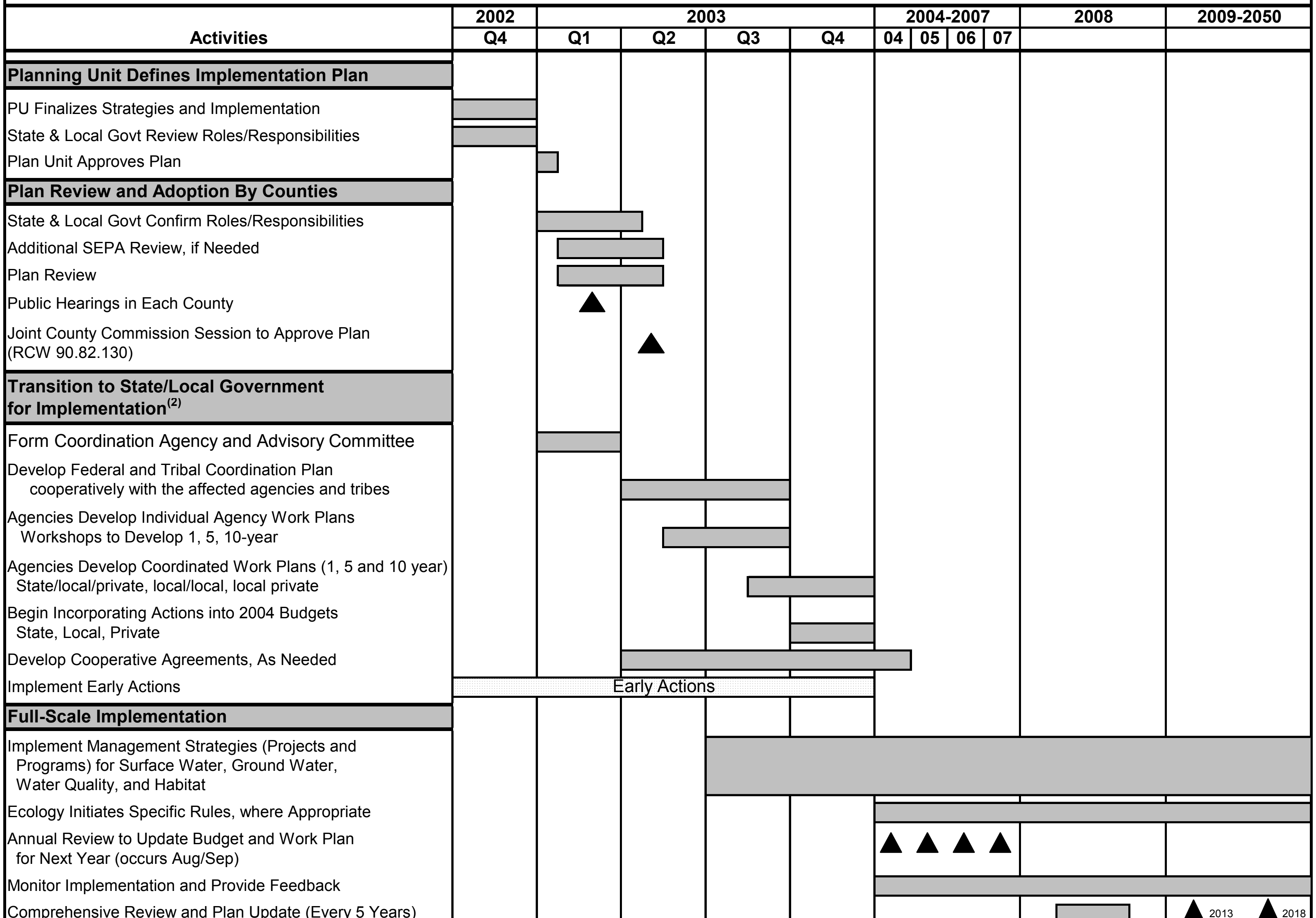
(*Note: Not comprehensive, see Table 8-2.)

Table 8-1 (cont.)*
Organizations With Primary Implementation Responsibilities

Implementing Organization	Subject	Actions
Washington State University	**Lead Responsibilities**	**NA**
	Other Responsibilities	
	Management of Ground Water Quality	• Improve public understanding and awareness • Work with local and state agencies to assess susceptibility of ground water supplies to contamination on a regional basis • Minimize impact of land use activities on ground water supplies by implementing technical management strategies
	Surface Water Quality Strategy	• Seek funding for research efforts and work with landowners to implement BMPs and projects that improve irrigation and cropland management, and reduce livestock impacts consistent with water quality and habitat strategies • Participate in interagency coordination forum • Improve cause-effect understanding • Improve problem/solution definition
Washington Department of Health	**Lead Responsibilities**	**NA**
	Other Responsibilities	
	Management of Ground Water Quality	• Support counties and cities in developing detailed ground water quality management strategies, focused on public awareness and susceptibility assessment
Washington Department of Natural Resources	**Lead Responsibilities**	**NA**
	Other Responsibilities	
	Surface Water Quality Strategy	• Prevent and mitigate forest impacts through existing programs and authorities • Prevent and mitigate recreation impacts through existing programs and authorities • Participate in interagency coordination forum, as appropriate • Support efforts to secure funding for increased monitoring activities
Washington Department of Agriculture	**Lead Responsibilities**	**NA**
	Other Responsibilities	
	Surface Water Quality Strategy	• Seek funding for research efforts and work with landowners through existing programs. • Participate in interagency coordination forum as appropriate
County Water Conservancy Boards	**Lead Responsibilities**	• **Process water right change/transfer applications in a timely manner (in cooperation with Ecology)**
	Other Responsibilities	NA

(*Note: Not comprehensive, see Table 8.2)

Exhibit 8-1
Yakima Watershed Plan - Proposed Implementation Schedule(1)



(1) Implementation schedule may be limited by available funding/resources, legislative authorizations, implementing rules and existing workloads.

(2)To coincide with budget preparation cycle for 2004.

8.3 Organizing and Coordinating Plan Implementation

The purpose of this section is to identify actions and management considerations for organizing and implementing the plan, including a recommended coordination framework.

8.3.1 Intergovernmental Coordination Framework

Multiple agencies with varying responsibilities will continue to administer water resource programs and projects in the Yakima Basin. Section 8.3 identifies specific actions recommended for various organizations in carrying out Plan strategies. As discussed further below, these assignments will primarily involve state and local entities, with linkages to federal agencies and indirect coordination with Yakama Nation activities. These assignments include different types of management activities and cover diverse activities involving surface and ground water, instream flow, water quality, and habitat conditions.

A coordination approach is recommended to take advantage of the potential benefits listed above. This coordination approach is described below, within the framework of three parallel tracks: state and local government management, federal management and Yakama Nation management.

Parallel Management Tracks

State and Local Government Management: This track is implementing the Yakima Basin watershed planning developed through the process outlined under Chapter 90.82 RCW, which includes a partnership between Washington State government and local governments. As described in Section 8.2, state agencies and county governments have legal responsibilities to implement certain aspects of the plan (contingent on their agreement to do so), once the plan is adopted. Accordingly, the plan focuses primarily on assignments to state and local entities.

Supplementing these assignments, specific linkages to federal activities, and indirect coordination with tribal programs have also been identified.

Federal Management: This track is the federal government's various programs for managing water resources. Notable among these are the USBR Yakima Irrigation Project, and Yakima River Basin Water Enhancement Project (YRBWEP); federal programs to protect species listed under the Endangered Species Act; and federal programs to support agriculture and timber production. The USBR has assisted in modeling flow enhancement scenarios for the Planning Unit. The USBR would need to play a primary role, if the recommended surface water strategy is to be implemented. Other federal agencies have been identified for involvement in other strategies, either as a regulatory agency or as a potential partner. For instance, National Marine Fisheries Service is responsible for steelhead recovery under the Endangered Species Act, and the U.S. Forest Service plays a major role in protecting high quality fish habitat in the upper, wooded areas of the Basin. The U.S. Environmental Protection Agency (EPA) is responsible for administering the Federal Clean Water Act and oversees Ecology's enforcement of the Act.

Yakama Nation Management - This track involves the Yakama Nation as a sovereign government with treaty rights on and off the Nation's reservation. The Yakama Nation has a vested interest in managing the Basin's fisheries resources. Additionally, the Yakama Nation has specific land use and resource management activities on the reservation. The Yakama Nation's role in Basin water resources management is referenced, but no specific assignments are defined in this watershed plan. However, their participation, input, and support for major projects will continue to be vital to the various agencies carrying out water resource management responsibilities. Accordingly, agencies with implementation responsibilities are encouraged to seek Yakama Nation support for recommended plan actions.

Recommended Coordination Approaches

As discussed above, achieving coordination and cooperation between the local governments, state agencies, federal agencies, and the Yakama Nation is critical for effective implementation, supported by ongoing stakeholder and public involvement. Several techniques are recommended to achieve this coordination, starting with designating a coordination agency.

Designation of a Coordination Agency

A coordination agency should be established to coordinate plan implementation, guided by a local board. This could be the existing Tri-County Water Resource Agency or a new agency. The local board comprised of County and other appropriate representatives would identify appropriate coordination actions and guide staff activities within an established coordination framework, as discussed further below. The coordination agency would conduct activities with input from an advisory committee comprised of both citizen and technical representatives. Technical representations would need to include local and state agency staff (also discussed further below).

The coordination agency board would be responsible for the functions listed below, and would guide agency staff and others in fulfilling these functions:

- ***Intergovernmental Coordination and Communications:*** Assist and encourage agencies to implement recommended plan actions by promoting communications among and within the three main tracks of water resources management in the Basin (State/local, Federal and Tribal) on specific management actions. Also includes coordination between state and local agencies, and among different local agencies.

- ***Pursue Additional Funding:*** Additional funding is needed to support ongoing coordination activities and specific projects identified by the watershed plan as priority for the basin. The coordination agency could pursue funding for these actions.
- ***Monitor Plan Implementation:*** Identify and summarize implementation actions. Identify areas where additional attention and resources may be needed, consistent with plan recommendations, or where a change in focus may be needed based upon changing conditions, new data, revised regulatory programs, etc.
- ***Information Clearinghouse:*** Serve as an information resource for agencies and individuals with implementation responsibilities.
- ***Support Specific Strategies:*** Supporting key strategies with multiple, basin-wide benefits, such as the recommended surface water enhancement strategy.
- ***Identify Issues/Barriers to be Addressed:*** Management issues, constraints or barriers that cannot be met without additional governmental participation will be identified and framed for consideration by implementation agencies. Interim strategies may also be recommended based on the collective wisdom and abilities of the participating governments.
- ***Targeted Public Outreach:*** Coordinate focused outreach activities as part of implementing basin-wide strategies. Some specific outreach approaches and tools that can be used are described in Section 8.6.
- ***Prepare Annual Progress Report:*** In coordination with the Water Resources Advisory Committee, prepare and publish brief report summarizing annual plan accomplishments. Identify actions to be completed in the next two years. Identify potential barriers or implementation issues to be resolved, and also potential areas to be addressed in a plan update.
- ***Coordinate Watershed Plan Updates:*** Work with the Water Resources Advisory Committee to update the watershed plan. It is envisioned that a comprehensive plan review and update will occur at least every five years. Targeted amendments or preparation of an addendum to the plan may occur more frequently.
- ***Board and Advisory Committee Administrative Support:*** Assist in scheduling meetings, preparing agendas, taking meeting minutes, and other support duties for the coordination agency board and advisory committee.

Water Resources Advisory Committee

It is recommended that a water resources advisory committee (WRAC) be established to continue the broad cross-section of stakeholder participation provided by the Planning Unit for the past fours years. The purpose of establishing the WRAC is to provide ongoing guidance and stakeholder input during plan implementation to the CA and other responsible agencies.

In forming the WRAC membership, the CA should draw from the existing planning unit membership and include both citizen and technical representation. This would make the WRAC similar to the makeup of the current planning unit, but a smaller committee size is recommended, e.g. 15 – 20 members, (approximately 40 planning unit members have been actively participating in plan development). Representation should include citizens from all three counties, state and local agencies and other stakeholders. The committee would be responsible for:

- ***Monitoring Plan Implementation*** - Meet periodically (e.g. quarterly or semi-annually) to review and monitor implementation progress for consistency with plan actions and priorities,
- ***Reviewing and Commenting on Annual Progress Report*** - Work with the CA to develop annual progress report as discussed further under CA responsibilities,
- ***Reviewing and Commenting on Watershed Plan Updates -*** Work with the CA to coordinate watershed plan updates as discussed further under CA responsibilities,
- ***Assisting in Identifying Management Issues and Solutions*** – Work with the CA and other implementing agencies to identify, frame and develop solutions for priority management issues, and
- ***Assisting with Strategies for Selected Actions*** – Assist the CA in developing outreach, public involvement and funding strategies for selected actions that have basin-wide benefits.

Forums for Detailed Coordination on Specific Efforts

In addition to the formal coordination framework recommended above, it is envisioned that the coordination agency would assist in establishing coordination forums, task forces, or other coordination mechanisms to implement recommended strategies for specific actions. For example, the surface water quality strategy recommends establishment of a formal interagency group to coordinate water quality plans, research and activities. A task force could be established for implementing the recommended surface water enhancement strategy. Additionally it is recommended that more detailed implementation strategies for habitat enhancement be developed through county workshops attended by implementing agencies and stakeholders.

Summary

Exhibit 8-2 displays these three parallel tracks and the recommended coordination approach. Note that in Exhibit 8-2 the three main tracks (state/local; federal; tribal) are presented as separate, but linked. These linkages provide further opportunities for coordination of water-resource management actions during implementation. For example, USBR has a responsibility to manage the Yakima Irrigation Project to meet project purposes, including the primary purpose of water supply. At the same time, the federal government has a trust responsibility with regard to the Yakama Nation. Water resource management actions of Ecology and USBR are somewhat intertwined, as are those of the Department of Fish and Wildlife, federal agencies with responsibilities under the Endangered Species Act (ESA), and the Yakama Nation as a co-manager of the fisheries resource. The U.S. Environmental Protection Agency delegates authority to Ecology for water quality programs, and maintains oversight responsibility to ensure federal rules and regulations are met.

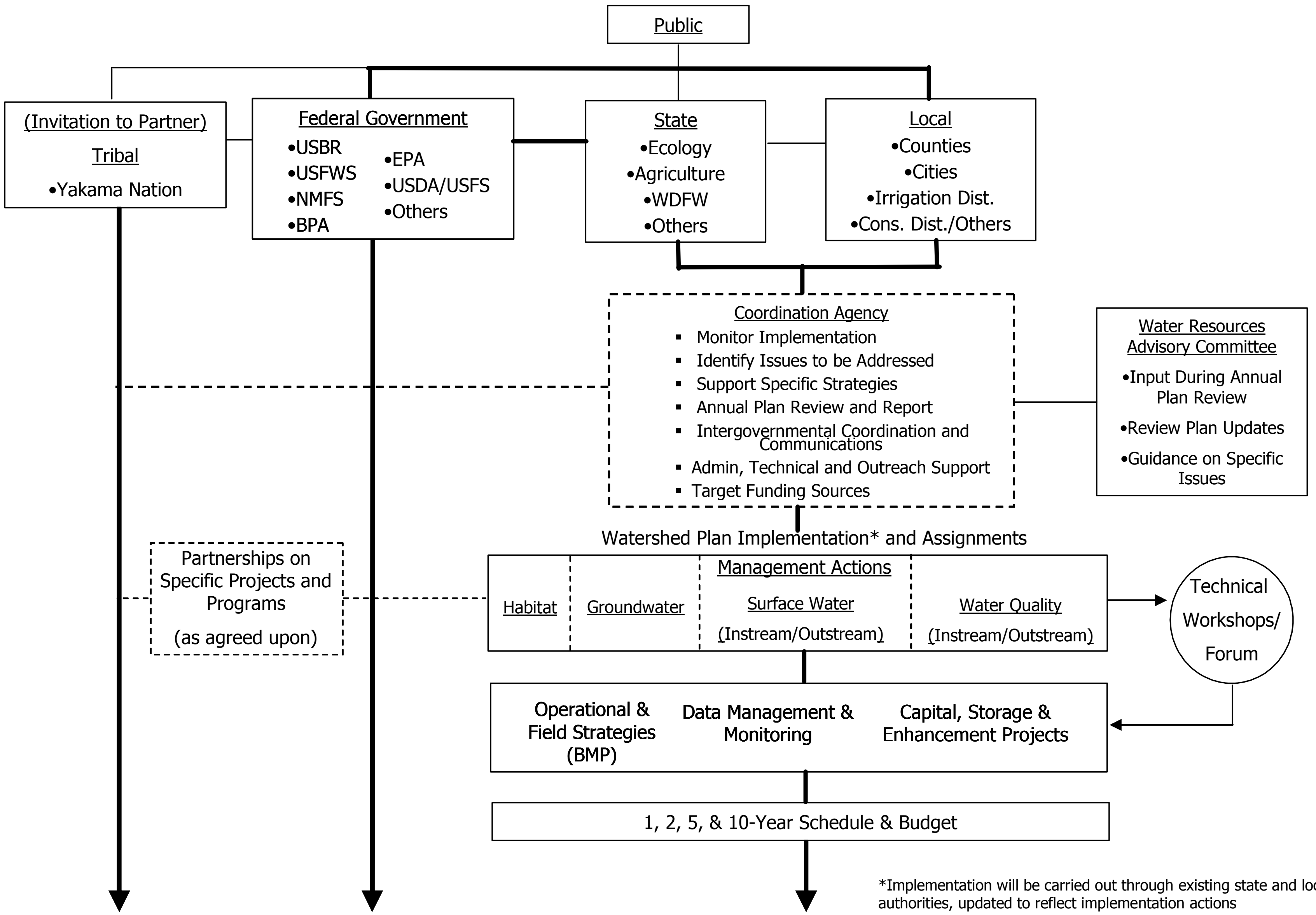
8.3.2 Establishing Cooperative Agreements

The Planning Unit has expressed that cooperative approaches (e.g. voluntary measures) are preferred over regulatory/enforcement approaches. Cooperative agreements can be more flexible and adaptive to adjust to new circumstances and information, and may actually achieve better results, as fewer resources are expended in the transaction and more resources are available for implementation. Having said this, it is recognized that regulatory compliance agreements may be necessary in some circumstances to realize desired changes.

Accordingly, this section identifies methods for establishing commitments for plan actions requiring cooperative agreements for successful implementation. Cooperative agreements can be viewed along a continuum, going from non-binding informal to formal and binding. The non-binding, informal agreements are primarily based upon trust and goodwill of the involved parties to follow through on expressed commitments, and have relatively low transaction costs. It is also assumed organizations will put forth best efforts to secure the necessary means (financial or otherwise) to fulfill commitments. On the other end of the continuum, the formal and binding agreements can be enforceable by law, and lack of follow through can result in financial or other penalties. There is often significant time and resources expended (high transaction costs) in developing formal agreements.

Exhibit 8-2

Conceptual Framework for Intergovernmental Coordination



*Implementation will be carried out through existing state and local authorities, updated to reflect implementation actions

The following list of agreements starts at the informal and progresses to more formal agreements:

- Verbal commitments,
- Letters or resolutions of support,
- Letters or resolutions containing specific commitments to action,
- Intergovernmental agreements,
- Permits,
- Regulatory Compliance Agreements, and
- Contracts.

Regardless of the type of agreement used to implement plan actions, the effectiveness of the agreement depends upon some basic elements being present to establish accountability for the involved parties. These elements include: identifying specific responsibilities to be fulfilled for each organization, the schedule for completing agreed upon actions, mechanism for follow-up/reporting, and process for evaluating results. Other agreement considerations that may be applicable include:

- Collaborative decision-making processes to allow for adaptive management over time;
- Criteria or decision making rules to trigger specific actions in response to incoming information;
- Contingency planning for unexpected conditions or to address cases where an organization proves unable or unwilling to implement the designated activities; and
- Dispute resolution measures.

8.3.3 Management Considerations for Organizing Plan Implementation

Management considerations specific to organizing plan implementation are discussed in this section to help focus early activities. Topics addressed include recommended activities and suggested milestones, primary funding sources, and areas for establishing cooperative agreements.

Recommended Activities and Proposed Milestones

Exhibit 8-1, Proposed Implementation Schedule (see Section 8.2), summarizes activities and timeframes for finalizing the implementation plan, plan adoption by the counties, transitioning to state and local government implementation and full-scale implementation. Plan adoption and organizing activities for plan implementation are expected to occur in 2003, with full-scale implementation beginning in 2004, noting that many early action activities are already underway and will continue during organization efforts.

Planning Unit Defines Implementation Plan

This activity continues through plan adoption, scheduled for no later than January 13, 2003. It includes:

- ❑ Planning Unit finalizing its recommended implementation strategy,
- ❑ State and local agencies reviewing implementation responsibilities outlined in the plan, and
- ❑ Planning Unit approval of the plan.

Plan Review and Adoption by Counties

The proposed plan review and adoption date is Fall 2003. It includes:

- ❑ State and local agencies confirming responsibilities for plan actions,
- ❑ Conducting additional SEPA review, if needed,
- ❑ Benton, Kittitas and Yakima County watershed plan review,
- ❑ At least one public hearing in each county, and
- ❑ One joint session attended by the Boards of County Commissioners of each county to approve the plan.

Transition to State and Local Government for Implementation

This portion of the proposed schedule has been designed to coincide with the adoption of local and state agency budgets for 2004. A first step in this transition is to organize the Coordination Agency and Advisory Committee. This is expected to take through Spring 2003. The next step is for state and local agency efforts to organize for 2004 plan implementation efforts. For local agencies this means plans will be established and associated budgets approved by no later than the end of 2003. For state agencies, this work would be completed by Summer 2004. State and local early action efforts are anticipated to be ongoing during this transition period. It is highly recommended that agencies begin plan organization efforts as soon as possible to be prepared, where possible, for full-scale implementation for selected items in 2004.

Ecology, the counties, and other state and local agencies with implementation responsibilities are encouraged to work individually and together on the following:

- Form CA and WRAC,
- Develop federal and tribal coordination plan on the recommended storage project(s) strategy, and other applicable activities,
- Hold internal planning sessions to develop individual agency 1, 5 and 10-year implementation plans,
- Work with private landowners on plan implementation activities,
- Identify areas where coordination needs to occur, and work to establish appropriate cooperative agreements, and
- Incorporate actions into budgets for 2004.

Full-scale Implementation

Plan adoption and organizing activities for plan implementation are expected to occur in 2003, with full-scale implementation anticipated to begin in 2004, noting that many early action activities are already underway and will continue during organization efforts. This includes beginning implementation on the actions summarized in Section 8.2 and detailed in Chapters 3 through 7 of the plan.

In addition to implementing management strategies, implementation also includes monitoring progress and annual plan review, and comprehensive reviews and potential plan updates every five years. Section 8.5 describes how these activities would occur.

Funding for Coordination and Oversight

The initiating governments have identified some potential local funding sources to help support the Coordination Agency in completing its responsibilities outlined in Section 8.4. Preliminary estimates for an annual budget for the Coordination Agency range from approximately $50,000 to $200,000 or more, depending upon where the agency is located, staffing arrangements, and the level of effort provided for each responsibility. Funding this Coordination Agency is vital for successful plan implementation over time. It is recommended the initiating governments seek state assistance for up to five years to be combined with local funding sources to establish the Coordination Agency and support ongoing coordination activities.

It is envisioned that within this five-year period, the Coordination Agency will be able to establish other funding sources to sustain the needed coordination level of effort.

Members of the Planning Unit are willing to work with the governments represented on the Tri-County Water Resource Agency Board and others to assist in securing state and local resources to establish and support the Coordination Agency.

Cooperative Agreements Recommended For Organizing Plan Implementation

One cooperative agreement has been identified for organizing plan implementation. This is an agreement to establish the Coordination Agency and Advisory Committee. Potential parties to this agreement include Counties, Cities, Irrigation Districts and other agencies.

8.4 Implementing Resource Management Actions

This section includes a summary of recommended actions from Chapters 3 through 7 for each resource management topic: surface water, ground water, surface water quality, ground water quality and habitat. Responsible entities and estimated resources are provided for each recommended action. Also included are management considerations specific to each resource management area to help focus early plan implementation activities, addressing primary recommended activities and suggested milestones, primary funding sources, and areas for establishing cooperative agreements. This section is concluded with a discussion on future data needs and adaptive management.

8.4.1 Summary of Recommended Actions

Table 8-2 includes a summary of recommended actions for surface water, ground water, surface water quality, ground water quality, and habitat management. (Many of these actions were also identified in Table 8-1, arranged by the main implementing organizations for the Plan.)

Table 8-2
Yakima Watershed Plan Implementation Actions[1]

Subject	Priority	Actions	Implementing Agencies [2] [3]	Estimated Resources [4]
	✓	Support design and construction of storage projects by providing seed funding, securing political support, seeking additional funding and processing permits in a timely manner	CNTY, Ecology, ID	Medium
		Assist with funding water reuse projects, as appropriate	Ecology	High
		Periodically review reuse opportunities during utility plan updates	**CITY**	Low
	✓	Process water right transfer/change applications in a timely manner	**Ecology**, **WCB**	Low to Medium
	✓	Work with USBR to implement water use efficiency projects, including establishing agreements, design and construction	**ID**	High
Management of Surface Water Resources (Chapter 3)	✓	Seek authorization and funding from Congress to conduct feasibility studies, prepare environmental review, obtain permits (including ESA Section 7 consultation) and design and construct recommended storage project(s), consistent with recommended surface water strategy, Alternative I-1.	**USBR**	High
	✓	Review existing flow management regime, identify opportunities to enhance instream flows for fish and implement where possible	**USBR**	High
	✓	Continue working with irrigation districts to implement water use efficiency projects through agreements, funding and other actions	**USBR**	High
	✓	Storage Projects	**USBR**, Ecology, CNTY, ID	$416 million – $2.73 billion
	✓	Water Efficiency Projects	**USBR**, **ID**	$359 million
		Water Reuse Projects	**CITY**	High
	✓	Water-Rights Transfers	**Ecology**, Landowners	Low

Table 8-2 cont)
Yakima Watershed Plan Implementation Actions[1]

Subject	Priority	Actions	Implementing Agencies [2] [3]	Estimated Resources [4]
Management of Ground Water Resources (Chapter 4)	✓	Track progress of USGS Study and provide input to its application and associated policy decisions	CA, CITY, CNTY, ID, **Ecology**	Low
	✓	Design and establish improved system for monitoring and managing aquifer water levels over the long term	CITY, CNTY , ID, Ecology	High
	✓	Establish formal program for issuance of new ground water rights in Yakima Basin, consistent with Watershed Plan, Alternative II-2 (Selective Restrictions on New Ground Water Development)	**Ecology**, CITY, CNTY , ID, Landowners	Medium
	✓	Define specific ground water management actions consistent with overall objectives of watershed plan. Address elements such as water-use efficiency, transfers, expanded service by public water systems within urban growth areas to replace exempt well use, etc.	**CITY**, **CNTY** , ID, Landowners	Medium
	✓	Design and implement public education program addressing ground water management to support actions above	CITY, CNTY , ID, Ecology	Medium
Surface Water Quality Strategy (Chapter 5)		***Prevent/Mitigate Forest Impacts***		
		Improve Forest Road/Trail Management (Action 1A)[5]	USFS, DNR, Landowners	High
		Improve Timber Harvest Management (Action 1B) [5]	USFS, DNR, Landowners	High
		Other Watershed Actions (Action 1C) [5]	USFS, DNR, Landowners	High
		Prevent/Mitigate Agriculture Impacts		
	✓	Improve Irrigation Management (Action 2A) [5]	CD, WSU, ID, USDA, Landowners	High
	✓	Improve Cropland Management (Action 2B) [5]	CD, WSU, ID, USDA, Landowners	Low
		Reduce Impacts of Agricultural Chemicals (Action 2C) [5]	CD, Ecology, ID, USDA, Landowners	High
	✓	Address Livestock Impacts (CAFOs) (Action 2D) [5]	CD, Ecology, USDA, Landowners	Medium
		Control Other Agricultural Impacts (Action 2E) [5]	ID, CD, WDOA, USDA, USGS	Medium
		Prevent/Mitigate Stormwater Impacts on Water Quality		
		Plan/Implement Municipal Stormwater Runoff Controls (Action 3A) [5]	**CNTY**, **CITY**, Ecology	Medium
		Plan/Implement Industrial Stormwater Runoff Controls (Action 3B) [5]	**CNTY**, **CITY**, Ecology, IND	Low
		Prevent/Mitigate Resource Extraction Limits		
		Control Impacts of Gravel Mining (Action 4A) [5]	Ecology, CNTY, IND, DFW, Landowners	High

Table 8-2 (cont.)
Yakima Watershed Plan Implementation Actions[1]

Subject	Priority	Actions	Implementing Agencies [2] [3]	Estimated Resources [4]
Surface Water Quality Strategy (Chapter 5) (cont.)		***Prevent/mitigate recreation impacts***		
		Improve Recreational Use Management (Action 5A) [5]	USFS, DNR	High
		Support/Maintain Point Source Pollution Control Programs		
		Upgrade Wastewater Facilities (Action 6A) [5]	CITY, IND, **Ecology**	High
		Accommodate Service Area Growth (Action 6B) [5]	CITY, CNTY, IND, Ecology	High
		Improve Interagency Coordination		
	✓	Improve Interagency Coordination (Action 7A) [5]	All agencies involved	Low
		Improve Understanding of Watershed Problems and Solutions		
	✓	Improve Cause-Effect Understanding (Action 8A) [5]	CD, USBR, Ecology, DFW, USGS, USFS, DNR, WSU	High
		Improve Problem/Solution Definition (Action 8B) [5]	CD, USBR, Ecology, DFW, USGS, USFS, DNR, WSU	Medium
	✓	Expand Monitoring Activities (Action 8C) [5]	Ecology, USGS, CD, DFW, USFS, DNR	Medium
		Ensure Water Quality Standards Reflect Natural Regional Conditions		
		Refine Water Temperature Criteria (Action 9A) [5]	**Ecology**, USFS, USGS, CD	Medium
		Define Background Turbidity Levels (Action 9B) [5]	**Ecology**, ID CD, USGS	Medium
		Minimize Water Resource Impacts on Water Quality		
		Improve Surface Water Resources Project Operations(Action 10A) [5]	ID, Landowners	High
		Assess Groundwater Impacts on Surface Water (Action 10B) [5]	USBR, USGS	High
Management of Ground Water Quality (Chapter 6)		***Improve Public Understanding and Awareness of Drinking Water Issues***		
	✓	Provide outlets for ground water protection information (Action 1A)[5]	CHD, WSU, CD	Medium
	✓	Develop a mass media campaign for ground water protection (Action 1B) [5]	CHD, WSU, CD	Medium
	✓	Develop ground water protection program for schools (Action 1C) [5]	CHD, WSU, CD	Medium
	✓	Conduct periodic public opinion surveys related to ground water protection efforts (Action 1D) [5]	CHD, WSU, CD	Medium
		Assess Susceptibility of Ground Water Supplies to Contamination		
	✓	Conduct level I risk assessment (Action 2A) [5]	**CHD**, CPD, Ecology, DOH, Local water purveyors	Low
	✓	Conduct level II risk assessment (Action 2B) [5]	**CHD**, CPD, Ecology, DOH, Local water purveyors	Medium to High

Table 8-2 (cont.)
Yakima Watershed Plan Implementation Actions[1]

Subject	Priority	Actions	Implementing Agencies [2] [3]	Estimated Resources [4]
Management of Ground Water Quality (Chapter 6) (cont.)	✓	Evaluate existing data management system and improve if necessary (Action 2C) [5]	**CHD**	Low
	✓	Produce regional maps showing results of risk assessment (Action 2D) [5]	**CHD**, CPD, Local water purveyors	Low
		Improve Ability To Detect And Monitor Impacts To Groundwater Supplies		
		Evaluate the availability and usefulness of existing ground water quality monitoring data (Action 3A) [5]	CHD, DOH, Ecology, USGS	Low
		Establish/facilitate short-term monitoring approach to determine baseline conditions of ground water supplies (Action 3B) [5]	CHD, Local water purveyors, DOH, Ecology, USGS	High
		Establish or facilitate long-term monitoring approach to detect impacted ground water supplies (Action 3C) [5]	CHD, Local water purveyors, DOH, Ecology, USGS	Medium
		Establish or facilitate long-term monitoring approach to evaluate the performance of implemented management strategies (Action 3D) [5]	CHD, Local water purveyors, DOH, Ecology, USGS	Medium
		Analyze data collected during monitoring programs (Action 3E) [5]	CHD, DOH, Ecology, USGS	Low
		Improve Local Wellhead Protection Programs		
		Enforce Wellhead Protection Program requirements for all "Group A" Public Water Systems (Action 4A) [5]	DOH, **Local water purveyors**	Low to Medium
		Facilitate use of a computer model for delineating select "Group A" Public Water Systems wellhead protection areas (Action 4B) [5]	DOH, Local water purveyors, USGS	High
		Encourage "Group B" Public Water Systems to voluntarily establish a Wellhead Protection Program (Action 4C) [5]	CHD, Local water purveyors, WSU, DOH	Medium
		Minimize Impact Of Land Use Activities On Groundwater Supplies By Implementing Technical Management Strategies		
		Identify land use activities and contaminants to be addressed with technical management strategies (Action 5A) [5]	CHD, CD, Ecology, WDOA, NRCS, WSU	Low
		Select and implement technical management strategies (Action 5B)[5]	CHD, CD, Ecology, WDOA, NRCS, WSU	High
		Clean Up Sources of Ground water Contamination		
		Evaluate the need for greater involvement as a stakeholder in clean up actions at Ecology regulated facilities and sites (Action 6A) [5]	CHD, **Ecology**, Local water purveyors	Low
		Evaluate the need for independent clean up actions (Action 6B) [5]	CHD, **Ecology**, WDOA, USGS	High

Table 8-2 (cont.)
Yakima Watershed Plan Implementation Actions[1]

Subject	Priority	Actions	Implementing Agencies [2] [3]	Estimated Resources [4]
		Protect Existing High Quality Habitats		
	✓	Road/Trail Impact Management (Action 1A) [5]	USFS, DNR, PTC	Medium
	✓	Watershed Headwaters Protection and Projects (Action 1B) [5]	USFS, DNR, PTC, CNTY	Medium
		Protect And Enhance Anadromous Fish Migration Corridors		
	✓	Flow Related Actions (Action 2A) [5]	USBR, Ecology, DFW, SOAC	High
	✓	Water Quality Actions (Action 2B) [5]	Ecology, CD, ID, Landowners	High
	✓	Passage Barrier Improvements (Action 2C) [5]	USBR, Landowners, ID, DFW	High
	✓	Regulate Land Uses (Action 2D) [5]	CNTY, CITY, Ecology, NRCS, USFS, DNR	Medium
		Enhance Downstream Reaches And Connect Associated Floodplains In Tributary Mainstem Reaches		
	✓	Improve In-Stream Flow Management (Action 3A) [5]	USBR, SOAC, Ecology	High
	✓	Improve Off-Channel Connectivity (Action 3B) [5]	DOT, DFW, CNTY, CD, Landowners	Medium
	✓	Water Quality Enhancement (Action 3C) [5]	Ecology, EPA, CD, ID, Landowners, USGS, USFS, DNR	High
Fish Habitat Enhancement (Chapter 7)	✓	Riparian Area Improvement (Action 3D) [5]	Landowners, USFS, DNR, CD, DFW	Medium
	✓	In-Channel Complexity Actions (Action 3E) [5]	DFW, CD, CNTY	High
	✓	Other Improvements (Action 3F) [5]	DFW, Landowners, ID	High
		Prioritize Enhancement Of Degraded Aquatic Habitats That Are Still Functional		
	✓	Improve In-Stream Flow Management (Action 4A) [5]	USBR, SOAC	High
	✓	Improve Off-Channel Connectivity (Action 4B) [5]	DOT, CNTY, Landowners	High
	✓	Water Quality Enhancement (Action 4C) [5]	Ecology, CD, ID, Landowners	High
	✓	Riparian Area Improvement (Action 4D) [5]	Landowners, USFS, DNR, CD, DFW	High
	✓	In-Channel Complexity Actions (Action 4E) [5]	DFW, CD, CNTY	High
	✓	Other Improvements (Action 4F) [5]	DFW, Landowners, ID	High
		Protect Existing Habitat Conditions From Further Degradation		
	✓	Regulate Land Use (Action 5A) [5]	**CNTY**, **CITY**, Ecology, NRCS, USFS, DNR	Medium
	✓	Evaluate/Regulate Water Use Impacts (Action 5B) [5]	Ecology, USBR	High
	✓	Focus on Non-Point Pollution (Action 5C) [5]	TCWRA, DFW, Ecology, USFS, DNR, CD, CC, CNTY	Medium

Table 8-2 (cont.)
Yakima Watershed Plan Implementation Actions[1]

Subject	Priority	Actions	Implementing Agencies [2] [3]	Estimated Resources [4]
Fish Habitat Enhancement (Chapter 7) (cont.)		***Improve Watershed-Wide Information Base***		
		Habitat Assessment (Action 6A) [5]	DFW, USBR, SOAC, CC, CD, ID, USFS, DNR, USGS, Ecology	Medium
		Monitor Aquatic Habitats (Action 6B) [5]	**DFW**, USBR, SOAC, CC, CD, ID, USFS, DNR, USGS, Ecology	Medium
		Focus On Habitat Condition To Measure The Effectiveness Of Habitat Enhancement Actions		
		Focus on Habitat Condition (Action 7A) [5]	DFW, Ecology, USFS, DNR, CD, CC	Medium
		Ensure Water Quality and Habitat Standards Reflect Natural Regional Conditions		
		Improve Information and Criteria (Action 8A) [5]	**Ecology**, DFW, USFS, DNR, USBR, USGS, CD	Medium

(1) Some of the specific actions listed in this table may require additional assessment and planning before proceeding into full implementation of the specific action.
(2) Implementing Agencies is defined as all agencies identified with some management responsibility for a recommended action, and includes: (CA) Coordinating Agency, (CC) Conservation Commission, (CD) Conservation Districts, (CHD) County Health Department, (CNTY) Counties, (CPD) County Planning Department, CITY (Cities), DFW (WA Department of Fish & Wildlife), (DNR) WA Department of Natural Resources, (DOH) WA Department of Health, (DOT) WA Department of Transportation, (Ecology) WA Department of Ecology, (EPA) US Environmental Protection Agency, (IND) Industry, (ID) Irrigation Districts, (Landowners) Individual Landowners, Local water purveyors, (NRCS) Natural Resource Conservation Service, (PTC) Private Timber Companies, (SOAC) Systems Operations Advisory Committee, (USBR) US Bureau of Reclamation, (USDA) US Department of Agriculture, (USFS) US Forest Service, (USGS) US Geological Survey, (WD) Water Districts, (WDOA) WA Department of Agriculture, (WSU) Washington State University, (WCB) County Water Conservancy Boards
(3) Bold in the Implementing Agency column indicates Lead Agency.
(4) Estimated resources for implementation of the action: In general (on co-lead), Low – less than $100,000, Medium – between $100,000 and $750,000, High – greater than $750,000
(5) These action numbers (e.g., action (1A)) simply identify the actions for referencing convenience with the respective Chapters of the Plan.

8.4.2 Considerations for Implementing Specific Management Actions

Management considerations specific to each resource management area are provided in this section to help focus early plan implementation activities. Topics addressed include primary recommended activities and suggested milestones, primary funding sources, areas for establishing cooperative agreements, and future data needs. It should be noted that this information is provided for many but not all of the actions identified as priority in Table 8-2. Additionally, many of the specific actions listed in this table may require additional assessment and planning before proceeding into full implementation.

Surface Water Management Considerations

Recommended Activities and Potential Milestones

Recommended activities and milestones are provided for each major element of the surface water management strategy, including storage, efficiency improvements, reuse, and transfers.

Storage

- ❑ Final selection of project(s) site(s) and prepare draft and final EIS related to site selection by 2005.
- ❑ Obtain permits and funding by 2007. (See Appendix 3-A, Table ___, Permitting Processes – Alternative I-1 for a list of major permits to be obtained.)
- ❑ Complete design by 2008.
- ❑ Construct by 2012.

Efficiency Improvements

(Schedule to be confirmed by USBR Feasibility Investigation Team)

- ❑ Complete necessary diversion reduction agreements/contracts by 2004.
- ❑ Obtain permits and funding by 2005.
- ❑ Complete design by 2005
- ❑ Construct capital improvements in 2006 – 2010.

Reuse

- ❑ Cities periodically review reuse during comprehensive utility plan review and updates or every 6 years.

Transfers

- Ongoing among individual water right holders
- Ecology and USBR annually review opportunities for water trust acquisition from voluntary parties, for instream flows

Anticipated Primary Funding Sources

Primary funding sources are identified for each including storage, efficiency improvements, reuse, and transfers.

Storage

The USBR is the primary funding source for the recommended storage project(s), supplemented by state and local sources primarily used in securing federal funding/congressional authorization.

Efficiency Improvements

The USBR is the funding source for efficiency improvement projects related to irrigation districts under YRBWEP. Local sources will be used in securing federal funding/congressional authorization.

Reuse

State funding programs applicable for reuse include the Public Works Trust Fund and the Centennial Clean Water Fund.

Transfers

The individual parties involved in the transfer transaction fund transfer costs.

Potential Cooperative Agreements

Two areas have been identified for cooperative agreements; one for storage and one for irrigation efficiency projects:

- Seeking support and funding for recommended storage project(s) - Potential partners include state, counties, irrigation districts, commodity groups, Storage Alliance, landowners and other parties.
- Water efficiency and conservation projects - Partnership between USBR and individual Irrigation Districts.

Groundwater Management Considerations

Recommended Activities and Potential Milestones

Organize in 2003 a group of water utilities with ground water as primary source of supply to:

- Monitor USGS ground water study and advise Ecology on policy that might result from this study, consistent with Alternative II-2 the recommended ground water strategy.
- Establish a data system to assess water level trends and ground water use patterns.
- Implement other interim actions recommended in Chapter 4.

Anticipated Primary Funding Sources

Local funding would be used for interim activities, such as those recommended above, while the USGS completes its study. It is anticipated that an updated groundwater management strategy will be developed by Ecology, with local input, as the USGS study information becomes available. Section 4.7.3 discusses potential funding sources that might be used in implementing this ground water strategy.

Areas for Establishing Cooperative Agreements

- Agreement organizing groundwater users to complete activities described above.

Surface Water Quality Management Considerations

Recommended Activities and Potential Milestones

Most of the recommended actions are expected to be implemented on an ongoing basis in a decentralized approach, where state agencies, local governments, and private sector organizations reference these actions in funding requests submitted to state and federal agencies for projects and programs to improve water quality.

Three specific actions have been noted, along with recommended milestones:

- Coordinating Agency re-establish in 2003 an interagency coordination forum to improve coordination among local, state and federal agencies involved in management of surface water quality,
- Identify lead and establish coordinated monitoring program to better understand surface water quality problems and solutions. Lead agency for implementing monitoring program to be to be identified in 2003.

Among other things, program lead agency would work with WSU and other appropriate parties to secure funding to support recommended research activities in 2004 and 2005,

- Monitor EPA/Ecology effort to revise water quality standards (2003 and beyond), and
- Coordinate with Ecology and EPA on TMDL processes and 303(d) listings.

Anticipated Primary Funding Sources

The primary funding sources for implementing the surface water quality actions are Public Works Trust Fund, Centennial Clean Water Fund, and Salmon Recovery Fund.

Areas for Establishing Cooperative Agreements

Establish Interagency Coordination group. Several state and local agencies would be involved in this effort. This group could collectively work together to address Actions 8A – 8C that help improve understanding of watershed problems and solutions.

Ground Water Quality Management Considerations

Recommended Activities and Potential Milestones

Develop detailed county water quality management strategies in 2003, with County Health Districts as lead. Focus on high priority actions, such as public awareness (See Section 6.2.1 for additional detail) and susceptibility assessment (See Section 6.2.2).

Anticipated Primary Funding Sources

Section 6.3.2 discusses potential funding sources that might be used in implementing the ground water quality strategy.

Areas for Establishing Cooperative Agreements

Organize County efforts to assess susceptibility of ground water supplies to contamination. County Health Districts are a logical lead for championing this effort, in partnership with DOH, Ecology and local water purveyors.

Habitat Enhancement Management Considerations

Recommended Activities and Potential Milestones

- Hold initial County Workshop(s) by June 15, 2003 (see below for additional details)

- Define county and/or subbasin strategies by October 31, 2003

Each County should consider convening one or more habitat enhancement workshops to develop more detailed approaches for applying the recommended basin-wide, non-flow related plan actions to its unique conditions. For example, the habitat strategy recommended for the basin will be applied differently in Kittitas County than it will in Benton County. Kittitas will focus more on those actions addressing habitat protection and enhancement of the upper watershed where there are several subbasins important to spawning and rearing habitat for salmonids. Actions in Benton County will be more limited, focusing on enhancing the migratory corridor and Chinook and Coho spawning and rearing conditions for the lower Yakima mainstem, and enhancing a few small tributaries.

Workshop invitees should include county and city planning staff, WDFW staff, conservation district staff, private citizens, and federal agency representatives (e.g. NOAA Fisheries and USFWS staff) and other appropriate individuals. The workshop(s) can include a) Review of the recommended actions, b) Discussion on the applicability of these actions to the County, c) Identification and assignment of priority management areas and actions, and d) Development of more detailed, local implementation approaches.

Some applicable areas to review include:

- County and city critical areas ordinances
- SEPA review procedures
- County and City Shorelines Management programs
- State hydraulic permitting
- Existing habitat enhancement resources and programs
- Education and outreach programs
- USBR Reservoir Dam Passage study
- ESA compliance strategies (e.g. Section 10 Habitat Conservation Plans or Section 4(d) programs)
- Opportunities for local, bi-county or basin partnerships on specific programs (e.g. Water diversion screening program)
- Wetlands Banking
- Other applicable programs and processes

Adapting this basin-wide habitat enhancement strategy into more specific, geographically based (subbasin) approaches can assist the entire basin in realizing improved conditions for salmonid populations. It can also foster communications, provide for education on plan elements, and result in tailored approaches to improve local conditions.

Anticipated Primary Funding Sources

Major funding sources for habitat enhancement actions include the State Salmon Recovery Funding Board, the BPA/NWPPC Fish and Wildlife Program, and the U. S. Department of Agriculture Conservation Reserve and Conservation Reserve Enhancement programs (CRP/CREP).

Areas for Establishing Cooperative Agreements

- ❑ Cooperate to improve watershed information base. See Table 8-2 for a list of potential parties to this agreement.
- ❑ Counties and cities cooperate to develop consistent critical areas protection and shorelines management approaches
- ❑ County-wide or subbasin HCP seeking incidental take permit for steelhead and bulltrout. Involved parties depend upon the potential take activities to be addressed in HCP.

8.5 Future Data Needs and Adaptive Management

Water management strategies must be based on the best available information. This information is not only critical to make confident, science-based management decisions, but also to track the impacts of management actions on water quality, water quantity, habitat, and salmon populations. Comprehensive and integrated watershed planning often reveals significant data gaps and deficits in associated monitoring regimes. Proper management of water resources in a dynamic environment requires sufficient information to attain maximum management flexibility. Incomplete information also compromises our ability to recommend and assess management strategies effectively to achieve long-term management goals. As a rule, development and implementation of watershed management strategies require a high level of confidence in the completeness and accuracy of resource data.

Management strategies should be reviewed and revised through an adaptive management process as new information becomes available. The watershed plan identifies significant data needs, which are summarized in Table 8-3.

Table 8-3
Data Needs for Implementation

Subject	Identified Needs	Responsible Organization(s)	Comments
Management of Groundwater Resources	• Numerical model of interactions among aquifers, as well as between groundwater and surface water	United States Geological Survey (USGS) study	Assessment of hydrologic characteristics between aquifers is critical for making informed water management decisions in the basin (§4.0).
	• Data on local/regional groundwater systems	The USGS study and Ecology's amended water management rule are intended to improve the availability of certain types of groundwater data	Significant groundwater data gaps exist with respect to ground water rights, the extent of use from different aquifers, the number and location of exempt wells, unauthorized withdrawals, and areas with long-term declines in water levels. Long-term water level monitoring data are needed basin-wide to determine long-term trends in groundwater levels (§4.1).
Surface Water Quality Strategy	• Water quality monitoring data	Implementing agencies and organizations	Data are necessary to understand the complex interrelationships involving watershed problems, their causes, and moreover the effects of management activities implemented under the watershed plan. Monitoring programs must be integrated and designed to help understand the complex interrelationships between water quality and habitat factors. This information is critical to assess whether desired management outcomes are being realized and to guide on-going implementation of the watershed plan. Monitoring activities should be evaluated and expanded/upgraded to ensure data integrity and geographical coverage. These actions may include expansion of water quality monitoring to cover the entire geographic area; expansion of tributary monitoring outside of forest areas; organization of main-stem river monitoring; broadening of topics covered in monitoring information base; and upgrading the data exchange network (§5.2).
	• Assessments of particular water quality parameters to establish appropriate background levels to reflect natural conditions	To be determined	Criteria used in water quality standards - such as for turbidity and temperature - are set to protect all designated uses, including fisheries, by reflecting what is naturally attainable in the region (considering climatic and geologic factors).

Table 8-3 (cont.)
Data Needs for Implementation

Subject	Identified Needs	Responsible Organization(s)	Comments
Surface Water Quality Strategy (cont.)	• Water quality assessment from the extensive water resource management operations	To be determined	Surface and groundwater management activities such as storage and release of water from reservoirs, operation of irrigation canals and drains, and pumping of shallow aquifers have a significant effect on water quality. Changes in the operations of these water management systems can benefit instream flows, which can also function to benefit water quality in flow-depleted reaches (§5.2).
	• Inventory of existing water quality data	To be determined	Prior to implementation of the monitoring plan, it is important to inventory existing data within and across agencies and organizations. Once a compendium of existing monitoring programs is complete, the suitability of available data should be assessed for analysis at a basin scale (§5.4).
Management of Groundwater Quality	• Improved capabilities to detect and monitor impacts to ground water	To be determined	A locally maintained ground water quality database should be developed to determine areas that are susceptible to ground water contamination. A locally maintained system is important in order to store, link, manipulate, and present data acquired from a variety of sources (§6.2)
Fish Habitat Enhancement	• Status of salmon populations in the watershed (e.g. distribution, fecundity, etc.)	To be determined	Detailed assessments of salmon populations and their ability to respond to habitat improvements will provide critical data for informed water management and fisheries restoration decisions. This information should include the status and capacity of existing hatchery, rearing, or fish transportation facilities or equipment, the availability of populations suitable (i.e. closely related to those which formerly existed in the basin or a given stream) for use as a brood stock for re-introduction, and changes in fish management which may have to occur in order to allow the stock to recover (§7.2)
	• Ongoing salmon habitat assessments	To be determined	Habitat data are needed to strengthen the watershed plan's adaptive management program for salmon recovery and management, where an expanding and refined information base supports improved habitat enhancement and protection activities. This will provide useful information to evaluate results of management strategy implementation (§7.3).

(1) This table should not be viewed as an exhaustive list of data needs, but as needs that were explicitly mentioned in the watershed plan.

8.6 Annual Plan Review and Future Plan Amendments

An important component of watershed plan implementation is the periodic review and analysis of the recommended management strategies and actions. Reviews are used to assess progress in implementing the plan and to provide a measure for achieving results. In addition to evaluating progress, implementation evaluations are used to identify areas where adjustments or amendments are needed to support long-term watershed management success.

Management actions recommended in the watershed plan will need to be refined or modified due to changing circumstances. For instance, one efficiency or storage project may be pursued but fatal technical challenges, prohibitive operating costs or other issues may be encountered as it moves forward, and a different project may be determined to be more feasible, and a course adjustment needs to be made.

Modifications may be necessary due to changing conditions such as results of monitoring programs or an analysis of experimental management tools; the adoption of rules or ordinances implementing specific plan provisions; or even programs or projects conducted outside of the watershed planning framework may affect the watershed plan policies, recommendations, or actions.

8.6.1 Recommended Plan Review Process

It is recommended that the watershed plan be reviewed and evaluated annually by the proposed Advisory Committee and implementing agencies, with a comprehensive review and update every five years. Exhibit 8-1, Initial Implementation Schedule, identifies the annual review would by completed by no later than September of each year and that the five-year comprehensive reviews would occur in 2008, 2013 and 2018.

During these reviews, the advisory committee should consider the following assessment questions:

- ❑ Have the coordination and resource management actions listed in the watershed plan been implemented?
- ❑ Are the desired results being achieved?
- ❑ Is the overall intent of the plan being met?
- ❑ Are there new information gaps or changing conditions that require review?
- ❑ Are there new issues that were not considered during the planning phase, that need to be addressed?

The conclusions and findings of watershed plan review should be reported to the Coordination Agency board and to the legislative authorities of counties and cities in the planning area, as well as to other agencies and organizations participating in plan implementation. Implementing agencies are expected to consider this information as the work plans are developed and finalized for the upcoming year.

For the five-year review, depending on the answers to the above questions, the Advisory Committee could recommend to the implementing governments that the plan be formally re-opened and updated. It is envisioned that the Coordination Agency would lead this review and plan update, with support from the Advisory Committee. A specific work plan and schedule for updating the plan would be developed prior to the update process beginning.

8.7 Public Involvement During Plan Implementation

As the watershed plan is implemented, continued stakeholder and public support are necessary to advocate for effective execution of recommended management strategies and actions. Continuous participation and support from individuals, the public, and organizations with diverse perspectives and interests helps bolster useful management actions, and thus multiple and appropriate significant water resource management benefits in the Yakima Basin.

Public involvement tools that can be used to communicate with the general public and key stakeholders are summarized below. The Coordination Agency would assist in organizing basin-wide public involvement efforts determined to be important to successful implementation of a project or program, and seek guidance from the Advisory Committee in these efforts. Potential tools to use include:

- Distribution of newsletters that provide periodic updates on implementation efforts.
- Create and maintain website.
- Presentations to service groups.
- Promoting special TV programs on public access cable channels for educational purposes.
- Issuing press releases.
- Distributing information and educational materials, such as a portable information booth that is set up at various events within the Basin;
- Encouraging Advisory Committee member communications/information distribution with others in their respective organizations;
- Facilitation of an E-mail distribution list to enhance the flow of useful information on general or specific issues;

- Hosting public conferences or forums, targeting both technical and non-technical audiences, to facilitate discussion among stakeholders and communicate watershed plan issues and successes; and
- Production of television and radio Public Service Announcements (PSAs).

Communication efforts should continue to target stakeholders with implementation responsibilities and others whose water practices may be impacted, but also include a broader range of citizen groups with vested interests in the planning area and process. Information conveyed to the public may include: management strategy needs and priorities; status of plan implementation and associated performance measures; successful management actions and projects; innovative water management BMPs; and/or a summation of on-going monitoring programs. These outreach efforts should be closely coordinated with established communication efforts (e.g. Washington State University's Cooperative Extension program), and target groups such as those listed below:

- County Farm Bureau and Cattlemen Associations;
- Environmental organizations and civic organizations;
- Commodity groups and trade associations;
- County Commissions, Town Councils, and Conference of Governments;
- Hunting and fishing interest groups;
- Outdoor recreation groups;
- Smaller irrigation districts;
- Agri-businesses and timber companies;
- Economic development organizations;
- Regional colleges and universities; and
- Businesses or landowners with significant land holdings along a river and/or with water intake facilities or outfalls.
- Water purveyors

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Appendices

Appendix 2-A

Maps of Mainstem Reaches and Tributary Subbasins

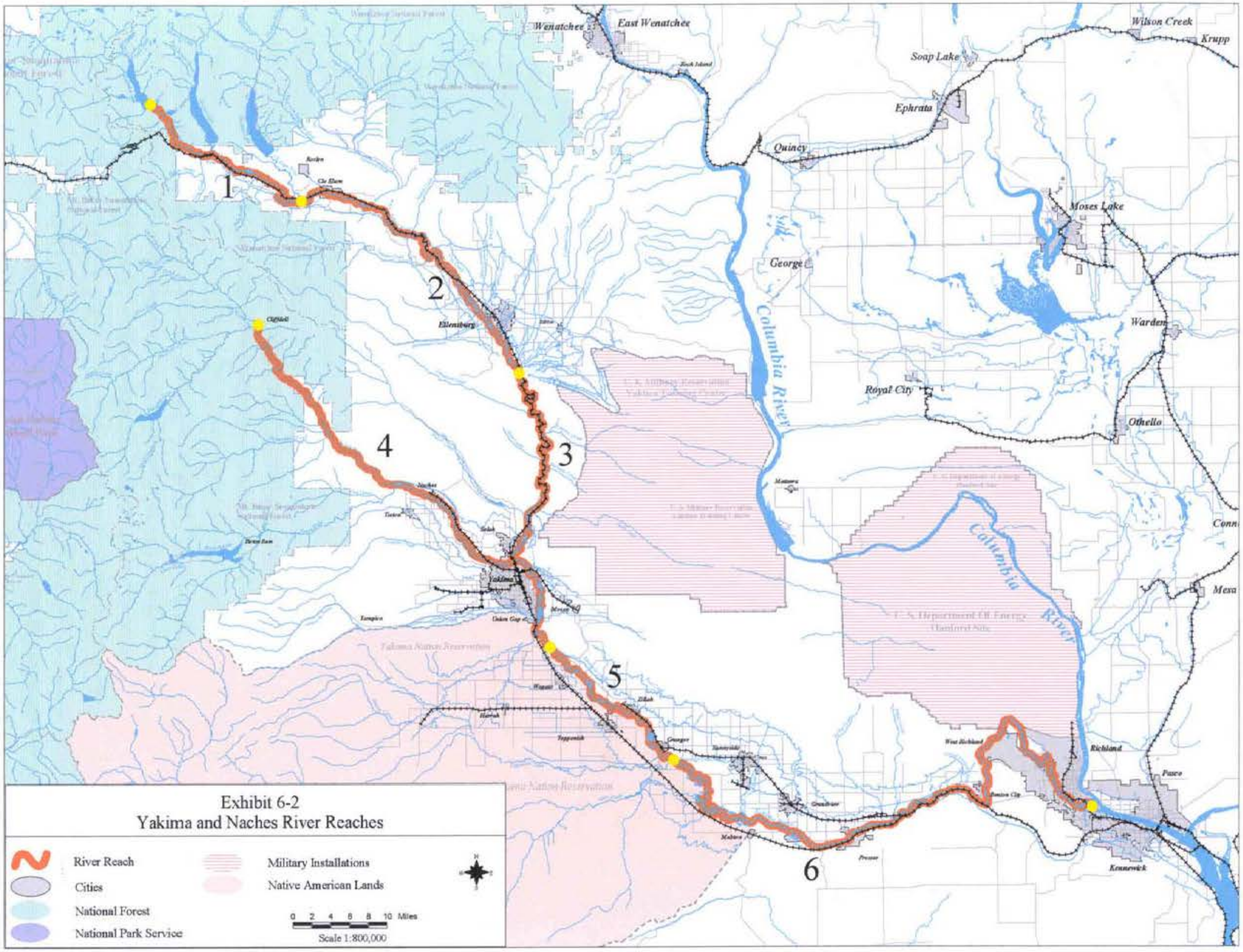


Exhibit 6-2
Yakima and Naches River Reaches

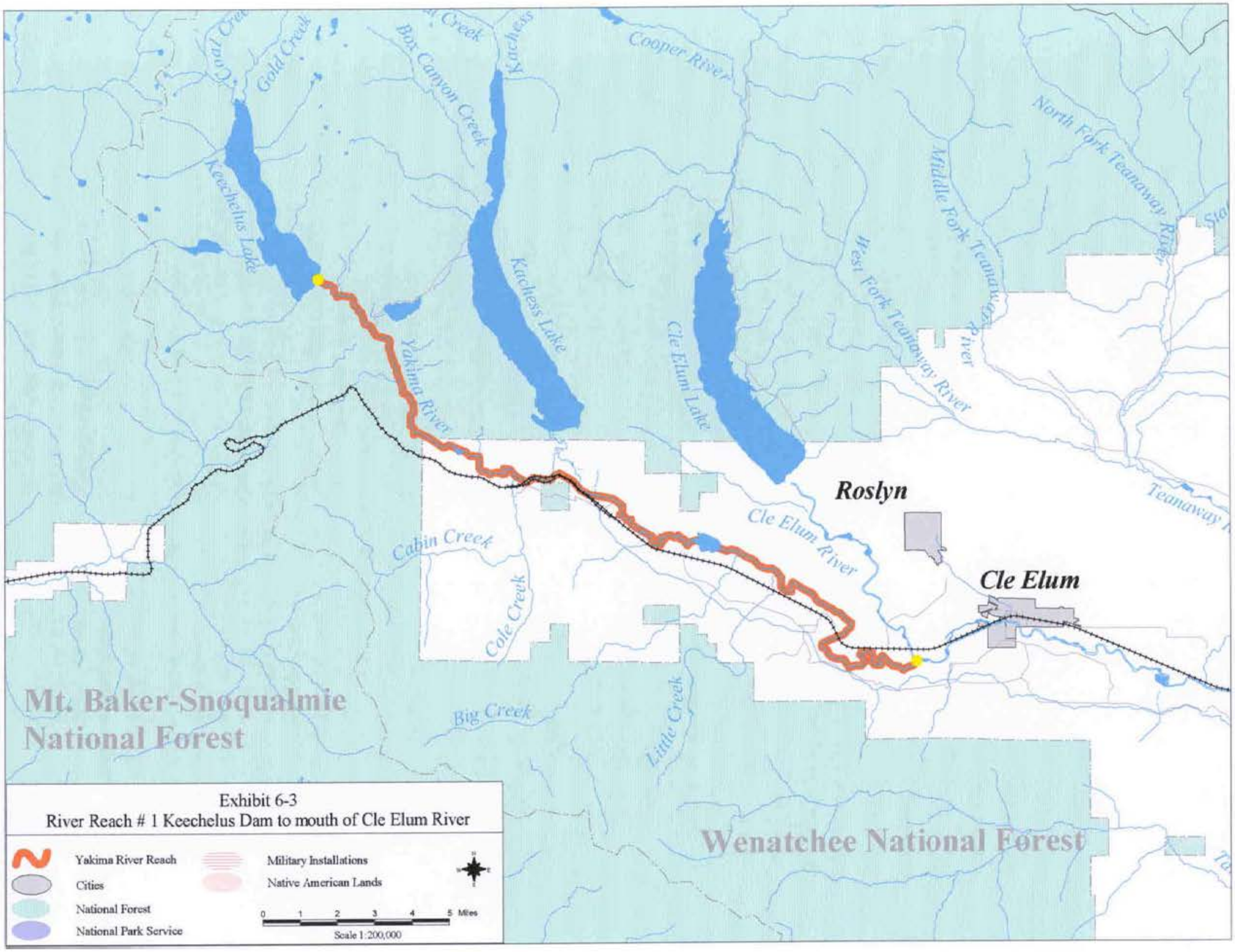


Exhibit 6-3
River Reach # 1 Keechelus Dam to mouth of Cle Elum River

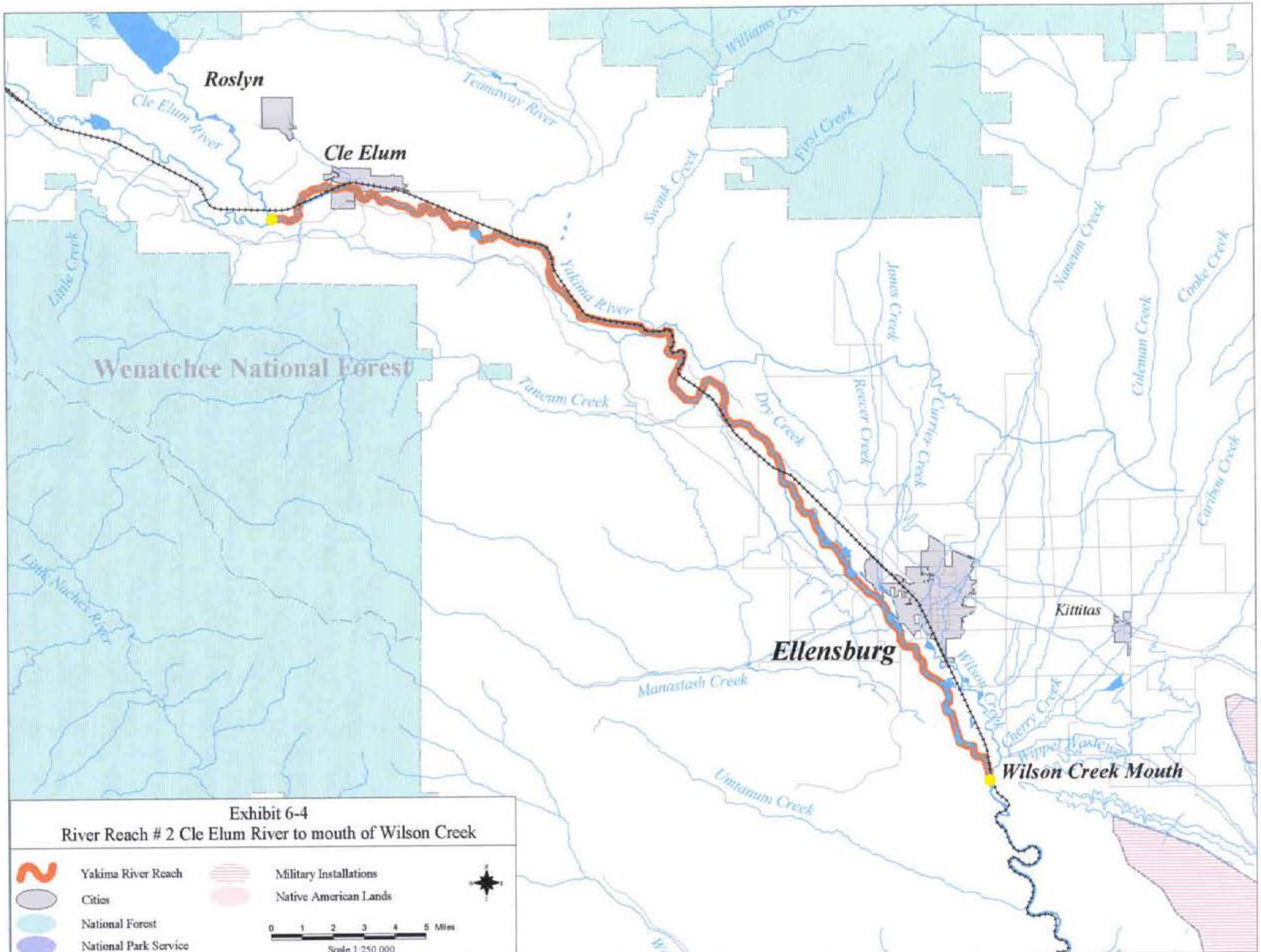
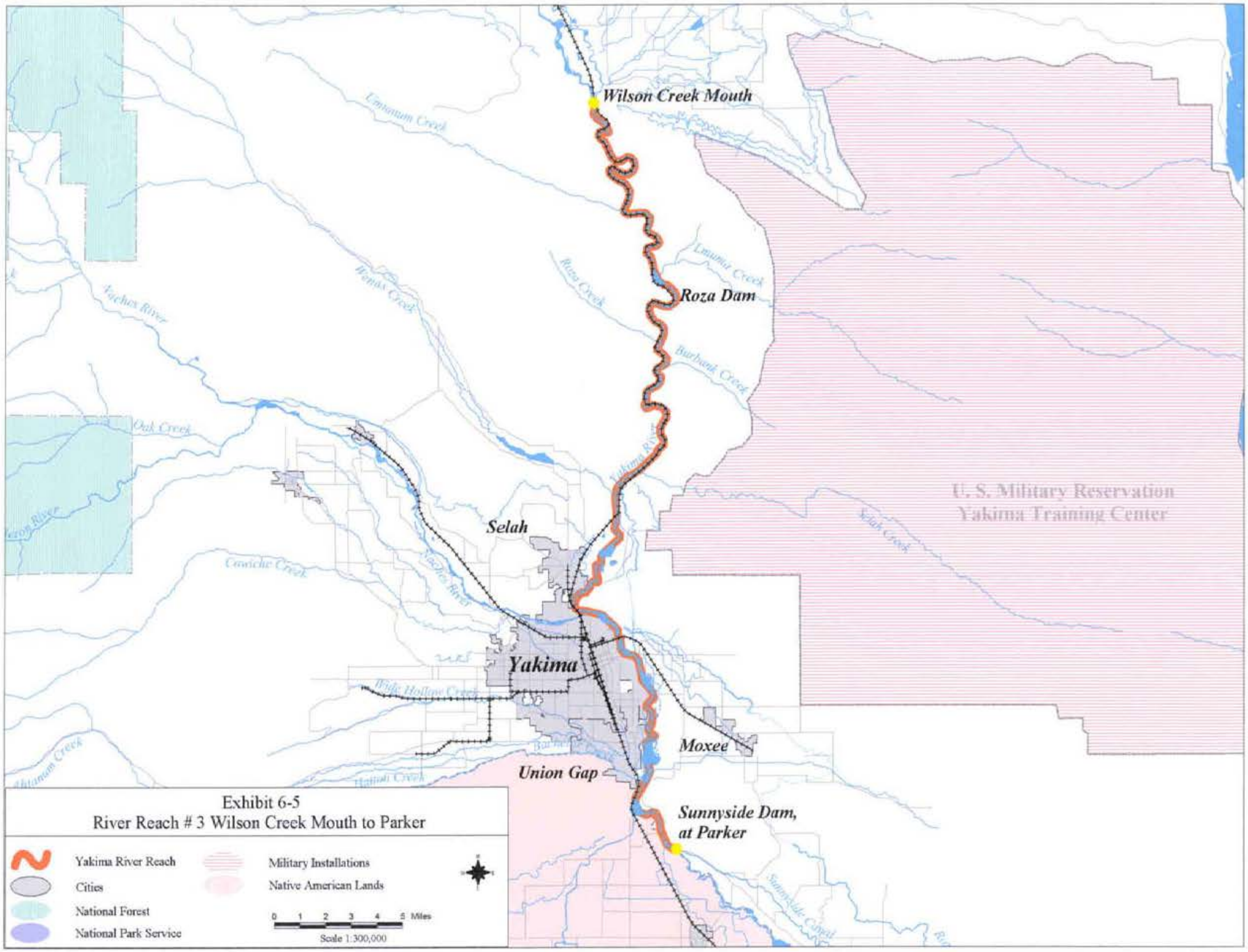


Exhibit 6-4
River Reach # 2 Cle Elum River to mouth of Wilson Creek


Wilson Creek Mouth
Umtanum Creek
Roza Dam
Roza Creek
Burbank Creek
Wenas Creek
Naches River
Oak Creek
Selah
Cowiche Creek
Yakima
Wide Hollow Creek
Moxee
Union Gap
Sunnyside Dam,
at Parker
Ahtanum Creek
U. S. Military Reservation
Yakima Training Center
Exhibit 6-5
River Reach # 3 Wilson Creek Mouth to Parker
Yakima River Reach
Cities
National Forest
National Park Service
Military Installations
Native American Lands
0 1 2 3 4 5 Miles
Scale 1:300,000

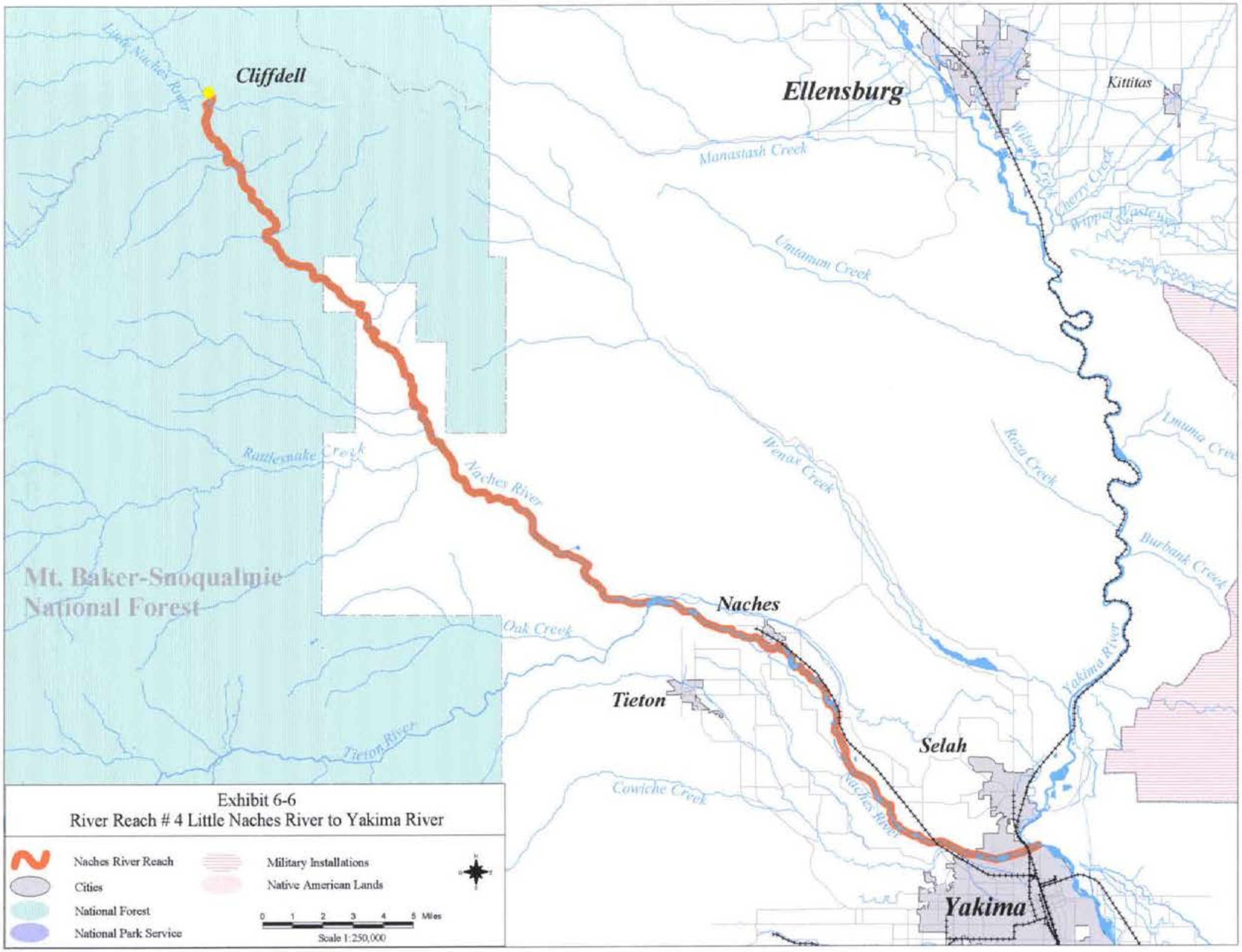


Exhibit 6-6
River Reach # 4 Little Naches River to Yakima River

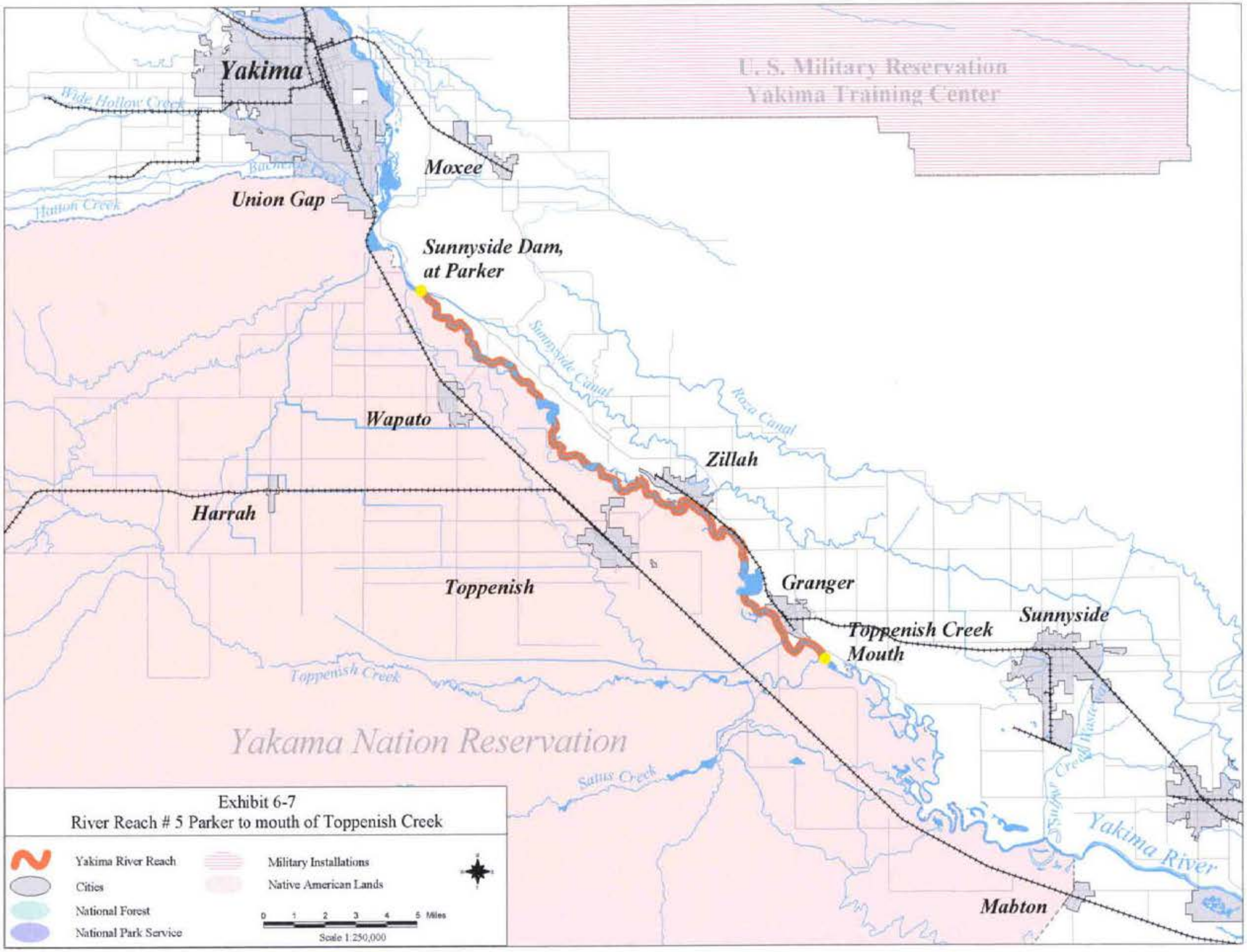
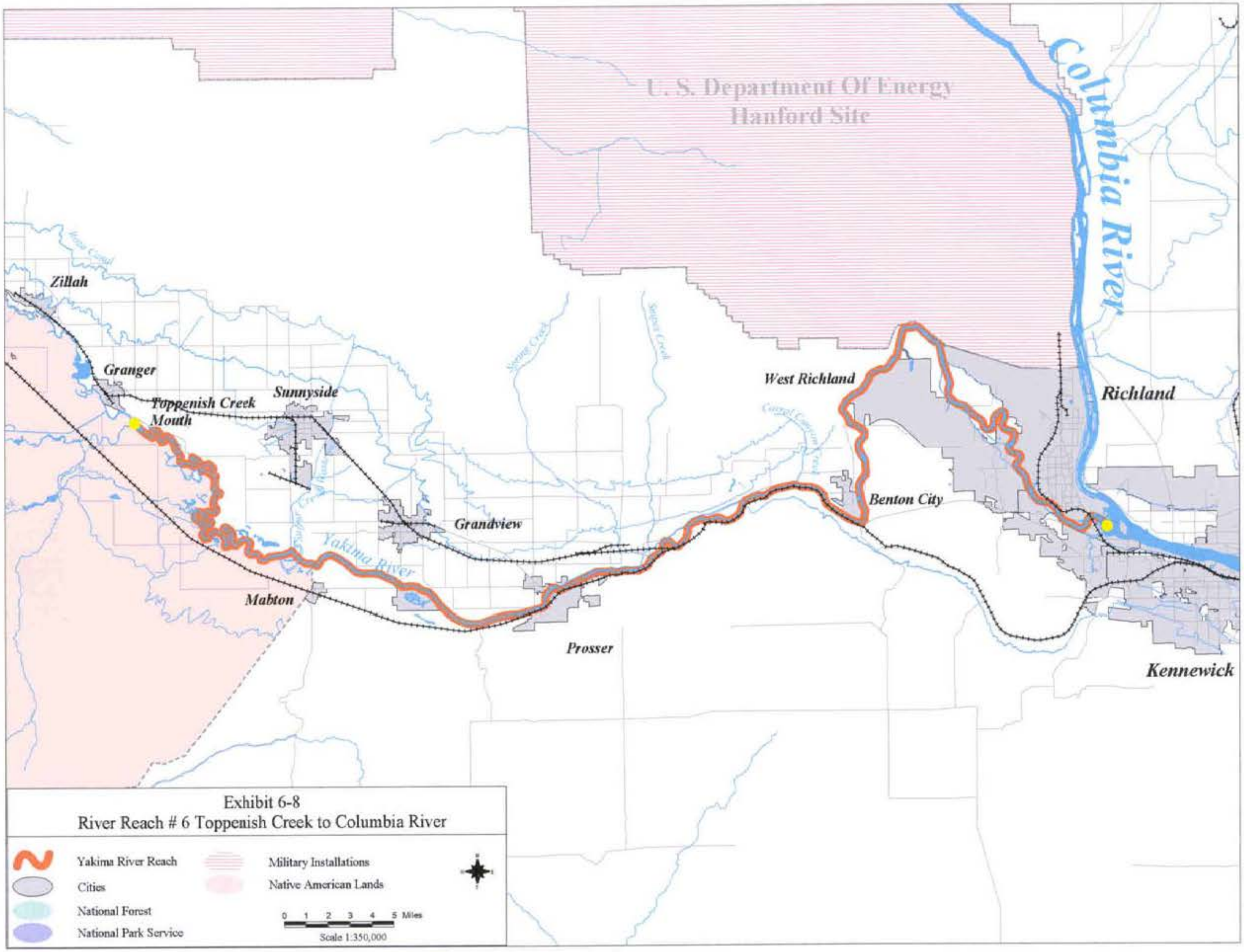


Exhibit 6-7
River Reach # 5 Parker to mouth of Toppenish Creek


U. S. Department Of Energy
Hanford Site
Columbia River
Zillah
Granger
Toppenish Creek
Mouth
Sunnyside
Grandview
Yakima River
Mabton
Prosser
West Richland
Benton City
Richland
Kennewick
Exhibit 6-8
River Reach # 6 Toppenish Creek to Columbia River
Yakima River Reach
Cities
National Forest
National Park Service
Military Installations
Native American Lands
0 1 2 3 4 5 Miles
Scale 1:350,000

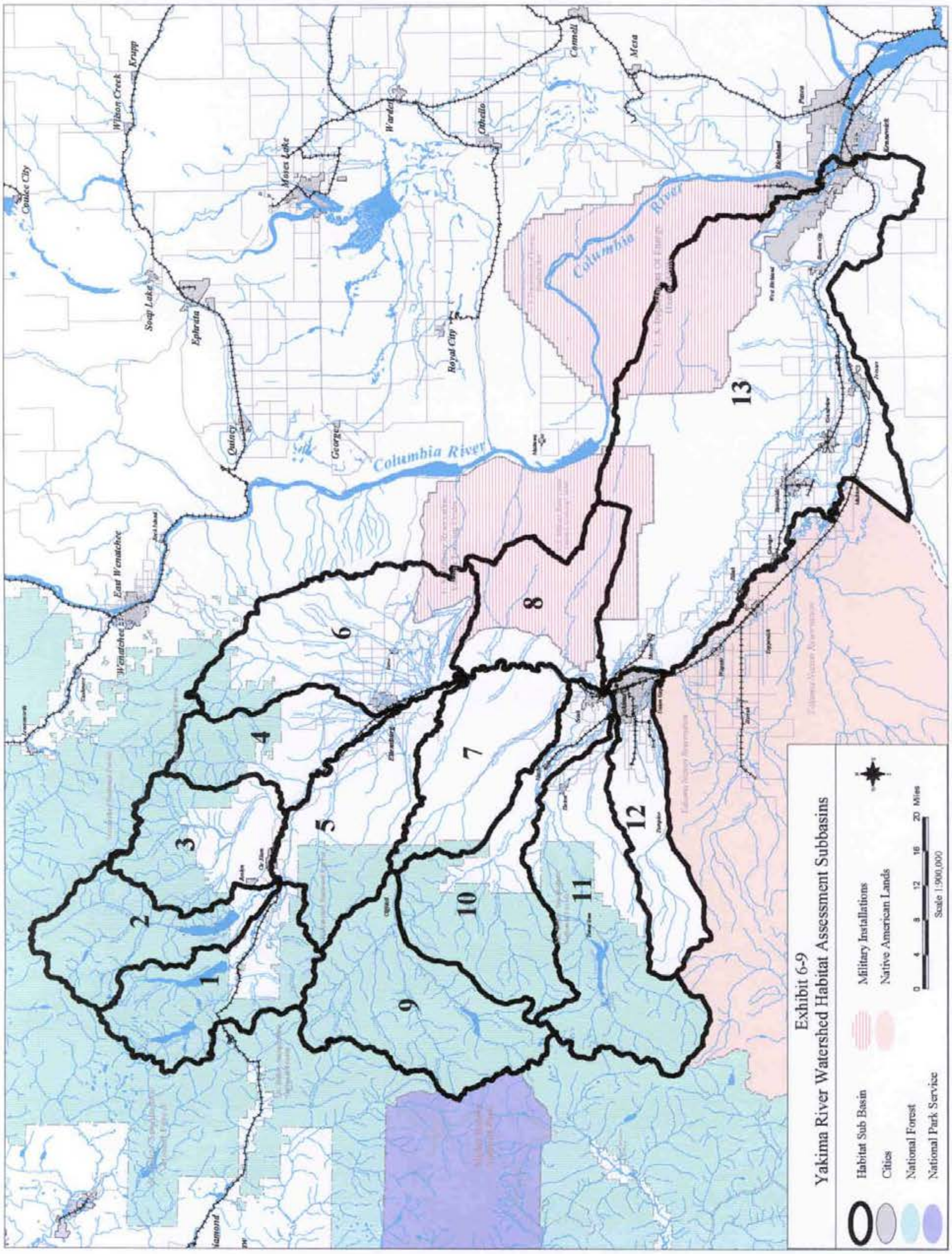
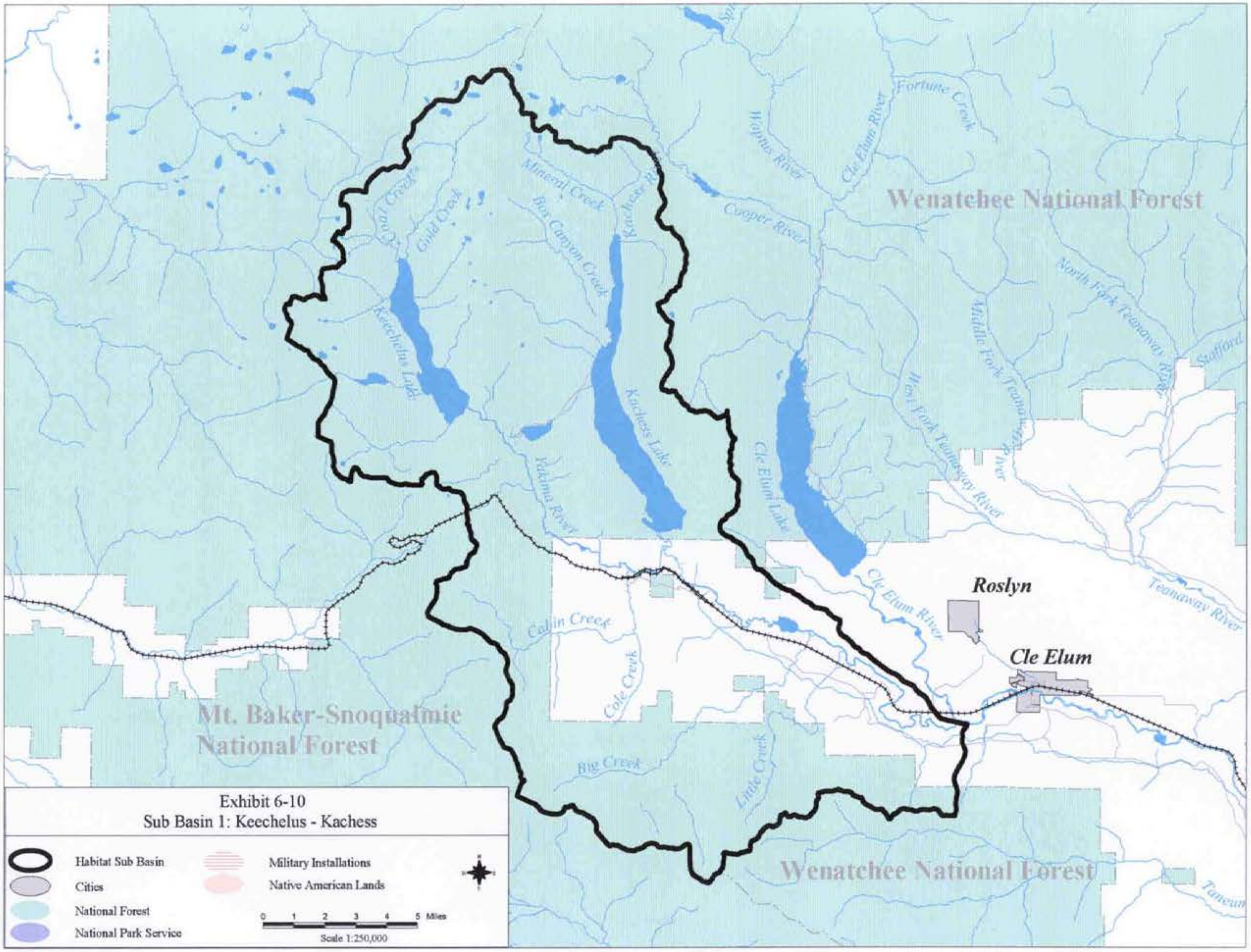


Exhibit 6-9
Yakima River Watershed Habitat Assessment Subbasins
Habitat Sub Basin
Cities
National Forest
National Park Service
Military Installations
Native American Lands
0 4 8 12 16 20 Miles
Scale 1:900,000
1
2
3
4
5
6
7
8
9
10
11
12
13
Columbia River
Columbia River
Coulee City
Wilson Creek
Krupp
Soap Lake
Ephrata
Moses Lake
Warden
Othello
Connell
Mesa
Royal City
Quincy
George
Wenatchee
East Wenatchee


Wenatchee National Forest
Mt. Baker-Snoqualmie National Forest
Wenatchee National Forest
Roslyn
Cle Elum
Keechelus Lake
Kachess Lake
Cle Elum Lake
Yakima River
Cle Elum River
Cooper River
Waptus River
Fortune Creek
Mineral Creek
Box Canyon Creek
Gold Creek
Cabin Creek
Cole Creek
Big Creek
Little Creek
North Fork Teanaway River
Middle Fork Teanaway River
West Fork Teanaway River
Teanaway River
Stafford
Exhibit 6-10
Sub Basin 1: Keechelus - Kachess
Habitat Sub Basin
Cities
National Forest
National Park Service
Military Installations
Native American Lands
0 1 2 3 4 5 Miles
Scale 1:250,000

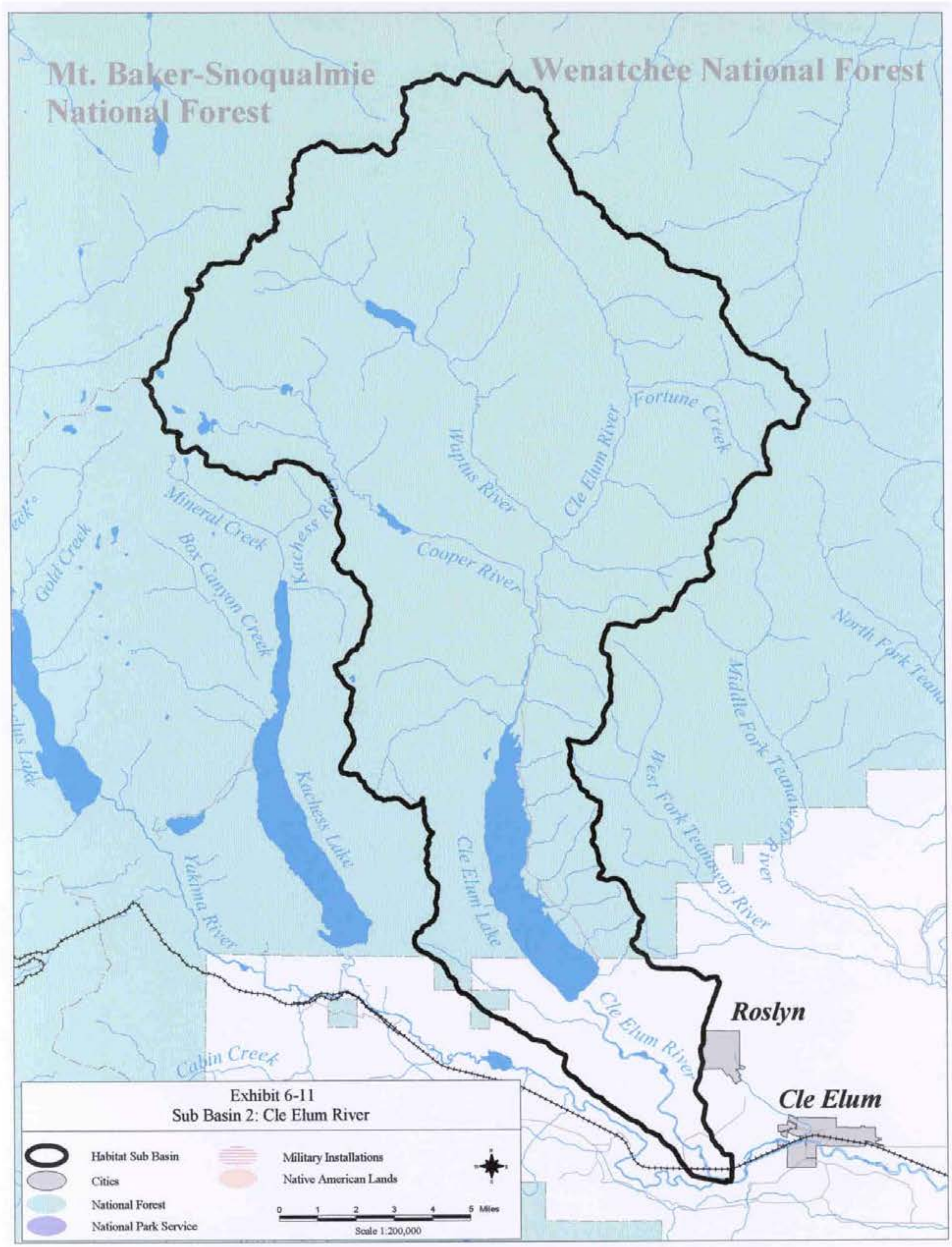
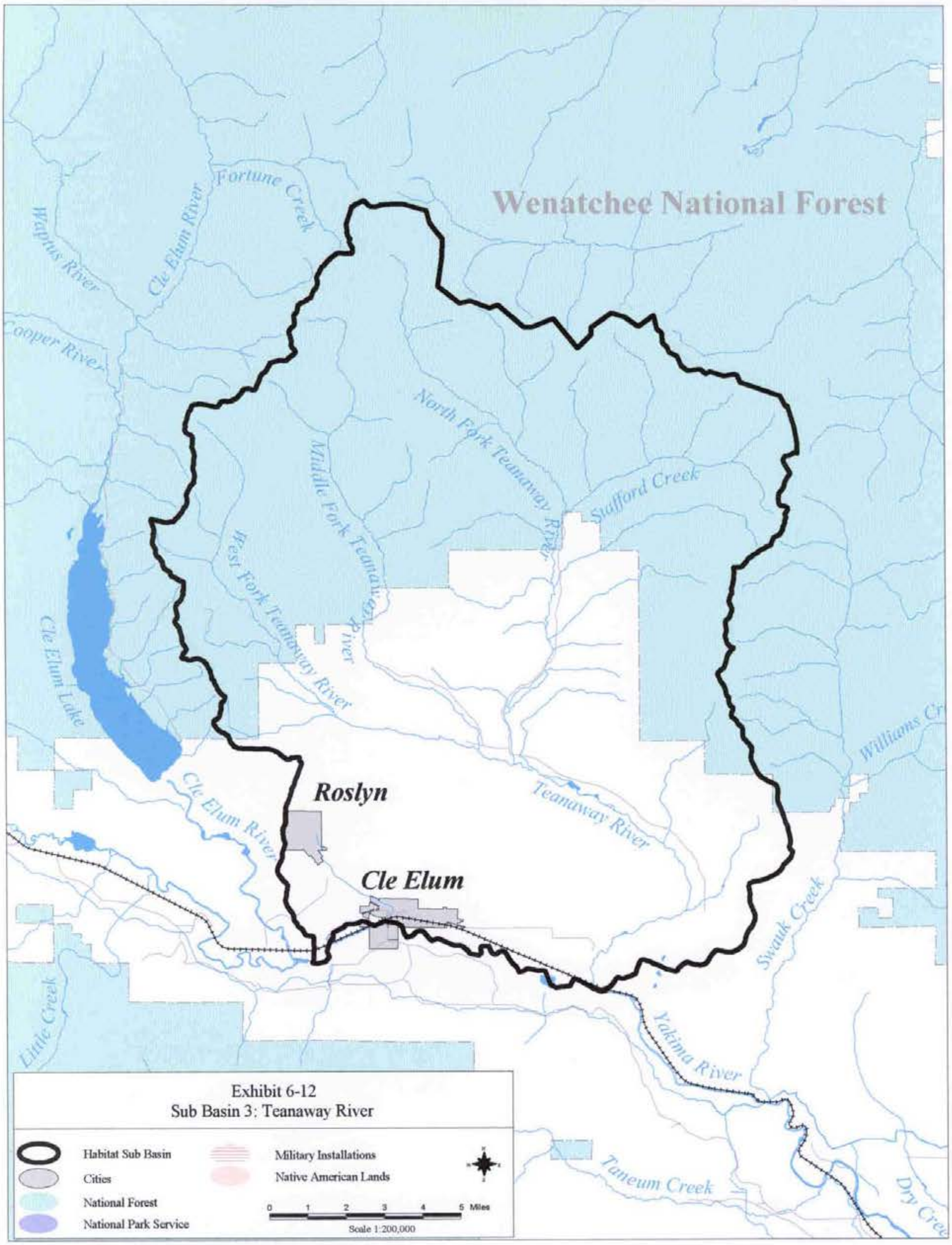


Exhibit 6-11
Sub Basin 2: Cle Elum River


Wenatchee National Forest
Fortune Creek
Cle Elum River
Waptus River
Cooper River
North Fork Teanaway River
Middle Fork Teanaway River
West Fork Teanaway River
Stafford Creek
Cle Elum Lake
Williams Cr
Roslyn
Teanaway River
Cle Elum River
Cle Elum
Swauk Creek
Little Creek
Yakima River
Taneum Creek
Dry Cre
Exhibit 6-12
Sub Basin 3: Teanaway River
Habitat Sub Basin
Cities
National Forest
National Park Service
Military Installations
Native American Lands
0
1
2
3
4
5 Miles
Scale 1:200,000

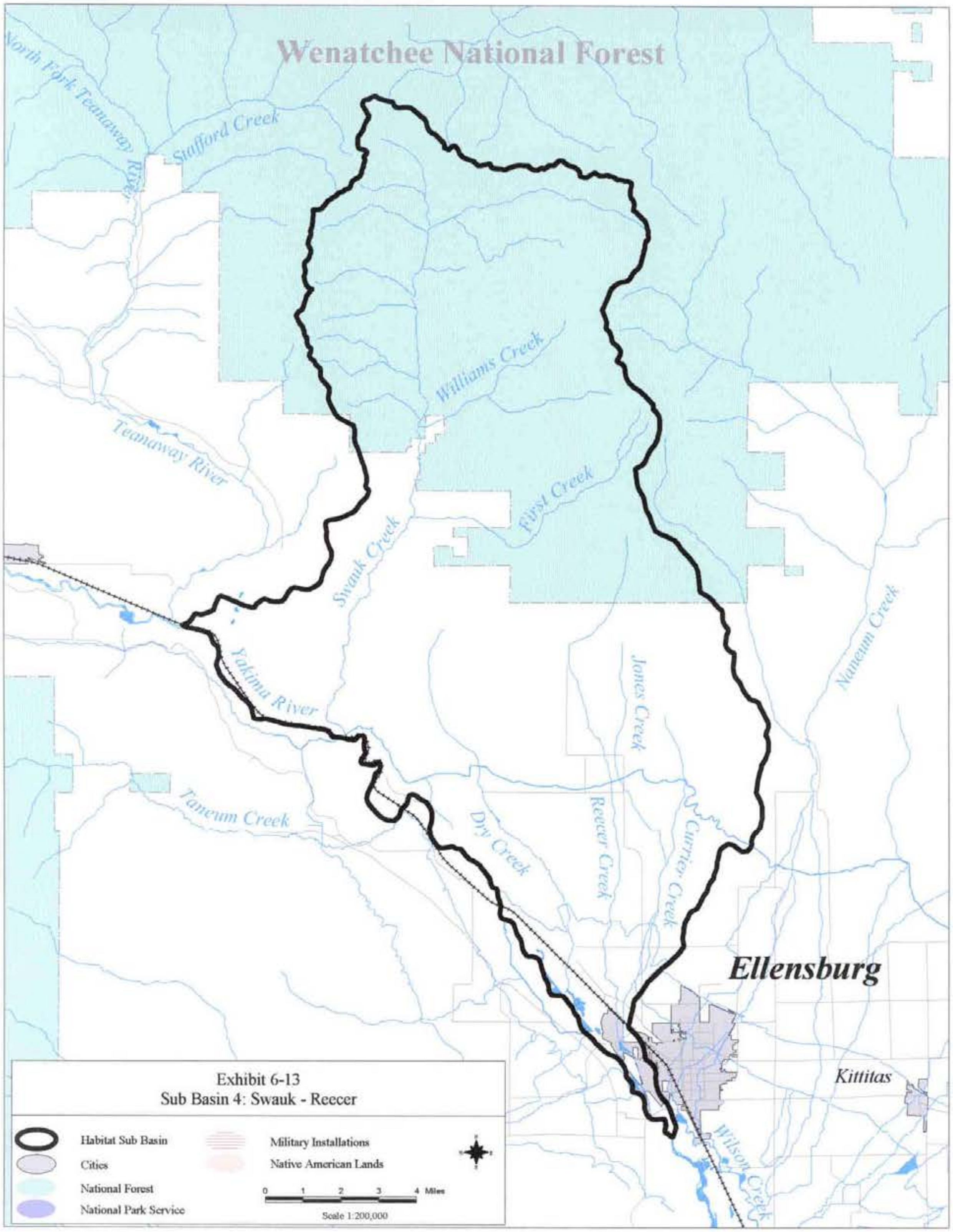
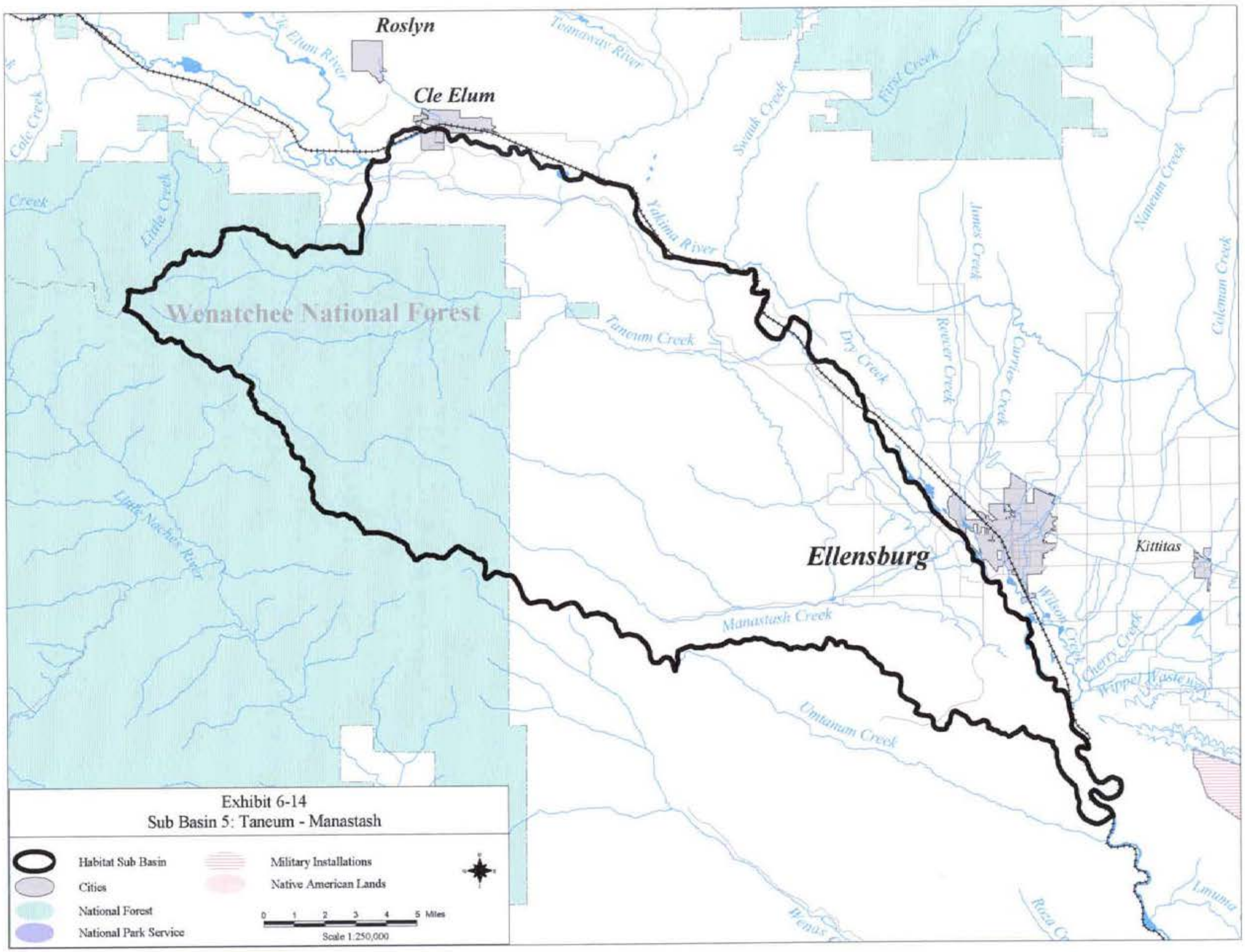
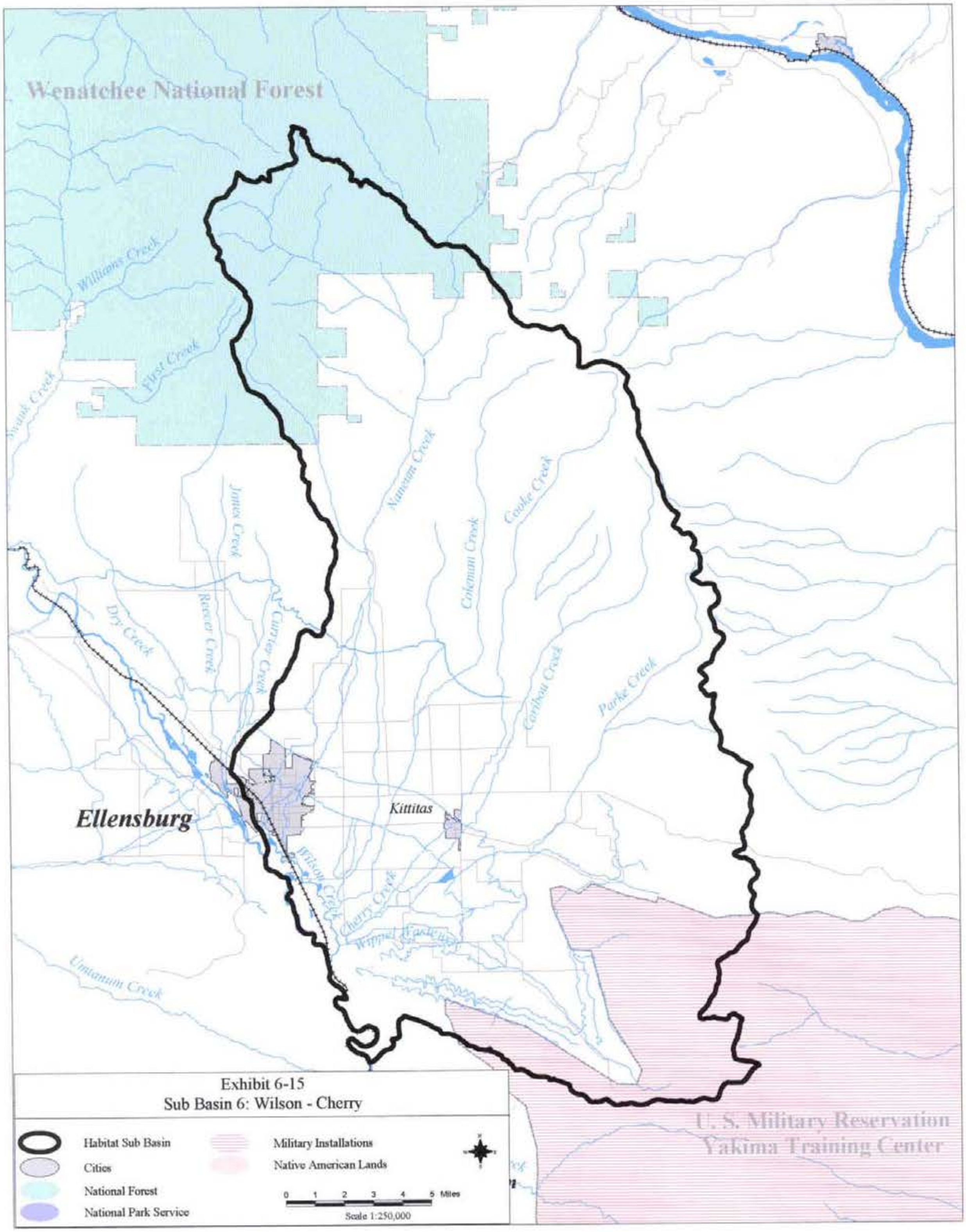


Exhibit 6-13
Sub Basin 4: Swauk - Reecer


Roslyn
Cle Elum
Ellensburg
Kittitas
Wenatchee National Forest
Cle Elum River
Teanaway River
Swauk Creek
First Creek
Naneum Creek
Coleman Creek
Jones Creek
Reecer Creek
Currier Creek
Dry Creek
Yakima River
Taneum Creek
Little Creek
Cole Creek
Little Naches River
Manastash Creek
Umtanum Creek
Wilson Creek
Cherry Creek
Wippel Wasteway
Lmuma
Roza Cr
Exhibit 6-14
Sub Basin 5: Taneum - Manastash
Habitat Sub Basin
Cities
National Forest
National Park Service
Military Installations
Native American Lands
0 1 2 3 4 5 Miles
Scale 1:250,000


Wenatchee National Forest
Williams Creek
First Creek
Swauk Creek
Naneum Creek
Cooke Creek
Coleman Creek
Jones Creek
Reecer Creek
Currier Creek
Dry Creek
Caribou Creek
Parke Creek
Ellensburg
Kittitas
Wilson Creek
Cherry Creek
Wippel Wasteway
Umtanum Creek
U. S. Military Reservation
Yakima Training Center
Exhibit 6-15
Sub Basin 6: Wilson - Cherry
Habitat Sub Basin
Cities
National Forest
National Park Service
Military Installations
Native American Lands
0 1 2 3 4 5 Miles
Scale 1:250,000

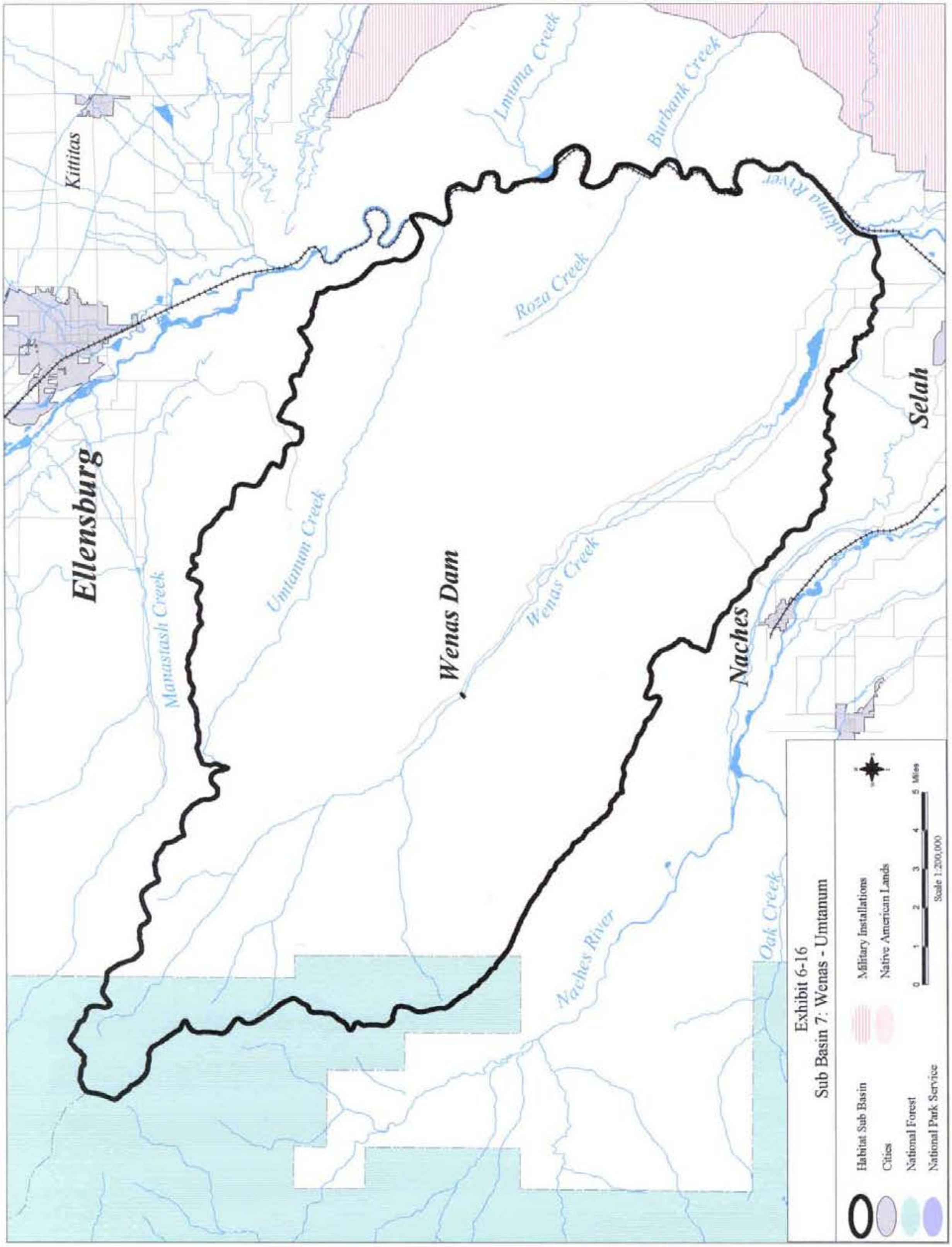
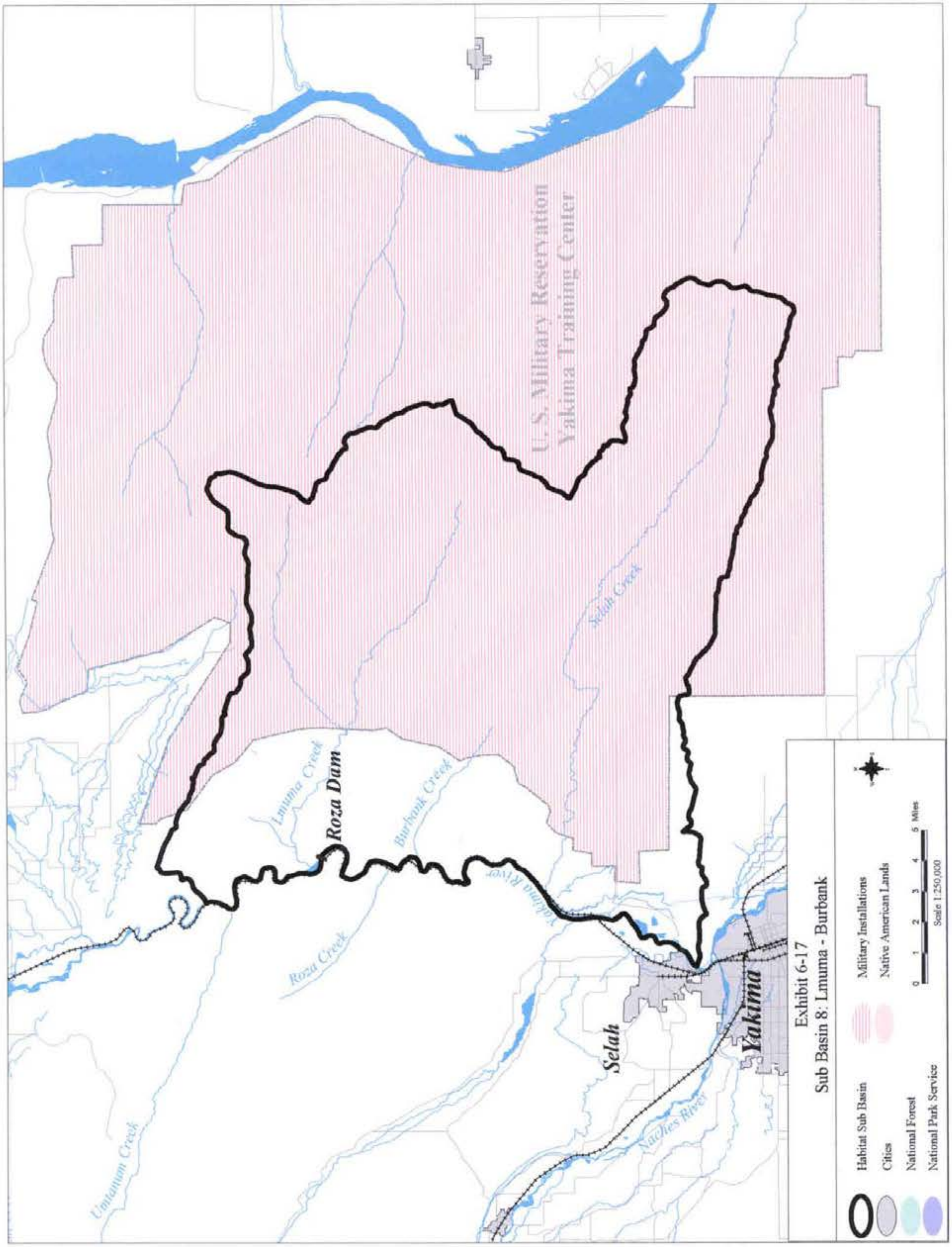


Exhibit 6-16
Sub Basin 7: Wenas - Umtanum
Habitat Sub Basin
Cities
National Forest
National Park Service
Military Installations
Native American Lands
Scale 1:200,000
Miles
Ellensburg
Kittitas
Wenas Dam
Naches
Selah
Yakima River
Roza Creek
Burbank Creek
Lmuma Creek
Umtanum Creek
Manastash Creek
Wenas Creek
Naches River
Oak Creek


U. S. Military Reservation
Yakima Training Center
Selah Creek
Lmuma Creek
Roza Dam
Burbank Creek
Yakima River
Roza Creek
Umtanum Creek
Selah
Yakima
Naches River
Exhibit 6-17
Sub Basin 8: Lmuma - Burbank
Habitat Sub Basin
Cities
National Forest
National Park Service
Military Installations
Native American Lands
Scale 1:250,000
Miles

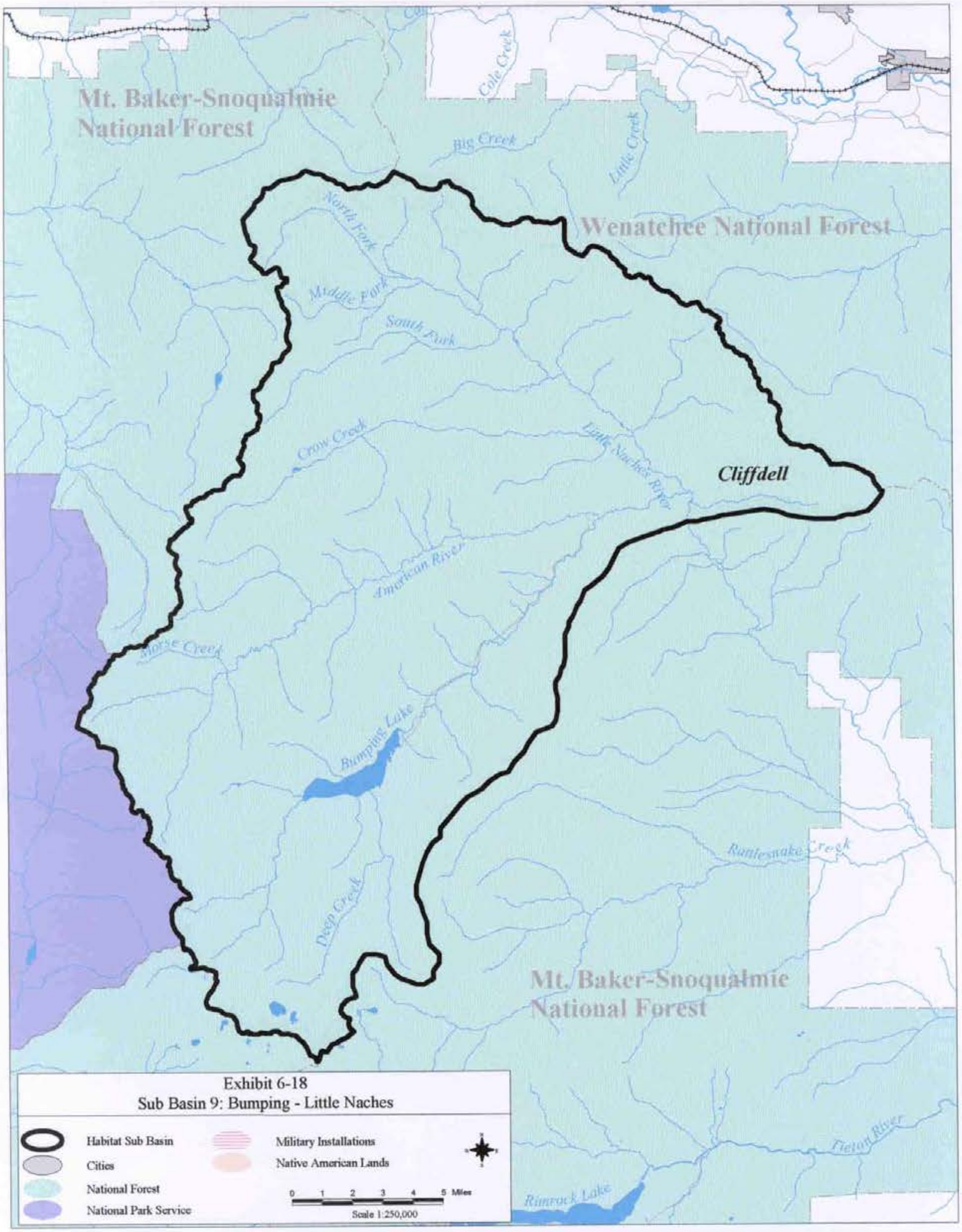


Exhibit 6-18
Sub Basin 9: Bumping - Little Naches

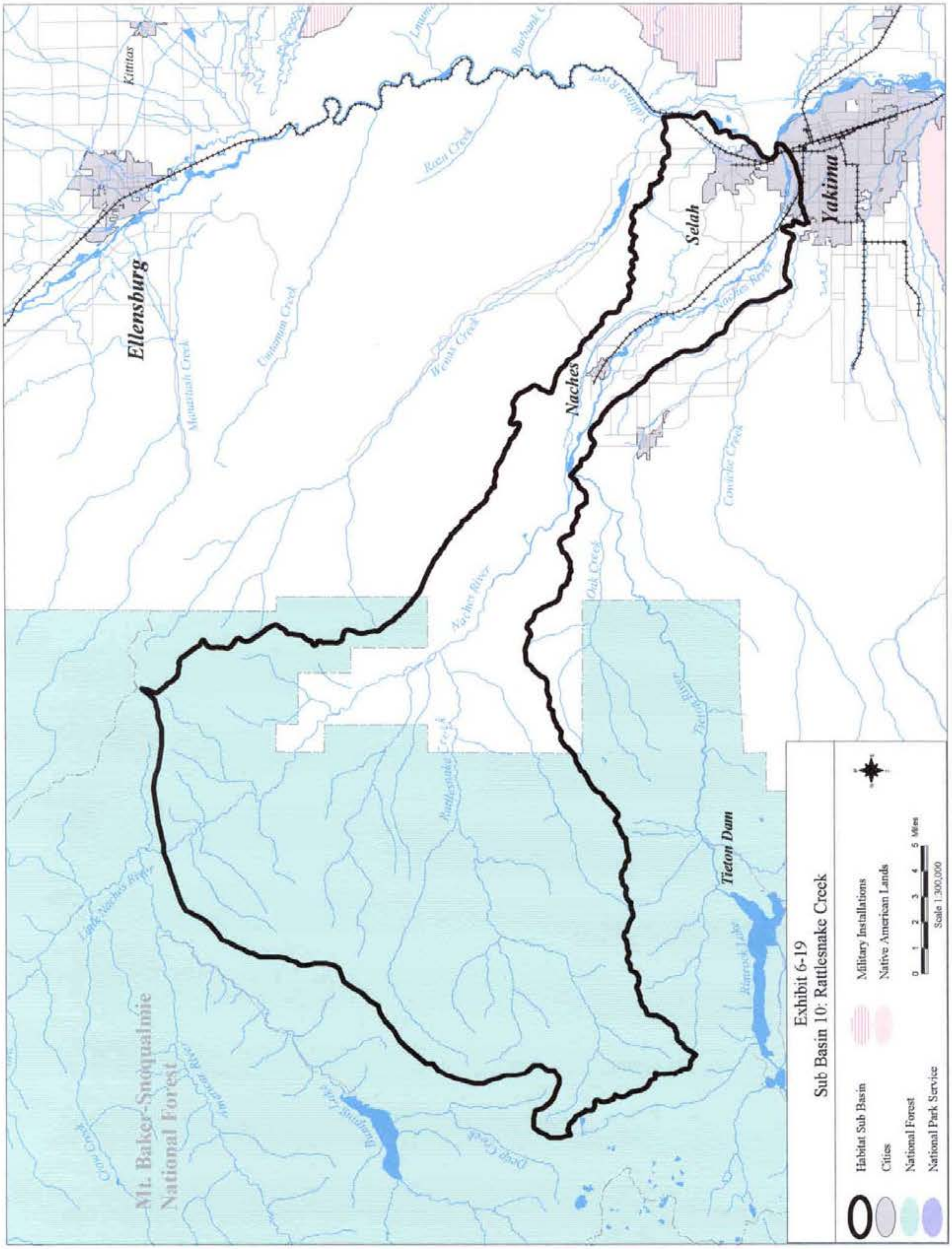


Exhibit 6-19
Sub Basin 10: Rattlesnake Creek
Habitat Sub Basin
Cities
National Forest
National Park Service
Military Installations
Native American Lands
Scale 1:300,000
Ellensburg
Kittitas
Selah
Yakima
Naches
Tieton Dam
Mt. Baker-Snoqualmie National Forest

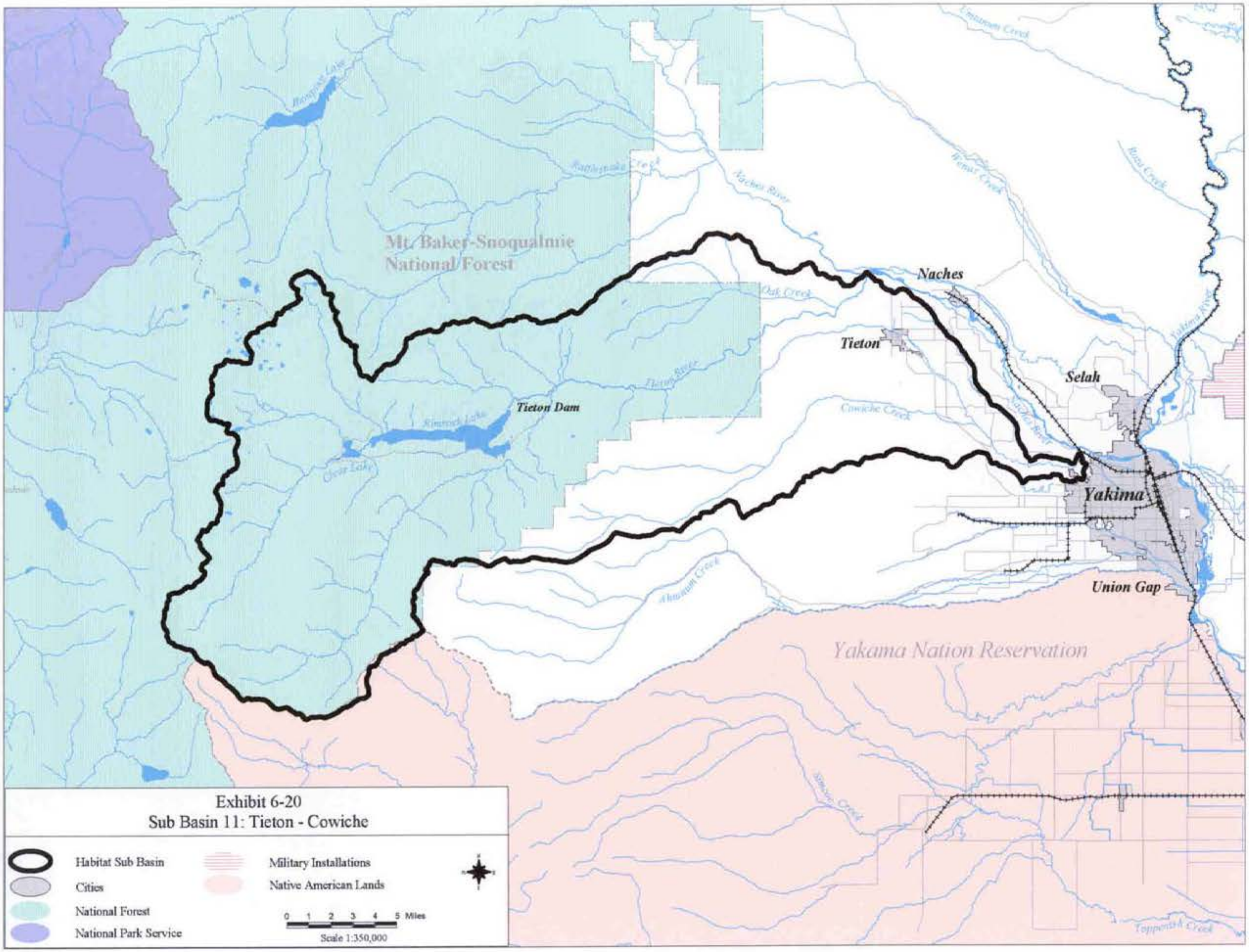


Exhibit 6-20
Sub Basin 11: Tieton - Cowiche
Habitat Sub Basin
Cities
National Forest
National Park Service
Military Installations
Native American Lands
0 1 2 3 4 5 Miles
Scale 1:350,000
Mt. Baker-Snoqualmie
National Forest
Yakama Nation Reservation
Tieton Dam
Naches
Tieton
Selah
Yakima
Union Gap
Rimrock Lake
Clear Lake
Oak Creek
Cowiche Creek
Ahtanum Creek
Naches River
Tieton River
Rattlesnake Creek
Wenas Creek
Yakima River
Toppenish Creek
Umtanum Creek
Bumping Lake

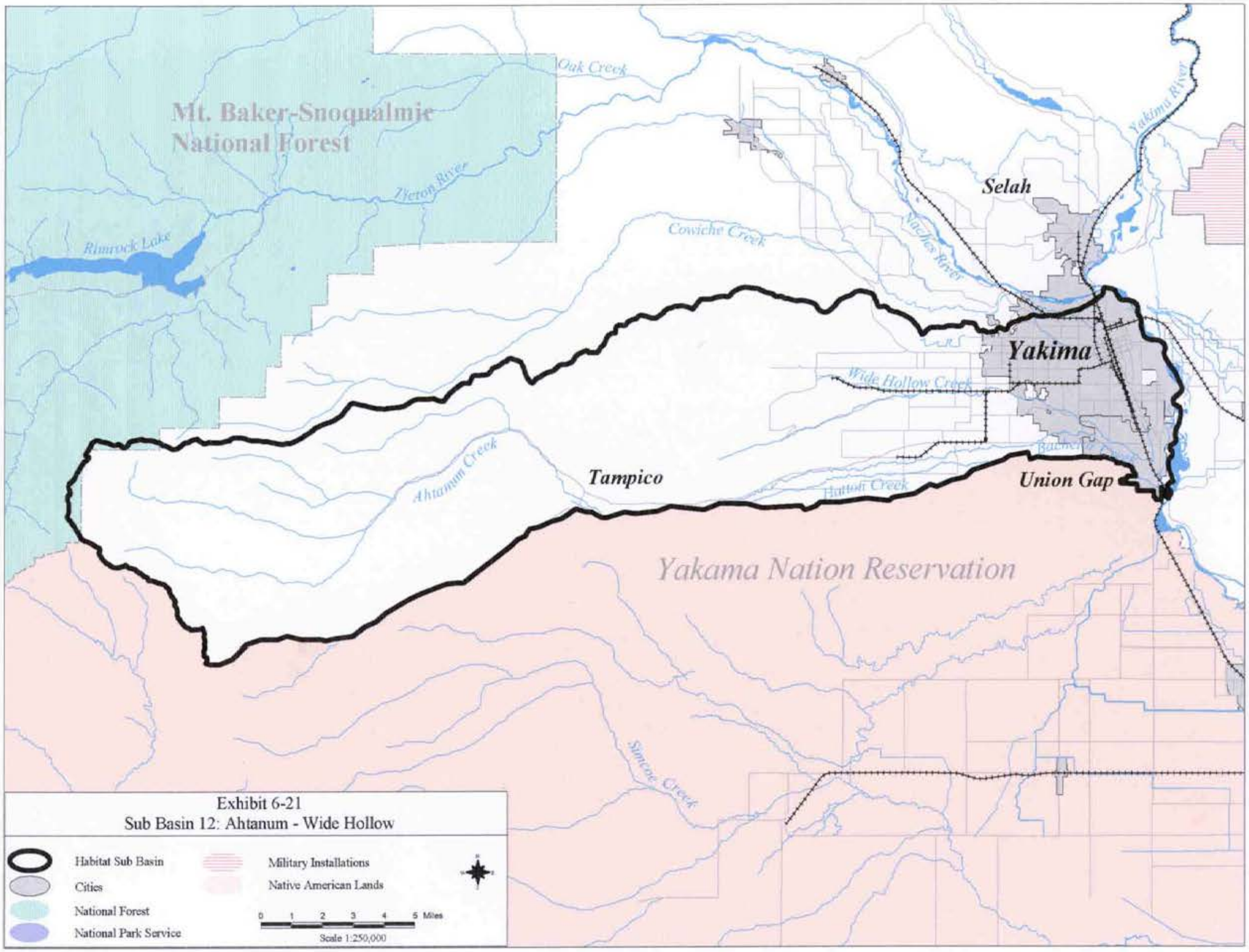


Exhibit 6-21
Sub Basin 12: Ahtanum - Wide Hollow
Habitat Sub Basin
Cities
National Forest
National Park Service
Military Installations
Native American Lands
0 1 2 3 4 5 Miles
Scale 1:250,000
Mt. Baker-Snoqualmie National Forest
Oak Creek
Tieton River
Rimrock Lake
Cowiche Creek
Naches River
Yakima River
Selah
Yakima
Wide Hollow Creek
Ahtanum Creek
Tampico
Hatton Creek
Union Gap
Yakama Nation Reservation
Simcoe Creek

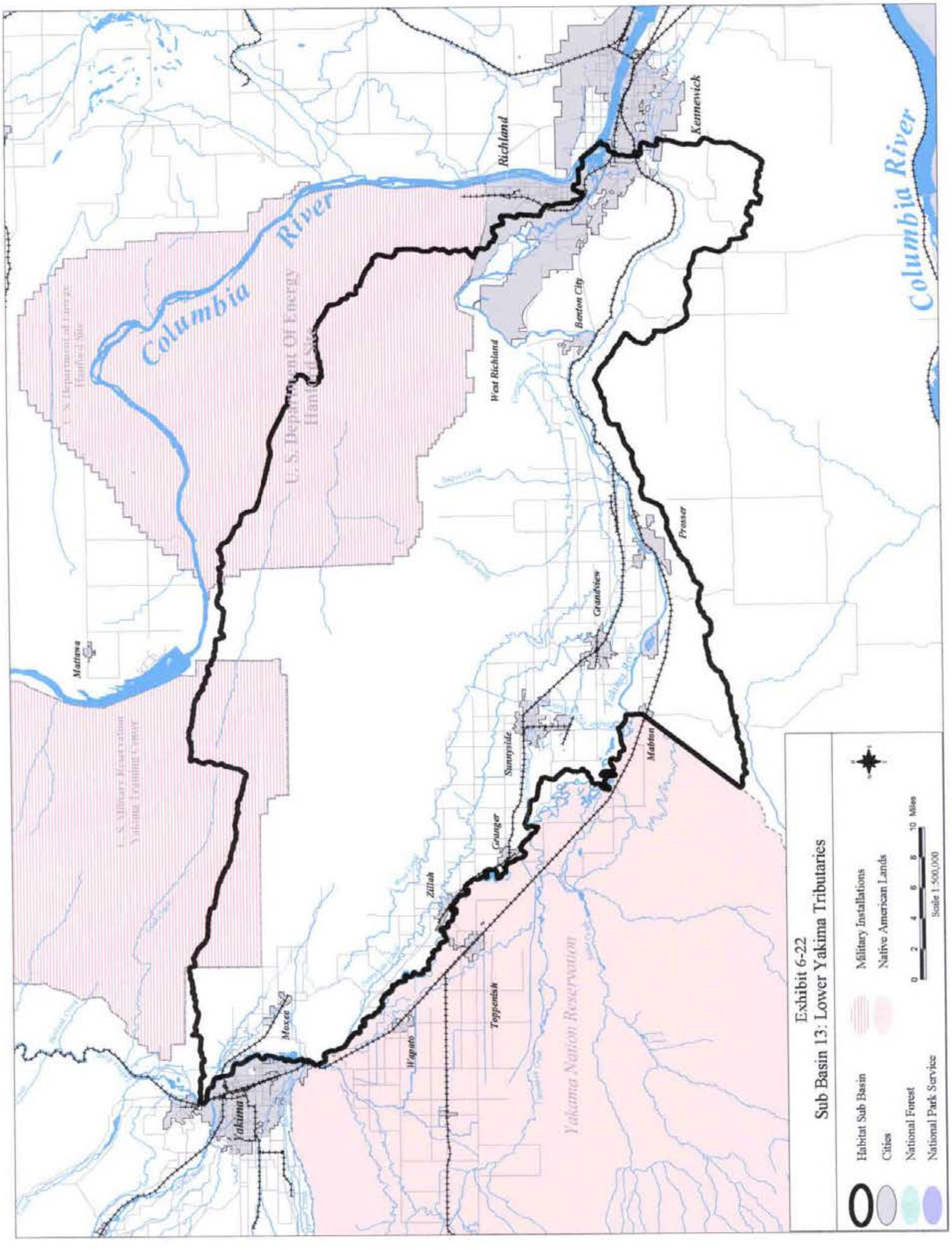


Exhibit 6-22
Sub Basin 13: Lower Yakima Tributaries
Habitat Sub Basin
Cities
National Forest
National Park Service
Military Installations
Native American Lands
0 2 4 6 8 10 Miles
Scale 1:500,000
Columbia River
Columbia River
U.S. Department Of Energy Hanford Site
Yakama Nation Reservation
Kennewick
Richland
West Richland
Benton City
Prosser
Grandview
Sunnyside
Mabton
Granger
Zillah
Toppenish
Wapato
Moxee
Yakima
Mattawa

Appendix 3-A

Application of Evaluation Criteria to Surface Water Alternatives

Appendix 3-A
Application of Evaluation Criteria to Surface Water Alternatives

This Appendix applies the 8 evaluation criteria described in Section 3.7 to the four Surface Water Management Alternatives.

The four alternatives considered are:

- Alternative I-1: Major Storage Enhancement, with Targeted Improvements in Water-use Efficiency and Additional Actions
- Alternative I-2: Medium Storage Enhancement, with Targeted Improvements in Water-use Efficiency and Additional Actions
- Alternative I-3: Reliance on Efficiency Improvements, Water Reuse and Voluntary Transfers, with No Storage Enhancement
- Alternative I-4: No Action

The criteria used include four related to effectiveness; and four related to feasibility:

Table 1
Criteria

Effectiveness Criteria	Feasibility Criteria
Overall effectiveness	Legal authority
Cost-effectiveness	Approvals and Permits
Flexibility over time	Cost and funding sources
Environmental Impacts	Integration with related programs

For full definition of the four alternatives and the 8 criteria, see Section 3 of the Watershed Plan.

In the following subsections, each alternative is considered in turn. For each alternative, all 8 criteria are discussed in terms of how they apply to the alternative. It should be noted that more detailed discussion of environmental impacts is presented in Appendix 3-B.

Alternative I-1: Major Storage Enhancement, with Targeted Improvements in Water-use Efficiency and Additional Actions

Overall Effectiveness

Alternative I-1 would provide a major enhancement of storage capacity in the Yakima Basin. Several projects have been identified that could provide a large volume of additional storage capacity. The largest of these projects include: construction of a new Wymer Reservoir, enlargement of the existing Bumping Reservoir, and construction of Black Rock Reservoir. In its largest proposed configuration, Black Rock Reservoir alone could serve as the storage project for this alternative. None of the other projects by itself is large enough to fully meet the Planning Unit's objectives. Therefore, if the other projects are developed, at least two of them would be needed, under this alternative.

This alternative also includes implementation of a selected set of water conservation plans developed by irrigation districts pursuant to the Yakima Basin Water Enhancement Project, as well as other measures such as water rights transfers and municipal wastewater reuse. However, the major benefits of this alternative in terms of meeting Planning Unit objectives come from the large storage enhancements. Therefore, this section focuses on the ability of the large storage projects to meet the Planning Unit's objectives.

The effectiveness of this alternative in meeting Planning Unit objectives was analyzed through the hydrologic modeling effort described in Section 3.5. This modeling effort expressly considered how various combinations of storage projects would contribute to three of the Planning Unit's objectives:

- ❑ Improve reliability of surface water supply for irrigation use;
- ❑ Provide for growth in municipal, domestic and industrial demand; and
- ❑ Improve instream flows for all uses, with emphasis on improving fish habitat;

With regard to Alternative I-1, two main "sub-alternatives" were modeled. One of these, labeled I-1A, relies entirely on water from within the Yakima River Basin. Modeling of this sub-alternative was performed for several storage projects, including: constructing Wymer Reservoir, enlarging Bumping Lake, operating Lake Cle Elum at a higher pool elevation; and diverting high flows from Cabin and Silver Creeks into Kachess Reservoir. The other sub-alternative, labeled I-1B, utilizes water from the Columbia River, stored in the proposed Black Rock Reservoir. For modeling purposes, under this sub-alternative the largest proposed configuration of Black Rock Reservoir was used (yielding 500,000 acre-feet per year).

An additional element included in modeling of *both* sub-alternatives was implementation of water conservation plans that have been prepared for Kittitas

Reclamation District (KRD), Roza Irrigation District, and Sunnyside Valley Irrigation District (above Parker); and, Kennewick Irrigation District and Columbia Irrigation District (below Parker).

A complete presentation of modeling results in presented in the technical memorandum, Hydrologic Modeling of Surface Water Alternatives (MWG, 2002a). In summary, for both of the sub-alternatives I-1A and I-1B, the hydrologic modeling demonstrated that:

- *Alternative I-1 is very effective in improving reliability of surface water supply.* In addition to providing full supply of non-proratable entitlements, at least 70 percent of proratable entitlements can be provided, even in dry years. The exact benefits for proratable supplies vary, depending on how the stored water is used to meet multiple objectives. As an example, if a portion of the stored water were used in part to maintain stream flows of at least 200 cfs in the Yakima River below Keechelus Reservoir, and the rest were used to improve reliability, the delivery to proratable users in very dry years such as 1994 could be increased by approximately 37 percent. This would allow delivery of over 85 percent of entitlements to proratable users.
- *Alternative I-1 could provide sufficient supply to serve projected growth in demand in the municipal and industrial sector through year 2050.* The modeling effort accounted for these demands by assuming they would be met fully by surface water. This is a conservative assumption, in that many communities are more likely to serve growth in demand from ground water supplies. However, in cases where ground water pumping is deemed to have an undesirable impact on surface water flows, the stored water in Alternative I-1 could be released to fully mitigate those impacts. Regardless of whether the stored water were used to supply municipal and industrial needs directly, or were used to mitigate the effects of pumping on surface flows, Alternative I-1 provides sufficient storage capacity that these benefits can be achieved simultaneously with the benefits to irrigation supply and instream flow.

  For the City of Yakima specifically, the improvements in reliability discussed above would offer considerable benefits in dry years. The City of Yakima is called out specifically here, since it is the largest community that currently relies mainly on surface water. The City depends, in part, on proratable supplies from the Naches River. This supply would be more available in dry years, compared with the status quo, thereby assisting the City meet the needs of its residents.
- *Alternative I-1 would provide significant improvements in flexibility for management of stream flows in the mainstem system.* The exact improvements depend on how the water is used in system operations, and choices about which reaches should be targeted for improved stream flow. The hydrologic modeling

explored improvements in stream related to several different scenarios[1]. These are: securing flows of at least 200 cfs in the Yakima River below Keechelus Reservoir; eliminating the "flip-flop" between the Naches and Upper Yakima reservoirs; meeting Title XII target flows at Parker; and achieving flow recommendations of the Instream Flow Technical Advisory Group (IFTAG) at Parker. With the exception of the IFTAG flow targets, all of these flow objectives can be met under Alternative I-1, while still achieving the desired improvement in reliability for irrigation supply. In regards to the IFTAG targets, the Black Rock project could deliver these flows while achieving the reliability goal, even in dry years. The other projects would not meet the reliability goal in some years, but would still allow IFTAG flows to be met with significant *improvements* in reliability.

Charts displaying these results graphically can be found in Section 3.5 of the Watershed Plan.

Results from the hydrologic modeling can be combined with available information on economic output to reach the following conclusion:

- *Alternative I-1 will provide significant economic benefits to the Yakima Basin.* This finding is based on the above findings with respect to reliability of irrigation supply, coupled with the results of a 1997 study by Northwest Economic Associates (NEA) titled *The Economic Benefits of Enhanced Water Supplies in the Yakima River Basin.* This study was reviewed in a technical memorandum developed in the watershed planning process, titled "Reliability of Surface Water Supply for Irrigation, Yakima River Basin (MWG, 2002b). Benefits were estimated as direct benefits in terms of the value of crops produced; and indirect benefits in regional output from industries linked to agriculture. The NEA study estimated that economic benefits on an average annual basis would range from $16 million to $30 million, depending on the size of the storage capacity increase. In dry years this effect would be magnified considerably, ranging from $112 million to $244 million. For comparison purposes, the total direct and indirect value of crop production in the Yakima Basin in 1997 was estimated to be $2.5 billion. This is approximately 38 percent of regional gross economic output for Kittitas, Yakima and Benton counties combined.

[1] The Planning Unit notes that the hydrologic modeling necessarily simplifies the objective of flow management by specifying a short list of flow levels at specific points in the system. The Planning Unit does not intend that flow management programs be limited to these specific scenarios. Instead, the results show whether, and how much flexibility can be improved for managing flows system-wide. In this regard, the scenarios should be considered illustrative, but not prescriptive.

Cost-Effectiveness

For the cost-effectiveness comparison, an estimate of cost per acre-foot of water yield was developed, for all of the various projects defined within each alternative (i.e. storage projects, efficiency projects, etc.). This cost was calculated for both maximum yield and dry-year yield. Costs presented here focus on dry-year yield, as that is the measure most applicable to the Planning Unit's objectives. This cost effectiveness measure is valuable, but can also potentially be misleading. That is because, while the cost per acre foot can be calculated, the effectiveness of the four alternatives various widely, in terms of their ability to meet Planning Unit objectives. This should be factored in, in comparing cost effectiveness.

As discussed in Section 3.3.3 of the Watershed Plan, the projects considered within Alternative I-1 have a range of estimated costs per acre-foot (see Table 3-4). These include both capital costs and operations and maintenance (O&M) costs, in year 2002 dollars, on a present value basis.

Section 3.6 of this Plan groups these costs for the various alternatives considered. Based on these projects, a weighted average of cost per acre-foot can be calculated for Alternative I-1 as a whole (see Table 3-7). The weighted average "weights" the cost of the various projects based on how much water they yield. For sub-alternative I-1A, which would involve all of the projects in the above table except Black Rock, the weighted average is $2,000 per acre foot of yield. For sub alternative I-1B, which would involve construction of the Black Rock Reservoir and the three water use efficiency projects listed in the above table, the weighted average is $3,200 per acre foot of yield. These compare with costs of the other alternatives that range from $1,300 to $2,100 per acre foot of yield.

Flexibility Over Time

As discussed above, Alternative I-1 involves a combination of storage projects and water conservation projects. The greatest benefits related to Planning Unit objectives accrue from the storage projects. Moreover, the number and/or magnitude of storage projects is the feature that distinguishes Alternative I-1 from the remaining three alternatives. Therefore, in discussing the criterion of "flexibility over time," this discussion will focus on the storage features.

With regard to the ability to make changes in response to new conditions or improved information, storage projects can be considered from two separate perspectives. On the one hand, *installation of a major structure on the landscape, together with the reservoir pool and associated features, should be considered essentially permanent. From this standpoint, the Alternative is relatively inflexible.*

On the other hand, the installation of additional storage capacity offers significant operational flexibility for the Yakima River system. For example, as described in the technical memorandum "Hydrologic Modeling of Surface Water Alternatives (MWG, 2002a), the stored water can be used in a variety of different ways, to meet irrigation needs, municipal and industrial needs, and instream flow needs. The stored water would likely be used in different ways from year to year, depending on moisture conditions and snowpack. With regard to instream flow, the stored water can be used to meet a wide range of desired flow levels, in a number of different reaches of the mainstem Yakima/Naches River systems. For example, depending on flow conditions in a particular year, evolving scientific information about the fisheries response, and changing policy directives over time, the increased storage capacity could be used to achieve different flow objectives. *In this sense, because Alternative I-1 offers a greater increase in storage capacity, it provides greater flexibility than the other three alternatives.*

It should be noted that among the storage projects that could be installed under Alternative I-1, two are "lowland" reservoirs that are located in areas where there are currently no reservoirs, and closer to diversion points for the largest demands in the system (e.g. Roza, SVID and/or Wapato). These two projects are Black Rock and Wymer. Because of the location of these two reservoirs, in comparison with other projects in the Naches arm and Upper Yakima mainstem, these two projects may offer greater flexibility in terms of system operation.

Environmental Impacts

The environmental impacts of this alternative are discussed in Appendix 3B; and are also summarized in Section 3.12 of the Watershed Plan. For a summary, see Table 3-9 in Chapter 3. This alternative would have significant environmental impacts, but also offers the opportunity to improve stream flows to benefit fish.

Legal Authority

It is assumed that the U.S. Bureau of Reclamation would construct and operate any of the storage projects or storage improvements considered in Alternative I-1. These activities are generally consistent with the Bureau's mission and legal authorities. However, projects would need to be specifically authorized by the U.S. Congress.

The Bureau has "withdrawn" unappropriated waters of the Yakima River Basin for federal purposes, such as operation of the Yakima Irrigation Project. This withdrawal has been periodically extended by the Washington State Department of Ecology[2]. Therefore, use of Yakima Basin waters under sub-alternative I-1A would appear to be generally consistent with this withdrawal.

In contrast, sub-alternative I-1B, involves use of water from the Columbia River (with return flows rejoining the Columbia River at Kennewick). This action would

[2] See Watershed Assessment, p. 3-12.

likely involve additional legal issues and could potentially be subject to legal challenge.

With regard to the water conservation projects that are part of Alternative I-1A, these projects have already been authorized by Congress under YRBWEP.

In summary, legal authorities for implementation of Alternative I-1 are similar to those for the remaining alternatives, with one exception: if waters of the Columbia River are required (sub-alternative I-1A), additional legal issues will likely arise that are not present for the remaining three alternatives.

Approvals and Permits

A variety of permits and approvals would be required for each project in Alternative I-1. *This alternative would likely be the most complex in terms of obtaining permits and approvals, because of the major storage enhancements included in this alternative, which inherently involve a range of permitting needs*. In the case of sub-alternative I-1A, there are two major reservoir projects, two minor reservoir projects, and several water-use efficiency projects. In the case of sub-alternative I-1B, the Black Rock reservoir would require permits and approvals, which would involve elements in both the Yakima River Basin and Columbia River Basin. Many of these will also involve consultation with the federal fish and wildlife agencies, under the Endangered Species Act.

With respect to the storage projects alone, the following table illustrates some of the major permitting processes involved. This list is not intended to be comprehensive at this time.

Table 2
Permitting Processes – Alternative I-1

Permit or Approval	Sub-alternative I-1A Wymer, Bumping, etc.	Sub-alternative I-1B Black Rock Reservoir
Permit to appropriate surface water	✓	✓
Reservoir Storage Permit	✓	✓
Consultation Under ESA	✓	✓
Wetlands Modification (CWA Section 404)	✓	✓
Water Quality Certification (CWA Section 401)	✓	✓
Approvals for use of public lands or condemnation of private lands	✓	✓
Hydraulic Permit Approval	✓	✓
Archaeological Approval	✓	✓
Rights of Way for access roads, canals, power lines, etc.	✓	✓

In addition, one or more project-level Environmental Impact Statements (EIS) would need to be prepared, as part of the process for obtaining many of the permits and approvals listed above.

The other elements of this alternative, such as water-use efficiency projects, water rights transfers, etc. also require specific approvals. However, these are generally less complex, as discussed under Alternative I-3, below.

Total Cost and Funding Sources

This alternative would be the most expensive to implement, of the three "action" alternatives. This is due to the large capital cost associated with major enhancements of storage capacity.

In addition, some of the specific projects that could be constructed under Alternative I-1, such as Wymer and Black Rock, would involve high operating expenses due to the power needs associated with pumping water over substantial lifts. In the case of Wymer Reservoir, this would involve pumping water up from the Yakima River to the top of the reservoir. In the case of Black Rock Reservoir, this would involve lifting water from the elevation of the Columbia River to the elevation of the reservoir (note: in both cases some of the energy costs can be recovered through power generation when the water is released).

The cost of additional activities under Alternative I-1 would add to that of storage enhancement. Costs have been estimated for the irrigation district efficiency improvements included in this alternative.

Table 3-6 (see Chapter 3) displays the major costs estimated for Alternative I-1. The total cost, expressed as the present value of capital plus O&M costs, in year 2002 dollars, ranges from $1.07 billion to $2.58 billion, depending on which projects are included.

Like the other "action" alternatives, due to the magnitude of these costs, it is likely that a combination of federal, state and local sources would be needed to plan, design, construct and operate the facilities, with the largest share coming from the federal government.

Some funds have already been appropriated by Congress for the efficiency improvements, under YRBWEP. All remaining funds would need to be appropriated or requested from existing funding sources.

Integration with Related Programs

In general, as with the other alternatives, *Alternative I-1 can be readily integrated with existing programs*. These include existing Yakima Project operations by USBR; implementation of YRBWEP, application of the 1945 Consent Decree, and existing activities of the various irrigation districts and communities that receive Project water.

As discussed above, it is assumed that USBR would construct and operate new or improved storage facilities. USBR currently has the technical and administrative capability to plan, contract and oversee construction, and operate the facilities identified under Alternative I-1. The increased extent and complexity of operating the Yakima Project with the additional projects may require some staffing increases.

If new or improved storage facilities are used to directly supply water to municipal and industrial water users, outside the framework of current entitlements, then specific authorizations will need to be developed for this purpose. The same may be true of water used for instream flow purposes, or to offset ground water pumping.

Alternative I-2: Medium Storage Enhancement, with Targeted Improvements in Water-use Efficiency and Additional Actions

Overall Effectiveness

Like Alternative I-1, Alternative I-2 involves enhancing storage capacity in the Yakima Basin. However, the increase in storage capacity is smaller than in Alternative I-1. Alternative I-2 would involve constructing only one "medium" sized storage project, such as either Wymer Reservoir or expansion of Bumping Lake. In addition, like Alternative I-1, this alternative includes implementation of a selected set of water conservation plans and other actions. With regard to these actions, Alternative I-2 is the same as I-1. Therefore, the primary difference between Alternative I-1 and I-2 is the magnitude of the storage enhancement.

The effectiveness of this alternative in meeting Planning Unit objectives was analyzed through the hydrologic modeling activity described in Section 3.5. A complete presentation of modeling results is presented in the technical memorandum, "Hydrologic Modeling of Surface Water Alternatives" (MWG, 2002a). In summary, the hydrologic modeling demonstrated that:

- *Alternative I-2 would improve reliability of surface water supply, but not as much as Alternative I-1.* In addition to providing full supply of non-proratable entitlements, at least 70 percent of proratable entitlements can be met in most years. However, in some dry years, the 70 percent goal cannot be met (although even in those years, reliability is improved). The ability of this alternative to improve reliability depends on how the stored water is used to meet multiple objectives. As an example, if a portion of the stored water were used in part to maintain stream flows of 200 cfs below Keechelus Reservoir, and the rest were used to improve reliability, the delivery to proratable users in dry years such as the 1992-1994 time period could be increased by approximately 6 to 18 percent.

- *Alternative I-2 could provide sufficient supply to serve projected growth in demand in the municipal and industrial sector through year 2050.* However, because Alternative I-2 provides less yield, and does not fully meet the 70% reliability objective, *use of Alternative I-2 for this purpose may conflict with the reliability objective in some dry years.* For the City of Yakima specifically[3], results of Alternative I-2 are similar to those discussed above, under Alternative I-1.
- *Alternative I-2 could improve the flexibility of the Yakima Project reservoir system by providing storage and releases closer to the largest demands in the Basin.* The USBR will be able to respond more quickly to changes in demands from water users downstream of Wymer Reservoir and possibly reduce flow fluctuations in the mainstem Yakima River. However, the volume of storage is not sufficient to provide a large degree of flexibility over a long period of time during drought years.

Charts displaying these results graphically can be found in Section 3.5 of the Watershed Plan.

Results from the hydrologic modeling can be combined with available information on economic output to reach the following conclusion:

- *Alternative I-2 will provide significant economic benefits to the Yakima Basin, but these benefits are less than provided under Alternative I-1.* For further information, see discussion above, under Alternative I-1. The difference in economic benefits is based on the fact that Alternative I-2 does not increase reliability of supply as much as Alternative I-1, and therefore the benefits in terms of crop production and indirect economic activity are not as large. Alternative I-2 would provide increased yield of less than 200,000 acre-feet, and the NEA report does not include estimates of benefits for increases in supply of less than this amount. However, it is reasonable to expect that the benefits would be less than the lower end of the range reported by NEA. Based on this assumption, benefits would be less than $16 million on an average annual basis; and less than $112 million in dry years when water deliveries to proratable users are cut the most. As with the discussion under Alternative I-1, these estimates include both the value of increased crop production, and indirect benefits in regional output from industries linked to agriculture.

[3] As discussed above, the City of Yakima is called out specifically, because it is the largest community that currently relies mainly on surface water.

Cost-Effectiveness

As discussed previously, for the cost-effectiveness comparison, an estimate of cost per acre-foot of water yield was developed, for all of the various projects defined within each alternative (i.e. storage projects, efficiency projects, etc.). This cost effectiveness measure is valuable, but can also potentially be misleading. That is because, while the cost per acre foot can be calculated, the effectiveness of the four alternatives various widely, in terms of their ability to meet Planning Unit objectives. This should be factored in, in comparing cost effectiveness.

Section 3.3.3 presents the estimated costs per acre-foot of yield of the various projects in Alternative I-2. These include both capital costs and operations and maintenance (O&M) costs, in year 2002 dollars, on a present value basis.

Based on these projects, a weighted average of cost per acre-foot can be calculated for Alternative I-2 as a whole. The weighted average "weights" the cost of the various projects based on how much water they yield. The weighted average of this alternative ranges from $1,300 to $2,100 per acre foot of yield in dry years. This range overlaps with the cost-effectiveness of both Alternative I-1 and I-3.

Flexibility Over Time

As discussed under Alternative I-1, this criterion can be considered from two separate perspectives.

From the perspective of installation of a major structure on the landscape, the improvements associated with Alternative I-2 would be just as permanent as those for Alternative I-1.

From the perspective of increased operational flexibility for the Yakima River system, Alternative I-2 would increase flexibility over current conditions, but not as much as Alternative I-1. This is because Alternative I-2 does not provide as much water for operational changes, as Alternative I-1. For further discussion, see Alternative I-1.

Environmental Impacts

The environmental impacts of this alternative are discussed in Appendix 3B; and are also summarized in Section 3.12 of the Watershed Plan. For a summary, see Table 3-9 in Chapter 3. This alternative would have significant environmental impacts, but also offers the opportunity to improve stream flows for fish. Flow improvements would likely be less than under Alternative I-1.

Legal Authority

As for Alternative I-1, it is assumed that the USBR would construct and operate the storage projects or improvements considered in Alternative I-2. USBR's legal authorities to do so are discussed under Alternative I-1, above. *There is essentially no difference between Alternative I-2 and the remaining alternatives, in this regard.* However, since Alternative I-2 does not involve use of water from the Columbia River, legal issues involving the Columbia River would not arise, as they would for one of the projects considered under Alternative I-1 (i.e. the Black Rock Project).

Approvals and Permits

A variety of permits and approvals would be required for the projects in Alternative I-2. Like Alternative I-1, this alternative would be complex in terms of obtaining permits and approvals, because the storage enhancement included in this alternative inherently involve a range of permitting needs. The permits and approvals needed would be similar to those listed for Alternative I-1, above. In addition, one or more project-level Environmental Impact Statements (EIS) would need to be prepared, as part of the process for obtaining many of the permits and approvals listed above.

However, since Alternative I-2 would involve only one storage project, and would not involve use of waters from the Columbia River, *this alternative would involve fewer permits and would generally be less complex than Alternative I-1 in this regard.*

The other elements of this alternative, such as water-use efficiency projects, water rights transfers, etc. also require specific approvals. However, these are generally less complex, as discussed under Alternative I-3, below.

Total Cost and Funding Sources

This alternative would be intermediate in cost, among the three "action" alternatives. This is because this alternative includes less storage enhancement than Alternative I-1, but still involves the large capital cost associated with a storage project such as Wymer or Bumping. In addition, the Wymer project, in its pumping configuration, would involve high operating expenses due to the power needs associated with pumping water up from the Yakima River to the top of the reservoir. (note: some of the energy costs can be recovered through power generation when the water is released).

The cost of additional activities under Alternative I-2 would add to that of storage enhancement. Costs have been estimated for the irrigation district efficiency improvements included in this alternative.

Table 3-6 (see Chapter 3) displays the major costs estimated for Alternative I-2. The total cost, expressed as the present value of capital plus O&M costs, in year 2002 dollars, ranges from $566 million to $791 million, depending on which projects are included.

Like the other alternatives, due to the magnitude of these costs, it is likely that a combination of federal, state and local sources would be needed to plan, design, construct and operate the facilities, with the largest share coming from the federal government.

Some funds have already been appropriated by Congress for the efficiency improvements, under YRBWEP. All remaining funds would need to be appropriated or requested from existing funding sources.

(comment on the sufficiency of these funds, for the three districts' efficiency projects covered in this alternative)

Integration with Related Programs

In general, as with the other alternatives, *Alternative I-1 can be readily integrated with existing programs.* These include existing Yakima Project operations by USBR; implementation of YRBWEP, application of the 1945 Consent Decree, and existing activities of the various irrigation districts and communities that receive Project water.

As discussed above, it is assumed that USBR would construct and operate new or improved storage facilities. USBR currently has the technical and administrative capability to plan, contract and oversee construction, and operate the facilities identified under Alternative I-2. The increased extent and complexity of operating the Yakima Project with the additional projects may require some staffing increases.

If new or improved storage facilities are used to directly supply water to municipal and industrial water users, outside the framework of current entitlements, then specific authorizations will need to be developed for this purpose. The same may be true of water used for instream flow purposes, or to offset ground water pumping.

Alternative I-3: Reliance on Efficiency Improvements, Water Reuse and Voluntary Transfers, with No Storage Enhancement

Overall Effectiveness

Unlike Alternatives I-1 and I-2, this alternative does not include storage enhancements. Instead, Alternative I-3 would rely entirely on efficiency improvements, water reuse projects, and voluntary transfers. The component with the greatest impact is the efficiency improvements associated with irrigation districts, already authorized under YRBWEP. For purposes of this Alternative, the agriculture efficiency projects that could be implemented are identified in water conservation plans identified by 13 irrigation districts[4]. Whereas Alternatives I-1 and I-2 include only a selected set of these plans (e.g. three districts were modeled in the hydrologic modeling activity), Alternative I-3 would include implementation of all of these plans.

The effectiveness of this alternative in meeting Planning Unit objectives was analyzed through the hydrologic modeling activity described in Section 3.5. A complete presentation of modeling results is presented in the technical memorandum, “Hydrologic Modeling of Surface Water Alternatives” (MWG, 2002a). In summary, the hydrologic modeling demonstrated that:

- *Alternative I-3 would improve reliability of surface water supply slightly, but not as much as Alternatives I-1 or I-2.* In addition to providing full supply of non-proratable entitlements, at least 70 percent of proratable entitlements can be met in most years. However, in some dry years, the 70 percent goal cannot be met (although even in those years, reliability is improved). The ability of this alternative to improve reliability depends on how the stored water is used to meet multiple objectives. As an example, if a portion of the stored water were used in part to maintain stream flows of 200 cfs below Keechelus Reservoir, and the rest were used to improve reliability, the delivery to proratable users in dry years such as the 1992-1994 time period could be increased by approximately 2 to 8 percent.
- *Alternative I-3 would provide improvements in stream flows in the mainstem system. However, with the conserved water used for stream flow, there is little improvement in reliability of water supply.* The hydrologic modeling activity examined scenarios in which water is used: to meet Title XII target flows at Parker; to meet IFTAG flows at Parker; and to increase flow in the Upper Yakima River below Keechelus Dam. Exact results vary, depending on which of

[4] Documented in technical memorandum entitled “Water Use Efficiency in the Agricultural Sector.” (MWG, 2002d). Does not include Wapato Irrigation Project, as Yakama Nation lands and activities are outside the scope of this Watershed Plan.

these scenarios is modeled. However, in general, this alternative cannot achieve both flow objectives and reliability objectives simultaneously.

Charts displaying these results graphically can be found in Section 3.5 of the Watershed Plan.

Outside the framework of the hydrologic modeling, some additional conclusions can be drawn with respect to the ability of Alternative I-3 to meet Planning Unit objectives:

- The modeling results for Alternative I-3 are not highly relevant to the goal of meeting growth in municipal and industrial needs, because the irrigation district efficiency projects modeled are not intended to provide water for these needs.
- *To the extent that municipal and industrial entities undertake water conservation programs, these can help extend existing water supplies as communities grow.* A detailed analysis of this effect has not been undertaken at this time for the Yakima Basin. *However, it is unlikely that water conservation can fully offset growth in demand.* For example growth in demand in the municipal, industrial and domestic sectors is estimated to be 41% from year 2000 to 2020 (see Section 2.3).
- *Voluntary transfers of water rights could potentially be an important source of water to serve municipal growth, in areas where circumstances permit. Voluntary transfers can also offer an effective means for improving stream flows in some locations. However, voluntary transfers offer little ability to improve reliability of water supply for agriculture at the basin-wide scale.*[5] For further information, see the technical memorandum "Voluntary Water Transfers as a Strategy for Meeting Planning Objectives" (EES, 2002e).
- *Reuse of municipal wastewater offers some ability to extend municipal supplies as growth occurs. However, there are significant limitations on this strategy.* In particular, return flows to the Yakima River system are relied on by downstream users, so reuse projects that reduce return flows from cities may be problematic. *In addition, reuse of municipal wastewater is relatively costly, compared with other alternatives such as ground water production.* For further information, see technical memorandum "Water Reuse Opportunities in the Yakima River Basin" (EES, 2002f).

Cost-Effectiveness

As discussed previously, for the cost-effectiveness comparison, an estimate of cost per acre-foot of water yield was developed, for all of the various projects defined within each alternative (i.e. storage projects, efficiency projects, etc.). This cost effectiveness measure is valuable, but can also potentially be misleading. That is

[5] Transfers can be highly significant to individual producers, especially those with junior water rights.

because, while the cost per acre foot can be calculated, the effectiveness of the four alternatives various widely, in terms of their ability to meet Planning Unit objectives. This should be factored in, in comparing cost effectiveness.

Section 3.3.3 of the Watershed Plan presents the estimated costs per acre-foot of yield of the various projects in Alternative I-3. These include both capital costs and operations and maintenance (O&M) costs, in year 2002 dollars, on a present value basis.

Based on these projects, a weighted average of cost per acre-foot can be calculated for Alternative I-3 as a whole (see Table 3-7 in Chapter 3). The weighted average "weights" the cost of the various projects based on how much water they yield. The weighted average of this alternative is $1,300 per acre foot of yield. This is lower than Alternative I-1, and at the low end of the range of Alternative I-2.

Flexibility Over Time

This alternative includes construction of irrigation district improvements that are long-lived and essentially "permanent." However, many of these improvements would upgrade or replace facilities that are already in place, such as irrigation canals and associated control structures.

In contrast with Alternatives I-1 and I-2, this alternative does not involve addition of storage capacity to the Yakima Project system (except for minor reregulation reservoirs located adjacent to irrigation canals). *Without additional storage capacity, operational flexibility within the Yakima Project system is only marginally improved by the irrigation conservation projects.* However, these projects will provide individual irrigation districts with an improved ability to manage their water supply during water-short years.

Increased emphasis on voluntary water rights transfers, as well as municipal conservation, does provide opportunities for flexible management from year to year. To some extent, these programs can be increased or decreased in intensity, to accommodate changing conditions over time. However, it should be recognized that these programs have much smaller benefits, and so the value of this flexibility to water management needs of the Basin is relatively small.

Reuse of municipal wastewater typically requires construction of additional wastewater treatment facilities, as well as new piping systems to deliver treated water to customers. Once in place, these facilities are long-lived. In addition, because customers typically require reliable supplies, *reuse projects do not have high operational flexibility*.

Environmental Impacts

The environmental impacts of this alternative are discussed in Appendix 3B; and are also summarized in Section 3.12 of the Watershed Plan. For a summary, see

Table 3-9 in Chapter 3. Environmental impacts of this alternative are less extensive than for Alternatives I-1 and I-2. However, this alternative offers less benefit in terms of improving flows for fish.

Legal Authority

Irrigation districts would be the primary implementers of the water-use efficiency projects under YRBWEP, and funding would be provided by USBR. These entities are already authorized under YRBWEP and State law to carry out these activities.

Municipal water systems have the legal authority to carry out water conservation programs within their service areas.

Municipal wastewater systems have the legal authority to construct and operate wastewater reuse systems. However, issues of potential impairment of downstream water rights could be an issue, since reuse projects in the Yakima Basin would reduce return flows to the river system.

Water rights transfers are authorized under State law, subject to certain conditions. The legal viability of transfers must be examined on a case by case basis.

Approvals and Permits

Alternative I-3 would involve extensive improvements by irrigation districts related to water use efficiency, water rights transfers, municipal water conservation programs, and municipal wastewater reuse projects. *In general, on a project-by-project basis, these permits and approvals needed for these activities would be less complex than those needed for Alternatives I-1 and I-2. However, it should also be noted that there would be far more individual projects to be permitted, and permitting activities would be spread out over many more implementing organizations, compared with Alternatives I-1 and I-2.*

Types of permits and approvals needed for implementation of Alternative I-3 are listed in Table 3. This list is not intended to be comprehensive at this time.

Total Cost and Funding Sources

This alternative would be the least costly, among the three "action" alternatives. This is because this alternative does not include storage enhancement (other than minor reregulation reservoirs associated with irrigation district efficiency projects).

Table 3-6 (see Chapter 3) displays the major costs estimated for Alternative I-3. The total cost, expressed as the present value of capital plus O&M costs, in year 2002 dollars, is $437 million.

Table 3
Permits and Approvals Needed for Implementation of Alternative I-3

Permit or Approval	Irrigation District Efficiency Projects	Water Rights Transfers	Municipal Wastewater Reuse Projects	Municipal Water Conservation Programs
Reservoir Storage Permit	✓	N/A	N/A	
Rights of Way for access roads, canals, power lines, etc.	✓	N/A	N/A	
Wetlands Modification (CWA Section 404)	✓	N/A	N/A	
Water Quality Certification (CWA Section 401)	✓	N/A	N/A	(No specific Permits/Approvals Required)
Water Rights Change	N/A	✓		
Waste Discharge Permit	N/A	N/A	✓	
National Pollutant Discharge Elimination System Permit	N/A	N/A	✓	
Utility Permit to for transmission mains	N/A	N/A	✓	
Wastewater Engineering Report	N/A	N/A	✓	

Costs have not been estimated for additional activities included in this alternative, such as water rights transfers, municipal wastewater reuse projects, and municipal water conservation programs. Some of these costs have been discussed in the various technical memoranda prepared during the watershed planning process (see Table 3-1 in Chapter 3). These costs can be substantial to the entities involved in carrying out these actions, but will not alter the fact that Alternative I-3 is much less costly than the other two "action" alternatives.

Like the other alternatives, due to the magnitude of these costs, it is likely that a combination of federal, state and local sources would be needed to plan, design, construct and operate the facilities, with the largest share coming from the federal government.

Some funds have already been appropriated by Congress for the efficiency improvements, under YRBWEP. However, the amount appropriated to date falls well short of the total cost listed above. All remaining funds would need to be appropriated or requested from existing funding sources.

For other projects, such as water rights transfers, municipal wastewater reuse projects, or municipal water conservation projects, additional funds would be needed. These types of projects are typically funded by a combination of local funds from the entity involved (e.g. a city, or an irrigation district); and available grant or loan funds from State sources. Availability of funding from state sources for these purposes may be available, but is not guaranteed.

Integration with Related Programs

Alternative I-3 is generally consistent with existing programs, such as YRBWEP, administration of the State water code; and delivery of municipal water and wastewater services in individual communities.

The most extensive activity under alternative I-3 would be the design, and construction of irrigation system improvements designed to improve water use efficiency. In general, both USBR and irrigation districts have adequate staff and administrative capacity to perform these activities. Some of this activity may be contracted to the private sector.

Staffing to process water transfers is already in place, involving both Water Conservancy Boards and the Department of Ecology.

Administration and staffing of municipal water conservation and wastewater reuse projects can represent a significant need in the local government context, depending on the size of the community involved.

Alternative I-4: No Action

Overall Effectiveness

The No-Action alternative offers no improvement over current conditions, in terms of meeting the Planning Unit objectives. Under this alternative, agricultural producers relying on proratable supplies from the Yakima Project would continue to experience substantial losses during drought years, substantially reducing the Basin's economic output and employment in those years. Management of stream flows in the mainstem Yakima River and Naches system would continue as under current conditions. Communities experiencing growth will face considerable difficulty in obtaining new water supplies, unless ground water supplies are made available (see Section 4).

Cost-Effectiveness

Not applicable. The No-Action alternative, by its nature, does not require an investment of financial resources. However, the Planning Unit notes that there are significant "costs" to the No-Action Alternative, in terms of the losses described above.

Flexibility Over Time

Under the No-Action alternative, the structures already present in the Yakima Basin, such as dams in the upper Yakima and Naches systems, would remain in place for the long-term. While the current system has some operational flexibility, this is limited due to the fact that the current system cannot meet all the needs of the Basin. In this regard, the existing system has less flexibility to adjust to changing conditions, in comparison with the three "action" alternatives.

Environmental Impacts

The environmental impacts of this alternative are discussed in Appendix 3B; and are also summarized in Section 3.12 of the Watershed Plan. For a summary, see Table 3-9 in Chapter 3. Essentially, the impacts would be zero, leaving a status quo result in terms of environmental quality and stream flows. Status quo flows are far from optimal in terms of fish habitat needs.

Legal Authority

No additional legal authorities are needed for the No-Action Alternative. It is assumed that current legal authorities would remain in place, for operation of the Yakima Basin's various water management activities.

Approvals and Permits

No new approvals or permits would be needed under the No-Action Alternative. It is assumed that existing water rights, federal responsibilities, etc. would remain in place.

Cost and Funding Sources

The No-Action Alternative, by its nature, does not impose new costs or require any additional funding sources. However, all existing programs currently operating in the Yakima Basin require ongoing funding, including the USBR's Yakima Project operations; the Department of Ecology's water rights administration activities; Water Conservancy Boards; municipal water and wastewater systems, etc.

Integration with Related Programs

A variety of existing programs is operational in the Yakima Basin, and would continue to operate. No special needs for integration are identified, under the No-Action Alternative. The No-Action Alternative, by its nature, does not require additional staffing or administrative structures. However, staffing of existing programs will continue to be needed, as described under the funding discussion, above.

Appendix 3-B

Environmental Review of Surface Water Management Alternatives

Appendix 3B
Environmental Review of Surface Water Management Alternatives

1.1 Introduction and Summary

The focus of this analysis is to assess basin wide environmental impacts and determine relative differences among the proposed surface water management alternatives. Details on site-specific impacts are not addressed in this analysis and in most cases analysis on a site-specific basis has not been conducted in existing studies. Due to available funding the watershed planning committee requested a preliminary environmental assessment identifying the major environmental issues associated with each alternative. A full Environmental Impact Statement may need to be conducted prior to the implementation of an alternative. The environmental impacts for each potential storage site and water efficiency measures are summarized below based on available information.

The following issues limit this environmental analysis:

- Lack of existing data on the environmental impacts of the storage reservoirs.
- How the reservoirs will be operated in terms of instream flows has not been fully defined. Operational decisions will affect the degree to which fish habitat is improved, impaired, or unaffected in various reaches.
- Environmental mitigation for these projects has not been defined and can limit the environmental consequences of construction activity associated with each alternative.
- This analysis only focuses on the direct short and long-term impacts of the alternative and not on indirect or secondary consequences the alternative may have.

Table 1 summarizes the relative environmental impact of each alternative.

Table 1
Environmental Impact Summary By Alternative

Alternative	Earth	Hydrology	Water Quality	Ground Water	Vegetation	Wildlife	Land Use	Cultural Resources
I-1A	High	High	High	Moderate	High	High	High	Moderate
I-1B	High	High	Moderate	Moderate	Moderate	Moderate	Moderate	Unknown
I-2	Moderate	Moderate	Low	Moderate	Moderate	Moderate	Low	Unknown
I-3	Low	Moderate	Low	Moderate	Low	Low	Low	None
I-4	None	None	None	None	None	None	None	None

Table 2 summarizes the ability of each alternative to improve habitat conditions for salmon. For each river section the primary problem regarding salmon production is stated. After determining the alternative's ability to alter flow in the listed reaches, each alternative was rated for its potential effectiveness in improving the habitat and conditions for salmonid species. A value of high was given to alternatives that have the potential to greatly improve the flow related problems; a value of moderate was given to alternatives that have the potential to partially improve the flow; a value of low was given to alternatives that would only slightly improve the flow; and none was stated if the alternative would have no impact on flow. Hydraulic modeling results for each alternative, which are included in Section 3-5, were used to develop these effectiveness values.

1.2 Alternative I-1A – Major Storage Enhancement, with Targeted Improvements in Water-Use Efficiency and Additional Actions (using water from within Yakima Basin)

This alternative relies primarily on increasing storage in existing reservoirs and construction of a new water supply reservoir within the Yakima River basin. Increased water storage capacity would be complemented by targeted improvements in water reuse, voluntary transfers, and water-use efficiency. Increased storage would rely upon water originating in the Yakima River Basin (also see Section 1.3, which addresses use of water from outside the Yakima Basin).

The primary environmental impacts associated with this alternative stem from increased storage in existing reservoirs or construction of new reservoirs. Significant land use impacts associated with this alternative are disturbance to national forest and other federal lands, state park land and other public recreation facilities, transportation infrastructure, utilities, and private property. In addition, this alternative may adversely affect recreation opportunities, although these impacts are not well characterized in the available literature. Targeted improvements in water efficiency may result in lowering of shallow aquifers and hydrologic impacts to associated wetlands, riparian areas, and wildlife. Overall, this alternative would provide significant additional storage capacity and increased operational flexibility and reliability of water supply and flow management. This alternative has the most significant environmental impact of all of the alternatives.

The storage projects included in this alternative are the construction of the Wymer Reservoir, and increased capacity of Kachess Lake, Cle Elum Lake, and Bumping Lake.

In addition to storage development impacts, environmental impacts will result from the implementation of selected irrigation district water use efficiency projects. Environmental impacts of these projects are described in Section 1.5.

Table 2
Ability of Alternative to Improve Problem Flows for Aquatic Resources

Location[1]	Problem[1]	Why is this a problem[1]	Alternative's Ability to Improve Flow Related Habitat Conditions				
			I-1A	I-1B [2]	I-2	I-3	I-4
Yakima River from Keechelus Dam to confluence of Cle Elum River	1. Seasonal low flows.	1. Seasonal low flows reduce overwintering habitat and access to side channels.	High	High	Moderate	Low	None
	2. Hourly and daily flow fluctuations.	2. Rapid flow fluctuations are a concern because this reach has a complex instream habitat and channel shape, including side channels, braids, and gravel bars. Abrupt flow decreases can cause spring chinook fry stranding.	High	High	Low	Low	None
	3. Reduced peak flows during spring.	3. Reduced flows affect juvenile out migration.	Undetermined [4]	Undetermined [4]	Undetermined [4]	Undetermined [4]	None
Yakima River from confluence of Cle Elum River to Roza Diversion Dam	1. Sustained high flows during summer months.	1. Sustained high flows increase velocity reducing available habitat.	High	High	Moderate	Low	None
	2. Reduced peak flows during spring.	2. Reduced flows affect juvenile out migration.	Undetermined [4]	Undetermined [4]	Undetermined [4]	Undetermined [4]	None
Cle Elum River to confluence with Yakima River	1. Seasonal low flows (winter).	1. The low flows reduce habitat for rearing juvenile salmonids.	High	High	Moderate	Low	None
	2. Sustained high flows preceding "flip-flop."	2. Fry and juveniles can be swept downstream - reduces sheltered rearing areas.	High	High	Low	Low	None
	3. Hourly and daily flow fluctuations.	3. Stranding and loss of habitat.	High	High	Low	Low	None
Tributary streams in the Yakima above Naches confluence	1. Flow depletions in late summer, especially in Big Creek, Taneum Creek, Manastash Creek, Swauk Creek, Wenas Creek, and Teanaway River.	1. These streams offer potential habitat for anadromous salmonids, but low flows limit habitat.	Moderate	Moderate	Low	Low	None
Naches River to from Tieton confluence to the Yakima confluence	1. Seasonal high flows in September and October during flip-flop.	1. Juveniles may be displaced by high flows.	High	High	Low	Low	None
	2. Reduced peak flows during spring.	2. Reduced flows affect juvenile out migration.	Undetermined [4]	Undetermined [4]	Undetermined [4]	Undetermined [4]	None
Yakima River from Naches River confluence to Union Gap	1. Sustained high flows during irrigation season and impaired riparian zones.	1. Important reach for juvenile steelhead and spring chinook rearing. Complex riparian areas reduced; thus, reduced cover for salmonids.	High	High	Low	Low	None
	2. Reduced peak flows during spring.	2. Reduced flows affect juvenile out migration.	Undetermined [4]	Undetermined [4]	Undetermined [4]	Undetermined [4]	None
Yakima River from Sunnyside Diversion Dam to Chandler Pumping and Power Plant discharge	1. Low base flow over Sunnyside Diversion Dam.	1. Fall chinook (spawning, incubation, and rearing).	High	High	Moderate	Moderate	None
	2. Reduced peak flows during spring.	2. Reduced flows affect juvenile out migration, increased flow would increase spring Chinook smolt survival.	High	High	Moderate	Moderate	None
	3. Hourly and daily flow fluctuations. Seasonally high water temperatures.	3. Stranding, reduced food supply.	High	High	Moderate	Moderate	None
Yakima River from Chandler Pumping and Power Plant discharge to Columbia River	1. Reduced peak flows during spring.	1. Reduced flows affect juvenile out migration.	None [3]	None [3]	None [3]	None [3]	None
Tieton River from Rim Rock Lake to Naches River	1. High flows September – October during flip-flop.	1. High velocity during flip-flop reduces available habitat and causes channel erosion reducing habitat diversity.	High	High	Low	Low	None
	2. Low flows mid October to April.	2. Reduces habitat for rearing.	High	High	Low	Low	None
	3. Reduced peak flows during spring.	3. Reduced flows affect juvenile out migration.	Undetermined [4]	Undetermined [4]	Undetermined [4]	Undetermined [4]	None

Note:
(1) Adapted from Programmatic Environmental Impact Statement, Yakima River Basin Water Enhancement Project, USBR (January 1999).
(2) Alternative I-1B instream flow impacts are evaluated for the Yakima River Basin only. Additional impacts to aquatic resources will occur, as water will be diverted out of the Columbia River. See Section 1.3.8 for discussion of potential impacts to the Columbia River.
(3) Will ***not*** improve unless flows over Parker Dam are increased.
(4) The ability of the alternatives to increase flow during the juvenile out migration time period was not studied in the hydrologic modeling performed. However, the additional volume of flow that is made available by the alternatives can be used for multiple purposes including instream flow improvement or increased flow during juvenile out migration.

Under this alternative, stored water would not be used to expand irrigated levels, beyond those lands with existing entitlements to water from the Yakima Irrigation Project.

The environmental review presented on this alternative relies largely on existing information. A complete environmental analysis has not been conducted for most of the proposed storage projects. Further analysis is needed. The following information describes the sources used in this review.

The US Department of Interior, Bureau of Reclamation conducted four studies on Wymer Dam from 1984 to 1988. Two of those studies provided some environmental information on the existing site and construction impacts in the Stage 1- Planning Design Summary Wymer Dam and Pumping Plant Document created as part of the Yakima River Basin Water Enhancement Project. Secondly, a final Environmental Assessment was developed by the U.S. Bureau of Reclamation for the proposed Bumping Lake enlargement, August 23, 1967. Thirdly, an environmental review for the Kachess Lake enlargement and Cle Elum Lake enlargement was conducted in a Final Programmatic Environmental Impact Statement developed by the U.S. Bureau of Reclamation for the Yakima River Basin Water Enhancement Project, January 1999.

The following analysis examines in greater detail the environmental impacts of this alternative.

1.2.1 Earth

Since this alternative involves the construction of four storage projects, the environmental impacts to land, soils, and associated resources are large compared to the other alternatives. The general geological description and amount of dredging and filling associated with each storage project are addressed below where information is available.

Wymer Reservoir: The proposed project is located in Lmuma Creek canyon. Excavation would occur to construct a dam, reservoir, pumping plant, and water transmission lines or waterways. The geology at the dam site is described as alluvium of varying thickness with slope wash from a few to many tens of feet which is present along the mainstream and in lesser quantities along the side drainage ways. Bedrock at the construction site consists of a thick sequence of competent basalt flows know as the Yakima Basalt Formation of the Miocene era. Interflow zones consist of varying amounts of friable, poorly cemented sandstone, claystone, and siltstone (U.S. Department of Interior, 1988). Soil in the area is considered highly erodible.

The amount of excavation and fill to occur for this project was estimated for the Yakima River Basin Water Enhancement Project in the Construction

Cost Estimate dated April 1985. For construction of the dam it is estimated that 12,290,000 cubic yards (CY) of stockpile slope wash, channel alluvium, sand, gravel and weathered rock will be excavated. The spillway is expected to involve excavation of 610,000 CY and 35,000 CY of pervious backfill. Riprap will also be used. The outlet structure will involve the excavation of 101,900 cubic yards. The Wymer pumping plant will involve excavation of 39,400 cubic yards and require 31,000 CY of backfill. The construction of waterways will involve excavation of 28,500 CY and backfilling of 24,000 CY for pipe installation.

The excavation and fill activities may result in increased erosion and this could impact vegetation, wildlife, and aquatic species during the construction period. Erosion could be reduced with the use of best management practices (BMPs).

Excavation associated with this project has a significant impact to the environment as the construction of each storage project will require large amounts of excavation and fill resulting in disturbing existing soils and increasing erosion.

Bumping Lake: The proposed project will require excavation and fill activities for the enlargement of the reservoir, construction of roads, and construction of the spillway and outlet works. The dam site is located in a deep, steep-walled erosional canyon that has been modified by alpine glaciations. The valley floor is deeply covered by bouldery glacial till and outwash. Approximately 11,100,000 cubic yards of earth, sand, gravel and rock fill material is required for the development of the dam. Approximately 450 acres of land could be covered by excavation of borrow areas for impervious fill material and rip rap for the dam and embankment (US Dept. of Interior, 1999). Soil erosion would occur and result in increased turbidity during project construction.

Kachess Lake: The amount of excavation to occur for this project has not been determined. Excavation will occur with the enlargement of the Kachess Dam and construction of a diversion dam on Cabin and Silver Creeks. Excavation will also occur with the construction of a gravity pipeline from Cabin and Silver Creeks to Kachess Lake. Research of existing information did not reveal or quantify impact to land or soils resulting from this storage project.

The excavation and fill activities may result in increased erosion during construction and this could impact vegetation and wildlife on land and aquatic species. Erosion could be reduced with the use of BMPs.

Cle Elum Lake: This project will involve excavation and clearing activities associated with road construction, shoreline excavation and dam improvements. Approximately 18 cubic yards will be hauled for road improvements and road construction; 100 CY will be used from pit excavation; 88 CY will be used for riprap and bedding. This project will require shoreline excavation of 143 CY, slopetoe backfill of 28 CY, and in-reservoir disposal of 401 CY. These excavation estimates were developed for the Cle Elum Improvement Project, construction estimate developed January, 2000.

The excavation and fill activities may result in increased erosion during construction and this could impact vegetation and wildlife on land and aquatic species. Erosion would be reduced with the use of BMPs.

1.2.2 Air

Air pollution impacts have not been determined for each storage project; however, short-term impacts will occur at all four storage sites. Air pollution may occur during construction activities. Emissions from internal combustion engines and dust from vehicular traffic would degrade air quality in the vicinity of construction activities. Further analysis would be needed to characterize the air quality impacts of this alternative.

1.2.3 Hydrology

A hydrologic model of the Yakima Project was prepared by the U.S. Bureau of Reclamation and used to evaluate flow impacts to the Yakima Basin from Alternative I-1A. For more information on the hydrologic modeling methods and results see Section 3.

This alternative if implemented could be used to meet the following objectives: water supply reliability, improve instream flows in the Yakima River at various locations including below Keechelus Reservoir or at Parker, and eliminate the “flip-flop” and “mini-flip-flop” on the Yakima River, Naches River and Tieton River. The degree to which each objective is met varies depending on prioritization of the objectives.

If the stored water were used first to improve instream flows in the Upper Yakima main stem reach (from below Keechelus to above Easton) instream flows could be maintained at or above 200 cfs, while meeting or exceeding the 70% reliability goal to meet agricultural and other water supply needs.

If the increased storage were used first to improve instream flows at Parker, instream flows could be maintained at or above 450 cubic feet per second (cfs) in all years, while meeting or exceeding the 70% reliability goal to meet agricultural and other water supply needs. IFTAG flows of 800 cfs could also be met by this alternative, but not without reducing the reliability goal to below 70% in some drought years.

A hydrologic model was also run to explore elimination of the “flip-flop” and “mini-flip-flop” operational practices. The model showed that “flip-flop” could be eliminated with this alternative; it would also result in a 20% reduction in summertime flows in the Yakima River through Kittitas Valley to the Roza diversion. Instream flows would be substantially reduced in the Tieton and Naches Rivers during the months of September and October. The resulting streamflow would more closely match natural flow conditions in those rivers.

1.2.4 Surface Water Quality

This alternative will result in water quality impacts to water bodies in the vicinity of construction activities and downstream. Short-term impacts will result primarily from construction of the storage reservoirs. Long-term water quality impacts may occur with increased reservoir levels and inundation of vegetation resulting in alteration of the chemical properties of the affected water body. The water quality impacts are addressed for each project below.

Wymer Reservoir: The proposed development would likely have short-term impacts on the surface waters of the Yakima River. Water pollution may occur during construction activities. Turbidity may result during construction along the shoreline and stream crossings from machinery and equipment entering the water body and removal and disruption of the stream banks. Sedimentation would also occur from surface water runoff of disturbed areas. Increased turbidity would also result in degradation of water quality. This may contribute to the direct mortality of various species of aquatic organisms and could affect anadromous fish movement. Oil and gas leaks or spills are also a short-term risk during construction.

Long-term water quality impacts may also occur on a seasonal basis in the Yakima River below the discharge area. During periods when the water reservoir levels are low the temperatures of the water discharged to the Yakima River may increase temperature of the water downstream of the outflow. If vegetation is left in place and inundated, during the first few years water released to the Yakima River may have elevated levels of nutrients.

Bumping Lake: The proposed development would likely have short-term impacts on the surface waters of the Bumping River and Bumping Lake. Water pollution would occur during construction activities. Turbidity may result from the machinery and equipment entering the water body, making channel adjustments, as well as construction of dikes and coffer dams. Sedimentation would also occur from surface water runoff of disturbed areas.

Increased turbidity would also result in degradation of water quality. This disruption of the environment may contribute to the direct mortality of various species of aquatic organisms and could affect anadromous fish movement. Oil and gas leaks or spills are also a short-term risk during construction.

Long-term impacts of the proposed project include downstream flows that are cooler in the summer months and warmer in the fall months. Higher levels of nutrients could be found in the water for several years, if vegetation is left in place and inundated.

Water quality impacts to the lake have not been defined; however inundation of vegetation from raising the reservoir may alter the chemical properties of the lake.

Kachess Lake: The proposed development would likely have short-term impacts on the surface waters of the Kachess Lake. Pollutant loading could occur during construction activities. Turbidity may result from the machinery and equipment entering the water body. Sedimentation would also occur from surface water runoff of disturbed areas. Increased turbidity would also result in degradation of water quality. This disruption of the environment may contribute to the direct mortality of various species of aquatic organisms and would affect anadromous fish movement and may contribute to mortality.

Nutrient loading is one long-term water quality impact to result from this project. High levels of nutrients could be found in the water for several years of operation, if vegetation is left in place and inundated (U.S. Department of Interior, 1985).

Cle Elum Lake: The proposed development would likely have short-term impacts on surface waters. Water pollution would occur during construction activities. Turbidity may result from the machinery and equipment entering the water body, making channel adjustments, as well as construction of dikes and coffer dams. Sedimentation would also occur from surface water runoff of disturbed areas. Increased turbidity would also result in degradation of water quality. This disruption of the environment may contribute to the direct mortality of various species of aquatic organisms and would affect anadromous fish movement.

Long-term impacts of the proposed project include downstream flows that are cooler in the summer months and warmer in the fall months. Higher levels of nutrients could be found in the water for the first several years of operation, if vegetation is left in place and inundated (U.S. Department of

Interior, 1985). Potential water quality impacts to the lake have not been defined.

1.2.5 Ground Water

Each of the storage projects would increase storage capacity and may increase infiltration, affecting water levels in surrounding aquifers. As each reservoir is alternately filled and drawn down, there may be localized effects on shallow ground water levels in the vicinity of the reservoir.

Some impacts would also occur from water conservation projects associated with irrigation districts. For more information on those impacts, see Section 1.5.

1.2.6 Vegetation

Development of all four storage projects will result in the inundation and disturbance of lands that contain a variety of vegetated habitats including shrub-steppe, riparian, habitat, coniferous forests, and wetlands. This alternative has the largest impact on vegetation compared to the other alternatives.

The implementation of irrigation district conservation measures is not expected to contribute to large amounts of vegetation disturbance; however the decrease in water levels may lead to the alteration of vegetation around irrigation district drains, laterals, and wetlands. More detail on impacts to vegetation is provided below for each project.

Wymer Reservoir: Approximately 1,530 acres of vegetation would be inundated and/or disturbed for the development of this project. The vegetation on the proposed Wymer Dam site is classified as shrub-steppe habitat. The four major plant associations in that habitat are the big sagebrush-bluebunch wheatgrass association, the three tip sagebrush-Idaho fescue association, the bitterbush-bluebunch-wheatgrass association and the Sandberg bluegrass stiff sagebrush association. Grasses such as needle-and-thread, Thurber's needle grass, bottlebrush, squirreltail and Crusick bluegrass may be found in the area. Some forbs that may be found in the area and disturbed include arrowleaf balsamroot, silky lupine and longleaf phlox. Cheat grass, an exotic annual, has become widespread.

The development of an outlet structure and pumping facility will disturb and/or eliminate some riparian habitat along Lmuma Creek. Exotic woody species such as willows, reed canary grass, cattail, and horsetail can be found in riparian areas in the Yakima Basin and may be disturbed during construction of this project. Black cottonwood, shrub willow, and mock orange are also commonly found in riparian areas. Native shrubby species that grow near these streams include chokecherry, serviceberry, golden currant, wild rose, red-osier dogwood, and blue elderberry.

Bumping Lake: Approximately 2,820 acres of terrestrial habitat would be inundated resulting in a loss of the wildlife populations depending on this habitat during any part of their life cycle. Table 3 lists the affected habitats and number of acres as listed in the Bumping Reservoir Environmental Impact Statement.

Table 3
Affected Habitats

Habitats	Acres	Remarks
Hemlock, Douglas fir, huckleberry, sedge	1,920	Includes spotted owl habitat
Lodgepole pine, larch, huckleberry, bearberry	500	Scattered ponderosa pine
Sedge, rush	180	Quality forage
Riparian	100	Streams upstream from damsite
Mostly rock	60	Marmot and pika habitat
Snowbrush, mountain ash, willow, bearberry	25	Quality browse
Cottonwood, alder, willow	10	Scattered maple shrubs
Hemlock, no understory	5	Low wildlife value
Manmade structures	20	Low wildlife value

Kachess Lake: Short-term impacts could occur during Kachess modification construction periods. Augmentation of Kachess Lake could adversely affect riparian areas, wetlands, and associated wildlife below the diversion of Cabin and Silver Creeks. Loss of coniferous forest may occur along the pipeline alignments and will occur with the inundation of land surrounding the existing Kachess Lake.

The amount and type of vegetation to be inundated or disturbed has not been determined specifically for this project. Information on the general vegetation characteristic of the area was provided in the Yakima River Basin Water Enhancement Project Final Fish and Wildlife Coordination Act Report, October 1996. Common wetland plants that may be disturbed and inundated include cattail, bulrush, spikerush, sedges, rushes, scouring rush, and various grasses such as reed canary grass, meadow foxtail and common reed. In forested wetlands, black cottonwood usually dominates with an understory of willows, red-osier dogwood, alder and /or birch (Haley, 1996).

Riparian forests in the Basin typically contain black cottonwood, but may also contain alder, willow, silver maple, mulberry and hackberry (Haley, 1996).

Cle Elum Lake: About 70 acres of riparian vegetation around the reservoir (coniferous trees with little or no understory) would be inundated by raising the gates at Cle Elum. Trees left in Cle Elum Lake would die, become snags, and could be used for perching, feeding, and nesting sites. Other short-term impacts to vegetation and wildlife could occur during construction. Further analysis is needed to determine the impacts to vegetation.

The amount and type of vegetation to be inundated or disturbed has not been determined specifically for this project. Information on the general vegetation characteristic of the area was provided in the Yakima River Basin Water Enhancement Project Final Fish and Wildlife Coordination Act Report, October 1996. Common wetland plants that may be disturbed and inundated include cattail, bulrush, spikerush, sedges, rushes, scouring rush, and various grasses such as reed canary grass, meadow foxtail and common reed. In forested wetlands, black cottonwood usually dominates with an understory of willows, red-osier dogwood, alder and /or birch (Haley, 1996).

Riparian forests in the Basin will also be disturbed and typically contain black cottonwood, but may also contain alder, willow, silver maple, mulberry and hackberry (Haley, 1996).

1.2.7 Wildlife

The construction of all four water storage projects will result in the disturbance or mortality of wildlife that rely on habitat that will be inundated and/or disturbed. The disruption of habitat corridors and the construction of reservoirs, dams, and canals will also disrupt and block movement of wildlife. This alternative will have the most adverse impact to wildlife of all the alternatives. Additional research is needed to completely assess the impact this alternative will have on wildlife.

Wymer Reservoir: The impact this project is expected to have on wildlife has not been determined in previous studies. Wildlife that rely on the lost habitat will be affected. The following species could potentially be impacted. Shrub-steppe riparian area habitats provide food for waterfowl such as Canada geese, and shorebirds including killdeer and spotted sandpiper. The riparian zone also provides food and cover for flocks of dark-eyed junco, white-crowned sparrow, American robin, and other species. Great blue heron, black-billed magpie, bank swallow and Bullock's oriole all nest in riparian habitat as do the Swainson's hawk, red-tailed hawk, and great horned owl. Bald eagles may also use the area (U.S. Department of Interior, 1999).

Animals commonly found in shrub steppe environments could be displaced or killed with the construction of Wymer. Some mammals using shrub-steppe habitat include mule deer, coyote, badger, blacktailed jackrabbit, bobcat, Washington ground squirrel, northern grasshopper mouse, Ord’s Kangaroo rat, and Merriam shrew. Birds using shrub-steppe habitat include prairie falcon, golden eagle, burrowing owl, long-billed curlew, chukar, sage grouse, western meadow lark, mourning dove, green tailed towhee, western kingbird, vesper sparrow, black-throated sparrow, Brewer's sparrow, lark sparrow and sage sparrow. Reptiles and amphibians using this habitat include western rattlesnake, striped whipsnake, Great Basin spade foot toad, short-horned lizard and northern sagebrush lizard.

Disruption of the riparian areas could also lead to the disturbance of other animals that rely on the habitat such as beaver and muskrat. Riparian areas provide drinking water and important cover and forage for mule deer and many reptiles and amphibians. Insects also use the riparian areas such as mayflies, stoneflies, caddisflies, beetles, mosquitoes, blackflies, and gnats (U.S. Department of Interior, 1999). Riparian insects provide important links in the food web of arid lands and are eaten by many other animals such as shrews, fish, and birds. Spiders are also part of the natural riparian environment.

Bumping Lake: The potential storage site will disturb mammals, birds, and reptiles in the short-term and long-term. The Bumping Lake EIS provided analysis on the effect this project may have on wildlife. Mammals, birds and reptiles will be disturbed and displaced, as their present habitat will be inundated. Mammals occupying the habitat include the Cascade red fox, elk, deer, lynx, marten, fisher, and wolverine. Raptors present in the area include the osprey, and possibly the northern spotted owl. Wildlife will be displaced and compete for habitat in surrounding areas which are already assumed to be at carrying capacity.

The altered environment would benefit and provide habitat for aquatic organisms favoring still or slow moving water. Standing trees and stumps in the reservoir would provide habitat for osprey, tree nesting waterfowl, woodpeckers, and swallows (U.S. Department of Interior, 1979). Mudflats or slopes would be exposed every year, providing habitat for shorebirds.

Kachess Lake: The impact of this project on wildlife was not evaluated; however this would result in an adverse impact to many species. Further analysis is needed to determine what species would be affected. Information on the wildlife found in the area was provided in the Yakima River Basin Water Enhancement Project Final Fish and Wildlife Coordination Act Report, October 1996. Animals that rely on coniferous forest riparian habitats found in the upper Yakima Basin include, elk, deer, beaver, mink, river otter, longtail vole, osprey, Cooper's hawk, sharp-shinned hawk, ruffed grouse, red-naped sapsucker, black swift, Vaux's swift, rufous hummingbird, calliope hummingbird, Pacific-slope flycatcher, Hammond's flycatcher, dusky flycatcher, veery, Swainson's thrush, western tanager, solitary vireo, MacGillvary's warbler, fox sparrow, redbreasted nuthatch and Cassin's finch (Haley, 1996).

Other animals found in coniferous forests that may be displaced include the marten, bobcat, short-tail weasel, bush-tailed woodrat, Douglas squirrel, yellow pine chipmunk, snowshoe hare, porcupine, vagrant shrew and heather vole (Haley, 1996).

Cle Elum Lake: The impact of this project on wildlife was not evaluated. Additional analysis is essential to determine the impacts to species in the area. Information on the wildlife found in the area was provided in the Yakima River Basin Water Enhancement Project Final Fish and Wildlife Coordination Act Report, October 1996. Animals that rely on coniferous forest riparian habitats found in the upper Yakima Basin include elk, deer, beaver, mink, river otter, longtail vole, osprey, Cooper's hawk, sharp-shinned hawk, ruffed grouse, red-naped sapsucker, black swift, Vaux's swift, rufous hummingbird, calliope hummingbird, Pacific-slope flycatcher, Hammond's flycatcher, dusky flycatcher, veery, Swainson's thrush, western tanager, solitary vireo, MacGillvary's warbler, fox sparrow, redbreasted nuthatch and Cassin's finch (Haley, 1996).

Other animals found in coniferous forests that may be displaced include the marten, bobcat, short-tail weasel, bush-tailed woodrat, Douglas squirrel, yellow pine chipmunk, snowshoe hair, porcupine, vagrant shrew and heather vole (Haley, 1996).

1.2.8 Fish

This alternative will negatively impact fish habitat and migration by removing natural vegetation on site and creating migration barriers and flow reductions on Silver and Cabin Creeks. Short-term construction impacts will also negatively affect fish on site or down stream from the site. Raising water levels of the existing lakes (Bumping, Kachess, and Cle Elum) will alter the water quality, which may impact resident fish. The increased storage, however, increases flexibility and ability to manage instream flows, which could be used to improve salmon habitat.

Impacts to salmon and trout listed under the Endangered Species Act are an important consideration. Further study is needed to determine the short and long term impacts this alternative will have on listed species. Table 4 summarizes this alternative's potential impacts on salmonid production based on information provided in the WRIAs 37, 38, & 39 Limiting Factors Analysis.

Additional details on impacts to fish are listed for each storage project below.

Table 4
Alternative I-1(A) Effects on Limiting Factors to Salmonid Production(1)

Description	Action	Effect on Fish
Benefits to Salmonid Production		
All storage projects – ability to increase instream flows.	Increase/restore in-stream flows for rearing and adult passage.	Improves summer low flows for trout and salmon and reduces predation by bass and northern pike minnow.
Agricultural Efficiency projects.	Implement methods to conserve irrigation water.	Improves summer low flows for trout and salmon and reduces predation by bass and northern pike minnow.
Obstructions to Salmon Production		
Blockage of Silver and Cabin Creek.	Reduces large woody debris (LWD) and sediment transportation downstream.	Reduces spawning and rearing habitat.
All construction projects in riparian areas.	Destruction of riparian areas.	Currently there is a lack of future LWD source and shading.
All storage projects.	Raised reservoirs and inundation of vegetation.	Contributes to eutrophication of waters, favoring non-native predatory species.
All construction projects and roads.	Increased sedimentation.	Currently there is excess sediment entering the system from erosion. This leads to spawning gravel embeddedness, reduced egg and larval survival, and changes in the diversity and abundance of macroinvertebrate food sources.

(1) Developed from information provided in the WRIA 37, 38, & 39 Limiting Factors Analysis.

Wymer Reservoir: The impact this project will have on fish has not been evaluated in detail. Short-term impacts will occur during shoreline construction of the pumping plant and intake. Stream crossings for the canal construction[1] will also alter habitat. Siltation, increased turbidity and removal of riparian habitat will occur.

Bumping Lake: Improved stream flow through storage releases from the enlarged Bumping Lake would enhance the production habitat for salmon, steelhead, trout, and resident fish species. Improved flows and fish passage facilities would also allow the habitat to be utilized. Provisions of minimum stream flows, screening of diversions, and supplemental fish stocking would result in benefits to the fish resource (U.S. Department of Interior, 1979).

Construction activities would cause additional temporary disturbances to the area's wildlife. Fisheries and aquatic life would be adversely affected during construction, due to sedimentation. If rotenone treatment were applied to the existing Bumping Lake, this would cause destruction of most fish and aquatic invertebrates. Rotenone treatment would be used to decrease non-native fish with the goal of making more habitat available for native species. This effect would be short-term (U.S. Department of Interior, 1997). A

[1] Canal construction would only occur with the enlarged Wymer Reservoir.

change in water quality that may occur with the raising of the water levels has not been assessed and those impacts on resident fish have not been determined.

Kachess Lake: Increased operational flexibility can be used for fish management purposes in the adjacent stream reaches. Modification can allow for fuller use of reservoir storage and can be timed in a manner that maintains spawning and incubation of spring Chinook salmon with a technique called mini “flip-flop”. This project could also adversely affect fish in Cabin Creek and Silver Creek because instream flows in these creeks would be reduced. Concerns have been raised over the measure’s potential impacts on spring flushing flows for salmonid downstream migrations.

Changes in water quality that may occur with the raising of the water levels have not been assessed and impacts on resident fish have not been determined

Cle Elum Lake: Suitable habitat for bull trout, sockeye, steelhead, Chinook, and coho salmon exists above the dam. The existing dam on Cle Elum Lake blocks passage to the upper reaches of the watershed. If improvements were made to allow and assist fish passage, prime habitat could be made available for fish. Changes in water quality that may occur with the raising of the water levels have not been assessed and impacts on resident fish have not been determined.

1.2.9 Land and Shoreline Use

Significant land use impacts associated with this alternative are disturbance to or inundation of federally designated wilderness land as well as national forest and other federal lands, state park land and other public recreation facilities, transportation infrastructure, utilities, and private property. The current land use and land ownership for each project site is addressed below. The shoreline impacts and current shoreline uses to be disturbed are also listed for each project if known.

Wymer Reservoir: A portion of the land on the proposed Wymer site is used as grazing land. A small orchard will also be inundated. Depending on the size of the Wymer Dam, a portion of I-82 may need to be relocated. Construction of a pumping facility and outflow location will alter the shoreline and riparian habitat along the river.

Bumping Lake: Most of the land surrounding the lake is designated as Wenatchee National Forest near the William O. Douglas Wilderness. Private residential property will also be affected and need to be acquired to develop the proposed site. Approximately 14 summer homes would be relocated and the owners would be directly and adversely affected by relocation plans.

The proposed project will interfere with recreation on and around Bumping Lake during construction. Most recreation near Bumping Lake is water oriented boating, swimming, and fishing. The season of heavy use is from mid-May to mid-October. Hunters use the area through November. The area is snow covered the remainder of the year and receives winter recreation use. Facilities include two developed campgrounds, a marina, two boat launch ramps, and 15 cabins (U.S. Department of Interior, 1975). Although slight changes may occur, recreation would experience no measurable long-term impact with the implementation of this project. Recreation would be limited during construction, which is estimated to be four years. This would displace recreation for approximately 34,800 day uses and 41,400 overnight uses per year. If recreational facilities are replaced around the lake, recreation will be restored to or above existing levels.

Kachess Lake: The proposed project will impact Wenatchee National Forest lands surrounding Kachess Lake. Recreational sites will be inundated as reservoir levels are raised. These sites could be replaced along the new shoreline.

Recreation on the lakes and shoreline will be affected by the proposed development. Kachess Lake is located between Keechelus and Cle Elum Lakes. Water surface available for recreation totals 4,535 acres with 24 miles of shoreline (U.S. Department of Interior, 1999). Developed public recreation acreage totals 100 acres, and undeveloped acreage totals 1,003 acres. Visitation totaled 280,000 in 1995. Sunbathing and water play activities are ranked as the primary use, followed by motorized boating and fishing.

The Kachess augmentation could improve the quality of reservoir-based recreation by holding additional water in Kachess Lake later in the season. More water would also remain in Keechelus Lake. Measurable changes are not apparent.

Cle Elum Lake: This project will affect private land, Wenatchee National Forest land, and state park land. Most of the private land to be inundated is owned by Plum Creek Timber. There are four other private land parcels that would need to be acquired. This would also require the demolition of one house.

Recreation will also be impacted in the short-term. Sunbathing, camping, motorized boating, and fishing are the primary activities on Cle Elum Lake during the summer months. Recreation activities are concentrated at Seelya Beach, a developed facility with parking and restrooms. Cle Elum Lake received about 350,000 visitors in 1995. Water surface totals 4,812 acres of land, developed public use areas total 105 acres, undeveloped lands total 886 acres and shoreline totals 19 miles.

1.2.10 Cultural Resources

The presence of archeological or culturally significant sites on project construction areas has not been determined for all four storage sites. The Kachess project is located in an area where concern has been raised by the Yakama Nation regarding the presence of archeological materials.

The construction impacts involved with the implementation of the irrigation district agricultural water use efficiency projects have not been determined and may need to be addressed on a case-by-case basis.

Wymer Reservoir: The impact of this project on cultural resources or historically significant sites has not been determined.

Bumping Lake: A search of records available to the Washington State Advisory Council on Historic Preservation shows no State or National Register historic properties or sites listed in the Washington state inventory of historic places within the enlargement area (U.S. Department of Interior, 1979).

Kachess Lake: The PEIS conducted by the U.S. Bureau of Reclamation states that consultations were completed with the Yakama Nation and the Nations Cultural Resources Program Manager and staff concerning archeological sites in the impact area for the Kachess dam channel modification. One sacred site was identified within the impact area for the dam channel modification.

Cle Elum Lake: The impact of this project on cultural resources or historically significant sites has not been determined.

1.3 Alternative I-1B – Major Storage Enhancement, with Targeted Improvements in Water-use Efficiency and Additional Actions (Using Out of Basin Water)

This alternative relies primarily on increasing storage with the construction of a new water supply reservoir, which relies on water outside the Yakima River basin (i.e., proposed Black Rock Reservoir). Increased water storage capacity would be complemented by targeted improvements in water reuse, voluntary transfers, and water-use efficiency by all water user groups. Increased storage would rely upon water from the Columbia River. As with Alternative I-1A, stored water would not be used to expand irrigated lands, beyond those lands with existing entitlements to water from the Yakima Irrigation Project.

The primary environmental impacts associated with this alternative stem from the construction and operation of Black Rock reservoir. Significant land use impacts associated with this alternative are disturbance to or inundation of public and private lands. Targeted improvements in water efficiency may result in lowering of shallow aquifers and hydrologic impacts to associated wetlands, riparian areas, and wildlife. Overall, this alternative would provide significant additional storage capacity and increased operational flexibility and reliability of water supply and flow management. This alternative has the second largest environmental impact of all of the alternatives.

Another alternative (Alternative I-2B(2)) was also considered that would involve the construction of a smaller Black Rock Reservoir than the one originally proposed. The environmental impacts of this alternative will be similar to those of Alternative I-1B(1). The environmental impacts associated with small Black Rock project is expected to be less than the full Black Rock. Since the small Black Rock project has not been fully defined, we are not able to determine the environmental impacts this alternative will have.

The following environmental review is based largely on information from the Black Rock Reservoir Study produced in June 2002 by Washington Infrastructure Services, Inc., as part of the Yakima River Storage Enhancement Project. Additional environmental impacts will result from the implementation of the irrigation district water use efficiency projects for which the environmental impacts are described in Section 1.5.

1.3.1 Earth

The amount of dredging and filling to occur with the development of this project has not been determined. The Black Rock Reservoir site consists of volcanic and interbedded sedimentary rocks of the Columbia River Basalt Group and recent sedimentary deposits consisting of loess, alluvium and landslides. The units have been folded and faulted along the alignment. Slope breaks generally indicate softer, interbedded sedimentary deposits or weathered tops of basalt flows.

Excavation amounts have also not been determined for the construction of the canal/tunnel system. There are four schemes for delivering water from the Priest Rapids Reservoir to the Black Rock Reservoir. The environmental impacts will vary for each scheme. Several conveyance methods were considered using tunnel and canal, and combinations of each. This conveyance system from the reservoir to the canal ranges from 93,700 feet to 48,500 feet long.

Conduit routs extend from the intake at Priest Rapids Dam to Black Rock Reservoir. The pipes will pass through folded faulted rocks of the Saddle

Mountains, Wanapum Basalt and Grand Ronde Basalt, and sedimentary deposits of the Ellensburg Formation. Landslides and loess have been mapped crossing the proposed alignments.

1.3.2 Air

Air pollution impacts have not been determined for this project, however short term air pollution would occur during construction activities. Emissions from internal combustion engines, dust from vehicular traffic, and burning refuse is likely to degrade air quality in the vicinity of construction activity.

1.3.3 Hydrology

A hydrologic model of the Yakima Project was prepared by the U.S. Bureau of Reclamation and used to evaluate flow impacts to the Yakima Basin from Alternative I-1B. For more information on the hydrologic modeling methods and results see Section 3.5.

This alternative, if implemented, could be used to meet the following objectives: water supply reliability, improve instream flows in the Yakima River at various locations including below Keechelus Reservoir or at Parker, and eliminate the "flip-flop" and "mini-flip-flop" on the Yakima River, Naches River, and Tieton River. The degree to which each objective is met varies depending on prioritization of the objectives.

If the stored water were used first to improve instream flows in the Upper Yakima main stem reach (from below Keechelus to above Easton) instream flows could be maintained at or above 200 cfs, while meeting or exceeding the 70% reliability goal to meet agricultural and other water supply needs.

If the increased storage were used to improve instream flows at Parker Dam, instream flows could be maintained at or above 450 cfs in all but severe drought years such as 1994, while meeting or exceeding the 70% reliability goal to meet agricultural and other water supply needs. IFTAG flows of 800 cfs could also be met by this alternative but not without further reducing the reliability to below 70%.

The hydrologic model was also run to explore elimination of the "flip-flop" and "mini-flip-flop" operational practices. The model showed that "flip-flop" could be eliminated with this alternative; it would also result in a 20% reduction in summertime flows in the Yakima River through Kittitas Valley to the Roza diversion. Instream flows would be substantially reduced in the Tieton and Naches Rivers during the months of September and October. The resulting streamflow would more closely match natural flow conditions in those rivers.

1.3.4 Surface Water Quality

The impacts this project will have on surface water quality have not been determined. It is likely that short-term impacts will occur during construction. Increased erosion and turbidity may occur during construction of an intake and pumping plant along the shoreline. Surface water quality may also be degraded during the construction of the canal in stream crossings.

Long-term water quality impacts will occur as well. Interbasin transfer of water may change the chemical properties of water in the Yakima River down stream from Black Rock Reservoir. This possibility has not been defined and additional analysis is needed to determine whether this would affect water quality.

1.3.5 Ground Water

Each of the storage projects would increase storage capacity and may increase ground water infiltration, affecting water levels in surrounding aquifers. As each reservoir is alternately filled and drawn down, there may be localized effects on shallow ground water levels in the vicinity of the reservoir.

1.3.6 Vegetation

Development of this storage project will result in the inundation and disturbance of a variety of vegetated habitats including shrub-steppe and riparian areas. The implementation of irrigation district conservation measures are not expected to contribute to large amounts of vegetation disturbance; however the decrease in water levels may lead to the alteration of vegetation around irrigation district streams and wetlands.

The impacts the development of the Black Rock Reservoir will have on vegetation were not evaluated in detail in existing documents. The reservoir is estimated to cover 6,700 acres of primarily crop and pasture land with some arid-steppe habitat. The canal/tunnel construction area will cross grazing and pasture lands as well as shrub-steppe habitat. Various types of vegetation may be planted on pasture or crop lands and provide marginal habitat for some wildlife.

A general description of shrub-steppe habitat was identified in the Fish and Wildlife Coordination Act Report. The four major plant associations in that habitat are the big sagebrush-bluebunch wheatgrass association, the three tip sagebrush-Idaho fescue association, the bitterbush-bluebunch-wheatgrass association and the Sandberg bluegrass stiff sagebrush association. Grasses such as needle-and-thread, Thurber's needle grass, bottlebrush, squirreltail and Crusick bluegrass may be found in the area. Some forbs that may be found in the area and disturbed include arrowleaf balsamroot, silky lupine and longleaf phlox. Cheat grass, an exotic annual has become widespread thought the region and has replaced some native grasses and shrubs.

1.3.7 Wildlife

The impacts of this project on fish and wildlife have not been determined, however the construction of the project will impact wildlife that rely on the inundated/disturbed habitats.

Wildlife typically found in grazing and crop lands include mule deer, elk, coyote, striped skunk, Pacific mole, deer mouse, garter snake and gopher snake. These lands also provide marginal habitat for various species of birds.

Wildlife relying on shrub-steppe habitat that may be impacted by this project include mule deer, coyote, badger, blacktailed jackrabbit, bobcat, Washington ground squirrel, northern grasshopper mouse, Ord's Kangaroo rat, and Merriam shrew. Birds using shrub-steppe habitat include prairie falcon, golden eagle, burrowing owl, long-billed curlew, chukar, sage grouse, western meadow lark, mourning dove, green tailed towhee, western kingbird, vesper sparrow, black-throated sparrow, Brewer's sparrow, lark sparrow, and sage sparrow. Reptiles and amphibians using this habitat include western rattlesnake, striped whipsnake, Great Basin spade foot toad, short-horned lizard, and northern sagebrush lizard.

1.3.8 Fish

This alternative's primary impact to salmon is from the operation of the Black Rock Reservoir and interbasin water transfer. This alternative will result in additional flow to the Yakima River, and may increase instream flows and improve fish habitat. As a result, instream flows would be reduced in the Columbia River, potentially impacting fish habitat in this system.

The timing of Columbia River withdrawals is an important factor in protecting threatened and endangered anadromous populations of salmon throughout the Columbia. Non-listed native fall Chinook could be particularly susceptible to effect of withdrawals if timing and volume are not carefully regulated. Intake design on the Columbia River must be constructed to minimize interference with downstream migrations of juvenile salmon. The appropriate fish screening and appropriate and flow velocity must be designed and implemented.

Potential interbasin transfer of fish disease pathogens is another concern created by this project. Also, a disturbance to fish migration – a process known as artificial attraction – may result from interbasin transfer of water from the Columbia River to the Yakima Basin. Fish could be attracted by olfactory cues present in the Columbia River waters.

Impacts to salmon and trout listed under the Endangered Species Act are an important consideration. Further study is needed to determine the short and long-term impact this alternative will have on listed species. Table 4 in the previous section summarizes this alternative's potential impact on salmonid production based on information provided in the WRIAs 37, 38, & 39 Limiting Factors Analysis.

1.3.9 Land and Shoreline Use

The construction of the reservoir will impact primarily private land and some public land. The public land is owned by the Washington Department of Natural Resources and the private land is owned by 10 different landowners. This project may also require the relocation of three or four private dwellings.

1.3.10 Cultural Resources

It is not known if the project will impact cultural resources in the area.

1.4 Alternative I-2 – Medium Storage Enhancement, with Targeted Improvements in Water-Use Efficiency and Additional Actions

This alternative relies on increasing water storage and improvements in water reuse, voluntary transfers, and water-use efficiency by all water user groups. The primary environmental impacts associated with this alternative stem from the construction and operation of the Wymer Reservoir. Significant land use impacts associated with this alternative are disturbance to or destruction of public and private lands. Targeted improvements in water efficiency may result in lowering of shallow aquifers and hydrologic impacts to associated wetlands, riparian areas, and wildlife. Overall, this alternative would some additional storage capacity and increased operational flexibility and reliability of water supply and flow management.

Under this alternative, stored water would not be used to expand irrigated levels, beyond those lands with existing entitlements to water from the Yakima Irrigation Project.

Section 1.2 discusses the environmental impacts of the construction and operation of the Wymer storage project. Additional environmental impacts will result from the implementation of the irrigation district water use efficiency projects for with the environmental impacts are described in Section 1.5. The U.S. Department of Interior, U.S. Bureau of Reclamation conducted four studies on Wymer Reservoir from 1984 to 1988. Some environmental information on the existing site and construction impacts was provided in the Stage 1 - Planning Design Summary

Wymer Dam and Pumping Plant Document created as part of the Yakima River Basin Water Enhancement Project.

1.4.1 Earth

The Wymer Reservoir would involve placing a reservoir in Lmuma Creek canyon and moving earth to construct a dam, reservoir, pumping plant, and water transmission lines or waterways. The impacts Wymer Reservoir will have on earth is described in Section 2.1. Sine this is the only storage project proposed for this alternative the impacts will be much less than Alternative I-1(A), however excavation and fill activities are likely to result in erosion and sedimentation.

1.4.2 Air

Air pollution would occur during construction activities. Emissions from internal combustion engines, and dust from vehicular traffic would degrade air quality in the vicinity of construction activity.

1.4.3 Hydrology

The hydrologic model of the Yakima Project prepared by the U.S. Bureau of Reclamation was used to evaluate flow impacts to the Yakima Basin from implementation of Alternative I-2. For more information on the hydrologic modeling methods and results see Section 3.

This alternative if implemented could be used to meet the objectives of improving water supply reliability and improving instream flows at various locations in the Yakima River including below Keechelus Reservoir or at Parker. The degree to which each objective is met varies depending on prioritization of the objectives. Since instream flow objectives are of some priority to the watershed committee, the increased water storage will likely be used to meet or partially meet all instream flow objectives.

If the increased storage were used to improve instream flows in the Upper Yakima main stem reach (from below Keechelus to above the City of Easton) instream flows could reach 200 cfs while slightly improving the reliability of water supply. The 70% reliability goal cannot be met in all dry years. If the increased storage were used first to improve instream flows at Parker, Title XII instream flows (after implementation of Title XII conservation measures) could be met while improving the reliability of water supply. However the 70% reliability goal cannot be met in all dry years. Instream flows that exceed Title XII flows (such as IFTAG flows) could be provided only with a reduction in reliability in water supply.

The effect on instream flow in other river reaches was also modeled. With the scenario of improving instream flow in the upper Yakima River along with implementation of Alternative I-2, it was found that flows decreased in the Yakima River between Cle Elum and Roza Dam by 500 to 1000 cfs in the summertime and increased slightly in the wintertime. Flows at Parker increased slightly in the wintertime with very little change in the summertime. The "flip-flop" operation was still needed and high flows in the Tieton and lower Naches River systems still occurred but were reduced in some years.

1.4.4 Surface Water Quality

Surface water quality impacts will result from the construction and operation of the Wymer storage project. These impacts are discussed in Section 1.2. The water quality impacts of this alternative are less than surface water quality impacts of Alternative I-1A, however short-term and long-term water quality degradation may occur.

1.4.5 Ground Water

The Wymer storage project would increase storage capacity and may increase infiltration to or levels of surrounding aquifers. Operational changes, such as timing of storage releases, may affect hydrologic continuity, but it is not expected to have a significant affect on groundwater levels.

1.4.6 Vegetation

This alternative will result in the disturbance to and inundation of vegetation on the site. Impacts to vegetation from the Wymer storage project are described in Section 1.2. In general, riparian areas and shrub-steppe habitat will be disturbed and inundated with the construction of the reservoir and intake and pumping structure.

1.4.7 Wildlife

This alternative will result in the displacement and disruption of wildlife at the site of the Wymer storage project. The impact this project is expected to have on wildlife however has not been determined in previous studies. Species that could potentially be impacted are listed in Section 1.2.

1.4.8 Fish

The impacts of the Wymer storage project on fish have not been determined. In general, short-term impacts on the riverbank will occur during shoreline construction of the pumping plant and intake. Stream crossings for the canal construction will also alter habitat. Siltation, increased turbidity and removal of riparian habitat will occur.

A positive impact to fish may result from the increase storage and ability to manage water and instream flows to benefit fish.

Impacts to salmon and trout listed under the Endangered Species Act are an important consideration. Further study is needed to determine the short and long impact this alternative will have on listed species. Table 4 in Section 1.2 summarizes this alternatives potential impacts on salmonid production based on information provided in the WRIAs 37, 38, & 39 Limiting Factors Analysis.

1.4.9 Land and Shoreline Use

A portion of the land on the proposed Wymer site is used as grazing land. A small orchard will also be inundated with development. Deepening on the side of the Wymer dam a portion of I-82 may need to be relocated

1.4.10 Cultural Resources

The impact of this project on cultural resources or historically significant sites has not been determined

1.5 Alternative I-3 – Reliance on Efficiency Improvements, Water Reuse and Voluntary Transfers, with No Storage Enhancement

This alternative relies on improvements in water reuse, voluntary transfers, and water-use efficiency. The primary environmental impacts associated with this alternative stem from implementation of the water efficiency measures identified in the plans developed by 13 irrigation districts. Land use impacts associated with this alternative are disturbance of public and private lands. Targeted improvements in water efficiency may result in lowering of shallow aquifers and hydrologic impacts to associated wetlands, riparian areas, and wildlife. Overall, this alternative would reduce water withdrawals and potentially increase instream flows.

Information on the environmental consequences of implementing agricultural water use efficiency projects was provided in the Yakima River Basin Water Enhancement Project Final Environmental Impact Statement (FEIS), January 1999.

1.5.1 Earth

The main impacts to earth that will result from the implementation of this alternative is dredging and filling activity that will result with the construction of pipeline upgrades, reregulation reservoirs, control structures, and canal lining. The amounts of dredge and fill activity required for the construction of these structures has not been determined. The construction areas associated with these projects are small and will have much less of an impact on earth then the alternatives involving storage.

1.5.2 Air

Air pollution impacts have not been determined for this project however short term air pollution may occur during construction of any of the water use efficiency projects. Emissions from internal combustion engines, and dust from vehicular traffic may degrade air quality in the vicinity of construction activity.

1.5.3 Hydrology

The hydrologic model prepared by the Bureau of Reclamation of the Yakima Project was used to evaluate flow impacts to the Yakima Basin for Alternative I-3. For more information on the hydrologic modeling methods and results see Section 3.

This alternative if implemented could be used to meet the following objectives: improve water supply reliability and improve instream flows in the Yakima River either at Parker or elsewhere, such as the Yakima River below Keechelus Reservoir. The degree to which each objective is met varies depending on prioritization of the objectives.

If the water conserved were used first to improve instream flows in the Upper Yakima main stem reach (from below Keechelus to above Easton) instream flows could be maintained at or above 200 cfs, but the 70% water supply reliability goal could not be met in all years.

If the conserved water were used first to improve instream flows at Parker, instream flows could be improved to be maintained at or above at least 450 cfs in all years, while maintaining current levels of reliability. The 70% water supply reliability goal could not be met in all years. IFTAG flow targets cannot be met with out reducing the current levels of water supply reliability.

This alternative does not provide improve the reliability of water supply sufficiently to meet the goal of 70% reliability even if all water saved through efficiency measures were to be used to improve water supply reliability.

1.5.4 Surface Water Quality

Short term impacts associated with the construction of water efficiency projects may result in increased turbidity and sedimentation due to disturbed stream banks and the use of construction equipment in and around the project area.

This alternative may improve water quality in the long term. In general the return flow water quality is lower than the quality of the water in the river, so by reducing diversions and leaving more water in the river the water quality would be improved compared to the no action alternative (U.S. Department of Interior, 1999). Return flows from irrigation districts typically involve temperature, sediment, nutrients, and pesticides. These water quality parameters may be improved in the river.

Water quality within the canal system will not be improved by reducing system delivery losses, canal lining, and canal operation and management. Temperature, sediment, and nutrient and pesticide levels are likely to remain the same. On farm conservation practices may however improve water quality (U.S. Department of Interior, 1999).

1.5.5 Ground Water

Water efficiency measures that reduce irrigation seepage losses may result in reducing groundwater recharge in the areas with improved efficiency. The actual volume of decrease in groundwater recharge is not known; however it may impact some well users as groundwater levels may drop. This may also have an effect on ground water quality. If less canal water is entering the ground water through seepage, a larger percentage of the ground water recharge will be coming from on-farm irrigation water. Crop application water tends to be higher in agricultural chemicals. Groundwater may be slightly degraded.

1.5.6 Vegetation

Vegetation impacts associated with this alternative are expected to be minor. In the short-term water efficiency project construction may result in the degradation of vegetation along canals due to canal lining, and shoreline reservoir areas due to re-regulation reservoir and canal management structures.

In the long-term increased flows in the river due to water efficiency measures may result in improving the riparian and wetland vegetation, as improvements in these habitats have been associated with higher instream flows. The increased ability to regulate flow with re-regulation and water control structures may also result in improved riparian habitat as consistent natural flows benefit these habitats.

Riparian areas and wetlands along canals with reduced seepage may be degraded or eliminated. Since water is no longer seeping into these areas the habitat may become too dry to support existing vegetation. The value of riparian areas along irrigation ditches is typically considered of low ecological value compared to riparian areas along natural streams.

1.5.7 Wildlife

This alternative may improve riparian habitat for wildlife since it will likely improve instream flows. Annual instream flow increases have been associated with increased riparian tree growth improving habitat for wildlife.

Riparian habitat for wildlife along canals may be reduced, having a negative impact on wildlife. Canals and laterals throughout the system could receive less water from reduced diversions. This spread-out reduction could adversely impact wetland and riparian areas and associated wildlife.

1.5.8 Fish

This alternative may have negative short-term consequences to fish due to construction activity; however increased flows and improved water quality would benefit the fish in the long-term. Water efficiency measures could also result in adverse impacts to fish if diversions are not reduced (preventing increases in instream flows) or return flows change reducing stream flows in critical reaches.

This alternative's impacts to fish have not determined and further analysis is needed. Table 5 summarizes this alternative's potential impacts on salmonid production based on information provided in the WRIAs 37, 38, & 39 Limiting Factors Analysis.

1.5.9 Land and Shoreline Use

This alternative is not expected to interfere with existing land and shoreline uses.

1.5.10 Cultural Resources

It has not been determined if any of the construction activities associated with this alternative will impact cultural resources in the area.

Table 5
Alternative I-3 Effects on Limiting Factors to Salmonid Production[1]

Description	Action	Effect on Fish
Benefits to Salmonid Production		
Agricultural Efficiency projects	Implement methods to conserve irrigation water	Improves summer low flows for trout and salmon and reduces predation by bass and northern pike minnow.
Obstructions to Salmon Production		
All construction projects in riparian areas	Destruction of riparian areas	Lack of future LWD source and shading.
All construction projects	Increased sedimentation	Excess sediment enters the system from erosion. This leads to spawning gravel embeddedness, reduced egg and larval survival, and changes in the diversity and abundance of macroinvertebrate food sources.

(1) Developed from information provided in the WRIA 37, 38, &39 Limiting Factors Analysis.

1.6 Alternative I-4 – No Action

1.6.1 Earth

This alternative will not result in any new impacts to land or soil resources.

1.6.2 Air

This alternative will not result in any new impacts to air quality.

1.6.3 Hydrology

No new impacts to hydrology will occur with this alternative. Current conditions will persist. For example, currently the Upper Yakima River below Keechelus Reservoir cannot meet flows of 200 cfs in the winter months. Instream flows of at least 300 cfs can be met at Parker. Flip-flop and mini-flip flop will continue.

1.6.4 Surface Water Quality

This alternative will not result in any new impacts to water quality. Existing water quality conditions in the Yakima Basin will continue.

1.6.5 Ground Water

This alternative will not result in any new changes to groundwater in the Basin. Existing groundwater levels and issues will persist.

1.6.6 Vegetation

No new disturbances to vegetation will result from this alternative. Existing conditions and issues will continue.

1.6.7 Wildlife

No new impacts to wildlife will result from the implementation of this alternative.

1.6.8 Fish

No new impacts to fish will result from the implementation of this alternative. Existing fish population trends will continue.

1.6.9 Land and Shoreline Use

No new impacts to existing land and shoreline use will occur.

1.6.10 Cultural Resources

This alternative will not result in any new issues or concern related to cultural or archeological resources.

Appendix 4-A

Evaluation of Ground Water Management Alternatives

Table 1
Ground Water Management Alternatives Evaluation
Effectiveness Criteria No. 1: Overall Effectiveness (1)

Considerations With Respect to Planning Unit Goals (2)	Alternative II-1 Key Resource	Alternative II-2 Selected Uses	Alternative II-3 Prohibit New Withdrawals	Alternative II-4 No Action
• Goal 1: Improve reliability of surface water supply for irrigation use	• Access to ground water can improve reliability of supply for irrigation, both as a primary supply and by supplementing surface water supplies	• Extent of improvements in reliability depend on how criteria are defined; would likely be lower than Alternative II-1	• Restrictions on new ground water development would provide no improvement in reliability for irrigation	• Effects unknown. Impact on reliability depends on whether future decisions permit new development of ground water resources.
• Goal 2: Provide for growth in municipal, rural domestic and industrial demand	• In many areas ground water is well-suited to provide municipal, domestic and industrial supplies. Access to ground water under Alternative II-1 would help provide for future needs.	• Could improve reliability in selected areas of the Basin, if municipal, domestic and industrial uses fit the criteria developed for this alternative • Extent of improvements in reliability depend on how criteria are defined; would likely be lower than Alternative II-1	• Restrictions would limit growth and development in many communities, particularly where ground water is the most viable source of supply for municipal, domestic and industrial needs • Alternative of using surface water supplies would cause higher costs due to treatment needs	• Effects unknown. Impact on ability to meet growth needs depends on whether future decisions permit new development of ground water resources.
• Goal 3: Improve instream flows for all uses, with emphasis on improving fish habitat	• With increased pumping of ground water, instream flows could be reduced in some areas, at some times • Improved data and extensive management effort may be needed to minimize flow impacts	• Criteria used to implement this approach could be designed to protect flows in high priority areas • Improved data and extensive management effort may be needed to minimize flow impacts • Likely to have fewer impacts on flow than Alternative II-1	• Restrictions on additional ground water development would not improve instream flows, but would limit impacts to current levels in areas where hydraulic continuity is significant.	• Effects unknown. Impact on instream flows depends on degree of connectivity between aquifers and surface waters; and on whether future decisions permit new development of ground water resources.

Table 1 (continued)
Ground Water Management Alternatives Evaluation
Effectiveness Criteria No. 1: Overall Effectiveness [1]

Considerations With Respect to Planning Unit Goals [2]	Alternative II-1 Key Resource	Alternative II-2 Selected Uses	Alternative II-3 Prohibit New Withdrawals	Alternative II-4 No Action
• Goal 5: Protect, improve, and sustain ground water quantity and pumping levels of aquifers for the benefit of current and future use	• May require active and complex management to prevent decline in water levels • Water levels may be impacted in some locations at some times despite management	• Criteria used to implement this approach could be designed to protect water levels in aquifers subject to depletion • Improved data and extensive management effort may be needed to minimize flow impacts • Likely to be more protective than Alternative II-1	• Would help limit decline in water level, but would not benefit users.	• Effects unknown. Impact on aquifer water levels depends on whether future decisions permit new development of ground water resources.
• Goal 7: Maintain economic prosperity by providing an adequate water supply for all uses	• Communities dependent on ground water supplies would have adequate water to provide for economic growth • Agricultural users could supplement surface water supplies in dry years, to reduce losses affecting Basin economy	• Economic impacts would depend on area or aquifer in question • Benefits depend on criteria developed to implement this Alternative • Likely to provide for less economic vitality than Alternative II-1	• Would likely compromise economic opportunities since communities dependent on ground water could not satisfy additional demands • Agricultural users may be significantly impacted during dry years	• Effects unknown. Impact on economic prosperity depends on whether future decisions permit new development of ground water resources.

Notes:
(1) Defined as "Among the alternatives considered, which are most effective at meeting Planning Unit objectives?"
(2) Five of the seven substantive goals are directly related to ground water management. Goals 4 and 6 relate to fish habitat and ground water quality, respectively. Note that goal numbers are not intended to indicate priority.

Table 2
Ground Water Management Alternatives Evaluation
Effectiveness Criteria No. 2: Cost-effectiveness (1)

Alternative II-1 Key Resource	Alternative II-2 Selected Uses	Alternative II-3 Prohibit New Withdrawals	Alternative II-4 No Action
• Quantitative analysis of cost-effectiveness not performed • Financial costs would likely be borne primarily by each water user • Cost-effectiveness depends on success of management program since active and comprehensive management program would be needed to balance multiple goals	• Similar considerations as Alternative II-1	• Does not meet water supply objectives, so cost effectiveness not definable. • For instream flow objective, financial cost is low, but cost in terms of lost economic opportunities may be high	• Current hiatus in processing permits has similar cost effectiveness considerations as Alternative II-3. • In long-term, cost effectiveness will depend on whether future decisions permit new development of ground water resources.

Notes:
(1) Defined as "Which alternatives deliver the highest benefits for each dollar invested"

Table 3
Ground Water Management Alternatives Evaluation
Effectiveness Criteria No. 3: Flexibility Over Time (1)

Alternative II-1 Key Resource	Alternative II-2 Selected Uses	Alternative II-3 Prohibit New Withdrawals	Alternative II-4 No Action
• Could potentially offer substantial flexibility from year to year, since ground water could be used in conjunction with surface water to meet Basin needs. • Comprehensive ground water management program may be necessary to fully realize opportunities for flexible use of this resource	• Improved flexibility for municipal, industrial, and domestic users. • Comprehensive ground water management program may be necessary to fully realize opportunities for flexible use of this resource. • Opportunities for flexible management reduced compared with Alternative I-1. Limited to those areas and uses where ground water development would be permitted.	• Little flexibility, since new use of ground water would be highly restricted in all years and all areas of basin	• Effects unknown. Depends on whether future decisions permit new development of ground water resources.

Notes:
(1) Defined as "Which solutions offer the ability to be readily modified over time, in response to changing conditions and improved information?"

Table 4
Ground Water Management Alternatives Evaluation
Effectiveness Criteria No. 4: Environmental Impacts (1)

Alternative II-1 Key Resource	Alternative II-2 Selected Uses	Alternative II-3 Prohibit New Withdrawals	Alternative II-4 No Action
• Increased ground water development could potentially impact regional aquifer system in Columbia Basalts • New ground water development may reduce summertime base flow, in some locations; and cause increase in surface water temperatures.	• Criteria used to implement this alternative could be designed to minimize undesirable side-effects • Would likely have fewer side effects than Alternative II-1 since ground water use would occur in fewer areas	• Status quo, since new withdrawals would not be permitted under this alternative.	• Effects unknown. Effects depend on whether future decisions permit new development of ground water resources.

Notes:
(1) Defined as "Do some of the potential solutions appear to create new problems, or exacerbate existing problems?"

Table 5
Ground Water Management Alternatives Evaluation
Feasibility Criteria No. 1: Legal Authority (1)

Alternative II-1 Key Resource	Alternative II-2 Selected Uses	Alternative II-3 Prohibit New Withdrawals	Alternative II-4 No Action
• Ecology has authority to issue new permits, so long as four tests in Chapter 90-03-290 RCW are satisfied • NMFS and USFWS may have authority to override state/local decisions if these decisions are deemed to harm fisheries • Yakama Nation has legal standing as co-manager of fisheries resources	• If specific criteria are developed to define selected uses, rule-making by Ecology may be needed • Local governments have some authorities to manage uses of ground water through land use regulations and permitting of development • Other considerations similar to Alternative II-1	• Rule making by Ecology needed, if Yakima Basin is closed to further ground water appropriations	• Ecology has authority to continue regulation of ground water withdrawals in current manner, subject to terms of MOA with USBR and YN

Notes:
(1) Defined as "Do the implementing organizations have the authority to implement the proposed solutions? If not, can ordinances or rules be adopted to provide that authority?"

Table 6
Ground Water Management Alternatives Evaluation
Feasibility Criteria No. 2: Approvals/Permits (1)

Alternative II-1 Key Resource	Alternative II-2 Selected Uses	Alternative II-3 Prohibit New Withdrawals	Alternative II-4 No Action
• Permits would be handled on case by case basis, through existing water rights administrative process managed by Ecology	• Same as Alternative II-1	• No permits or approvals will be required since development of new withdrawals will not be allowed (except under emergency circumstances)	• Effects unknown. Permitting would be handled as shown for Alternative II-1, but would depend on whether future decisions allow new development of ground water resources.

Notes:
(1) Defined as "What approvals or permits will be required, especially by organizations not represented on the planning unit. Are those approvals or permits likely to be granted?"

Table 7
Ground Water Management Alternatives Evaluation
Feasibility Criteria No. 3: Cost and Funding Sources (1)

Alternative II-1 Key Resource	Alternative II-2 Selected Uses	Alternative II-3 Prohibit New Withdrawals	Alternative II-4 No Action
• Cost of ground water development is usually borne by individual water user; using funding sources available to them. • Generally, funding is not a prohibitive factor in developing new ground water resources. • Development of improved data and a comprehensive ground water management system would entail new costs. Funding source(s) to be determined.	• Similar to Alternative II-1. • May be additional legal or administrative costs involved in managing a system that permits some ground water uses, but not others.	• Since further development of ground water prohibited, no capital or operational costs involved • May be substantial costs associated with legal challenges	• Effects unknown. Impact depends on whether future decisions permit new development of ground water resources.

Notes:
(1) Defined as "How expensive is each alternative, and who will bear the cost? Will funding sources be available, both in the short-term and long-term?"

Table 8
Ground Water Management Alternatives Evaluation
Feasibility Criteria No. 4: Integration with Related Programs [1]

Alternative II-1 Key Resource	Alternative II-2 Selected Uses	Alternative II-3 Prohibit New Withdrawals	Alternative II-4 No Action
• Compatible with Ecology's Water Resources Program • Compatible with local land use planning and economic development programs • Would require careful management to be compatible with fish recovery programs • Would increase demands on Ecology's administrative system for processing permit applications. This has been a significant limitation on permitting system in recent years. • To improve data and ground water management capabilities would require new or expanded administrative structures, including state and local participation	• Generally, same as Alternative II-1. However, compatibility with local land use and economic development programs depend on criteria developed to implement this alternative.	• Compatible with Ecology's Water Resources Program • Compatible with fish recovery programs. • Not compatible with local land use planning and economic development programs, unless alternative sources of water are identified to serve growth	• Effects unknown. Impact depends on whether future decisions permit new development of ground water resources.

Notes:
(1) Defined as "How will each solution fit in with related programs and plans?"

Appendix 5-A

Identification of Priority Actions for Surface Water Quality Strategy

Table 1
Surface Water Quality Strategy

Action	Criteria for Evaluating Priorities: Addresses a Major Cause of Impairment	Or	Provides Improved Foundation for Other Actions	Adequately Addressed by Existing Programs	Cost-Effective	Funding Available	Supported by Stake-holders and Public	Watershed Plan Suitable Vehicle for Advancing Action	**Priority Level scale of 1 to 3 (1)**
GOAL 1: REDUCE NON-POINT SOURCE POLLUTION									
Objective 1: Prevent/mitigate forest practices impacts									
▪ Action 1A: Improve Forest Road/Trail Management	**Yes**		**N/A**	**Yes**	**ND**	**ND**	**Yes**	**No**	**3**
▪ Action 1B: Improve Timber Harvest Management	**Yes**		**N/A**	**Yes**	**ND**	**No**	**Yes**	**No**	**3**
▪ Action 1C: Other Watershed Actions	**N/A**		**Yes**	**Yes**	**Yes**	**No**	**(Yes)**	**Yes**	**2**
Objective 2: Prevent/mitigate agriculture impacts									
▪ Action 2A: Improve Irrigation Management	**Yes**		**N/A**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**1**
▪ Action 2B: Improve Cropland Management	**Yes**		**N/A**	**No**	**Yes**	**No**	**Yes**	**Yes**	**1**
▪ Action 2C: Reduce Impacts of Agricultural Chemicals	**(Yes)**		**N/A**	**Yes**	**Yes**	**(Yes)**	**(Yes)**	**Yes**	**2**
▪ Action 2D: Address Livestock Impacts	**Yes**		**N/A**	**(No)**	**(Yes)**	**Yes**	**Yes**	**Yes**	**1**
▪ Action 2E: Control Other Agricultural Impacts	**N/A**		**Yes**	**No**	**Yes**	**No**	**Yes**	**Yes**	**2**
Objective 3: Prevent/mitigate stormwater impacts on water quality									
▪ Action 3A: Plan/Implement Municipal Stormwater Runoff Controls	**Yes**		**N/A**	**(Yes)**	**Lower**	**No**	**Yes**	**Yes**	**2**
▪ Action 3B: Plan/Implement Industrial Stormwater Runoff Controls	**No**		**N/A**	**Yes**	**Lower**	**No**	**Yes**	**N/A**	**3**

Table 1
Surface Water Quality Strategy

Action	Criteria for Evaluating Priorities							Priority Level scale of 1 to 3 [1]
	Addresses a Major Cause of Impairment	Or Provides Improved Foundation for Other Actions	Adequately Addressed by Existing Programs	Cost-Effective	Funding Available	Supported by Stake-holders and Public	Watershed Plan Suitable Vehicle for Advancing Action	
Objective 4: Prevent/mitigate resource extraction impacts								
▪ Action 4A: Control Impacts of Gravel Mining	**Yes**	**N/A**	**No**	**ND**	**No**	**Yes**	**Yes**	**2**
Objective 5: Prevent/mitigate recreation impacts								
▪ Action 5A: Improve Recreational Use Management	**No**	**N/A**	**No**	**ND**	**No**	**Yes**	**Yes**	**3**
GOAL 2: SUPPORT/MAINTAIN POINT SOURCE PROGRAMS								
Objective 6: Maintain/improve compliance with discharge permits								
▪ Action 6A: Upgrade Wastewater Facilities	**Yes**	**N/A**	**Yes**	**Yes**	**(Yes)**	**Yes**	**Yes**	**3**
▪ Action 6B: Accommodate Service Area Growth	**Yes**	**N/A**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**2**
GOAL 3: IMPROVE INTERAGENCY COORDINATION OF WATER QUALITY PROGRAMS								
Objective 7: Improve interagency coordination								
▪ Action 7A: Improve Interagency Coordination	**N/A**	**Yes**	**No**	**Yes**	**N/A**	**Yes**	**Yes**	**1**
GOAL 4: IMPROVE WATERSHED-WIDE INFORMATION BASE								
Objective 8: Improve understanding of problems and solutions								
▪ Action 8A: Improve Cause-Effect Understanding	**N/A**	**Yes**	**No**	**N/A**	**No**	**No**	**Yes**	**1**
▪ Action 8B: Improve Problem/Solution Definition	**N/A**	**Yes**	**No**	**ND**	**No**	**No**	**Yes**	**2**
▪ Action 8C: Expand Monitoring Activities		**Yes**	**No**	**Yes**	**No**	**No**	**Yes**	**1**

Table 1
Surface Water Quality Strategy

Action	Criteria for Evaluating Priorities								Priority Level scale of 1 to 3 [1]
	Addresses a Major Cause of Impairment	Or	Provides Improved Foundation for Other Actions	Adequately Addressed by Existing Programs	Cost-Effective	Funding Available	Supported by Stake-holders and Public	Watershed Plan Suitable Vehicle for Advancing Action	
GOAL 5: ENSURE WATER QUALITY STANDARDS REFLECT NATURAL REGIONAL CONDITIONS									
Objective 9: Ensure water quality standards reflect natural regional conditions									
▪ Action 9A: Refine Water Temperature Criteria	**N/A**		**Yes**	**No**	**N/A**	**No**	**Yes**	**Yes**	**2**
▪ Action 9B: Define Background Turbidity Levels	**N/A**		**Yes**	**No**	**N/A**	**No**	**Yes**	**Yes**	**2**
GOAL 6: MINIMIZE WATER RESOURCE MANAGEMENT IMPACTS ON WATER QUALITY WHILE SUPPORTING LOCAL WATER USES									
Objective 10: Minimize water resource impacts on water quality									
▪ Action 10A: Improve Surface Water Resource Project Operations	**Remedial Action**		**N/A**	**Yes**	**ND**	**No**	**Yes**	**Yes**	**2**
▪ Action 10B: Assess Groundwater Impacts on Surface Water	**N/A**		**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**2**

[1] Priorities: 1 = high priority; 2 = medium priority; 3 = low priority
N/A = Not Applicable
ND = Not Determined

Priority Level (Notes)

Objective

1A - Responsibility of Fish and Water or TFW forest management programs.
1B - Same as above.
1C - Monitoring information forested headwaters important because of large area, major source of water supply and importance to fish habitat.

2A - Extent of agricultural activity; importance in WQ impacts.
2B - Extent of agricultural activity; importance in WQ impacts.
2C - Largely covered by existing regulatory programs.
2D - Not adequately covered by existing programs; importance in loading; public health effects.
2E - Monitoring/education needed; but not top priority.

3A - Already required; implementation best handled at local level; main need is funding assistance to local governments.
3B - Implementation program substantially in place under existing regulations.

4A - Important water quality and habitat issues being addressed.

5A - Impacts are localized and somewhat transitory.

6A - Covered by existing regulatory programs. Effective ongoing programs in place.
6B - Covered by existing regulatory programs. Main need is resources to expand systems and solve local problems.

7A - Water quality issues cut across jurisdictions and government programs; coordination needed for effective actions and use of funds.

8A - Priority information required to effectively address issues and direct future resources. Investment for long term.
8B - Localized data needed at sub-basin scale; but lower priority for watershed plan compared with basin-wide needs.
8C - Comprehensive and integrated monitoring needed to effectively address issues and direct future resources. Investment for long-term.

9A - Important background information (uses and background) for WQ standards application; but very complex to develop.
9B - Important background information for comparison with standards and TMDL compliance. May be costly to develop.

10A - Important connection between quality and quantity but too many unknowns; difficult to define feasibility at this time.
10B - Important information already being gathered for future groundwater management.