CHAPTER 3.
PREVIOUS STUDIES

Several hydrologic and hydraulic investigations have been conducted in Yakima County over the last 70 years, mostly within the Upper Yakima CFHMP study area. An initial focus was the provision of flood elevations to design flood control works and levees after the flood of 1933. Many of these studies were directed toward developing and revising floodplain maps as flood elevations and floodplain boundaries have long been disputed within the study area. Due to the mobile nature of the river and its sediment depositions, floodplain maps have required periodic updating. Other studies reviewed associated flood reduction alternatives. For example, a 1978 comprehensive flood study proposed a flood reduction plan from which a number of recommendations were implemented by the County.

More recently, studies have examined the relationships between flow, magnitude and duration, associated movement and accumulation, sediment supply, and floodplain confinement, in the mainstem Yakima River. While flood hazard reduction or flood protection were not the primary focus of these studies, they do provide insight into riverine processes and how these processes interact with infrastructure. For instance, in the 1996 flood, there was the potential for levee failure at several locations. The causal mechanism for failure was erosion at the toe of the levees. This erosional process is a function of the flow, magnitude and duration, the sediment supply in the river, the degree of confinement produced by the levees themselves, and the effects of other infrastructure such as bridges and their associated diversions on stream energy. Understanding these factors and processes has lead to better design and location of infrastructure and flood protection works, as well as increased predictive capability potential through an understanding of causal factors and failure of these structures.

Another impact change over the last decade is the listing of 2 species of salmonids, Mid-Columbia River Steelhead and Bull Trout, as Threatened under the Endangered Species Act (ESA). The provisions of the ESA require additional analysis of actions, especially federally-funded or federally-permitted actions, that may effect habitat for listed species. Actions to reduce flood hazard have to be implemented in this regulatory context, which is based on the biological needs of the listed species.

A better understanding of physical riverine processes including flow regime, and sediment movement and floodplain function, and how those processes effect salmonid biology, will lead to better, more robust designs and much more rapid permitting of flood hazard and habitat reduction actions. Studies since 2000 have increasingly addressed these concerns. In most cases, there is not inherent conflict between meeting the objectives of flood hazard reduction and the requirements to "cause no harm" or benefit to the listed and non-listed species of salmonids that inhabit the Yakima River watershed.

Summaries of studies between 1970 and 2000 and since 2000 given in Tables 3-1 and 3-2 provide an overview of historical flood control work and identifies flooding issues that remain a concern. Recommendations made in previous studies are summarized in Table 3-1, along with the status of their implementation.

REVISED PRELIMINARY YAKIMA COUNTY FLOOD INSURANCE STUDY

The revised preliminary Yakima County Flood Insurance Study (FIS), which modifies the original FIS published in 1985 by FEMA, addresses the contention that floodplain boundaries were inaccurate because the original study did not properly take into account hydraulic conditions such as the geometry of the river channel and levees. In 1992, Diking Improvement District #1 undertook a project to survey and raise their levees in Gap to Gap levees to insure Corps 100-year certification, and levee inclusion within the floodplain mapping, and turn over ownership of these levees to Yakima County once they were certified as meeting Corps standards. The final revised FIS and floodplain maps were published in 1998 and include further modifications to flood hazard zones and base flood elevations based on information collected from the February 9, 1996 flood.

Flood risk data developed in the FIS are used by the National Flood Insurance Program (NFIP) to determine flood insurance ratings. The NFIP, a federal program established in 1968 and administered by FEMA, allows property owners to purchase federally backed flood insurance. In return for insurance protection, participating communities are required to implement floodplain management measures to reduce flood risks in new developments.

Yakima County and the incorporated cities in the study area currently participate in the NFIP. Table 3-3 summarizes city and County coverage, insurance premiums, and claims from 1978 to June, 30 2006. The number of policies indicates only the number of structures insured, not the total number of structures at risk of flood damage.

Estimated Flood Flows

The revised preliminary FIS made estimates of Yakima and Naches River flood flows based on statistical analysis of flow records, Ahtanum and Wide Hollow Creek flood flows based on synthetic frequency curves developed by the COE, and Spring Creek flood flows based on Yakima River discharges (FEMA 1994). Table 3-4 summarizes the 100-year flood flow estimates, which determine the extent of the 100-year floodplain.

To compute the magnitude of the 100-year flood, the revised preliminary FIS used updated flow records accounting for the effects of upper basin storage reservoirs, which have been informally operated for flood control since the 1933 flood. The use of these records reduced the estimates of 100-year flood flow from the original FIS.

TABLE 3-1.
SUMMARY OF RECOMMENDATIONS MADE IN STUDIES BETWEEN 1970 AND 2000

Study (Source)	Description of Recommendations or Problems Identified	Status
Floodplain Information - Yakima and Naches Rivers (COE 1970)	The KOA levee provide less than 100-year protection.	Levee upgraded
	Culvert openings in I-82 cause backwater flooding.	Corrected
	Near the mouth of the Naches River, the underpass through the Burlington Northern Railroad allows downstream floodwater inundation.	Considering upgrading Naches levee
	Dikes around borrow pits (gravel extraction pits) are obstructing flood flows and may cause channel migration during flood events.	Migration alterns being examined
Floodplain Information - City of Selah & Vicinity (COE 1973)	No recommendations presented.	—
Yakima-Union Gap Flood Damage Reduction (COE 1977)	Control development in unprotected floodway lands.	Regulated
	Raise existing levee system upstream of the old Moxee Bridge.	Completed
	Construct a 2.5-mile right bank and 1.1-mile left bank levee extending downstream from the old Moxee Bridge.	Proposed
	Install control gates on two culverts which pass Spring Creek beneath I-82.	Completed
	Place additional riprap along I-82 embankment near Union Gap.	Completed
Yakima-Union Gap Flood Control Project (COE 1986)	Update floodplain maps to reflect existing hydraulic conditions.	Being completed
Yakima River Flood Evaluation for Yakima County Diking Dist No. 1 (Irrigation & Hydraulics 1991)	Incorporate changed hydrologic conditions and 100-year protection provided by the federal levee system into floodplain boundary maps.	Being completed
	Raise the KOA levee and levee near Moxee-Hubbard diversion to provide 100-year protection.	Completed
	Modify East Valley flood hazard zones to reflect historical and existing hydraulic conditions.	Being completed
Yakima County FIS (FEMA 1994)	Update floodplain maps upon completing the KOA levee upgrade.	Being completed
	Upgrade the right bank Naches River levee located near the river's mouth to contain the 100-year flood.	Awaiting funding
	Upgrade and tie the right bank Yakima River levee into I-82.	No action
	Modify floodplain maps to reflect the elimination of Spring Creek backwater flooding.	Being completed

TABLE 3-1 (continued).
SUMMARY OF RECOMMENDATIONS MADE IN STUDIES BETWEEN 1970 AND 2000

Study (Source)	Description of Recommendations or Problems Identified	Status
Revised Yak Co FIS (FEMA 1998)	The levee between the BN bridge and I-82 fails to meet freeboard requirements for the 100-year flood and should be raised.	Completed
DNR "Flood Plains, Salmon, Habitat, and Sand and Gravel Mining" (1998)	Provided goals for planning, siting, and reclamation of flood plain mining if it is approved. If mining is approved the goals are: • Mining should not increase the potential for river avulsion. • Fish and wildlife habitat should be protected. • Riparian areas should be protected, both to provide habitat and to improve flood-plain stability. • Reclamation should ultimately enhance salmon habitat. • If there is potential for migration of the river into a gravel pit, the site must be reclaimed in a way that is hydrologically comparable with the adjacent river.	No action
DNR "Reclamation of Flood-Plain Sand and Gravel Pits and Off-Channel Salmon Habitat" (1998)	This study reviewed several examples of reclaimed sand and gravel pits as off-channel salmon habitat in Washington including the Edler gravel ponds along the Yakima River near Union Gap. The authors of this article concluded that if the Yakima River captured the Edler pits, the off-channel habitat would be lost, but regulatory agencies anticipated few other additional negative impacts on the Yakima River given that the pit lakes were not overly wide or deep relative to the river.	No action

TABLE 3-2.
SUMMARY OF RECOMMENDATIONS FROM RELATED STUDIES AFTER 2000

Study (Source)	Description of General Recommendations or Problems Identified	Status
Yakima River Floodplain Mining Impact Study (2002)	Future mines should be located outside of 100 year flood plains. The Yakima River will in the future avulse some part of the gravel mine pits. Floodplain mining must not destroy intersections between modern Yakima River channel and paleochannels where increased hyporheic ground water flow to the river contributes a high concentration of dissolved oxygen. Ground-water flow into and out of ponds should be protected. Until additional mitigation options and protocols are in place to address large gravel ponds that pose an immediate avulsion risk to major infrastructure as a catastrophic scale, precautionary site protection measures should be considered.	Guidance document
The Reaches Project (2002)	All five (Yakima River mainstem) reaches have significant potential for restoration. However, the restoration potential is highest in the Union Gap reach. The Union Gap reach depends on sediment from the Naches reach. Sediment from the Selah reach is limited due to the gravel mining and Roza Dam has stopped all bedload sediment. Sediment transport out of the Naches should be improved and maintained. Another risk is the avulsion capture of bedload by the existing gravel pits. Pit capture of the river by some of the very deep gravel pits (~15 m) could disconnect groundwater-surface water interaction across the floodplain for periods of several decades. The acquisition of floodplain habitat in all reaches should be a priority, particularly those areas that yet maintain some degree of habitat complexity. The general pattern is for the lower end of each of the various reaches to maintain higher complexity.	Proposed in this CFHMP Actions proposed in Lower Naches River Coor. Partnership Study or project proposed in this CFHMP In progress through YRBWEP
SR 24 Project Floodplain Consistency Report (2003)	Levees and bridge abutments in danger of erosion, New SR 24 bridge should be substantially longer. Floodplain function compromised for habitat, sediment transport, and riverine processes.	In progress

TABLE 3-2 (continued).
SUMMARY OF RECOMMENDATIONS FROM RELATED STUDIES AFTER 2000

Study (Source)	Description of General Recommendations or Problems Identified	Status
Lower Naches River Coordination Project (2005)	Remove Fruitvale Diversion, restore connection of Cowiche Creek with Lower Naches River, combine diversions at Nelson Dam.	Under development
	Acquire floodplain properties in Lower Naches River to allow habitat restoration and flood hazard reduction projects to occur while minimizing impact on private properties.	In progress (grant applications)
	Remove Ranney Collector System and associated levee to improve floodplain function and reduce flood hazard.	Under development
	Implement large scale bioengineering and structural repairs to US Highway 12 in the vicinity of 16th Avenue to reduce flood hazard to the City of Yakima and US Highway 12, and improve habitat.	In design, funding secured
	Improve sediment transport in this reach – lengthen current Powerhouse/Twin Bridges/Nelson Dam constriction point, redesign Nelson Dam to allow for better sediment transport.	Under development
Yakima County Minerals Resource Task Force (2006)	The Board of Yakima County Commissioners established a minerals resource task force to address the Washington State Growth Management Act (GMA) requirement that local jurisdictions designate mineral resource lands for the extraction of minerals.	No action

TABLE 3-3.
NATIONAL FLOOD INSURANCE PROGRAM PARTICIPANTS IN THE CFHMP STUDY AREA

Community	Date of Coverage	No. of Policies	Annual Premium	Coverage (x1,000)	Total Claims Since 1978	Dollars Paid Since 1978
Yakima County (unincorporated)	June 5, 1985	592	$347,294	$87,301	175	$866,675
City of Yakima	Dec. 15, 1981	22	$11,501	$4,417	9	$14,964
City of Selah	May 2, 1982	5	$7,068	$864	38	$537,239
City of Union Gap	May 2, 1983	14	$4,214	$1,715	1	$3,291

SOURCE: FEMA 2006.

TABLE 3-4.
FLOOD INSURANCE STUDY 100-YEAR FLOOD FLOWS

Stream and Location	Drainage Area (sq. mi.)	100-Year Discharge (cfs)
Yakima River at Parker	3,660	56,300
Yakima River Upstream of Naches River	2,135	35,500
Naches River at Mouth	1,125	27,100
Ahtanum Creek at Union Gap	173	2,850
Wide Hollow Creek at Burlington Northern Railroad Bridge	65.7	640
Spring Creek at confluence with Wide Hollow Creek	Data not Available	285

SOURCE: FEMA 1998.

Hydraulic Computer Modeling

Yakima River flood elevations from Wapato Dam to Selah were estimated using the COE's HEC-2 computer program. The program calculates flood elevations based on flood flows and the physical characteristics of the floodplain and river channel. Floodplain topographic information was taken from hydraulic analysis performed in an unpublished 1986 flood reduction study. River channel geometry was surveyed in 1984 and overbank elevations were determined in 1985 from topographic maps using photogrammetrical methods.

The HEC-2 computer model was calibrated by reproducing the water surface elevations measured during the November 1990 flood. To verify the computer model, the 1933 flood was simulated by modifying the topographic cross-sections to reflect 1933 conditions. The 1990 calibration and 1933 verification reproduced floodwater elevations to within 0.5 feet of measured elevations.

Key differences between the 1994 and 1985 computer modeling efforts include the following:

The new model used improved flood flow estimates as described above.

- The new model accounted for recent upgrades to federal levees that provide 100-year flood protection.
- The new model confined flood flows between COE-certified levees. The 1985 model extended floodplain boundaries beyond federal levees because portions of the levees did not meet FEMA standards. The 1985 flood elevations were computed by confining the flood flow within the levees and extending the water surface elevations beyond the substandard levees. This 1985 technique exaggerated the extent of overbank floodplain boundaries.
- I-82 elevations were inspected for the 1994 study and determined to contain the 100-year flood with adequate freeboard. Levees that fail to meet FEMA elevation requirements between the river and the highway are predicted to overtop but floodwaters are prevented from spreading by I-82.
- Floodplain boundaries estimated in the 1994 study incorporated a private levee near the KOA campground. The levee did not meet FEMA elevation requirements; however, Diking District No. 1 has since raised the levee to federal standards.

Flood Insurance Rate Maps, Floodway Maps, and Flood Boundary Maps

FEMA uses the results of the FIS to prepare Flood Insurance Rate Maps (FIRMs) identifying special flood hazard areas—areas subject to inundation by the 100-year flood. The FIRMs show different types of flood hazard areas, or zones, based on the location of the 100-year floodplain and the type of analysis used to predict water surface elevations. Flood hazard zones are used to determine insurance rates. FEMA delineated the following zones within the study area:

- **Zone A**—Areas subject to inundation by the 100-year flood where base (100-year) flood elevations and flood hazard factors were not determined. Mandatory flood insurance purchase requirements apply in this zone.
- **Zones AE and A1, A4, A7, A8, and A9**—Areas subject to inundation by the 100-year flood determined by the FIS using detailed methods; base flood elevations shown. Mandatory flood insurance purchase requirements apply.
- **Zone B, C, and X**—Areas with moderate or minimal flood hazard from the principal source of flooding in the area. These areas may experience flooding from severe storm events or inadequate local drainage. Flood insurance is available but not required in these zones. Zone X is used on new and revised maps in place of Zones B and C.

Floodway and flood boundary maps, like FIRMs, show 100-year flood boundaries, as well as the floodway as determined by FEMA. A floodway includes the channel of the stream and the adjacent floodplain that must be reserved in an unobstructed condition in order to discharge the 100-year flood without increasing flood levels by more than one foot (less if specified in local ordinances). FEMA requires communities to designate the floodway to avoid significantly increasing upstream flood elevations. To maintain insurance coverage, communities must prohibit development within the designated floodway that would cause any increase in the 100-year flood elevation. Appendix C shows the revised preliminary 100-year floodplain as

currently defined in the County's GIS system. The GIS floodplain is based on the most recent information; however, modifications are expected when the final maps are completed and the FIS is adopted.

1970 FLOODPLAIN INFORMATION; YAKIMA AND NACHES RIVERS

This report was prepared to help identify flood hazard areas; it did not address flood reduction measures. The report contains maps, flood profiles, and river cross-sections indicating the extent of past and probable future flooding. The following flood issues identified in the report are still being discussed today:

- The left bank levee upstream of SR 24 bridge (KOA levee) does not provide adequate protection (recently upgraded)
- Backwater flooding occurs due to culvert openings in I-82 (box culvert near Union Gap recently upgraded)
- Near the mouth of the Naches River, an underpass through the Burlington Northern Railway needs additional stop-log bulkheads to protect the area downstream from inundation (no longer necessary due to upgrade of US Highway 12).
- Dikes surrounding borrow pits (locations of former gravel extraction operations) obstruct flood flows and could cause channel shifting during extreme floods.

This was the first study to define the 100-year floodplain in the CFHMP study area. The original 1985 FIS used this information to produce floodplain maps. However, the unpublished 1986 COE study found significant differences in the 100-year flood levels and flood magnitudes. These discrepancies prompted the January 6, 1989, floodplain map revision and subsequent revisions made in the 1994 FIS.

1973 FLOODPLAIN INFORMATION; CITY OF SELAH AND VICINITY

This study identified areas subject to flooding near Selah by examining historical floods and mapping inundation areas for specific flood flows. The study area included the Yakima River from Yakima Canyon to Selah Gap. The work did not present solutions to flood problems, but it did provide information on land use controls to limit future flood damage.

The flooded areas identified in the study are similar to those seen today. East Selah is hit hardest by flooding. Accounts of historical floods describe several homes being evacuated in East Selah, farmlands being lost as the river cut new channels, and the golf course being entirely inundated and covered with silt. The largest recorded flood, 41,000 cfs at Umtanum in 1906, caused extensive agricultural damage. During the 1933 flood, the river flow exceeded the bank-full flow of 10,000 cfs at Umtanum for nine consecutive days and rose at a maximum rate of 4 feet per day.

Flood hazards were also identified by mapping flood inundation areas for the 100-year flood event. The Yakima River 100-year flood flow was estimated at 39,000 cfs at Selah Gap, slightly higher than current estimates (35,500 cfs). Identified flooded areas are similar to those determined in the 1994 FIS; as the Yakima River leaves Yakima Canyon the floodplain is narrow and confined between the Burlington Northern Railroad grade to the east and high ground to

the west. Flooded areas widen significantly after Harrison Road bridge as floodwater spreads out over the Selah Valley. Flood boundaries extend east from the Burlington Northern Railroad grade into East Selah. Downstream, floodwaters again become constricted as they approach the golf course and Selah Gap.

1978 YAKIMA-UNION GAP FLOOD DAMAGE REDUCTION REPORT

This flood damage reduction report, prepared by the COE, was a comprehensive examination of floodplain management in the Yakima-Union Gap area. An interim report was issued in May 1977 and a draft environmental impact statement (EIS) was completed in 1978.

The plan developed in this report was intended to reduce flood damage potential and threats to public welfare within existing economic constraints. The report assessed levels of protection provided by existing flood control facilities, determined current and future potential for flood damage, and examined alternative flood reduction measures with regard to engineering and economic feasibility and associated environmental impact.

Seven alternative were considered and are described below.

Alternative 1—No Action

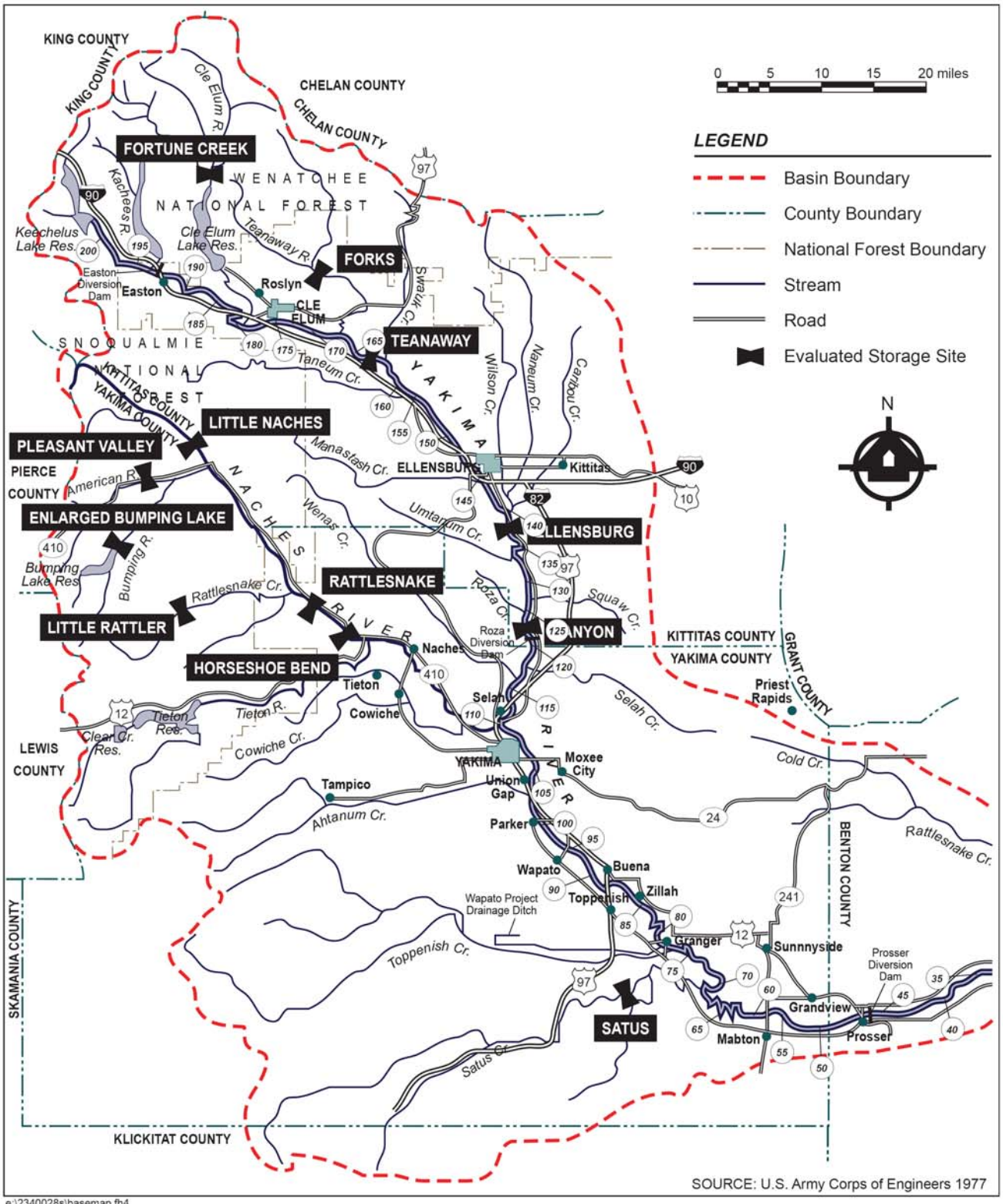
This alternative called for maintaining the status quo of minimal floodplain management, which would allow the continued encroachment of development into the floodplain and result in greater flood damage. No structural or nonstructural measures would be implemented. Alternative 1 was evaluated as a baseline for comparison with other alternatives.

Alternative 2—Floodplain Management Alone

Alternative 2 would maintain existing flood management conditions, with the addition of land use restrictions, an early warning system, and floodproofing for new construction. This alternative would provide no protection for current floodplain residents, but would reduce future increases in flood damage. Estimated annual flood damages were reduced by 56 percent from alternative 1. This alternative has a positive benefit-to-cost ratio, but would not eliminate the flood threat to current floodplain residents.

Alternative 3—Floodplain Management with Additional Flood Control Storage

A preliminary review was conducted to examine the feasibility of constructing additional reservoirs in the upper Yakima basin. Twelve potential reservoir sites, proposed by the Bureau of Reclamation and shown in Figure 3-1, were examined. It was concluded that such projects were economically unjustified, environmentally unsound, or not technically feasible, except for the Bumping Lake Enlargement Project. The Bumping Lake project, proposed by the Bureau of Reclamation and the U.S. Fish and Wildlife Service, would be used to enhance in-stream flows for fisheries. Additional storage projects would negate Bumping Lake enhancements, require excessive development costs, and produce significant adverse environmental impact. Alternative 3 was dropped from further development based on this preliminary evaluation. The Bumping Lake proposal has remained in the planning stage.



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KCM 1917 First Avenue Seattle, Washington 98101	Yakima County UPPER YAKIMA RIVER CFHMP	Figure 3-1. EVALUATED FLOOD CONTROL STORAGE FACILITIES

Alternative 4—Floodplain Management with Levees

Alternative 4 incorporated structural alternatives along with the floodplain management measures proposed in Alternative 2. The structural measures included improvements to existing levees above Moxee Bridge, construction of two levees below Moxee Bridge, application of riprap along I-82, and installation of control structures at the Spring Creek culvert crossings under I-82. The levees upstream of the Moxee bridge would be upgraded from a 25-year to a 200-year level of flood protection. The levees downstream of Moxee bridge would be upgraded from 2-year to 100-year flood protection.

An additional 3,300 acres of suburban and agricultural lands would be protected under this alternative. Average annual flood damages in the year 2032 would produce a 77 percent reduction from Alternative 2.

Alternative 5—Floodplain Management with Channel Modification

This alternative included dredging the Yakima River to increase conveyance capacity and reduce flood levels. An evaluation was made for straightening and dredging the channel between Moxee Bridge and Ahtanum Creek to convey the 100-year flood. The analysis assumed that upstream levees would be upgraded.

Cost and maintenance requirements associated with additional sediment removal, and environmental impacts made this alternative infeasible.

Alternative 6—Purchase of Development Rights Within Floodway

This alternative called for the purchase by public agencies of development rights on 850 undeveloped acres in the Yakima River floodway downstream of Moxee Bridge at a price equal to the loss of market value associated with further land use restrictions. Only pasture, open space, general recreation, and wildlife habitat would be allowed in the floodway. This alternative offered no additional benefits; existing floodplain regulations already limit floodway development.

Alternative 7—Purchase of Floodway

This alternative considered purchasing the floodway downstream of Moxee bridge for conversion to a regional park. This alternative, like Alternative 6, would provide minimal additional benefits because existing floodplain regulations already limit floodway development.

The benefits and costs for each alternative were projected from 1977 to 2032 in order to determine benefit to cost ratio. The annual costs and benefits of the seven alternatives and benefit-to-cost ratios evaluated are summarized in Table 3-5.

TABLE 3-5.
SUMMARY OF ALTERNATIVES EVALUATED IN THE 1977 FLOOD REDUCTION STUDY

Alternative	Average Annual Flood Damage	Average Annual Benefits	Average Annual Costs	Benefit-to-Cost Ratio
1. No Action	$825,100[a]	$0	$0	Not Applicable
2. Floodplain Management Alone	$825,100[a]	$428,700[b]	$245,300[c]	1.7
3. Floodplain Management with Additional Upstream Storage	Not Evaluated			
4. Floodplain Management with Levees	$583,400	$508,700[d]	$261,500	1.9
5. Floodplain Management with Channel Modification	$583,400	$635,900[e]	$1,280,000	-0.5
6. Purchase Development Rights within Floodway	$583,400	$0	$9,000	0
7. Purchase Floodway	$583,400	$0	$34,200	0

a. Assumes no restriction on future development
b. Includes damages prevented ($241,700) and flood insurance payments ($187,000)
c. Includes flood insurance premium ($208,000), cost of administering floodplain management ($22,000), and floodproofing costs ($15,300)
d. Includes damages prevented ($419,700), area redevelopment ($70,000), elimination of future floodproofing ($15,300), and intensification benefits ($3,600)
e. Includes area redevelopment benefits ($110,000)

SOURCE: COE 1977 [2006 values can be estimated by use of multipliers between Consumer Price Index (36) and Civil Works Cost Index (26)]

Recommended Plan

The seven alternatives were compared for benefits and adverse effects in reducing potential flood damage. Alternative 4 was selected as the recommended plan based on its ability to maximize national economic benefits and limit environmental impact while meeting the planning objective. The recommended plan consisted of the following:

- Control the development of 2,300 acres of unprotected floodway lands
- Raise the existing levee system above Moxee Bridge for 200-year flood protection and provide additional riprap protection. Left bank improvements include upgrading the Moxee Bridge-to-Roza Wasteway levee, the Burlington Northern Railroad embankment levee, and the cross levee extending from the railroad embankment. Right bank improvements include upgrading levees from Moxee Bridge to the Burlington Northern Railroad bridge crossing the Naches River
- Construct two levees extending from the Moxee Bridge to a 100-year flood capacity; a 2.5-mile right bank levee and 1.1-mile right bank levee to protect the City of Yakima's regional sewage treatment facility

- Install drainage control gates on the two culverts that conduct Spring Creek under I-82 (completed by Yakima County and WSDOT)
- Protect I-82 by placing additional riprap on the highway embankment near Union Gap (completed by WSDOT). It should be noted that the inflation rates assumed in the 1977 study were exceeded over the past 29 years so that the difference in cost-benefit ratios between alternatives 2 (no levee) and 4 (levee) will have decreased and the two alternative would be more comparable from a flood hazard perspective.

The recommended project had a benefit-to-cost ratio of 1.9 to 1, but was not constructed as a federal project due to lack of local support. However, since the issuance of this report, Diking Improvement District #1 has made improvements to the KOA levee upstream of Moxee Bridge to provide 100-year protection, Yakima County and WSDOT installed control structures on the Spring Creek culverts, and WSDOT placed additional riprap on the I-82 embankment (Simonson, R., 15 March 1995, personal communication). It should be noted that the inflation rates assumed in the 1977 study were exceeded over the last 29 years so that the difference in cost-benefit ratios between alternatives 2 (no levees) and 4 (levees) will have decreased and the two alternatives would be more comparable for a cost/benefit perspective.

1986 YAKIMA-UNION GAP FLOOD CONTROL PROJECT

This unpublished COE report, completed in 1986, examined floodplain boundaries and found significant differences from an earlier flood study conducted in May 1970, triggering an official request to modify the existing floodplain boundary maps. The modification, called a Letter of Map Revision (LOMR), was issued on January 6, 1989, making this the official FIS. However, this study estimated floodplain boundaries by modeling the flood flow confined within the levee system and, because some levees did not meet FEMA standards, extending the levee-confined water surface elevations into the floodplain. This technique exaggerated the extent of the overbank floodplain boundaries. No adjustments were made to account for levee failures or for levee sections with elevations exceeding FEMA requirements. These problems led to the release of an additional LOMR dated May 16, 1994. The revised preliminary FIS incorporated the 1994 LOMR to reflect current levee conditions.

1991 YAKIMA RIVER FLOOD EVALUATION FOR YAKIMA COUNTY DIKING DISTRICT NO. 1

The 1991 Yakima River Flood Evaluation, conducted by Irrigation & Hydraulics Unlimited for Yakima County Diking District No. 1, sought to determine whether East Valley base flood elevations and flood hazard zones were overestimated in previous studies. Analysis included review of flood frequencies, historical floods, flood risks, and previous flood studies, focusing on the East Valley area, the Diking District's primary service area. Recommendations were made for protection of properties in the East Valley and potential problems with previous flood studies were identified. The study objectives were as follows:

- Estimate flood flows using data that account for Bureau of Reclamation reservoir management.
- Analyze the data used to develop previous FIRMs and compare those data to historical water surface elevations.

- Calculate the Yakima River flow that would overtop SR 24 and the Moxee-Hubbard diversion.
- Analyze the impact of the SR 24 bridge on flood elevations.
- Evaluate the flooding impact of gravel bar and vegetation growth upstream of the SR 24 bridge on flooding.

Estimated Flood Flows

Following the 1933 flood, the Bureau of Reclamation began informal operation of upper basin reservoirs to reduce flood flow. To assess the impact of reservoir management on flood flows, a flood frequency analysis of winter floods was performed for the entire 1909-1990 period, as well as for 1933 to 1990, omitting the years prior to the use of the reservoirs.

Results of the flood frequency analysis for the Yakima River at Parker, completed by Irrigation & Hydraulics Unlimited and shown in Table 3-6, indicate that flood flows are reduced by reservoir management for all floods except the two-year flood. This demonstrates the capacity of the reservoirs to reduce flow during extreme events and increase it during low-flow events. Recent floodplain mapping takes the effect of the reservoirs into account. FEMA still uses the flows shown in Table 3-4.

Review of Historical Floods

The 1933, 1948, and 1990 flood events were reviewed to assess historical flood damages in the East Valley. East Valley flood damage was described as generally minor for these flood events (see Chapter 4).

During the 1933 flood, the largest flood of record, moderate flooding was experienced in East Valley. West Birchfield Road had water extending over the road for 800 feet. The depth of flow was computed to be 9 inches, resulting in a calculated flow of approximately 2,000 cubic feet per second (cfs). The flow originated from the north and was not a result of downstream backwater. During the 1948 flood, floodwaters entered East Valley through a small levee failure south of Terrace Heights Boulevard. Damage was minimal as floodwaters were primarily confined to fringes of the Yakima River. During the 1990 flood, floodwaters did not enter the East Valley. Some water seeped through the levees, causing only minor damage.

TABLE 3-6.
RESULTS OF FLOOD FREQUENCY ANALYSIS

Flood Frequency (years)	1909 - 1990 Flood Flows (cfs)	1933 - 1990 Flood Flows (cfs)
200	70,536	66,515
100	57,542	51,809
50	46,248	44,472
25	36,804	35,204
10	24,697	24,519
2	8,633	9,122

SOURCE: Irrigation & Hydraulics Unlimited 1991

Issues Identified as Affecting Flood Risks

Three issues were identified as affecting flood risks in the East Valley: federal levee construction, informal reservoir management for flood control, and construction of SR 24 across the Yakima River.

The federal levee system, completed in 1948, greatly reduced flood risks (see Chapter 5). Right and left bank levee segments extend from the Naches River confluence to the old Moxee bridge. The system was constructed to contain floods equal to the 1933 flood, and provides protection for many floodplain residents.

Flood risks also decreased when the Bureau of Reclamation began informal operation of upper basin storage reservoirs for flood control following the 1933 flood. The reservoirs store floodwaters, thereby reducing flood flows and flood risk. Reservoir flood flow reduction is a function of available storage capacity, the duration of the flood, and the amount of runoff during the flood.

Construction of the new SR 24 bridge was identified as increasing flood risk by constricting the Yakima River and raising floodwater elevations. A left bank levee directly upstream of the bridge (the KOA levee) faces increased flood risk as a result. This levee is not high enough to contain the 100-year flood; floodwaters would overtop the levee and cause additional damage. Recommendations were made to raise the levee or increase the size of a downstream culvert to convey overtopping flow back into the Yakima River main channel.

Assessment of Previous Studies

The Diking District's flood evaluation included review of FEMA's 1985 Flood Insurance Study and the unpublished 1986 COE study to assess the accuracy of their predictions for East Valley floodplain boundaries and base flood elevations. The review identified the following concerns about the previous studies:

- Flooding conditions may have been overestimated through the use of a one-dimensional steady-state computer model to predict floodplain boundaries.

- Improper computer model cross-sections were used near the SR 24 bridge, causing the computer model to be unstable.
- An entire left bank levee was modeled to fail even though only a portion of the levee was below FEMA standards.
- The flood studies should have integrated historical flood data.
- It is improper to compute floodplain boundaries by confining the flood flow within the levees and extending the confined water surface elevations beyond substandard levees.

Key Results from Previous Studies

The Diking District's study highlighted the following findings and recommendations as the key results of the evaluation; many of the recommendations were incorporated into the 1994 FIS:

- Flood magnitudes estimated in the evaluation were consistent with previous work performed by FEMA and COE
- FEMA-estimated floodway elevations are consistent with historical floods
- FEMA estimates of flood elevations north of SR 24 are low due to the poor cross-sections used in FEMA's computer model
- One-dimensional computer modeling should not have been used to determine overbank flood elevations in previous studies
- The 1985 FEMA FIS should have incorporated historical flood elevation data
- It was improper for previous studies to have defined floodplain boundaries by extending floodway elevations beyond the levees and into the floodplain
- FEMA's floodplain boundary maps should take into account the protection provided by the levee north of West Birchfield Road. The FIS incorrectly represented the levee north of SR 24 to Terrace Heights Boulevard as one levee system. The levee north of West Birchfield Road should have been represented as providing 100-year flood protection, and the levee south of West Birchfield Road should have been represented as a separate system that would fail during the 100-year flood
- The levee south of West Birchfield Road (KOA levee) should be raised by 5 feet to provide 100-year flood protection and the dike's river slope should be modified from 2:1 to 3:1
- The levee near Moxee-Hubbard diversion should be raised to provide 100-year flood protection
- The levee north of SR 24 (KOA campground levee) should be raised to provide 100-year flood protection
- East Valley flood hazard zones should be modified to reflect historical and existing conditions
- Gravel deposition near the SR 24 bridge does not significantly affect flood depths.

RECENT RELATED STUDIES

1998 Department Of Natural Resources "Flood Plains, Salmon Habitat, and Sand and Gravel Mining"

This 1998 study funded by the U.S. EPA analyzed the relationships of flood plains, salmon habitat, and sand and gravel mining, in Washington rivers, including the Yakima River. It concluded that for flood plain mining to be approved, the main goal of planning, siting and reclamation were as follows:

- The mining should not increase the potential for river avulsion
- Fish and wildlife habitat should be protected
- Riparian area should be protected, both to provide habitat and to improve flood-plain stability
- Reclamation should ultimately enhance salmon habitat
- If there is potential for migration of the river into a gravel pit, the site must be reclaimed in a way that is hydrologically comparable with the adjacent river.

This study also suggested that before any mining or expansion is allowed on a flood plain, miners must make a rigorous environmental analysis of the planning area that should include as a minimum a geohydrological analysis of the affected areas of river system. This thorough plan should include:

- A topographic map of the existing conditions and surrounding lands as well as flood profiles.
- Maps and cross sections of all bodies of waters, the stream profile, and the elevation of the river bed.
- A geomorphic analysis that identifies historic channels and channel migration trends, on the basis of examination of all available data.
- A detailed chronology and description of historic precipitation, flooding, discharge, sediment transport, including description of sediment sizes in and adjacent to the proposed mine site.
- Maps of vegetation and analysis of its role in flood and erosion control, as well as a description of the relation between the sediment distribution and the biota, especially as it applies to bank erosion and avulsion.
- An analysis of avulsion or stream capture potential, including the consequences of stream capture, channel incision, and scouring.
- An analysis of potential damage to neighboring properties, fish and wildlife habitat and other capital improvements.
- An analysis of channel stability, magnitude and frequency of the 5, 10, 25, and 100 year floods, channel and flood-plain hydraulics near the proposed mine site, and any previous stream capture events.
- A carefully documented study of potential impacts to endangered salmon species listed under the Endangered Species Act.

1998 Department of Natural Resources "Reclamation of Flood-Plain Sand and Gravel Pits and Off-Channel Salmon Habitat"

This study reviewed several examples of reclaimed sand and gravel pits as off-channel salmon habitat in Washington including the Edler gravel ponds along the Yakima River near Union Gap.

Avulsion occurred in 1971 at gravel pits downstream of the Edler site. The authors of this article concluded that if the Yakima River captured the Edler pits, the off-channel habitat would be lost, but regulatory agencies anticipated few other additional negative impacts on the Yakima River given that the pit lakes were not overly wide or deep relative to the river.

The summary conclusions from this study were that digging additional ponds for off-channel habitat may be counterproductive in some reaches and the ponds are not likely to outperform the natural system. Creation of off channel habitat for salmon should be firmly coupled with plans for long-term monitoring to determine effectiveness.

1998 Revision to Yakima County Flood Insurance Study

The driving force behind this revision of the FIS was a disagreement with the methodology used in the 1994 FIS along the eastern portion of the Yakima River floodplain from approximately Birchfield road to the end of the Diking Improvement District #1 levee, two miles downstream of SR 24. The 1994 FIS determined that this levee did not meet the material or freeboard standards to withstand the 100-year flood without failure or overtopping. The base flood was modeled with the levee in place, and this (elevated due to the presence of the levees) flood elevation was extended outside of the levees. This resulted in the large area of floodplain in this location having base flood elevations of 7 to 8 feet above the ground surface level. The 1998 revision models the base flood elevation with the DID #1 levee removed, which lowered the base flood elevation and revised the FEMA maps. This lowering of the base flood elevation did not result in significant reduction in the areal extent of the floodplain, as the floodplain's eastern boundary was and remains the edge of a floodplain terrace that parallels the river along its entire length in the Selah Gap to Union Gap reach.

In addition, the former DID #1 levee (i.e., "KOA levee"), now operated by Yakima County, had been raised to meet Corps requirement for a 100-year levee in order for Yakima County and the Corps of Engineers to accept the levee as part of the Federal Flood Control Project. There was hope that the area north of SR 24 and east of Keys Road would be removed from the 100-year floodplain as a result of this activity. The new modeling showed that SR 24 would theoretically be overtopped should the DID #1 levee downstream of SR 24 fail during a major flood event.

It should be noted that the February 9, 1996 flood was slightly in excess of the predicted 100-year flood, and while the DID # 1 levee south of SR 24 did require emergency repair and re-enforcement during the flood, it did not fail or overtop.

Yakima River Floodplain Mining Impact Study (2002)

Beginning in 2002, a joint study of the effect of floodplain gravel mines was initiated by an interjurisdictional study team led by Yakima County and composed of participants from Yakama Nation, the Washington State Departments of Ecology, Natural Resources, and Fish

and Wildlife, and Central Pre-Mix Concrete Company (Floodplain Mining Impact Study Team, 2004). The Yakima River Floodplain Mining Impact Study examined the current regulatory requirements and processes required for locating new floodplain gravel mines, the ecological effects of existing gravel mines, and made recommendations regarding reclamation and long term management existing and future sites and considerations for development of new gravel mining sites in the floodplains of the entire Yakima Basin.

The relationship of this study to the Upper Yakima CFHMP can be summarized as follows:

1) The CFHMP study area lies in the "middle reach" of the Yakima Basin. Former pits located in this area have a low potential for use as salmonid habitat, and may actually have negative effects on salmonid populations in the study area and in the basin as a whole if fish passage to and from the Yakima River is provided or occurs as a result of channel migration or levee failure. This is due to temperature and ecological conditions that exist in these former mine sites. Temperatures exceed those for spawning and rearing of salmonids, and allowing access to these sites will likely result in some direct mortality to these fish. In addition, the temperature regimes in these ponds are favorable to both native and non-native predatory fish such as Northern Pikeminnow, and several species of warm water fish such as Smallmouth and Largemouth Bass, and non-native competitors such as suckers, carps, pumpkinseed, etc. These are important considerations or constraints to future management and reclamation of these sites to functioning floodplain (i.e. floodwater storage, flood energy dissipation, and sediment supply and storage) or flood hazard reduction such as reducing the potential for avulsion or levee failure at these locations.

2) The report recommends that the following principles be used in consideration of future efforts to manage existing or site future gravel mines:

    - Future mines should be sited outside the 100-year floodplain and, if at all possible, beyond the historic (100+ years) channel migration zone, as determined by aerial photograph and topographic map reconstructions. Data and observations within the Yakima River basin, as well as within other alluvial river systems of Washington State, show that natural avulsion into a mine pond is more likely to occur if a pond is situated within the 100-year floodplain and historic channel migration zone.

    - At some point in the future (perhaps at geologic as opposed to human time scale), the river will avulse some part of a floodplain gravel mine pit. Avulsion may damage infrastructure (e.g., bridges, dikes, sewer outfall pipes). An effort should be made to reclaim the site such that when avulsion occurs, there is a maximum benefit for salmonid habitat as well as protection of upstream and lateral public infrastructure. Future ponds, if permitted by local and state government agencies to be developed in the floodplain or channel migration zone, should be designed for connection to the river (due to future natural avulsion events) without endangering infrastructure or encouraging avulsion. Future ponds constructed in these sensitive locations, as well as reclaimed existing ponds, should be designed and excavated to mimic river side channel morphology (length, width, depth, sinuosity) to

accelerate conversion to river side channel fish and wildlife habitat when avulsion (natural or engineered) occurs in the future.

- Floodplain mining must not destroy intersections between the modern Yakima River channel and paleochannels where increased hyporheic ground-water flow to the river contributes a high concentration of dissolved oxygen. It is at such locations that salmonid populations congregate (J. Vacarro, U.S. Geological Survey, oral communication, 2003). A layer of gravel between the river and adjacent floodplain paleochannels should be left to increase hydraulic connectivity, protect ground-water resources, and benefit habitat for benthic macro invertebrates.

- Ground-water flow into and out of mine ponds should be protected. Mining through the Holocene alluvium into underlying less permeable geologic units such as the Thorp or Ellensburg Formations should be prohibited by regulatory agencies because ground-water flow may be reduced. Ponds without ground-water inflow become stagnant warm-water habitat with low dissolved oxygen concentrations.

- Until additional mitigation options, standards, and protocols are in place to address large gravel ponds that pose an immediate avulsion risk to major infrastructures at a catastrophic scale, precautionary site protection measures should be considered.

The Reaches Project Report (2002)

The Reaches Project, prepared by Stanford et al., is a report that was funded by the US Bureau of Reclamation, the Bonneville Power Administration, and the Yakama Nation to take a more comprehensive look at the ecosystem characteristics of the Yakima River Watershed, especially the effect of flow and floodplain management on the fisheries resources of the basin. The authors specialize in the analysis of large alluvial (composed of stream-deposited sediments) floodplains, and the majority of the analysis in the report focuses on five of the major alluvial reaches in the system. Two of these reaches are within the CFHMP study area – the lower Naches and the Union Gap (i.e. Gap-to-Gap) reach. The Selah Reach was excluded from the study "owing to significant gravel mining and floodplain modification".

Much of the analysis in the report is not germane to discussion in a CFHMP, however one (of the four) major section of the report is relevant in its entirety, that is the section by Lorang "PART B: LINKING FLUVIAL PROCESSES TO FLOODPLAIN ECOLOGY OF THE YAKIMA RIVER, WASHINGTON". In this section of the report, the analysis is primarily focused on how the physical environment – the shape of the floodplains and channels, the amounts of coarse and fine sediments in the river/floodplain system, flow patterns, and the amount of energy available during floods to transport sediment, erode banks (or damage infrastructure). The analysis of the distribution of energy, the total amount of energy exerted over time, and sediment supply in the Gap-to-Gap reach are of particular importance. The results of modeling the distribution of energy in this reach closely match the observed patterns of sediment accumulation and channel aggradation in the Gap-to-Gap reach. The theoretical distribution of high erosive energy or stream power within the report also closely match areas of infrastructure

such as levees and bridge piers which have experienced damage or potential failure during flood events.

A major conclusion from previous work by the authors was that the lower portions (from 1/3 to 1/2) of these alluvial reaches are the most biologically valuable sections in terms of overall ecosystem productivity. Salmonids have adapted to these conditions, and many portions of their life histories in the watersheds (migration and rearing) occur in these areas of high productivity in the lower alluvial reaches. From the standpoint of restoration of salmonids, these areas were considered as among the most valuable areas for restoration in the entire watershed.

Of special concern to the Flood Control Zone District is the potential for failure of the Corps levee at the Beech Street pit. The models show very high erosive forces at this location, and this location was the site failure of the levee toe and erosion of a significant portion of the levee prism during the 1996 flood. Based on calculations in this report, a levee breach in this location would starve downstream reaches of sediment for several decades. Downstream infrastructure that could be expected to be damaged by sediment starvation and increased erosive force are the Corps levees, the SR 24 bridge, the DID #1 levee, the Wastewater Treatment Plant levees, I-82, and many facilities of the Yakima Greenway.

Another conclusion from this section of the report is that for the foreseeable future, the Yakima River below the confluence with the Naches river is entirely dependent on the Naches River for continuous supply of bedload sediments. This is because the levee failure and capture of the gravel pits that occurred in the Yakima River in the 1996 flood have essentially starved that arm of the river of sediment for several years. Resulting increased sediment recruitment in the upper portions of the Gap-to-Gap reach can increase flood hazard to levees and bridges by both downcutting of the channel and simply by more erosive forces (which would normally be reduced by bedload transport) being available to erode levee toes and embankments. Improvement of sediment supply or movement from the Naches system to the mainstem Yakima River will decrease erosive energy and reduce flood hazard over time. Current flood hazards related to this loss of bedload recruitment are the undercutting of the armor and abutments that protect the I-82 crossings of the Naches and Yakima rivers near their confluence, and undercutting of the armor that protects the Yakima Greenway Trail and the Federal levee upstream of I-82 on the Naches River.

While only parts of the analysis are germane to flood hazard reduction, the conclusions and potential restoration activities have much in common with flood hazard reduction, and are especially relevant in the Gap-to-Gap Reach. The study also provides common ground alternatives and considerations for flood control and habitat enhancement that would promote flooding for flood control. The authors conclude that, due to its location in the basin and the relatively high availability of water, the Gap-to-Gap reach is the reach which has the highest potential for restoration actions. Secondly, the Gap-to-Gap reach has sufficient energy available to rework sediments in the floodplain and regain a somewhat natural character without rechannelization efforts and expense. Thirdly, common bank erosion/infrastructure damage and habitat problems can be reduced by restoration of floodplain function and areal extent.

As a result of this report, the US Bureau of Reclamation has purchased over 1,100 acres of floodplain property downstream of SR 24 as part of the Yakima River Basin Water Enhancement Project (YRBWEP), in an effort to improve fish habitat and acquire and conserve

water resources. In order to achieve the full benefit of this land purchase, changes in the configuration of the levees and other infrastructure (such as SR 24) must occur, similar to the findings within the 1977 Corps study.

SR 24 Project Floodplain Consistency Report (2003)

The existing SR 24 bridge was designated by WSDOT as a "scour critical" bridge as a result of repeated damage to the outside bridge piers or bents during past flood events. Observations by Stanford et al., (2002) and other conditions such as aggradation upstream of the bridge, channel down cutting, and repeated damage to the Yakima Regional Wastewater Treatment Plant levee downstream indicate that this reach is subject to very high water velocities during flood events. These velocities and stream energy were sufficient to cause repeated damage to the SR 24 bridge and adjacent infrastructure.

This report was prepared by WSDOT staff, and it examined the floodplain conditions upstream and downstream of the SR 24 bridge and relates those conditions to design alternatives for the replacement of SR 24 bridge. There were several different design alternatives considered, including moving the bridge upstream to the "Old Moxee Bridge" site upstream, increasing bridge length, or a combination of the two. The design objectives were to 1) ensure the new bridge would not be subject to damage during floods below the 100 year discharge, 2) maintain or improve floodplain function, especially sediment transport, in the immediate vicinity of the bridge, 3) give consideration to the effect of the new bridge's location and length on floodplain restoration and flood hazard reduction projects both upstream and downstream of the bridge site.

The major recommendation in the report was that the bridge could remain in its current location , but should be lengthened considerably to ensure stability of the bridge abutments during floods, and to allow for floodplain restoration and flood hazard reduction downstream. The eventual design of the new SR 24 bridge currently under construction is approximately 1200 feet longer than the previous structure.

Lower Naches River Coordination Project (2005)

This is a cooperative project between the Washington State Department of Transportation, Yakima County, and the City of Yakima. The project area (Figure 3-2) is from the area of Nelson Dam/Twin Bridge to the confluence with the Yakima River. The cooperative partners all anticipate that they will undertake infrastructure projects (some 20 at last count) within the project area over the next several years, and each project will have common design constraints and goals for improvement in infrastructure efficiency (transportation, irrigation), fish habitat and habitat enhancement, and in most cases, flood hazard reduction. The objectives of the Lower Naches River Coordination Partnership are to "make better decisions collectively , share and accumulate data and information to complete planned projects, work together whenever possible to complete partnership actions, and to help protect the environment for all to enjoy."

Actions recommended for anticipated infrastructure projects will be based on an understanding of the physical and biological conditions in the reach. These conditions have been documented and described in more recent studies, including (1) Golder (2003) – analyzed the geomorphic processes in the reach since the 1920s, (2) Aggett (2003) - surveyed cross sections within the reach, (3) GeoMax (2002) – analyzed stream power, sediment transport, and available sediment,

and (4) Yakima County (2006 and interim studies) – hydraulic modeling and supporting data for the updated Flood Insurance Study on the lower Naches River.

Recommended actions that effect reduction of flood hazard include the following:

- Purchase of the majority of privately owned parcels in this reach – this action is recommended to save project costs given the number of projects that will occur in this reach in the future, and to maximize floodplain function and flood hazard reduction.
- Decommission the City of Yakima's Fruitvale diversion and associated structure, and decommission the City of Yakima's Ranney Well system. The Fruitvale diversion and associated structures are a chronic flood hazard problem at the diversion dam and also in lower Cowiche Creek, which is heavily modified to

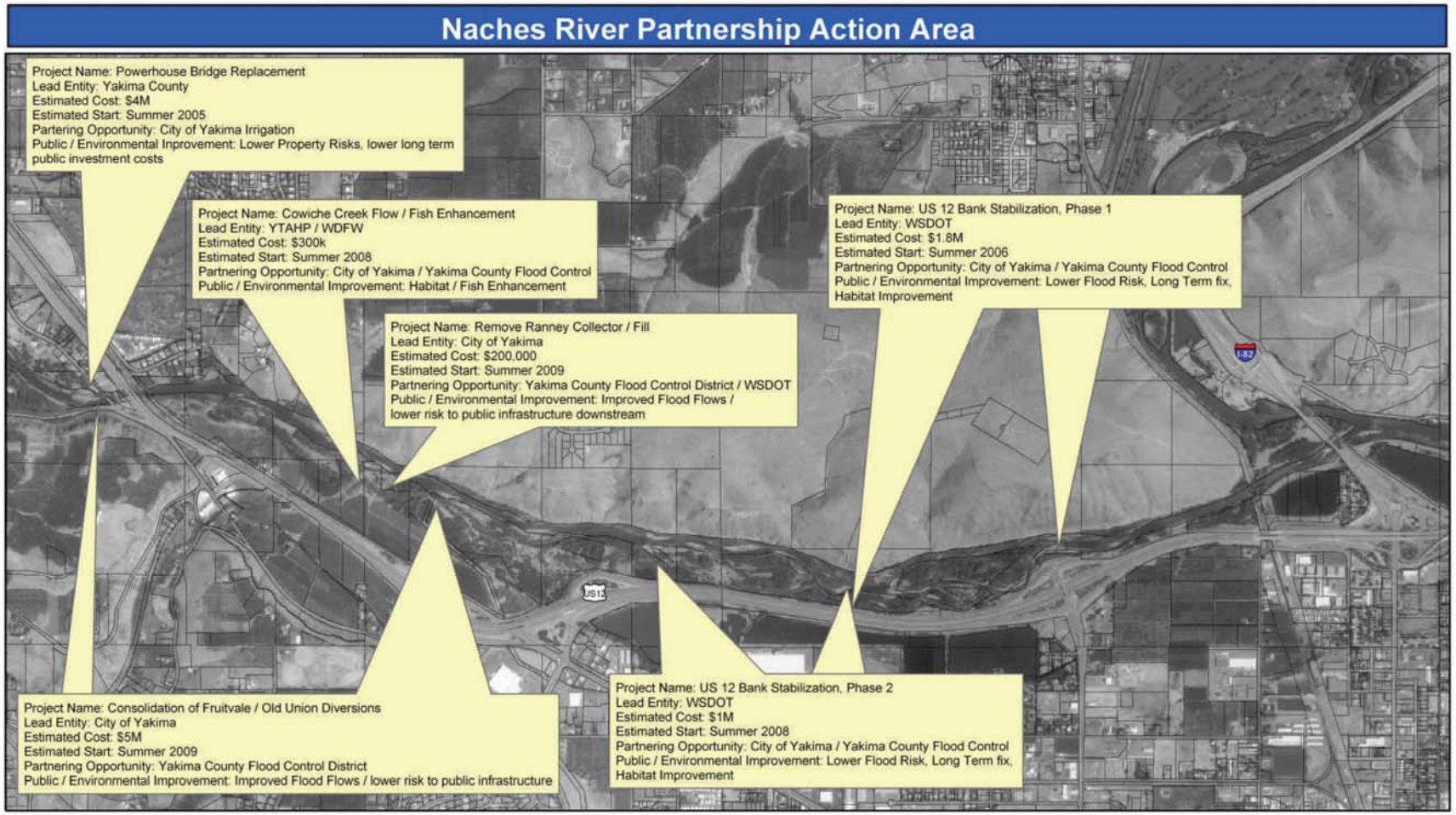
Naches River Partnership Action Area
Project Name: Powerhouse Bridge Replacement
Lead Entity: Yakima County
Estimated Cost: $4M
Estimated Start: Summer 2005
Partering Opportunity: City of Yakima Irrigation
Public / Environmental Inprovement: Lower Property Risks, lower long term public investment costs
Project Name: Cowiche Creek Flow / Fish Enhancement
Lead Entity: YTAHP / WDFW
Estimated Cost: $300k
Estimated Start: Summer 2008
Partnering Opportunity: City of Yakima / Yakima County Flood Control
Public / Environmental Improvement: Habitat / Fish Enhancement
Project Name: Remove Ranney Collector / Fill
Lead Entity: City of Yakima
Estimated Cost: $200,000
Estimated Start: Summer 2009
Partnering Opportunity: Yakima County Flood Control District / WSDOT
Public / Environmental Improvement: Improved Flood Flows / lower risk to public infrastructure downstream
Project Name: US 12 Bank Stabilization, Phase 1
Lead Entity: WSDOT
Estimated Cost: $1.8M
Estimated Start: Summer 2006
Partnering Opportunity: City of Yakima / Yakima County Flood Control
Public / Environmental Improvement: Lower Flood Risk, Long Term fix, Habitat Improvement
I-82
US12
Project Name: Consolidation of Fruitvale / Old Union Diversions
Lead Entity: City of Yakima
Estimated Cost: $5M
Estimated Start: Summer 2009
Partnering Opportunity: Yakima County Flood Control District
Public / Environmental Improvement: Improved Flood Flows / lower risk to public infrastructure
Project Name: US 12 Bank Stabilization, Phase 2
Lead Entity: WSDOT
Estimated Cost: $1M
Estimated Start: Summer 2008
Partnering Opportunity: City of Yakima / Yakima County Flood Control
Public / Environmental Improvement: Lower Flood Risk, Long Term fix, Habitat Improvement
Lower Naches River Partnership
Washington State Department of Transportation
Agency Leads:
City of Yakima
Yakima County
Washington Department of Transportation
Drawing Date: 2/2/05
Projects support the following Agency Visions / Policies:
Washington Fish & Wildlife
YTAHP / YHIP
Bonneville Power Administration
Bureau of Reclamation
NOT TO SCALE
N

Figure 3-2

serve as irrigation conveyance for a short distance. Removal of these structures will have water quantity, flood hazard reduction and major fish habitat and fish passage benefits. Decommissioning the Ranney well system will allow removal of associated diking and other infrastructure that currently limit sediment transport in this reach.

- Stabilize US Highway 12 upstream of 16th Avenue – This area is also subject to chronic damage from relatively minor flood events. WSDOT proposes to protect the highway using bioengineering as well as standard bank protection techniques in compliance with WDFW's model streambank protection guidelines. These guidelines also call for analysis of the causal factors that drive bank erosion in this area, and to attempt to rectify those factors at the larger scale. These causal factors include poor sediment transport capacity, sediment starvation, and increased stream power. Actions to address these causal factors in the larger reach are also called for in the report.
- Reduce flood hazard – Implement the proposed projects in a manner that reduces flood hazard. Means to implement include proper infrastructure design with goals of improved sediment transport, improved floodplain function, improved flood conveyance capacity, purchase of private property subject to high flood hazard, and cooperation among partners to share data and cooperatively implement projects.
- Improve sediment transport at Nelson Dam and in the reach overall – Studies have shown that Nelson Dam, also known as "Powerhouse Dam", inhibits sediment transport in the lower Naches, causing sediment to accumulate above the dam and starving downstream reaches of sediment. Over time, this increases flood heights and flood hazard upstream, and channel erosion downstream, causing chronic problems at the Fruitvale Diversion and other areas downstream. This reach is currently the major source of sediment for the mainstem Yakima below the confluence.

Yakima County Mineral Resource Task Force (2006)

The Board of Yakima County Commissioners established a minerals resource task force to address the Washington State Growth Management Act (GMA) requirement that local jurisdictions designate mineral resource lands for the extraction of minerals. The recommendations from the task force were as follows:

- Site Selection Criteria
  - The task force developed revised site selection criteria to be used in the future potential/prospective mineral resource sites
- Supply and Demand
  - Existing sites should be designated and zoned for minerals if they are not already
  - Proposed and future sites (10 and 20 year sites) should be designated and zoned mineral and 50 year sites should be designated but not zoned.
- Site Designation

  - Eliminate the zoned mineral resource sites from the mineral resources inventory as identified by the supply and demand sub-group
  - Update the resource site information of the existing sites identified in Plan 2015
  - Allow small-scale mining in lands zoned Agricultural Resource, Forest Resource, Rural Self-Sufficient, and Rural remote and require WADNR reclamation standards as stated in recommendations 3-5 in the Site Mitigation section
  - Have the task force and current planning staff review zoning ordinances related to stockpiling and amend them to allow mining activities such as stockpiling n non-mining zones and non-mineral designation sites.
- Site Mitigation
  - Reduce the 1,000 foot setback to 500 feet for landowners adjacent to zoned mineral resources lands
  - Retain the setbacks within Yakima County Code 15.45.060 (6) for lands zoned under the mining zone
  - In addition to the existing setbacks listed in YCC 15.45.060 (6) allow for a special exception process to adjust the setback standards where viable alternatives exist and utilization of the site mitigation options
  - Adopt DNR's small scale mining reclamation standards for all "small scale" mining operations to ensure the long term quality and of our natural resource land is accounted of prior to and after mining occurs.
- Incentives
  - Develop a policy with local, state, and federal agencies which would allow and expedite the availability of water for private and government resources extraction entities that choose to mine upland sites rather than the geomorphic floodplain
  - Allow mining in Agricultural Resource and Rural Remote lands to supply economic alternatives
  - Facilitate and support a public outreach that caters towards owner initiated designation. Have Yakima County, resource agencies and industry present the incentives identified and allow for public input workshops that would generate additional or alternatives incentives strategies
  - Initiate a sub-area plan for the State Route 24 Bridge in order to assess the feasibility of developing a mixed use plan that would facilitate the co-existence of functional wildlife habitat and anthropogenic needs.

CONCLUSION – ADDITIONAL ONGOING EFFORTS THAT AFFECT FLOOD MANAGEMENT

There are additional efforts underway in the Yakima River Basin that have the potential to impact flood hazards over the long term. Three major efforts are discussed below.

2003 Yakima River Basin Water Storage Feasibility Study

In 2003, Congress directed the Secretary of Interior acting through the Bureau of Reclamation to conduct a feasibility study of the options for additional water storage for the Yakima River Basin. Reclamation initiated the *Yakima River Basin Water Storage Feasibility Study*.

The goals of the Yakima River Basin Water Storage Feasibility Study are to provide more normative flow condition for fisheries; to provide a more reliable water supply for existing proratable water users; and to provide additional water supply for future municipal water demands.

The Yakima River Basin Storage Alternatives Appraisal Assessment (a component of the overall Water Storage Study) analyzed the technical viability and capability of three in-basin storage alternatives to bring forward into the Plan Formulation Phase. The three storage alternative included Bumping Lake enlargement, Wymer dam and reservoir, and Keechelus-to-Kachess pipeline. The conclusion of the report was that the Wymer dam and reservoir alternative will be analyzed further in the Plan Formulation Phase of the Yakima River Basin Water Storage Feasibility Study.

Reclamation also initially placed study priorities on activities related to the Black Rock Reservoir. Reclamation released the Appraisal Assessment of the Black Rock Alternative In February 2005. Reclamation concluded that based on current information, a Black Rock Reservoir appears to be technically viable and could meet the goal of the Storage Study.

Of particular relevance to flood hazard management are the related studies that will be generated by the Storage Study EIS, among these are basin-wide sediment transport, temperature, flow, fisheries habitat, and fisheries productivity.

The Black Rock and Wymer dam and reservoir alternatives will be compared in the Plan Formulation Phase and the alternatives deemed adequate, if any, will be selected for further analysis in the final or feasibility phase of the study. Public involvement activities will be continued throughout the Storage Study.

Yakima Subbasin Plan and Yakima Subbasin Salmon Recovery Plan

An elected board composed of the Yakima subbasin Cities, Counties, and the Yakama Nation has been formed to guide the development of two important ecosystem management plans: (1) the Yakima Subbasin Plan and, (2) the Yakima Subbasin Salmon Recovery Plan. The Board, known as the Yakima Subbasin Fish and Wildlife Recovery Board, has guided these important plans with the input of numerous stakeholders.

Yakima Subbasin Plan

The Yakima River Subbasin Plan has been developed to guide how the BPA focuses fish and wildlife mitigation work within the Yakima River Basin. The plan and the mitigation it guides, is required to compensate for the impacts of the Columbia River Power System on fish and wildlife resources. Since the achievable level of fish and wildlife improvements within the main stem Columbia River is limited, the federal government is required to mitigate within the tributaries, including the Yakima River Basin. The Subbasin Plan helps ensure that

BPA/NWPPC money is spent in a prioritized and coordinated manner based upon a sound understanding of the status of fish and wildlife resources and the conditions limiting their productivity. Projects that are consistent with the Subbasin Plan are eligible for funding assistance from BPA/NWPPC.

Yakima Subbasin Salmon Recovery Plan

The Yakima Subbasin Salmon Recovery Plan has been prepared in accordance with the requirements of the Endangered Species Act (ESA), and is aimed at recovering threatened Steelhead and Bull Trout. The final Recovery Plan will be released by NOOA Fisheries in the near future. The Recovery Plan will guide salmon recovery projects within the Yakima River Basin in order to return steelhead runs to a sustainable or "healthy and harvestable" level. A major part of the Recovery Plan involves in-stream, riparian, and floodplain habitat restoration, enhancement, and protection projects. It is important that many types of projects be consistent with the Recovery Plan in order to receive local, state, and federal funding and permits.

While the implications of these two plans on the array of flood protection and floodplain management approaches are numerous, of particular importance for this CFHMP is the potential benefit of restoring floodplain connectivity within the Gap to Gap reach on fish and wildlife resources. The stream and floodplain geology and hydrogeology of the Gap to Gap reach is one of a few areas in the Yakima River Basin where salmon spawning and productivity was very high prior to the construction of the levee system (*open gravel spawning areas, migrating sinuous channels with off channel rearing and feeding areas, connected hyporheic zone with high productivity of food insects and cold ground water fed off-channel refugia*). Areas such as the Gap to Gap reach are ranked high for restoration priority in the Subbasin and Recovery Plans. As such, projects aimed at moving streamside levees back away from the river have a high potential for being funded and permitted due to the fisheries benefits, while also greatly lowering flood hazards. Such projects are truly multi-objective in nature resulting in more natural riverine processes, improved fish and wildlife habitat, lowered flood hazards and damages, and a reduced and more accurate regulatory floodplain area.