Floodplain Discipline Report
East/West Corridor Crossing of the Yakima River in Yakima WA

Joel Freudenthal, Strategic Manager, Yakima County Public Services, Water Resources Division

1. Introduction

Yakima County is proposing to construct an East-West Corridor in the City of Yakima and unincorporated Yakima County, Washington from North 1st Street and East H Street on the west side of Interstate 82 (I-82) in the City of Yakima to the eastern terminus on the east side of the Roza Canal Wasteway #2 in the community of Terrace Heights. This corridor will connect with Yakima County's Phase 1 of Cascade Mill Parkway (currently under construction) which will continue to Butterfield Road and North Keys Road. The project would include construction of three separate streets:

- **East H Street** –The existing road would be extended to the east from the current terminus at North 7th Street where it would connect to Bravo Company Boulevard as the road turns to the south. The existing portion from North 1st Street to North 7th Street would be widened. A new signal would be installed at the intersection with North 1st Street.
- **Bravo Company Boulevard** – An extension of Bravo Company Boulevard connecting to East H Street would be constructed which would turn south and connect to the current terminus near Fair Avenue. A roundabout intersection with Cascade Mill Parkway would be constructed along with one additional roundabout intersection to connect to an existing access road to the adjacent properties.
- **Cascade Mill Parkway** –Cascade Mill Parkway would connect to Bravo Company Boulevard at a roundabout intersection and then continue east beneath I-82 and across the Yakima River and Roza Canal Wasteway #2.

The East-West Corridor project will involve improvements to existing roadways, including transforming East H Street from a residential street to a free-flowing arterial between North 1st Street and North 7th Street; the building of new connections and roundabouts; non-motorized facilities including bike lanes, sidewalks, Americans with Disabilities Act (ADA) ramps, crosswalks, and a shared-use path that will connect to the Yakima Greenway Trail; and construction of four bridges: two to carry I-82 over the proposed roadway, one over the Yakima River, and one over the Roza Canal Wasteway #2. This project will also involve restoration and levee work along the Yakima River floodplain including removal and/or setback of levees and floodplain habitat restoration.

Purpose of Project
The purpose of the proposed project is to reduce congestion and connect the growing neighborhood of Terrace Heights to the City of Yakima (Widener & Associates 2022) the proposed project will:

- Provide an alternative Yakima River crossing for east-west travel between the City of Yakima and Terrace Heights.
- Increase mobility, by decreasing travel delay, and relieving traffic congestion at the I-82/Yakima Avenue Interchange and on Terrace Heights Drive and Yakima Avenue.
- Construct the local road corridor which would allow for the consideration of construction of the recommended alternative for an interchange with I-82 identified in the WSDOT I-82/Yakima Avenue/Terrace Heights Drive IJR.
- Provide bicycle and pedestrian facilities including a connection to the Yakima Greenway Trail.
- Serve the existing approved transportation and land use planning along the roadway corridor as documented in the Yakima Valley Conference of Governments (YVCOG) 2020-2045 Metropolitan and Regional Transportation Plan.

Needs for the Project
The needs for the project include the following (Widener & Associates 2022):

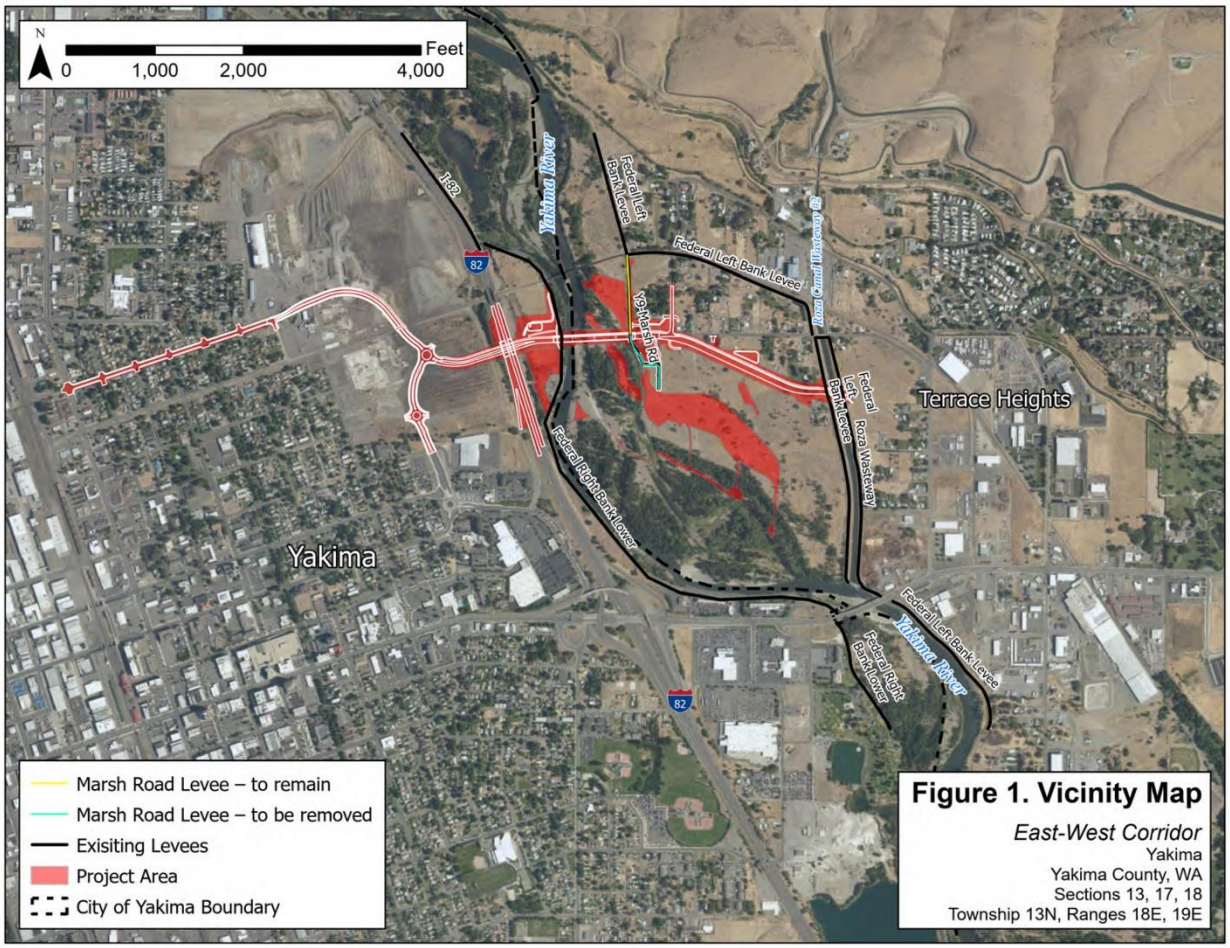
- *Congested Corridor* –The current road network cannot support the growth anticipated in the area under the current comprehensive plan. The Terrace Heights neighborhood lies just to the east of the City of Yakima. The neighborhood, an unincorporated part of Yakima County, has grown considerably over the last five decades, with its population increasing fivefold in the 30 years between 1970 and 2000, to a 2019 total of 8,507. Redevelopment of the Boise Cascade Mill Site consistent with the planned land use in the current City of Yakima Comprehensive Plan is also anticipated to increase traffic demand within the City of Yakima.

  The level of service (LOS) on the Yakima Avenue/Terrace Heights Drive corridor has been getting steadily worse and by 2035 it is expected to have multiple turning movements operating at LOS E or F. LOS is a letter grade corresponding to the amount of congestion a road has when completed to a standard. LOS A is the best or the least congested grade. LOS F indicates failure because the demand for a road is more than its capacity.

  The current LOS along the Yakima Avenue/Terrace Heights Drive corridor has triggered Yakima County's concurrency requirements, which limits new development permits along the corridor. In order to relax the restrictions, the County must either increase the capacity of the existing corridor or divert sufficient traffic volume onto another route. Right-of-way constraints along the existing Yakima Avenue/Terrace Heights Drive route prevent widening of the existing roadway. The future LOS at the Yakima Avenue interchange is also anticipated to cause back-ups onto the I-82 mainline.

- *Emergency Response* – The Yakima River poses a natural barrier to travel between Yakima and Terrace Heights. Historically, east-west traffic in the project vicinity has had only one option to travel between these two locations: the Yakima Avenue/Terrace Heights Drive corridor. A new corridor is needed to provide an alternative redundant route to Terrace Heights during any future closures of the Terrace Heights Bridge as well as an additional route for emergency services.

- *Lack of pedestrian and bicycle connectivity* – Access to the Greenway Trail is limited as it travels between I-82 and the Yakima River. The existing East H Street corridor does not include sidewalks or bike lanes and there is no access for pedestrians to the Greenway Trail from the surrounding residential neighborhood.



The EWC alignment on the east side of the river was evaluated in 2011 and 2012 in alignment alternative and engineering reports and public hearings held by the Board of Yakima County Commissioners.

The original designs called for the route to be located generally farther east (on the valley wall outside of the geologic floodplain) and farther upstream (upstream of the existing rail line and bridge). After the preparation of an engineering report evaluating 4 proposed

alternatives, the City of Yakima requested an additional alternative be evaluated generally along the existing alignment. Upon development of a supplemental report with provided analysis of this alternative, it was found that this "lowland" alignment conformed better with existing transportation, irrigation, and flood protection infrastructure, and had a reduced disruption of local neighborhoods, specifically including the Columbia Cascades office of the United States Bureau of Reclamation. The alignment was also analyzed for other issues including cost, constructability, meeting design guidelines, permitting, and other considerations. This analysis and prior analyses are included in Appendix A.

The selected alignment traverses an area of floodplain which is owned by the United States Bureau of Reclamation (Reclamation). These properties are historic active floodplain of the Yakima River, and were, until 2011, protected from flooding by County Flood Control levees and levees constructed by WSDOT as components of a large gravel mine in the Yakima River.

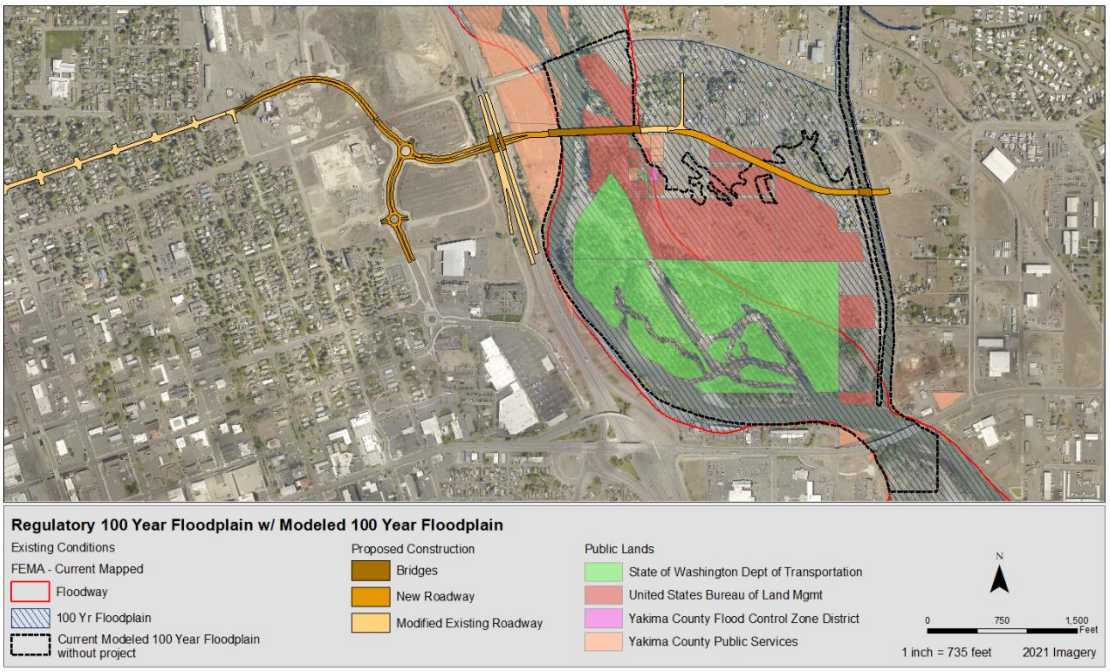


Figure 1- Ownership and Floodplain Extent, Current regulatory floodplain based on 1992 data shown as blue crosshatch. Black line represents current extent of modeled 100 year flows, reduction due to past levee removal and floodplain restoration projects.

Since 2011, the Yakima County Flood Control Zone District has implemented the recommendations contained in the Upper Yakima Comprehensive Flood Hazard Management Plan (CFHMP) through a series of levee removal activities in cooperation with Reclamation and WSDOT, which has resulted in large drops in modeled Base Flood Elevation and a much broader distribution of stream energy at and downstream of the proposed alignment. This lowering of the BFE has reduced the extent of the modeled 100 year floodplain, but a formal Flood Insurance Rate Map (FIRM) amendment has not yet been

started. Other actions already implemented and planned actions in the Gap to Gap reach will have similar effects in reducing the BFE and will require map amendments upon completion since those actions include reconfiguration of the Corps of Engineers Federal Project Levees which form the boundary of the 100 year floodplain on the FIRM maps. The current plan is to remap those areas and the area of the EWC upon completion of those downstream actions.

All of the EWC alignment east of the river to the Federal Project Levee are in the currently mapped regulatory floodplain. The majority of that alignment is not in the current modeled floodplain, except for the most downstream sections of the EWC alignment traverses an area of mapped floodplain, but this are ineffective flow areas and do not cause a rise in the BFE – the floodplain is relatively wide here in a backwater upstream of the constriction of the river by the Roza Wasteway on the east bank and the Federal Project Levee on the west bank. The proposed bridge itself spans the floodway and some adjacent floodplain, there is minor skew to the alignment of the current channel, and the bridge is at a 90 degree alignment to levees on either side of the river which will control channel alignments over the long term.

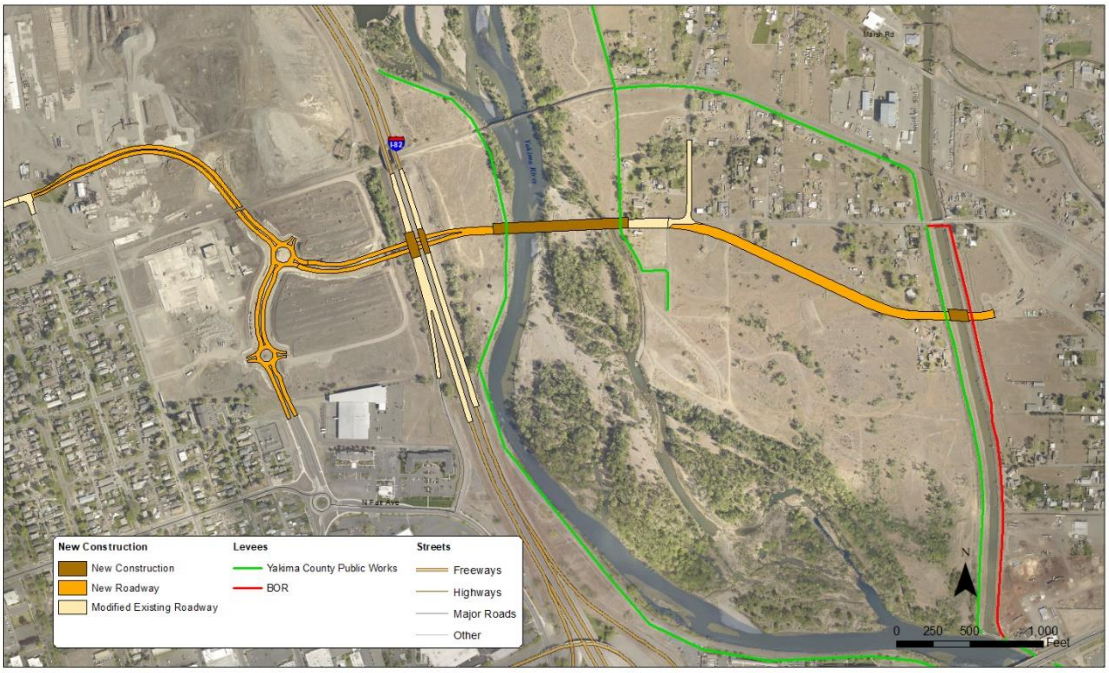


Figure 2 – Proposed bridge location relative to channel and levee alignment. Note that both abutments fall landward of the existing levee system. Levee downstream of the bridge on the east bank will be removed by this project.

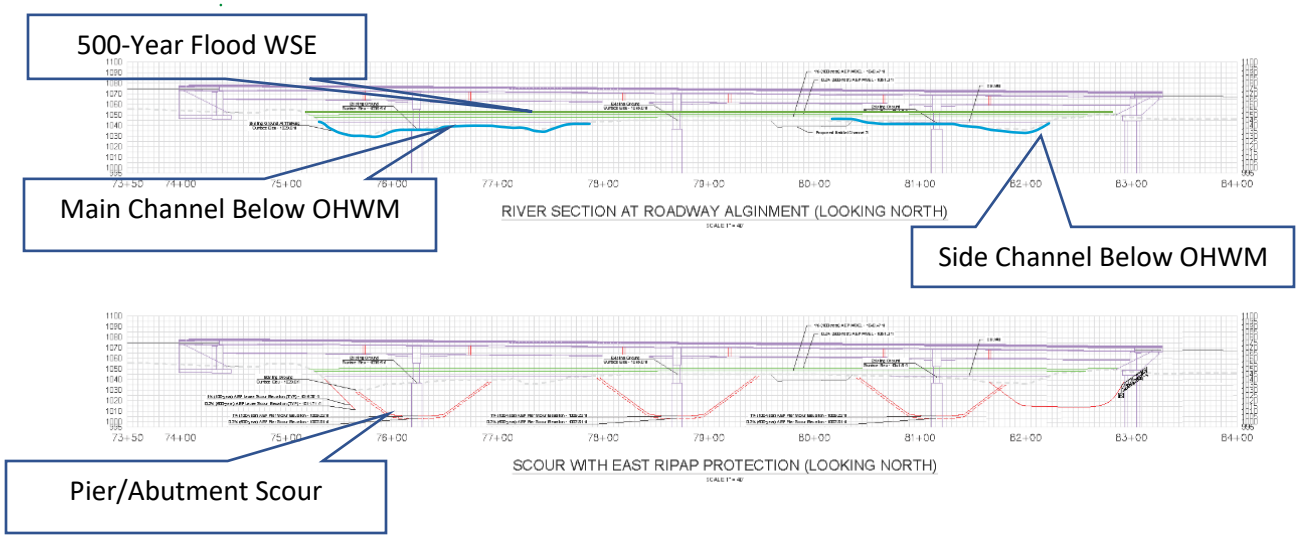


Figure 3 – Bridge Cross Sections showing 500-year scour and water surface elevations

The EWC project includes areas of channel excavation, levee and residential structure removal, LWD installation, and revegetation that are designed to:

1. Mitigate for the rise caused by the bridge piers, habitat elements and channel excavation and further reduce the Base Flood Elevation. Current models with all elements included show a drop in the BFE of more than 1 foot.
2. Facilitate floodwater and active channel migration onto the Reclamation, Yakima County, and WSDOT parcels.
3. Better distribute stream power and encourage the river to move away from the west Bank Corps of Engineers Federal Project Levee.
4. Be compatible with and still provide habitat benefits in consideration of future floodplain restoration projects such as the widening of the Terrace Heights Bridge and reconfiguration of the Roza Wasteway at the downstream limit of the project.

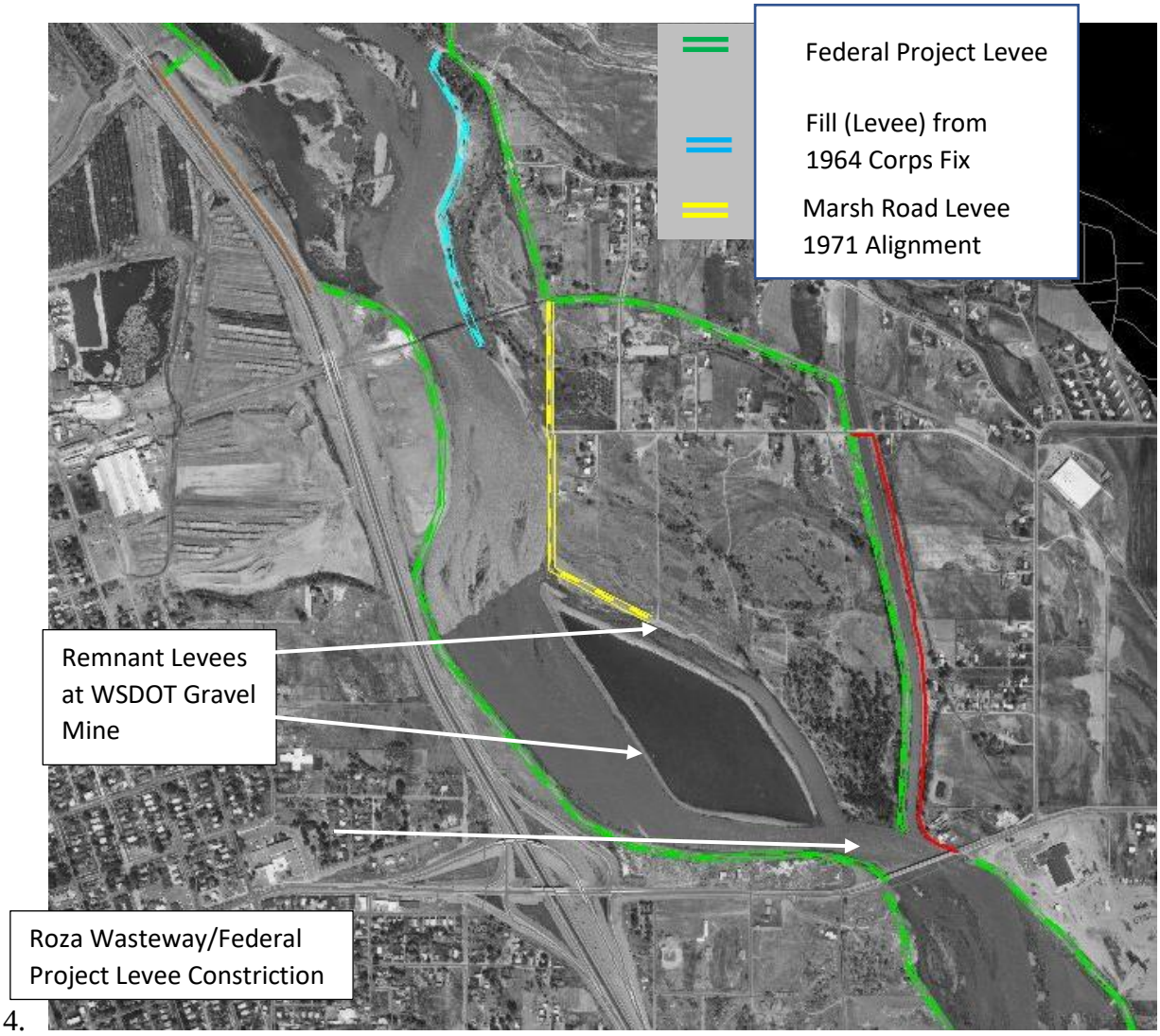
The proposed new bridge will provide freeboard to the estimated 500 year flood, and the traveled surface of the road on either side of the bridge will be above the post-project estimated 100 year flood, and related future projects. This project will still require floodplain permits from Yakima County including the submission of a formal no-rise determination. Additional permits for the project are:

1. Compliance with SEPA and NEPA processes
2. Compliance with Section 401 and 404 of the Clean Water Act and Water quality Certifications from Ecology
3. Compliance with 33 USC 408 (modification of the Federal Project Levee)
4. Compliance with ESA consultation requirements
5. Compliance with the Washington State Hydraulic Code
6. Compliance with Shoreline Codes of the City of Yakima and Yakima County
7. Yakima County Floodplain Development Permit and Building Permit

2. Flood Hazard analysis

Current flood hazard in the project area is mostly related to the alignment of the river adjacent to the West Bank Corps Federal Project Levee (which protects I-82 alignment and the City of Yakima), and indications that the channel is incising along the levee toe, resulting in repeated emergency fixes and more frequent need to maintain the levee – such as after the 2011 flood and major repair in 2018. The river has been against this levee essentially since its construction in 1947, and to a precursor to this levee constructed in the 1920s. The progression of levee construction on the east bank, including:

1. The construction of the Federal Project Levee along the Roza Wasteway near the Terrace Heights bridge in 1947
2. A repair to the West Federal Project Levee in 1964 which included dredging of the channel and placement of excavated fill on the east bank
3. The levees associated with the WSDOT gravel pit in 1969, including the expansion of the Marsh Road Levee in 1971 connecting with the gravel pit levees



4. Photo 1– Project Area Vicinity, 1971 The WSDOT mine had ceased operation in 1970.

Parts of the Marsh Road Levee were haul roads from the 1964 Corps fix, it was extended and tied into a large spoil pile from the WSDOT mine in the high flows of 1971.

These structures all have reduced the ability/prevented the river from migrating away from the West Bank Corps Levee. Even with the majority of the levees removed since 2011, the configuration of the Roza Wasteway levee as currently the narrowest constriction in the Gap-to-Gap reach and the levee remnants from the WSDOT pit that still exist near that location (and cannot be removed without significant road building and riparian zone degradation) are keeping the river from normal channel migration, which continues focusing energy against the Corps levee at the downstream end of the project area, and continued channel incision along the levee throughout the project area.

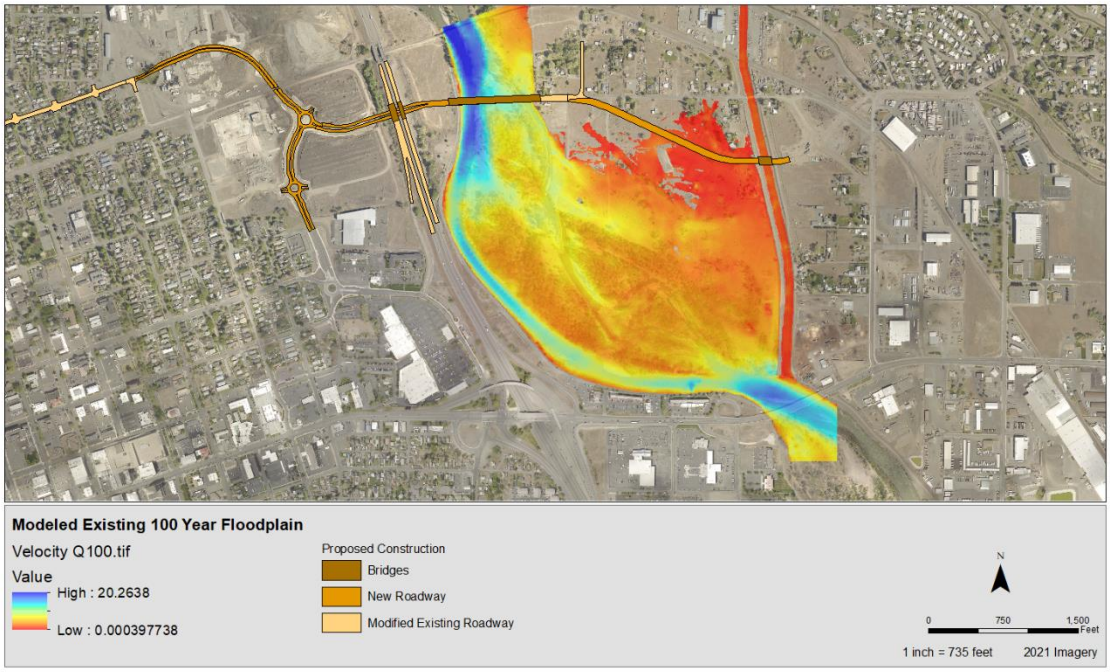


Figure 4 – Existing modeled 100 year discharge and velocity. Note the high velocity along the west bank near the proposed bridge location, and at the downstream constriction. Note areas of low velocity in the backwater of the constriction and crossing of this ineffective flow area by the proposed roadway.

The reduction in sediment supply is reflected in the results of a 2010 sediment transport study in the Gap to Gap reach by the Bureau of Reclamation's Denver Technical Services Center (Hilldale and Godaire, 2010). The 1964 channel dredging and the WSDOT gravel pit, likely totaling over a million cubic yards of sediment loss, are primary indicators of reduction of sediment supply in the reach. From a larger perspective, the capture of the gravel pits in the Selah Reach upstream have also reduced sediment supply from the Selah reach of the Upper Yakima River to the Gap to Gap Reach on the order of 300,000 cubic yards (Norman et al, 1998). In addition, Nelson Dam on the Naches Arm has acted as a sediment trap for over 80 years, leading to river incision in the Naches along US 12. The energy regime of the river in this

reach has also been increased by the operation of Reclamation's Yakima Project for flood control. While this has reduced peak flows, the duration of floods, specifically the duration of floods when the flow is above sediment entrainment thresholds, has increased by almost 100%. This, in combination with the reduced sediment supply, increases the river's ability to incise, and undercut levee and bridge foundations, as have occurred frequently in the past, especially during long duration flood events.

The Marsh Road Levee is managed by Yakima County, maintained by the Yakima County Flood Control Zone District and is enrolled in the Corps of Engineers PL84-99 program, which allows the Corps to assist in emergency levee repairs but requires levee maintenance to Corps of Engineers standards for levee construction. The removal of the sections of this levee (and related acquisition of 4 residences protected by the levee) downstream from the alignment as a component of the project will require that the new downstream terminus of the levee be designed to Corps of Engineers' standards to prevent failure of the levee from the downstream end during flood events. This can be met through reconfiguration of the existing riprap on the levee or through connections of the levee terminus to the riprap which will protect the abutment fills from scour. Practically, the totality of the levee and residence removal, new channel excavation and floodplain grading will result in lowering of the Base Flood Elevation to such an extent that portions of that levee will meet the "Base Flood Elevation plus 3 feet" standard for a levee to be certified as providing 100 year protection. The Cascade Mill Parkway project does not include this certification action and related map revisions, which may or may not be undertaken later by the Yakima County or the Flood Control Zone District.

3. Future Flood Hazards

The proposed Cascade Mill Parkway actions to construct the bridge, remove levees and construct channels to encourage migration onto lands owned by Reclamation, Yakima County and WSDOT serves to distribute stream energy more evenly across the floodplain, and to provide the Yakima River access to a large reserve of sediment that is stored on these properties. Upstream of the project on the Naches River, Nelson Dam is currently being replaced to improve sediment transport and restore continuity of sediment from the Naches River to the Gap to Gap reach. Given the narrow channel in the lower Naches, sediment models created for that project indicate that some of the sediment currently sequestered upstream of Nelson Dam should begin recruiting to this reach in the next decade or so. Much of that material is currently bound up by vegetation in the riparian zone, and the Yakima County Flood Control Zone District has funding and a completed project design for a series of pilot channels and floodplain restoration actions to release that sediment over time and return to a more normative sediment transport regime. (see https://www.yakimacounty.us/DocumentCenter/View/29001/2021-Flood-Control-Zone-District-Activities-and-Projects Ramblers Reach Phase VI.)

Current climate change forecasts do not indicate an increase in flood peak flows, in fact peak flows may decrease. Future climate forecasts indicate an overall increase in winter precipitation with less contribution to snowpack and more rain. This results in somewhat higher average flows over the winter, and earlier and longer spring snowmelt runoff with a lower peak. Because most of the historic high peak flow events are rain on snow events, the reduction in snowpack means peak flow events are also expected to decrease. (Ecology, 2021). However, there will generally

be longer duration sediment transport flows or stating it another way, an increase in stream energy. This makes providing the river with sufficient sediment is advisable to reduce channel incision and failure of the levee system and further simplification of habitat. The Yakima Basin Integrated Plan is also proposing increased water storage in the basin, while maintaining the existing flood control rules and operations. Increased surface storage in the basin will decrease energy and flow available for sediment transport and flooding, and the physics of expanded surface storage reservoirs would also have an effect on flood routing and energy as the more massive reservoirs will absorb more stream energy and slow progression of flood waves from high elevation to downstream areas.

The project will have effects on future channel stability. As mentioned above, the project is designed to destabilize the downstream channel and encourage it to move onto properties owned by Reclamation and WSDOT, which should reduce flood hazard, improve fish and wildlife habitat, and be compatible with future actions such as widening of the Terrace Heights Bridge. Upstream of the bridge alignment, a levee was constructed as part of the 1964 Corps of Engineers repair on the east bank of the river, apparently to protect the eastern span or abutment and likely the trestle portion of the former BNSF railroad crossing, which is located approximately 840 feet upstream of the proposed bridge alignment. This levee segment is in the process of failing at in several locations along its length, and there are no known easements for that facility (on private lands), no known legal responsibilities to maintain or repair the levee, or no known entities which plan to repair the levee once it does eventually fail. In terms of overall channel stability and flood hazard, this upstream failure will allow the channel to move east away from the Federal Project Levee and distribute flood flow energy across a much broader cross section of floodplain and channel, which is the overall goal of river, levee, floodplain and habitat management in this portion of the in the Upper Yakima CFHMP.

5. Effects on the Aquatic Environment

Taken as a whole, this project is designed to implement the Upper Yakima CFHMP which contains goals for restoration of riverine processes which form habitat for fish and wildlife in this reach. The CFHMP itself is very closely aligned with the Steelhead Recovery Plan and the Habitat Goals of the Yakima Basin Integrated Plan, which include the Upper Yakima CFHMP actions as major steps to recovery of salmonid productivity at a Yakima Basin Scale. The project takes advantage of the Reclamation, Yakima County and WSDOT Properties (including formally putting the WSDOT properties in conservation status). In lieu of payment to Reclamation for allowing a portion of the project to be constructed on Reclamation lands, the project will implement revegetation and habitat enhancement actions consistent with restoration of this reach and the ecosystem function purposes for which this land was acquired. These actions will be in addition to any other required mitigation actions for the project itself and will be designed to have function and values in the near term, and over the long term which anticipates reconfiguration of the Roza Wasteway and Terrace Heights Bridge to reduce or eliminate the current constriction and improve sediment transport and the ability for a more normal channel migration regime to downstream reaches.

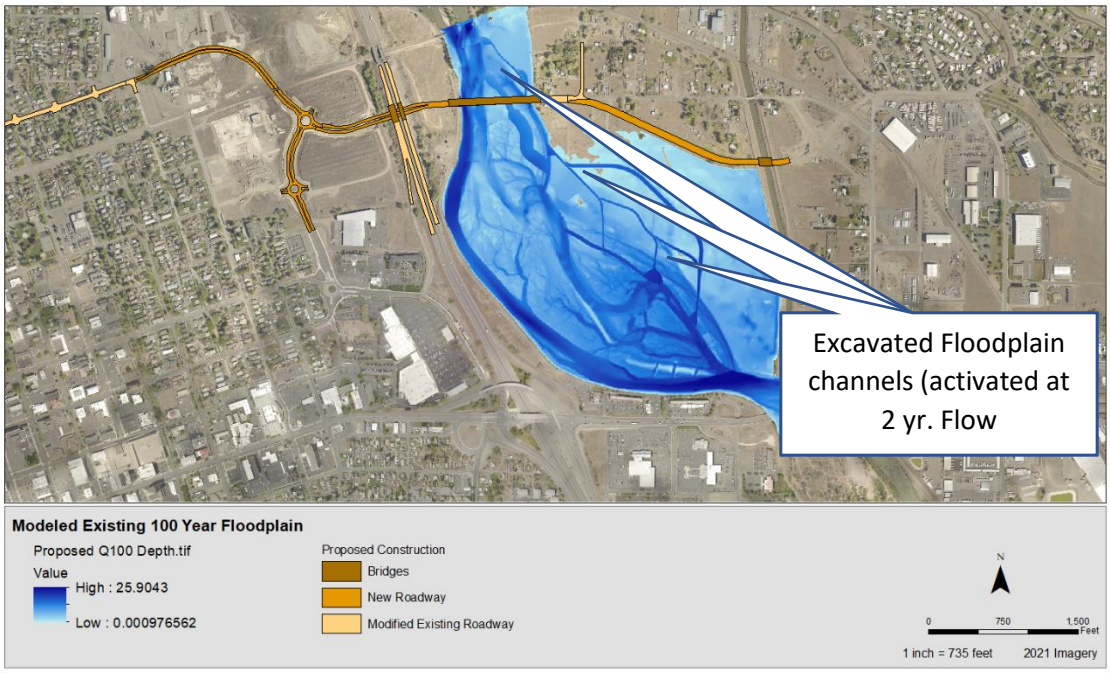


Figure 5 – showing proposed 100 year floodplain extent, water depth and channel excavations. Note lack of floodplain north of proposed roadway, modeled flood depths along the roadway are less than 1 foot.

There are currently no formal recreation facilities on the east side of the river in the project area. On the West Side of the river, the Yakima Greenway Trail and Rotary Playground are in the project area, and the project does include connections to the Greenway trail that will allow traffic across the bridge and along the alignment on the east side of the river. This project, and the other projects that have been implemented in the Gap to Gap Reach will call for the development of a new Greenway Master Plan that overtly incorporates existing and planned recreation activities and facilities, and the impact of recreation on the environment, on both sides of the river in the urban area of Yakima. As a component of the overall Gap to Gap Project, the Flood Control Zone District, in cooperation with the Yakima Greenway, is beginning to develop this overall Recreation, Habitat, and Flood Hazard Management Plan and related MOUs for integrated management of those issues in the Gap to Gap reach, including within the EWC project area.

Specific to the effects of a new bridge, we have had no instances of problems with Large Wood debris accumulations on bridge piers at any of the County or WSDOT bridges in the Gap to Gap reach. This reach is dominated by Black Cottonwood and the FCZD is re-introducing Ponderosa Pine as well. Generally, the relatively low frequency of debris recruitment events limits the accumulation of debris at any one time. Accumulations of debris on piers will generally dry out and become extremely brittle in the years between floods, and accumulations will break up early in subsequent flood events. There are areas with significant accumulations of debris in the reach, and the 2011 flood – a long duration, 25 year event – did cause riverine response and resultant significant amounts of LWD input to the reach, but very little if any of that material interacted

with the piers of any of the bridges in the reach. Periodically, there will occur ice debris flows. These flows are the result of ice which has collected upstream of the Roza diversion dam, located on the Upper Yakima approximately 13 miles upstream. Significant amounts of ice can accumulate for several miles upstream of the dam and as that icepack forms and resets due to temperature and flow changes, ice can develop into significant weakly cemented bus sized chunks, especially along the banks and on islands in the river. These release event usually occur at about a 2 year flow in a small to moderate flood, which breaks up most of the pieces on the bed of the river, and has low velocity of ice movement, and leaves the largest pieces on the banks. Rarely there can occur a rapid rise in flow which will trigger a mass movement event. There has never been a report of ice damage to infrastructure from these events. Ice accumulation in the riparian zone that damages cottonwood stands and recreational facilities (trails, golf courses) in the floodplain has occurred however.

5. Flood History

The Yakima River basin typically produces winter and spring floods. Spring floods are caused by snowmelt aggravated by periods of unusually warm weather and rainstorms. The magnitude of spring floods is generally moderate, but they can last 10 or more weeks, resulting in very large total volumes of runoff and river erosion. The more frequent winter floods are caused by rain on snow and warm winds that produce runoff from snowmelt and rain. They typically follow precipitation periods that have saturated the soil and replenished groundwater reserves, or extended periods of below freezing temperatures, which freezes the soil surface and causes even minor amounts of snowmelt to generate high rates of runoff. Historically, winter floods are the largest in magnitude, but their durations are typically less than one week, so the total volume of runoff is not as high as that of spring floods. The largest flood of record, the flood of December 1933, was the result of a winter rain-on-snow event. Upper basin reservoir storage typically reduces the magnitude of winter floods, which occur after the irrigation season when reservoir storage is available.

Conditions that cause winter and spring floods on the Yakima River also produce flooding in smaller tributary basins. Mid-valley creeks are susceptible to flooding during Chinook weather (snow accumulation followed by a period of warming temperatures, high winds, and heavy rainfall) due to their location and the limited number of trees in their drainage areas. Eastern tributary basins are susceptible to flash flooding caused by thunderstorms. Flood damage is frequent along the Wenas, Cowiche, Wide Hollow, Ahtanum, Toppenish, and Satus creeks.

The largest historical floods are summarized in Table 1. The return periods for this table are probably an overestimate due to the occurrences of three of the 6 greatest floods after the USGS gage record period.

TABLE 1.
LARGEST YAKIMA RIVER FLOODS

	Measured at Parker Dam			
Date	Flow (cfs)	Stagea (feet)	Return Periodb (years)	Comments
December 23, 1933	65,000	17.7	200	Largest flood of record. Resulted in construction of extensive federal levee system.
February 9, 1996	57,500c	16.2	100	Yakima Co. declared a fed disaster area.
December 1917	52,900	16.8	95	
May 29, 1948	37,700	15.0	30	
May 16, 2011	37,593	13.2	27	
November 30, 1995	36,000c	14.6	25	Yakima Co. declared a fed disaster area January 3, 1996.
December 13, 1921	35,800	14.7	25	
November 26, 1990	35,620c	14.5	25	Yakima Co. declared a fed disaster area.
November 25, 1909	35,000	14.6	22	
December 2, 1977	34,320	14.0	20	Yakima Co. declared a fed disaster area.
December 27, 1980	31,675	13.4	18	
January 18, 2011	28,650	12.23	15	

January 16, 1974	27,700	13.3	11	Yakima Co. declared a fed disaster area.
December 4, 1975	27,600c	13.3	11	Yakima Co. declared a fed disaster area.
November 24, 1959	27,400	13.2	10	Yakima Co. declared a fed disaster area.
April 1, 2011	24,880	11.27	9	
June 16, 1916	24,800	12.7	9	
February 21, 1982	23,414	11.6	7	
January 31, 1965	22,900	12.3	7	Yakima Co. declared a fed disaster area in December 1964.

a. Flood stage equals 10 feet.

b. Based on flood for the Yakima River at Parker frequency curve for the period 1908-1976. (excludes recent events)

c. From BOR gage.

Summary of Past Flood Events

The most recent significant floods in Yakima County are described below to examine present flooding conditions. The 1933 and 1948 floods are also briefly described for a comparison between recent flooding characteristics and historical flooding conditions. The floods described are typical for the study area and help identify areas susceptible to flood damage. The hydraulic models for the current regulatory floodplain maps were developed based on the 1990 flood and high water marks. The current Hydraulic Model used for this project was developed after the 2011 flood and has been calibrated against high water marks taken from minor floods in 2018 and 2020. Watershed area upstream from the bridge crossing is approximately 3,382 square miles.

January – August 2011 Flood

The table above shows 3 peak flow entries for 2011- in January, April and May. The May event was the largest and continued above the sediment entrainment threshold well into July. In late July, a portion of the Federal Project Levee upstream of the Terrace Heights Bridge collapsed, and other portions of the Federal Project Levee experienced toe erosion as the river bed reformed near the end of the flood. Damage to these sections of levee exceeded $9.5 million and were not fully repaired until Feb of 2012.

February 9, 1996, Flood

The February 9, 1996, flood was the second largest flood of record. Flow crested on the Yakima River at Parker at 57,500 cfs, which exceeded the predicted 100-year event of 56,300 cfs. Water elevations exceeded flood stage by over 6 feet at Parker. This flood was a typical winter event caused by unseasonably warm weather and rainfall on a significant snow pack. Weather conditions produced flood flows from snowmelt combined with rainfall runoff. Keechelus Reservoir reported over 11 inches of precipitation within a three-day period; 5 inches of rain fell in 24 hours on Wednesday, February 7. Flooding conditions were aggravated by ice jams on the Yakima River near Selah Gap and along tributary creeks.

Flood damage was region-wide, occurring both along the Yakima mainstem and tributary creeks. Areas receiving the greatest damage included the Upper Naches, Selah, Ahtanum Creek, Wapato, White Swan, and Toppenish. Within the study area, several million dollars of flood damage occurred. Damage was primarily associated with roads, Yakima Greenway facilities, levees, wastewater treatment facilities.

November 30, 1995, Flood

The “Pineapple Express” brought record high temperatures of up to 66 degrees to the Yakima Valley in late November and early December 1995. Keechelus Reservoir, located at the head of the Yakima River near Snoqualmie Pass, received 10 inches of rain in a 48-hour period, November 29 and 30. Precipitation at Keechelus was 200 percent over normal for the water year. Warm temperatures melted the existing snowpack and, combined with heavy precipitation, resulted in flooding on the Yakima and Naches Rivers. This flood exceeded the levels of both February 1995 events, and was similar in many respects to the 1990 flood. Both floods are estimated to be in the order of 25-year floods.

The winter flood caused the Yakima River at Parker to crest on November 30 with a flow of 36,000 cfs. This flow reached an elevation of 14.61 feet, over 4½ feet above flood stage.

February 1995 Floods

January 1995 was the wettest January on record in the City of Yakima and the City's third wettest month on record, with a total precipitation of 3.67 inches; the wettest months on record were December 1964, with 4.19 inches, and December 1931, with 3.75 inches. These amounts are very high for an area with average annual precipitation of only 8 inches. Saturated soils, continued precipitation, and unseasonably warm temperatures produced typical winter flooding in February 1995.

Flooding occurred twice in February. The Yakima River at Parker crested on February 1, with a flow of 16,930 cfs, and again on February 25, with a flow of 19,486 cfs. These flows reached elevations 0.8 feet and 1 foot above flood stage, respectively. The Yakima River crested without overflowing its banks during the February 1 flood, and produced minor flooding near Selah and Parker during the late February flood

November 26, 1990, Flood

The 1990 flood was the sixth largest flood on record. Peak flow at Parker dam equaled 35,600 cfs and was estimated as a 25-year flood event. The flood event was short, with peak flow occurring at 12:00 AM and river levels dropping nearly three feet by 7:00 AM the next morning. This typical winter flood was caused by unseasonably warm weather producing snowmelt runoff compounded by significant rainfall. Keechelus Reservoir reported over 10 inches of rain within a four-day period.

December 27, 1980, Flood

The December 1980 flood resulted from unseasonably warm and wet winter weather. Record high temperatures of 67° F combined with rain caused rapid snow melt and runoff. The Yakima River flow peaked at 31,675 cfs at Parker, more than 3 feet above flood stage. Most flooding was adjacent to the Yakima River with minor flooding along Toppenish and Satus Creeks.

December 2, 1977, Flood

Typical winter flood conditions produced the December 1977 flood. Warm Chinook winds and excessive rainfall resulted in loss of high elevation snow and produced significant runoff. Flow on the Yakima River crested at 13.97 feet (34,320 cfs), 4 feet above flood stage. The Naches River crested at 20.06 feet, 3 feet above flood stage. It was the seventh largest Yakima River flood on record.

January 16, 1974, Flood

The January 16, 1974, flood was a significant winter flood event, and part of a series of floods and long duration spring runoff events which destabilized the river in the early 1970s. Rain showers, rising temperatures, snowmelt, and ice debris in the river produced typical winter flood conditions. The January 1974 event resulted in ice jams near Selah allowing floodwaters to back up until ice debris dislodged. This produced a small flood wave and additional bank erosion along the Yakima River. Peak flow on the Yakima River at Parker reached 27,700 cfs. The Naches River peaked at 10,800 cfs.

Excluding the 1933 flood, the January 1974 flood produced the greatest damage before the February 1996 flood. Yakima County was declared a federal disaster area. Six major bridges were damaged and two were completely washed out. Military helicopters were brought in to assist with evacuations and drop supplies.

May 29, 1948, Flood

The 1948 flood, the fourth largest on record, is one of the few significant spring floods. Unseasonably warm weather followed a winter with above-average snow pack. Warm temperatures and rain produced excessive high elevation snowmelt and runoff. On May 27 and 28, over 3 inches of rain fell in the Cascades, and May temperatures reached the high 80s. Flow on the Yakima at Parker peaked at 37,700 cfs, 5 feet above flood stage. The Bureau of Reclamation reported that the peak flow could have been reduced to 22,000 cfs if snow pack information had been available. At the time of the flood, upstream reservoir storage was inadequate to greatly reduce the peak flow.

Brief newspaper accounts report region-wide damage. In the Upper Valley, several families were driven from their homes in East Selah, the golf course was inundated, the river cut new channels through farmlands upstream of Selah, Selah Bridge was inundated, and a Naches River levee near its mouth experienced serious erosion. Additional reported damage included settlement of the Terrace Heights Bridge caused by scour of a mid-span pier, washout of 100 feet of the Moxee highway, loss of numerous dikes between Selah Gap and Union Gap, major levee breaks between Moxee highway and Terrace Heights Bridge, water over Moxee Bridge, and flooding in the Toppenish/Buena area. Many of the levee failures were subsequently repaired by the COE.

December 23, 1933, Flood

The 1933 flood was a winter flood caused by rain on snow in the lower valley; it is the largest flood on record. Precipitation in the upper watershed was 500 percent above normal. Approximately 3 inches of rain per day fell in the upper watershed prior to peak flow. Over 16.5 inches of rain was reported at Keechelus Lake from December 17 through 22. Flow in the Yakima River at Parker peaked at 65,000 cfs and was estimated as approximately a 200-year flood event (see Table 1).

The flood caused extensive damage in the Yakima Valley, estimated at over $1 million. Newspaper accounts report water rushing over both approaches to the Terrace Heights Bridge, Naches Bridge being washed out, loss of the Union Gap bridge approach, and isolation of the City of Yakima due to loss of train and highway service for 36 hours.

The high level of damage provided the incentive to construct an extensive federal levee system of approximately 25,000 feet of right bank levees, 10,700 feet of left bank levees, and associated closure structures and culverts between Selah Gap and the Moxee bridge. Construction began in July 1947 and the primary system was completed in March 1948.

Summary of Historical Floods

Review of historical floods reveal common problems and general trends. Historical flood accounts indicate the following flood problems within Yakima County:

- Major flood damage is typically caused by high-magnitude winter floods. Eighteen of the 24 largest Yakima River floods were winter floods.
- Excessive damage from earlier floods was concentrated in the Mid-valley area. Damage from recent floods has been concentrated more in the Lower Valley and along tributary streams.
- The extensive levee system has protected much of the mid-valley from flooding since 1948. Damage would have been much greater without the levees.
- Damage within the local area is concentrated in Selah, Pomona, along existing levees, along state and county roads, and within the Yakima Greenway. Since construction of the levees within the study area, damage has been significantly reduced in the areas protected.

IV. Summary

A. The objectives of the project.

The proposed East-West Corridor would consist of a 5-lane roadway that would improve vehicular and pedestrian access between Yakima and Terrace Heights. This new corridor is necessary as right-of-way (ROW) constraints along the existing Yakima Avenue/Terrace Heights Drive route prevent widening of the existing roadway. In developing the roadway alignment additional objectives for neighborhood compatibility and conformance with the 2007 Upper Yakima Comprehensive Flood Hazard Management Plan, including:

1. Mitigate for the rise caused by the bridge piers and further reduce the Base Flood Elevation.
2. Facilitate floodwater and active channel migration onto the Reclamation and WSDOT parcels.
3. Better distribute stream power and encourage the river to move away from the west bank Corps of Engineers Federal Project Levee.

4. Be compatible with and still provide habitat benefits in consideration of future floodplain restoration projects such as the widening of the Terrace Heights Bridge and reconfiguration of the Roza Wasteway at the downstream limit of the project.

B. Current floodplain use.

Much of the land within the project area is owned by public agencies and retained for conservation purposes. In 1977 the State Legislature created the Washington State Yakima River Conservation Area, which has managed for conservation, parks and parkways purposes. Yakima County is the lead entity for the Conservation Area, and originally much of the public land in and along the river in the Conservation Area were lands or other property interests held by Yakima County which were related to the Federal Project Levee system on both sides of the river. On the west side of the river, the Yakima Greenway Foundation manages the Greenway trail and other publicly owned property through agreement with the County. On the east side of the River, Yakima County has supported the purchase of properties by the Yakima Greenway, worked with WSDOT on previous projects to improve floodplain function and habitat, and acquired properties as associated with levee removal projects. Generally to the east of the roadway alignment, the land use is rural residential, but it is within the Yakima Urban Growth and is facing some development and access pressures.

C. Projected changes in flow and flood elevation due to climate change.

Current Climate projections anticipate an increase in precipitation as rain, and generally an earlier and lower volume spring runoff, and less precipitation in the summer. With the decrease in snowpack, it is uncertain that there will be any increase in flood elevation or flood frequency beyond these changes in seasonality. With the decrease in snowfall it is difficult to forecast how the system will respond – it would require much more severe storms to penetrate to the east side of the Cascade Range. Theoretically, climate change will increase drought frequency, increasing the pressure to store water in the reservoirs, and in turn reducing flood control space. Changes of that nature would require changes to federal law regarding flood control in the Columbia Basin, and those changes have not been proposed.

D. Impacts of all alternatives including the no-build alternative.

For any build alternative, the selected alignment improves floodplain impact the most. Other alignments that cross upstream would have required much longer spans or resulted in some encroachment of floodplain capacity between the levees. This alignment and pier placement allows some actions to be taken in the near term to spread flow and energy across the floodplain, in conformance with the standards of the NFIP, management and impacts on the Federal Project Levee System, and in advance of improved sediment supply conditions in the future. The no-build alternative would require implementation of future levee removal projects – which would be likely occur but over a much longer time frame, dependent on acquisition of developed residential property. The additional LWD structures and channels to access the floodplain parcels would likely not occur in this reach of the river without this or a similar project to fund their construction and import the material. Yakima County, WSDOT and other parties have tried to implement LWD projects of this kind in the Lower Naches and Yakima River but have been

unsuccessful – due to difficulty in securing materials (here the large trees can come on the railway, or on the paths created for the bridge girders) or space/construction (cranes, large excavators and off road dump truck already on site with bridge construction) safety limitations.

E. Recommended mitigation including measures to increase climate change resiliency. Mitigation associated with this project includes the creation of new channels in the context of energy distribution and access to floodplains in conservation status and improvement of sediment supply in this reach and downstream. The project has been designed to be consistent with, and implement the goals of, the Upper Yakima Comprehensive Flood Hazard Management Plan and related plans such as the Steelhead Recovery Plan. Final mitigation plans will include a more detailed planting plan based on the river/infrastructure configuration that is in place during construction of the project elements in this project area, plus additional habitat enhancement actions to compensate Reclamation for the use of their lands as Right of Way for the project.

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