APPENDIX G.
FLOOD HAZARD MANAGEMENT RISK AREAS

This appendix contains a listing of the known flooding and erosion related risk areas identified by the River and Floodplain Management Program staff during the preparation of the King County Flood Hazard Management Plan that will not be addressed by the Action Plan to be implemented from 2013-2018. The approach to identifying and characterizing these risk areas varied from river to river and was influenced by both the characteristics of each river, and by the professional judgment of the team compiling this information. In many cases the magnitude of these risks described is not well understood but will be further evaluated through future technical studies and risk assessments.

SOUTH FORK SKYKOMISH RIVER, MILLER RIVER, MALONEY CREEK, TYE RIVER AND ANTHRACITE CREEK (WRIA 7)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
7.1	7.4	R	Montagna Park: The upstream end of NE 196th Street has been undermined by severe bank erosion during moderate flooding. Emergency revetment construction did not achieve a slope that will be stable over the long term. Both the road and one residence are at risk from this erosion problem. Several homes and nonresidential structures exist in both the floodplain and floodway; many were built after 1993. (South Fork Skykomish River, Unincorporated)	Feasibility and technical analysis required.
7.4	7.6	R	Chamonix: Bank erosion threatens several homes built very near the edge of the river bank. A revetment of large rock riprap has slowed, but has not halted, this erosion. (South Fork Skykomish River, Unincorporated)	Feasibility and technical analysis required.
7.5	7.9	L	Skylandia: Existing homes have been inundated by fast-moving flood waters. Erosion and deposition damages are locally severe. Residential damages included structural problems as high-velocity waters shifted homes on their foundations. Flood study shows 100-year depths as great as 8 feet at these homes. (South Fork Skykomish River, Unincorporated)	Feasibility and technical analysis required.
7.8	8.0	R	Skyko Park: Several residential erosion problems have been patched with revetments and rockeries that are not showing recent damages but remain susceptible to extreme flood flow. Several homes and nonresidential structures exist in both the floodplain and floodway; it appears some were built after 1993. (South Fork Skykomish River, Unincorporated)	Feasibility and technical analysis required.
8.1	8.9	R	Riverwood Park: Several residential erosion problems have been patched with revetments and rockeries that are not showing recent damages but remain susceptible to extreme flood flow. Several homes and nonresidential structures exist in both the floodplain and floodway; it appears some were built after 1993. Flood study shows 100-year depths of 3 to 6 feet through most of this large subdivision. (South Fork Skykomish River, Unincorporated)	Feasibility and technical analysis required.
7.9	8.4	L	Baring Left: Severe channel erosion problems have been evident in this area, especially near the south end of 639th Ave NE, where one home was nearly undermined and perched over a tall vertical erosion scar that has been patched with concrete revetments. Although such revetments and rockeries are not showing recent damages, they remain susceptible to extreme flood flow. (South Fork Skykomish River, Unincorporated)	Feasibility and technical analysis required.

SOUTH FORK SKYKOMISH RIVER, MILLER RIVER, MALONEY CREEK, TYE RIVER AND ANTHRACITE CREEK (WRIA 7)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
10.8	12.2	R	Grotto: Extensive fill restricts natural floodplain conveyance and storage functions. (South Fork Skykomish River, Unincorporated)	Feasibility and technical analysis required.
12.6	13.2	L, R	Money Creek: Logs and debris are jammed against the piers of the Miller River Road bridge over the South Fork Skykomish River at the Money Creek Campground. Downstream of the bridge, severe bank erosion has claimed residential property but does not imminently threaten residences. Further upstream, overbank flows were concentrated along the riverward side of the BNSF Railway grade. Where these concentrated flows hit the Miller River Road, they exceeded culvert capacity and damaged the road where they overtopped it. Further damages occurred as these flows split and continued, generally westward, overbank. A northwest split scoured both the railroad grade and the adjacent portions of the Money Creek Campground. A southwest split scoured through commercial and industrial property on its way to the Money Creek channel. (South Fork Skykomish River, Unincorporated)	Feasibility and technical analysis required.
15.3	15.7	L	Milltown: Homes in old Milltown neighborhood west of Skykomish are subject to inundation by the river and by local drainage. (South Fork Skykomish River, Unincorporated)	Feasibility and technical analysis required.
17.2	17.9	L	Riverview: Eight homes along the left-bank of the Tye River (looking downstream) were damaged by erosion and inundation. Severe erosion continues to threaten several of these homes, and all but one are subject to inundation damages when overbank flows cross the Riverview point. Flood study shows depths of 5 to 8 feet near these homes, and all are within the one-foot floodway. (Tye River, Unincorporated)	Feasibility and technical analysis required.
18.3	18.4	L	Timber Lane Village Reach of Anthracite Creek: Sediment and debris flows in Anthracite Creek frequently plug its narrow channel. This sends flows over the Stevens Pass Highway (SR 2) and through Timber Lane Village. This damage area includes a private road, an extension of NE 122nd Street, and the community's potable water supply watershed and pump station. (Anthracite Creek, Unincorporated)	Feasibility and technical analysis required.
21.4	22.1	L	Profitts Pond: High-velocity inundation is likely for two residences situated on very large lots. Because there is a large log jam in main channel, channel migration is likely; an avulsion path is very near these homes. (Tye River, Unincorporated)	Feasibility and technical analysis required.

SOUTH FORK SNOQUALMIE RIVER, (WRIA 7)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
5.6	6.2	L, R	Riverbend Flooding and Erosion: A manually-adjustable flood gate that separates the South Fork Snoqualmie River from a private lake can allow floodwater to enter the lake, increasing water surface elevations and causing flood damage to homes around the lake. Flood waters in this constricted reach also cause erosion problems on the right bank. (South Fork Snoqualmie River, Unincorporated)	Feasibility and technical analysis required.
8.5	9.2	L, R	Edgewick Area Flooding: Flooding along this steep reach affects homes on both banks of the river in this reach. The left bank abutment of the Edgewick Road Bridge encroaches sharply into the channel and is subject to erosion. (South Fork Snoqualmie River, Unincorporated)	Feasibility and technical analysis required.
2.2	2.3	L, R	Replacement / retrofit of SR202 Bridges	Feasibility and technical analysis required.

MIDDLE FORK SNOQUALMIE RIVER AND NORTH FORK SNOQUALMIE RIVER, KIMBALL (WRIA 7)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
0.4	1.0	L, R	Upper Norman Flooding, Erosion and Habitat Degradation: Channel aggradation and changes in the thalweg have contributed to damage to two river facilities in this constrained reach. The status of these two facilities with respect to the need to maintain is rather ambiguous. One home on the right bank is subject to both flood and, in the long term, channel migration. The Upper Norman flood protection facility effectively isolates a fish bearing wetland from the mainstem of the river except during extreme high flows. Both facilities inhibit natural riverine process and are largely devoid of native vegetation. (Middle Fork Snoqualmie River, Unincorporated)	Feasibility and technical analysis required.
3.7	4.0	L	Tanner Revetment Erosion: Extreme high flows could result in damage to the Tanner revetment which protects the intersection of SE Tanner Road and North Bend Way. (Middle Fork Snoqualmie River, Unincorporated)	Feasibility and technical analysis required.
4.1	4.4	L	Tanner Neighborhood Erosion: Bank erosion threatens several residential properties both upstream of the Tanner revetment. (Middle Fork Snoqualmie River, Unincorporated)	Feasibility and technical analysis required.
1.0	2.0	R	Schodde Revetment and Ernie's Grove Residential Property Erosion and Flooding: Reoccupation of the side channel running along the base of the Schodde revetment would likely result in damage to private property. (North Fork Snoqualmie River, Unincorporated)	Feasibility and technical analysis required.
0.5	2.2	L	Moon Valley Residential and Road (sole access) Flooding: Inundation of residential properties and public and private roads and fast-moving water on Moon Valley Road completely isolates this community during moderate and extreme flood events. (North Fork Snoqualmie River, Unincorporated)	Feasibility and technical analysis required.

UPPER SNOQUALMIE RIVER, (WRIA 7)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
39.1	41.1	L	Neighborhood Flooding in Snoqualmie Area: More than 600 homes and hundreds of other structures are subject to flood inundation in and around the City of Snoqualmie. Recent projects have reduced the frequency and severity of local flood conditions, but the area continues to be at risk. (Upper Snoqualmie River, City of Snoqualmie)	City of Snoqualmie Natural Area Acquisitions: This project is to acquire property along the Snoqualmie River for shoreline, floodplain and native habitat protection. The project would acquire flood-prone land and eliminate flood risk to one home. (Upper Snoqualmie River, City of Snoqualmie)
0.7	1.1	R	Confluence Channel Process Restoration and Floodplain Reconnection: Recent and on-going channel position changes on the North Fork Snoqualmie upstream of the North Fork Bridge, is causing dramatic lateral migration of the river channel within and adjacent to the Three forks Natural Area. These changes have severely damaged the privately owned and maintained Shake Mill Left levee on the left bank of the river immediately upstream of the North Fork Bridge. Understanding the recent changes and forecasting future geomorphic evolution is important to inform flood hazard management decisions in this area. (Upper Snoqualmie River, Unincorporated)	Three Forks Natural Area Restoration: The project would conduct a geomorphic, hydraulic, and natural resource study to evaluate the existing flood facilities and geomorphic conditions and propose actions that would reduce flood hazards. Development of actions would be consider the existing flood facilities, flood and geomorphic hazards, natural resources, infrastructure and property ownership, and management goals and strategies of the Three Forks Natural Area. Actions proposed could include modification, creation, or removal of flood protection facilities, roads, bridges or drainage infrastructure, property acquisition, vegetation management or restoration or other structural or non-structural actions.
40.3	41.9	R	Reinig Road Erosion and Neighborhood Flooding: A 1.8 mile segment of Reinig Road borders the channel migration zone and in one location has been damaged to the point that an emergency repair was required. Five homes along this road segment are also subject to flooding and erosion. (Upper Snoqualmie River, Unincorporated)	Feasibility and technical analysis required.
42.2	42.3	R	Reinig Road Slope Instability: Road bank failure at this location at which the river make a nearly 90 degree bend has been repaired by King County Roads. Continuing erosion at the revetment's shallow toe is likely to undermine this repair. Upstream and downstream banks are unprotected, leaving the road at risk from future erosion damage in these areas as well. (Upper Snoqualmie River, Unincorporated)	Feasibility and technical analysis required.
41.6	41.9	R	Reinig Road Erosion across from Confluence with South Fork: Right bank erosion at the confluence of the South Fork and the mainstem Snoqualmie may damage Reinig Road in this location. (Upper Snoqualmie River, Unincorporated)	Feasibility and technical analysis required.
38.8	40.8	L, R	Evaluation of flood risks and hazards main stem above the falls	Feasibility and technical analysis required.

LOWER SNOQUALMIE RIVER (WRIA 7)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
TBD	TBD	TBD	Repetitive Flood Damages to Residential and Agricultural Structures: There are a number of residences and agricultural structures in the Agricultural Production District along W. Snoqualmie River Road NE that have experienced repeated flood damages. (Lower Snoqualmie River, Unincorporated)	Lower Snoqualmie Elevations: Pursue elevations of residences or agricultural structures in this area, as appropriate and consistent with mitigation strategy criteria in Chapter 4.
TBD	TBD	TBD	Vegetation Maintenance: Existing levees and revetments have been built to reduce risk of damage from flooding and erosion. This represents a significant extent of riparian land that has problems with invasive, non-native vegetation. Eradication of these invasive plants and the establishment of native riparian plantings remain as a levee or revetment maintenance need. (Lower Snoqualmie River, Unincorporated)	Lower Snoqualmie Restoration and Maintenance: Revegetation of existing levees or revetments to reduce cost of flood risk reduction. Includes enhancement of 3 miles of riparian habitat, improve access to off-channel habitat, open 1.5 miles of rearing habitat by removing blockages and restore a three-acre wetland. (Lower Snoqualmie River, Unincorporated)
TBD	TBD	TBD	Vegetation Maintenance: Existing levees and revetments have been built to reduce risk of damage from flooding and erosion. This represents a significant extent of riparian land that has problems with invasive, non-native vegetation. Eradication of these invasive plants and the establishment of native riparian plantings remain as a levee or revetment maintenance need. (Lower Snoqualmie River, Unincorporated)	Snoqualmie River Restoration on Agriculture Lands: Revegetation of existing levees or revetments to reduce cost of flood risk reduction. The goal is to plant 50 acres of floodplain habitat throughout the Snoqualmie. (Lower Snoqualmie River, Unincorporated)
0.0	0.4	L, R	Levee and Revetment Maintenance: Existing levees and revetments have been built to reduce risk of damage from flooding and erosion. These facilities require maintenance and repair in order to preserve their function. (Lower Snoqualmie River, Unincorporated)	Cherry Creek Mouth Restoration: Revegetation of existing levees or revetments to reduce cost of flood risk reduction. This project would restore the old channel alignment, circa 1960, before it was straightened and channelized. This would create approximately 2000 feet of new channel. The project would also eliminate any need for maintenance of existing channelized outlet (to be abandoned). (Lower Snoqualmie River, Unincorporated)
5.5	9.2	L	Dutch Row Riverbank Erosion and Slumping: The shoulder of the West Snoqualmie River road, which is a primary access to 25 large agricultural properties, is exhibiting slumping caused by scour on the left bank of the Snoqualmie River. (Lower Snoqualmie River, Unincorporated)	Feasibility and technical analysis required.
8.9	9.2	L	Joy Revetment Erosion and Slumping: Erosion at the toe rock of the Joy revetment threatens this flood protection facility and adjacent private road. (Lower Snoqualmie River, Unincorporated)	Feasibility and technical analysis required.

LOWER SNOQUALMIE RIVER (WRIA 7)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
9.2	9.2	L	Woodinville-Duvall Road Backwater Flooding and Bridge Abutment Erosion: Fill placed in the floodplain for construction of the Woodinville-Duvall Road exacerbates flooding problems upstream of this heavily used cross-valley road. Despite the multiple bridges in this road fill, the road blocks most of the floodplain conveyance capacity, contributes to flood depths upstream, and can cause localized high-velocity flows that lead to scour damages on adjacent private lands. Road elevation leads to frequent inundation and access being cut off. (Lower Snoqualmie River, Unincorporated, City of Duvall)	Feasibility and technical analysis required.
16.6	16.8	L	Adair Road Revetment Erosion and Slumping: Erosion at the toe rock of the Adair Road revetment potentially threatens this flood protection facility and road. In addition, the bank opposite this flood protection facility is actively eroding. (Lower Snoqualmie River, Unincorporated)	Feasibility and technical analysis required.
21.9	22.7	R	NE 50th to Horseshoe Lake Flooding and Erosion: Flood flows over the right bank of the Snoqualmie River cause minor damage to 55th Ave NE and more significant damage to the more heavily used Carnation Farms Road. (Lower Snoqualmie River, Unincorporated)	Feasibility and technical analysis required.
22.1	22.7	R	Levee and Revetment Maintenance: Existing levees and revetments have been built to reduce risk of damage from flooding and erosion. These facilities require maintenance and repair in order to preserve their function. (Lower Snoqualmie River, Unincorporated)	McElhoe/Pearson Levee: The project will remove or set back about 1,300 feet of the levee, reconnecting floodplain habitat and increasing side channel formation. The setback project would reduce the need for maintenance and flood repair along existing McElhoe/Person levee. (Lower Snoqualmie River, Unincorporated)
22.4	22.7	R	NE 60th St. to NE 55th Flooding: There are a number of residences between NE 60th St. and NE 55th St. that could flood or have experienced flood damages. (Lower Snoqualmie River, City of Carnation Planned Annexation Area)	Lower Snoqualmie Elevations: Pursue elevations of residences or agricultural structures in this area, as appropriate and consistent with mitigation strategy criteria in Chapter 4.
23.8	27.6	R	There are a number of residences and agricultural structures in the Agricultural Production District between Tolt confluence and RM 27.6 (Changing Seasons Farm) that have experienced repeated flood damages. (Lower Snoqualmie River, Unincorporated)	Lower Snoqualmie Elevations: Pursue elevations of residences or agricultural structures in this area, as appropriate and consistent with mitigation strategy criteria in Chapter 4.

LOWER SNOQUALMIE RIVER (WRIA 7)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
26.0	26.6	L	Byers Farm Flood Damage: Unique hydraulic patterns on the Byers farm cause massive and repetitive deposition of flood-borne debris - mostly fallen trees - on arable land. (Lower Snoqualmie River, Unincorporated)	Snoqualmie River Byers Floodplain and Riparian Restoration: Install a 600 foot long "drift fence" to capture the large amount of woody debris that is accumulating in the back/tree line of the property to reduce erosion along agricultural property. Feasibility and technical analysis required to assess potential for removing flood facilities in conjunction with conversion of golf course to farming and restored wetland. (Lower Snoqualmie River, Unincorporated)
27.4	27.6	L	Levee and Revetment Maintenance: Existing levees and revetments have been built to reduce risk of damage from flooding and erosion. These facilities require maintenance and repair in order to preserve their function. (Lower Snoqualmie River, Unincorporated)	Gonneson Revetment Removal/Acquisition: The project will restore the Snoqualmie River to allow it to migrate laterally along this meander bend by removing existing bank armor. This proposal would require the acquisition of 12 acres of property in order to allow the project to occur. It would also eliminate any need for maintenance of existing Gonneson revetment (to be removed). (Lower Snoqualmie River, Unincorporated)
29.3	31.5	R	SE 19th Way Road and Revetment Damage: Erosion along the left bank of the Snoqualmie River channel threatens to undermine the road bed of SE 19th Way, a county road which serves one farm. A rock revetment was installed in response to this problem in the 1960s, but the problems involve deep failure surfaces that have not been stabilized by the rock riprap. (Lower Snoqualmie River, Unincorporated)	Feasibility and technical analysis required.
34.2	34.9	R	Washington State Department of Transportation Overbank Flooding: Floodwaters overtop SR 202 where it abuts the right bank of the Snoqualmie River, across from and upstream of the Raging River confluence. This causes deep, fast, erosive flows in this rural residential area. (Lower Snoqualmie River, Unincorporated)	Feasibility and technical analysis required.

TOLT RIVER (WRIA 7)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
2.3	2.9	R	Levee and Revetment Maintenance: Existing levees and revetments have been built to reduce the risk of damage from flooding and erosion. These facilities require maintenance and repair in order to preserve their function. (Tolt River, Unincorporated)	Tolt River Natural Area Floodplain Reconnection/Acquisition: This project would assess the feasibility of removing a levee that is currently disconnecting a side channel from being active. In order to remove the levee several residences must be bought out as they are directly in the old side channel. The project would reduce the need for maintenance of existing Edenholm levee (portion to be removed) resulting in an elimination of the risk to two homes. (Tolt River, Unincorporated)
4.2	4.9	R	San Souci Neighborhood Flooding: Deep, fast flood waters surround several residences in the San Souci area. These can isolate the neighborhood, preventing travel in or out, during relatively minor flood events. Many residents elect to stay in these homes, which are higher than moderate flood levels. However, all of the homes are at risk during extreme flood events. By the time the hazard becomes convincingly visible, high water may prevent evacuation. This compounds the life safety concerns in this area. (Tolt River, Unincorporated)	San Souci Neighborhood Buyout: Remove all homes from this hazardous area. Then, remove existing rubble levee at upstream end of community access road. Feasibility and technical analysis required to evaluate potential river response from levee removal .(Tolt River, Unincorporated)
2.0	6.0	L, R	Tolt River Residential Hazards: Problems described above for the San Souci area exist more generally. Due to the severity and concentration of these problems at San Souci, it is a priority for action, but similar needs will remain throughout the corridor upstream of the leveed segment after that project is complete. (Tolt River, Unincorporated)	Feasibility and technical analysis required; Tolt Corridor Study should provide much of required analysis.

RAGING RIVER (WRIA 7)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
0.0	1.5	L, R	Fall City Area Channel Aggradation and Flooding: Although the Fall City levees were raised in 1997, channel aggradation continues in a manner that may diminish flood containment capacity, particularly downstream of the Preston-Fall city Road Bridge at RM 0.5. Channel aggradation upstream of the Preston-Fall City Road bridge is not as severe as in the downstream reach, but continued aggradation, combined with the already constrained channel and the angle at which the river passes under the bridge, may create an increasing risk for flooding through Fall City. (Raging River, Unincorporated)	Fall City Levee Setback Feasibility Study: The proposed project would involve setting back portions of the existing levee system on both the right and left banks to increase channel capacity and optimize the angle at which the Raging River passes under the Preston-Fall City Road Bridge. The project would require acquisition of, or additional easement rights across, up to seven privately held parcels on the left bank of the river and up to 31 parcels on the right bank of the river. Because of the large number of property owners and stakeholders that would be involved in project, and the potential for alternative solutions, work on this project is currently proposed to be limited to the completion of a feasibility study. (Raging River, Unincorporated)
0.0	0.4	R	See Fall City Area Channel Aggradation and Flooding description (above).	Lower Raging River Restoration: This project seeks to setback existing Raging River levee system to increase its level of flood protection to the Fall City community. (Raging River, Unincorporated)
1.45	4.20	L,R	Preston-Fall City Road Flooding and Erosion : Preston Fall City Road and rural residential development in many locations are within or at risk from flood and channel migration hazards. Ongoing lateral migration and bank erosion creates numerous geotechnical instabilities for the road that require repairs. (Raging River, Unincorporated)	Feasibility and technical analysis required.
1.45	4.20	L,R	Preston - Fall City Road Realignment: A considerable length of the Preston – Fall City Road lies within,or immediately adjacent to the Raging River channel migration zone (see Preston - Fall City Road Erosion and Flooding A-F above). Ongoing lateral migration and bank erosion creates numerous geotechnical instabilities for the road. As an alternative to ongoing erosion and repair of the existing Preston - Fall City Road alignment, consider potential road realignment between the Town of Preston and the 328th Street Bridge. (Raging River, Unincorporated)	Feasibility and technical analysis required.
1.5	4.9	L,R	Levee and Revetment Maintenance: There are a number of flood facilities along the I-90 to Fall City segment which are subject to erosion and damage. (Raging River, Unincorporated)	Feasibility and technical analysis of potential facility removal or setback required; should include acquisition strategy.

RAGING RIVER (WRIA 7)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
4.30	4.47	L, R	Town of Preston Residential Erosion: Homes and a church camp downstream from the SE 86th St Bridge are at risk from erosion. (Raging River, Unincorporated)	Feasibility and technical analysis required.
4.70	4.90	L, R	Upper Preston Road Erosion: 0.3 miles of the Upper Preston Road and road bridge are within the moderate or severe channel migration hazard area. (Raging River, Unincorporated)	Feasibility and technical analysis required.
4.82	4.94	L, R	Hursh Neighborhood Access Erosion: Erosion around the freeway support on the left bank of the river may threaten the sole access to the upstream community of five or six homes. Most of access road is in severe channel migration hazard area. (Raging River, Unincorporated)	Feasibility and technical analysis required.
5.38	5.55	R	Upper Preston Road Slope Instability: A shift in flow patterns could result in increased flows in a side channel running along the slope upon which the Upper Preston Road has been built resulting in erosion and potential slope failure. (Raging River, Unincorporated)	Feasibility and technical analysis required.
7.64	8.14	L,R	Arruda Neighborhood Residential Flooding and Erosion: Several homes off the end of the Upper Preston Road are at varying degrees of risk from channel migration. (Raging River, Unincorporated)	Feasibility and technical analysis required.

SAMMAMISH RIVER AND ISSAQUAH CREEK (WRIA 8)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
0.0	0.0	N/A	Delta Sedimentation at Mouth: Sediment frequently tends to build up just downstream from the mouth of the river, forming a delta in Lake Washington. Periodically, dredging of these accumulated sediments is performed by the U.S. Army Corps of Engineers in order to maintain commercial navigation at the north end of the lake. During the interval between dredging, the expanding delta in the lake may reduce river velocities at the river's outlet, leading to sediment build-up in the channel. Homeowners along the lower end of the river frequently request that King County dredge the river in order to maintain recreational navigation for large-hulled boats between the river and the lake. (Sammamish River, City of Kenmore)	Feasibility and technical analysis required to determine where and how much sediment is accumulating, if there are an associated flood risks, and what actions are recommended for any identified flood risks.
All	All	L, R	Issaquah Creek Undeveloped Property (Issaquah Creek, City of Issaquah): Undeveloped properties in areas of known high flood hazard within the Issaquah Creek floodplain that can be developed into residential homes. Development of these properties could result in future flood losses and risks to public safety. Recent floods, including 1990 and 1996, demonstrates that this area experiences significant flooding causing repetitive losses at existing structures. While current development standards for construction in floodplains are in compliance with FEMA, residual safety risks remain because floodwaters cut off access to these properties, preventing emergency response actions during flooding events.	Purchase of flood-prone undeveloped residential parcels will help prevent future flood losses and risks to public safety. Existing homes in many neighborhoods along Issaquah Creek have experienced repetitive losses during the 1990 and 1996 floods. For current undeveloped parcels this can be avoided if acquired prior to development and dedicated as open space. Also, property acquired and dedicated as open space provides a significant benefit towards preserving valuable habitat for fish and wildlife. Issaquah has implemented several stream, floodplain and wetland restoration projects in the last five years, which can be expanded to newly acquired properties, and King County has also purchased many properties to prevent future floodplain development and preserve the stream corridor

SAMMAMISH RIVER AND ISSAQUAH CREEK (WRIA 8)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
All	All	L, R	Issaquah Creek Loss Area Structure Elevations and Floodproofing (Issaquah Creek, City of Issaquah): Single family repetitive loss structures, including two in rural King County and 13 in the City of Issaquah, located in high flood hazard areas of the Issaquah Creek floodway and floodplain. Many residential developments were constructed before flood development standards for construction in floodplains were enacted in 1980. Recent floods, including in 1990 and 1996, demonstrates that Issaquah Creek experiences significant flooding, resulting in repetitive losses at existing structures. Future floods will likely cause additional repetitive damages, along with risks to public safety because floodwaters cut off access to these properties, preventing emergency response actions during flooding events.	Provide assistance to repetitive loss single family structures within the Issaquah Creek floodplain to elevate and/or floodproof structures to current floodplain standards. This will help mitigate current repetitive losses to allow them to be taken off of repetitive loss lists. Elevations will raise first floors to 1-2 feet above the base flood elevation. Mitigation of future flood losses at existing repetitive loss properties.
2.5	2.8	L	Gilman Square Repetitive Loss Area Structure Elevations and Floodproofing (Issaquah Creek, City of Issaquah): Commercial structures, including five repetitive loss structures, next to Gilman Boulevard within a known high flood hazard area in the Issaquah Creek floodplain. The Gilman Repetitive Loss Area, located on Issaquah Creek next to Gilman Boulevard in the Gilman Square development, consists of several commercial buildings that were built many years ago in a high flood hazard area. Recent floods, including in 1990 and 1996, demonstrates that this area experiences significant flooding, resulting in repetitive losses totaling $786,000 at four structures. Future floods will likely cause additional repetitive damages, along with risks to public safety because floodwaters cut off access to these properties, preventing emergency response actions during flooding events.	Provide assistance to up to six commercial buildings within the Gilman Repetitive Loss Area to elevate and/or flood proof structures to current floodplain standards. This will help mitigate current repetitive losses at up to four structures, to allow them to be taken off of the City's repetitive loss list (the total number of repetitive loss properties in Issaquah is 19). Elevations will raise first floors 1-2 feet above the base flood elevation, or floodproofing methods will be used based on current criteria, based on floodplain mapping recently developed for the Issaquah Flood Insurance Study update. Mitigation of future flood losses at up to six properties, including four repetitive loss properties.

SAMMAMISH RIVER AND ISSAQUAH CREEK (WRIA 8)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
All	All	L, R	Issaquah Creek Property Acquisition Opportunity Fund (Issaquah Creek, City of Issaquah): Existing developed single family, multi-family, and commercial structures in high flood hazard of Issaquah Creek, East Fork Issaquah Creek, and North Fork Issaquah Creek floodways and floodplains. Many existing developed properties in the Issaquah Creek watershed were developed before flood development standards for construction in floodplains were enacted in 1980. Past land use regulations allowed construction of buildings close to the creek, along with filling that impacted adjacent properties. Recent floods, including in 1990 and 1996, demonstrates that many areas of Issaquah experience significant flooding. Future floods will likely cause additional repetitive damages, along with risks to public safety because floodwaters cut off access to these properties, preventing emergency response actions during flooding events.	This project will provide long-term financing to acquire non-repetitive loss properties having flood prone structures along Issaquah Creek. Funds will be held in an opportunity fund that will be available for acquisitions when properties become available, either as identified through a City or County mitigation proposal or by property owners who contact the City or County for possible buyouts. This will help mitigate current flood losses and assists with stream and floodplain restoration projects in accordance with the policies and funding guidance of the WRIA8 Chinook Salmon Conservation Plan.
5.3	5.6	R	Squak Valley Park Levee Removal and Habitat Restoration (Issaquah Creek, City of Issaquah): Flooding of the Sycamore neighborhood, a single family residential development with approximately 1/2 dozen homes on left bank Issaquah Creek upstream of Sycamore Drive that is prone to flooding (including two repetitive loss properties). A levee that was constructed on the Erickson Property (now city-owned Squak Valley Park North) in the 1930's is contributing to flooding of the Sycamore neighborhood because the levee is on the right bank of Issaquah Creek and is much higher than the floodplain area where homes are built on the left bank. Floods of 1990 and 1996 caused widespread flooding in the Sycamore neighborhood area. Full or partial removal of the levee will help mitigate flood losses through lower flood elevations, and also provide an opportunity to improve stream and riparian habitat. The levee provides very little flood protection benefit; a small portion of Issaquah-Hobart Road that does obtain some benefit from the current levee can be protected with a small setback levee outside of the stream buffer area.	Construct the Squak Valley Park stream and riparian restoration project that includes partial or full levee removal. Project will include fish habitat enhancement, consistent with WRIA8 Salmon Conservation Plan proposal (on 3-year high priority list), and floodplain reconnection with remainder of city park property. Levee removal will help lower peak flood elevations in the area by creating additional conveyance area, and will reconnect Issaquah Creek to the floodplain which will restore natural floodplain processes such as sediment deposition, and also improve fish, riparian, and wetland habitats.

SAMMAMISH RIVER AND ISSAQUAH CREEK (WRIA 8)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
All	All	L, R	Issaquah Creek Bank Stabilization Opportunity Fund (Issaquah Creek, City of Issaquah): Many structures are located within a very short distance of Issaquah Creek, East Fork Issaquah Creek, and North Fork Issaquah Creek, and thus are at risk of flood damage caused by bank erosion. Construction of these structures was made possible by past land use regulations that allowed such development, and also by active public assistance programs from King County to stabilize stream banks. These assistance programs have ceased in recent decades due to lack of funding. After moderate to high floods there is typically a need to construct one or more bank stabilization projects to restore stream bank erosion to protect existing structures.	Provide assistance to private and public property owners by implementing bank stabilization projects and other needed maintenance, incorporating current techniques such as bioengineering, setback revetments, and relocation. Proposed work includes design, permitting and construction of minor projects costing less than about $150,000 each. Projects can be combined with habitat improvements, funded through other sources. Stabilization of stream banks and maintenance of existing bank stabilization structures that are located in areas of where existing structures are close to the active stream channel will help mitigate future flood losses and improve public safety.
1.6	1.9	R	Carco Theater (Cedar River, City of Renton): During floods equal to or greater than 50-yr events (> 8000 cfs), the Carco Theater and Renton Community Center at 1717 and 1715 Maple Valley Hwy are flooded and damaged. The Carco Theater had water inside the building during the 1990 flood (10,600 cfs) and suffered flood damages. Flood fighting efforts during other floods has prevented the damage from reoccurring. Flooding of building due to high flows can cause drainage system back-up or over bank flows to flood the building.	Carco Theater Flood Hazard Reduction: Construct a setback levee to protect the building from damages and modify storm systems that surcharge during flood events to prevent surcharging back into the building. The project would prevent damage to a public facility and prevent damages from re-occurring.
2.1	2.5	R	Riviera Apartments (Cedar River, City of Renton): During floods equal to or greater than 50-yr events (> 8000 cfs), the units in the existing apartment buildings closest to the river are flooded. The Riviera Apartments are located at 2205 Maple Valley Hwy. The lowest floor of the apartments and parking lot are flooded. The apartment units were flooded during the 1990 flood (10,600 cfs) and suffered flood damages. Residents had to be evacuated and placed into shelters. Flood fighting efforts during other floods has prevented the damage from reoccurring. High flows that overtop existing river bank results in flooding into the apartment buildings.	Riviera Apartments Setback Levee: Construct a setback levee that is FEMA certified to protect buildings. Alternatively the building can be elevated or bought out. If the site is redeveloped in the future, the possibility exists to get the redevelopment project to construct building at an elevation that prevents them from flooding (1-ft above 100-yr base flood elevation – Renton Standard).The project would prevent damage to private buildings and prevent damages from re-occurring, which impacts the residents of the apartment units. Habitat improvement could be also incorporated into the project if FEMA levee certification requirements could be also achieved and maintained.

SAMMAMISH RIVER AND ISSAQUAH CREEK (WRIA 8)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
1.5	1.6	L	Old City Hall (Cedar River, City of Renton): During floods equal to or greater than 50-yr events (> 8000 cfs), the Old Renton City Hall building at 200 Mill Avenue South is flooded. The lowest floor of the building and parking lot is flooded. The City building had floodwater inside of it during the 1990 flood (10,600 cfs) and suffered flood damages. Flood fighting efforts during other floods has prevented the damage from reoccurring. A small wall was build in the 1990's to provide additional protection, but may not be sufficiently high enough to protect the building during the revised 100-yr flood flow of 12,000 cfs.	Old City Hall Flood Protection: Reconstruct or modify existing wall to increase height and include required freeboard so the wall can be FEMA certified as a floodwall. Modify onsite storm system to prevent surcharging during high flows and flooding behind the wall. Alternatively, a levee could be reconstructed by removing gabions, if sufficient space is available to meet levee design standards and FEMA levee certification requirements. The project would prevent damage to a public building and prevent damages from re-occurring. Habitat improvements could also be incorporated into the project if FEMA levee or floodwall certification requirements could be also achieved and maintained.
0.1	1.7	L, R	Sunset Creek (Lake Washington, City of Bellevue): The regional METRO sewer line located in the Richards Creek valley in south Bellevue is at-risk due to stream erosion where a new channel is developing across a forested wetland adjacent to the sewer line. Through natural processes, the stream channel shifted course and today flows across an area where previously no stream corridor existed. The stream shift occurred where Richards Creek had been channelized along property lines in the 1970's (prior to Sensitive Area ordinances). At that time, the streams were forced into unnatural right-angle bends and aligned to flow between several commercial box structures. Three separate creek systems (Richards, East, and Sunset) merge in the project vicinity. Each creek is constrained by long, straight stream corridors between commercial warehouse buildings. The project site is a historic wetland/ floodplain area where the valley slope flattened and thus is a natural sediment deposition zone. Currently, the creeks in this area have no functioning floodplain and have extremely limited riparian habitat. Spawning salmon, including species protected under the Endangered Species Act, are known to use the corridors. Engineering solutions to increase conveyance capacity are limited due to narrow creek corridors, the need to excavate excess sediment and the presence of the buildings. Private property issues are also an obstacle.	Sunset Creek Acquisitions: Eliminate repetitive flooding by acquiring several commercial and vacant properties in the area where the three creeks merge. Next, design a stabile channel adjacent to the METRO sewer line. Demolish the commercial buildings and restore the area as natural open space to establish a functioning system by reconnecting the creeks with the floodplain, providing spawning and rearing aquatic habitat, and providing a natural deposition area for sediment.

SAMMAMISH RIVER AND ISSAQUAH CREEK (WRIA 8)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
0.0	0.7	L, R	Lower Coal Creek (Lake Washington, City of Bellevue): Homes downstream of the I-405 regional detention facility are constructed on an historic river delta where the creek empties into Lake Washington. Preliminary floodplain modeling predicts that many of the homes are at risk of structural flooding beginning with moderate storms. One house in this area is identified as FEMA repetitive flood loss property. It last flooded prior to construction of the regional detention pond, thus it is considered to be a mitigated property in the FEMA program. The creek is confined to a narrow corridor flowing through manicured lawns in an upscale residential neighborhood. Five box culverts interspersed throughout the neighborhood, each too small to convey the 100-year flow rate, exacerbate the flooding situation. Levees constructed along the left and right banks, do not meet federal standards, nor do they contain the 100-year flow, and do not connect to higher ground. Stream bed aggradation has dramatically reduced the stream conveyance capacity since the neighborhood was constructed in the late 1960's. Sediment delivery rates are higher than what might be expected in a watershed of this size due to mining practices in the upper watershed in the early 20th century. The I-405 regional detention facility is a 20 acre-foot, in-channel regional detention pond facility located at the upstream extent of the Newport Shores reach of Coal Creek. Peak storm flows are mitigated, but not sufficiently to prevent flooding for moderate to severe storm events (e.g. 100-year storm). Reducing the flood risk in this area is problematic because many of the threatened structures are not necessarily next to the creek. Those distant properties are threatened because the storm drain connections to the creek have very flat slopes thus allowing water to "backup" through the system.	Lower Coal Creek Phase 2: Increase the storage capacity of the regional pond while maintaining fish passage to effectively reduce flow rates to protect private property and maintain stream channel capacity. Increase conveyance capacity of five box culverts and construct Army Corp of Engineer's approved levees where feasible.

CEDAR RIVER – LAKE WASHINGTON (WRIA 8)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
6.50	7.3	R	Brassfield Revetment: Revetments currently constrain both sides of the river in much of this segment, creating high velocities and elevated flood levels. As a result, the flood protection facilities are highly susceptible to erosion and scour. On the right bank, the Brassfield Revetment armors the bank against undercutting to protect a row of homes located just along the top-of-bank, and Jones Road behind them. The banks throughout this area are over steepened, and the flood protection facilities are a major encroachment into the river channel, leading to increased velocities, reduced instream habitat, and inadequate riparian buffer. This flood protection facility has experienced significant damages in recent floods, and while repaired, remains vulnerable. (Cedar River, Unincorporated).	One possible flood solution could involve exploring possible flood buyouts and levee setback opportunities to reduce damages to the flood protection facility and adjacent homes, lower flood elevations and velocities through the reach, and improve riparian habitat conditions. Buyout of the flood-prone Riverbend Mobile Home Park, located behind a revetment on the opposite bank, is recommended in the Action Plan. Iimplementation of that project would reduce, but not eliminate, risk of damage to this facility. (Cedar River, Unincorporated)
			Riverbend Lower Revetment (Cavanaugh): Revetments currently constrain both sides of the river in much of this segment, creating high velocities and elevated flood levels. As a result, the flood protection facilities are highly susceptible to erosion and scour. The downstream extension of the Riverbend revetment protects the ecologically-significant Cavanaugh Pond from regular overtopping and channel migration, but this armoring may interfere with beneficial ecosystem processes. The banks throughout this area are over steepened, and the flood protection facilities are a major encroachment into the river channel, leading to increased velocities, reduced instream habitat, and inadequate riparian buffer. (Cedar River, Unincorporated)	Explore the possibility of lowering flood elevations and velocities and increasing overbank conveyance by removal or setback of the levee/revetment that currently separates Cavanaugh Pond from the mainstem river. (Cedar River, Unincorporated)

CEDAR RIVER – LAKE WASHINGTON (WRIA 8)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
7.75	8.50	R	Cook-Jefferies Revetment (Horse Farm): The Cook-Jefferies Revetment extends along the entire right bank through this reach and is a constriction to flood conveyance and channel forming processes. Portions of the revetment were modified by an adjacent landowner. Large rounded rocks were placed on the banks and toe. This rock overlay is intact along some portions of the flood protection facility, but in others it is placed over scour and erosion damage. This modified reach is likely to be unstable and vulnerable during future flood events, but does not pose a direct risk to homes, or public safety. At the downstream end, a former oxbow, lined by mature cottonwood trees, is still present but disconnected from the river by the revetment, limiting the availability and quality of habitat. The Cook-Jeffries Revetment also forces flood flows toward two Cedar River Trail revetments on the opposite bank that protect the trail, the Maple Valley Highway, and portions of the regional park system. Lacking room for setback, these two trail revetments are over-steepened and highly susceptible to erosion and scour. . (Cedar River, Unincorporated)	Feasibility and technical analysis required.
8.50	9.40	R	Scott - Indian Grove Revetment (Big Bend): A number of homes on the right bank are located in an area of severe channel migration based on preliminary findings of the channel migration zone study currently underway. Toward the middle of this segment, several additional homes are behind the Scott Indian Grove Revetment. Most of these homes are on relatively high ground, and are not known to experience regular flooding. However, they are susceptible to undermining by channel migration or erosion. At the downstream end, there are no homes at risk, but the Scott-Indian Grove revetment constricts conveyance, deflects flows toward the Cedar River Trail flood protection facility, and prevents natural river processes and establishment of an adequate riparian buffer. (Cedar River, Unincorporated)	The homes are not known to experience regular flooding, but are susceptible to undermining by channel migration or erosion. One possible alternative to address the over-steepened banks should explore options for setting back the banks to increase conveyance, independently or in combination with possible flood buyouts from willing sellers in this neighborhood. (Cedar River, Unincorporated)

CEDAR RIVER – LAKE WASHINGTON (WRIA 8)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
9.35	9.8	L	Littlefield-Cummins (Cedar Mountain): This reach contains two left bank flood protection facilities and a bridge, and is underlain by one of the river's few areas of bedrock. Toward the upstream end, the Cummens levee provides limited reduction in overbank flooding at low to moderate flood events affecting one or two homes. The river is confined by bedrock on the opposite bank, making the flood protection facility a constriction to flood conveyance and channel process. Downstream, a gravel bar has formed riverward of the Littlefield revetment, making it obsolete. New abutments were installed along both banks for support of the reconstructed Jones Road Bridge. These are expected to provide substantial stability in this segment of the river, but a portion of the Cedar River Trail protection downstream from the abutment on the left bank may remain vulnerable to scour, erosion, or slumping. (Cedar River, Unincorporated)	One alternative solution through this area could involve exploring options for setting back the banks to increase conveyance, independently or in combination with possible flood buyouts. Depending on site-specific conditions, where acquisitions eliminate the risks to homes, the levees could be setback or removed. (Cedar River, Unincorporated)
10.65	11.0	L	WPA Levee: The WPA Levee reduces the risk of channel migration and provides a minimal level of protection from overbank flooding to two homes on the left bank which are located in the floodplain, floodway and what appears to be an area of severe channel migration based on preliminary findings of the channel migration zone study currently underway. The levee also constricts flow conveyance through this segment, which is area that has been largely set aside for restored natural river and floodplain processes. . The levee's bank armor also inhibits establishment of adequate stream buffer in the vicinity of some of the highest quality instream habitat in the lower Cedar River. (Cedar River, Unincorporated)	Acquisitions have been initiated in this reach by several habitat restoration partners, with the long term goal of setting back the banks to lower flood velocities and elevations, reconnect side channels and floodplain areas, and restore habitat. A continuation of the buyout program is a viable solution ot the flood hazards for the two remaining homes in this area. Depending on site-specific conditions, where acquisitions eliminate the risks to homes, the levees could be setback or removed. (Cedar River, Unincorporated)
11.50	11.7	L	Cedar Grove Road: High velocity flows overtop the MacDonald levee on the left bank, threatening several homes and their sole access road. At the downstream end of this segment, Cedar Grove Road cuts across the flow path of heavy overbank flooding through this neighborhood. Portions of the roadway are on a raised prism, making it susceptible to damage and causing backwater effects through the neighborhood. Flows over the lowest section of the roadway drop off a steep shoulder grade at the downstream edge before re-entering the river, leading to road washouts and closure of a major transportation connection. (Cedar River, Unincorporated)	A solution to this flood problem is likely to involve purchase of repetitive loss properties as well as adjacent flood-prone homes and parcels. Opportunities could then be pursued to reconfigure or remove the levee to reduce channel confinement and reconnect flows in the river with the flows across the floodplain. Modification of Cedar Grove Road and the overbank flow path through the upstream neighborhood should be explored to address the backwater behind the road and allow overbank conveyance to re-enter the river. This could be evaluated as a possible solution in the Byers Bend Flood Hazard Mitigation Analysis. (Cedar River, Unincorporated)

CEDAR RIVER – LAKE WASHINGTON (WRIA 8)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
			Taylor Creek Confluence: At high flow events, Taylor Creek backwaters from its confluence with the Cedar River, flowing across public an dprivate properties and the privately maintained sole access road tot eh neighborhood, often damaging the road and cutting off ingress and egress to the neighborhood.	Feasibility and technical analysis required.
14.05	15.1	L, R	Royal Arch: At high flows the river engages with multiple side-channels through occupying the wide floodway and floodplain covering the right bank through this segment Numerous homes in this area were severely flooded and access was cut-off during the 2009 flood. King County coordinated with the City of Seattle to buyout several of these homes, but others remain at risk. In the middle and downstream portion of this reach the left bank is dominated by an active landslide that contributes a substantial amount of hillside material to the river. A major landslide from this steep slope could block all or portions of the river, placing the homes upstream and across the river at even greater risk from overbank flooding. A revetment lines the downstream –most portion of the left bank to direct the river beneath a bridge span. (Cedar River, Unincorporated)	Feasibility and technical analysis required. One option for directly reducing flood hazards is continued acquisition of flood-prone homes.
15.10	15.25	R	Bain Road Upper: This stretch located between the SR-169 and SR-18 bridges has been identified as repetitive loss for two of the three developed properties in this area, all of which are outside the floodway but within the floodplain. Constriction of flows caused by the embankments under the SR-18 bridge at the downstream end of this segment may contribute to the recurrent flood damage. (Cedar River, Unincorporated)	Feasibility and technical analysis required to determine whether home acquisitions or elevations are appropriate to mitigate the risks to these repetitive loss properties.
15.8	15.9	R	Banchero Revetment: The Banchero Revetment is a rip-rap armored bank designed to reduce erosion and scour along an outside bend of the river in the vicinity of several homes. The flood protection facility does not prevent overtopping, but rather reduces the likelihood of channel migration that could cut off the sole access to the neighborhood or undermine the homes closest to the river. The close proximity of several of the homes to the river prevents establishment of a healthy riparian buffer. The flood protection facility is in an area of historic channel migration, and is repeatedly damaged – most recently during the 1995-96 and 2006 floods. Repairs were completed in 2008, but the bank remains vulnerable to ongoing future damage. (Cedar River, Unincorporated)	One alternative solution through this area could involve exploring options for purchase of flood prone homes. Depending on site-specific conditions, where acquisitions eliminate the risks to homes, existing levees could be setback, modified, or removed in order to reconnect areas of the floodplain with the river, improving conveyance as well as restoring off-channel habitat. Feasibility and technical analysis required. This area should be included in the Dorre Don Flood Hazard Mitigation Analysis.

CEDAR RIVER – LAKE WASHINGTON (WRIA 8)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
15.9	16.3	L, R	Dorre Don Side Channel: This area contains relatively dense residential use in areas of deep and fast flow. Flows overtop both leveed and unleveed sections at moderate flood events. The area is typified by wide meander bends and active side channels, and is subject to severe channel migration and avulsion hazards, which can flood homes or cut-off access. (Cedar River, Unincorporated)	One alternative solution through this area could involve exploring options for purchase of flood prone homes. Depending on site-specific conditions, where acquisitions eliminate the risks to homes, existing levees could be setback, modified, or removed in order to reconnect areas of the floodplain with the river, improving conveyance as well as restoring off-channel habitat. Feasibility and technical analysis required. This area should be included in the Dorre Don Flood Hazard Mitigation Analysis.
16.3	17.00	R	Lower Dorre Don: The right bank through this area contains relatively dense residential use, almost entirely within the floodway or the area that appears to be the severe channel migration hazard area, based on preliminary findings of the channel migration zone study currently underway. The entire right bank is hardened by levees and revetments which prevent channel mobility and create an inadequate stream buffer. Flows overtop the banks at moderate flood events, sometimes transporting and depositing substantial amounts of large woody debris. Several homes have been elevated, possibly above the base flood elevation, reducing but not eliminating overall flood risk. However, these elevations do not reduce the risks from levee failures, debris build-up against the structures, or access cut-off due to fast and deep flows through the neighborhood. (Cedar River, Unincorporated)	One alternative solution through this area could involve exploring options for purchase of flood prone homes. Depending on site-specific conditions, where acquisitions eliminate the risks to homes, existing levees could be setback, modified, or removed in order to reconnect areas of the floodplain with the river, improving conveyance as well as restoring off-channel habitat. Feasibility and technical analysis required. This area should be included in the Dorre Don Flood Hazard Mitigation Analysis.

CEDAR RIVER – LAKE WASHINGTON (WRIA 8)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
17.00	17.60	R	Orchard Grove: A continuous line of homes along the right bank are located in severe flood hazard areas. These homes are subject to flooding due to both inundation and erosion. Along the upstream portion of this segment, all but a few of the homes are in the floodway, but the extent and frequency of overbank flooding has been reduced for relatively minor floods by the Orchard Grove Levee. However, this levee does not provide protection for higher flows, nor does it tie into high ground at its downstream terminus, so even the homes behind the levee remain susceptible to overtopping and backwater flooding. While the benefits are limited, the the largely intact levee provides some benefit, and due to growth of riparian vegetation along the banks, the downstream end of the flood protection facility has started to accumulate a sand and gravel bar along the channel margin. This slows localized velocities, reducing risk of future scour or erosion along the bank. In the downstream portion of this segment, the homes are largely located outside the floodway, but remain in the floodplain as well as the area that appears to be the severe channel migration hazard area, based on preliminary findings of the channel migration zone study currently underway. These homes are at risk from both overbank flooding and back erosion. Fortunately, the sole access road for the entire area is just outside the boundaries of these severe flood hazards. (Cedar River, Unincorporated)	One alternative solution through this area could involve exploring options for purchase of flood prone homes. Depending on site-specific conditions, where acquisitions eliminate the risks to homes, existing levees could be setback, modified, or removed in order to reconnect areas of the floodplain with the river, improving conveyance as well as restoring off-channel habitat. Feasibility and technical analysis required.
17.60	17.85	L,R	Cedar Trail Bridge at Orchard Grove: Steep unstable slopes along the right bank have contributed to a somewhat dynamic channel in this reach, with active mid-channel gravel bar formations in several locations. On the right bank, a private road skirting the unstable hillside has experienced repeated damage due to landslide activity. Homes located on this road are at risk for loss of their sole access. The approach to the trail bridge remains forested and supports varied and beneficial habitat, but is at risk from erosion and scour which could undermine the bridge abutments. Collapse of the bridge would cause a major blockage in the river that could have devastating effects up and downstream. On the left bank, the revetment that protects the base of the bridge abutment was repaired following damages in the 2009 flood. (Cedar River, Unincorporated)	Feasibility and technical analysis required.

CEDAR RIVER – LAKE WASHINGTON (WRIA 8)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
18.50	20.10	L, R	Arcadia-Noble: Homes on both banks of the river are located in the area that appears to be the severe channel migration hazard area, the floodway, or both. Mid-reach, the Arcadia Revetment runs along a number of homes, including one repetitive loss property, reducing flood risk due to channel migration and inundation during moderate flows. However, the flood protection facility does not provide containment or 100-year protection. This reach of the river also contains numerous landslide-prone hillsides. One slide site, at the apex of a tight meander bend, contributes an estimated 1600 cubic feet of material annually. Several other slide areas are evident through the reach, any of which could cause a blockage of the river. The riparian buffer is absent or disconnected from the river along the length of the levee alignment. (Cedar River, Unincorporated)	Feasibility and technical analysis required.
20.10	20.35	L, R	Below Landsburg: Two revetments are located along undeveloped portions of the river on publicly owned lands. These flood protection facilities were probably originally constructed to prevent channel migration or avulsion that might adversely affect the railroad, now the Cedar River Trail. The condition of these revetments is unknown largely because there are no structures other than the trail itself at risk in the vicinity, and because the adjacent lands are largely forested, providing limited access to them. The revetments, in combination with the trail, limit conveyance and storage as well as off channel habitat and natural river processes. (Cedar River, Unincorporated)	Feasibility and technical analysis required.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
5.2	5.52	R	Boeing Frontage: Old pilings and wooden current deflector structures attempt to reduce erosion and slumping of narrow embankment fronting private (Boeing) access and covered walkway immediately at top-of-bank. Building corner is built right to edge of embankment near downstream end. Channel is deep with a moderately vegetated depositional area in the lee of an old piling array near the upstream end. Extreme tides have been shown to flood adjacent parking in the past. Privately owned and maintained.	None feasible at this time due to land use conditions.
5.52	5.69	R	S. 104th Road Protection/Top Bank Protection Right: Log piling current deflector structure at downstream end attempts to minimize erosion of Boeing Oxbow Bridge. Facility fronts S. 104th Street at top of extremely steep slope with unknown toe depth or structural characteristics. Upper bank has previously been repaired by Tukwila with County cooperation, using a version of bioengineered slope repair. Overall integrity of the slope and the road is highly questionable. Overall habitat value is negligible at present.	Perform soil investigations and embankment survey to define physical and structural parameters. Evaluate road embankment and slope stability with geotechnical study. Define slope stability and structural needs. Acquire any lands needed. Reconstruct toe and slope to stable configuration with fully bioengineered solution preferably including a vegetated midslope bench.. Setback and reconstruct roadway, or abandon.
5.69	5.82	R	East Marginal Way Slope Protection: Outer bend with road at immediate top of bank. Toe structure undetermined. Erosion and slumping of embankment have occurred in the past with localized repairs by the City of Tukwila using a version of bioengineered slope stabilization. Overall the slope is steep, structurally at risk and of uncertain construction and structural integrity. The roadway is a major 6-lane arterial and sits immediately at the top of slope and would be impacted by any slope failures.	Perform soil investigations and embankment survey to define physical and structural parameters. Evaluate road stability with geotechnical study. Define slope stability and structural needs. Acquire any lands needed. Reconstruct toe and slope to stable configuration with fully bioengineered solution, preferably including a vegetated midslope bench.. Setback and reconstruct roadway as needed.
5.82	6.14	R	Privately owned: Slopes are steep, erosion and slumping is visible, the toe structure is questionable and the vegetation is limited to the riverbank itself and is dominated by blackberries with scattered, immature deciduous trees present in a few locations. Industrial properties border over steepened slopes with substantial debris and rubble fills forming the embankment. Parking lots, roads and commercial structures are located at the top of bank. Space for a vegetated buffer area is absent.	Consider acquisitions over time based on market conditions to allow bank restoration, and shallow water habitat creation.
10.15	10.95	R	Railroad Embankment: It may be presumed that the toe structure here is adequate.	Preliminary evaluation.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
12.44	12.5	L	Tukwila 205 Levee Terminus: A paved asphalt trail ramping down to pass underneath I-405abuts a vertical concrete retaining wall along the riverward margins of the 66th Avenue S. abutment. Banks are steep, riverward margins of the trail show settlement and cracking. Toe support to the riverbank is questionable. A 90" iron flapgate at the confluence of Gilliam Creek, at the upstream end, has previously stuck open due to entrainment of large woody debris from upstream. The inlet to this outfall pipe is not screened to prevent debris accumulations, the flapgate impairs fish passage, and there is no backup closure device present. Local interior flooding occasionally needs to be pumped out of street manholes into the river during high water events.	Survey and geotechnical evaluation of the river embankment should be performed as an initial step, and a plan for stabilizing the riverbanks defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties and easements as needed, and as conditions and funding may allow. Reconstruct toe and slope to stable configuration with fully bioengineered solution, preferably including a vegetated midslope bench.. Establish uniform riparian buffer with native vegetation. Replace flood closure structure with fish passable device. Install backup flood closure device. Install trash rack at outfall culvert inlet end.
12.5	12.6	L	Tukwila 205 / Levee Christensen Park: A small mowed park with tables, non-native landscaping, and a parking area extends from Christensen Road to the top of the steeply vegetated riverbank. The overall structural integrity of the slope is undetermined. The presence of an adequate rock toe structure is also undetermined.	Survey and geotechnical evaluation of the river embankment should be performed as an initial step, and a plan for stabilizing the riverbanks defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties and easements as needed, and as conditions and funding may allow. Reconstruct toe and slope to stable configuration with fully bioengineered solution, preferably including a vegetated midslope bench. Reconstruct trail and raised levee crest as defined.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
12.56	12.78	R	Best Western (Nendel's): The levee here is steep, armored with riprap and includes rubble near its upstream end. A few cottonwoods are present where it joins SR-181, also known as the West Valley Highway, and adjacent to I-405. The toe structure is questionable throughout this segment, and the levee face is dominated by blackberries. Localized slope failures are present and progressing. Portions of the adjoining site are mapped within the 100-year floodplain.	To the extent that 500-year flood risk management policy decisions may require levee modifications to protect other uses in affected floodplain areas, survey and geotechnical evaluation of the river embankment should be performed as an initial step, and a plan for stabilizing the riverbanks defined in concert with riparian buffer restoration. Relocation of structure to setback levee possible in the future pending zoning code changes. Perform soil investigations and embankment surveys to define physical and structural parameters. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties and easements as needed, and as conditions and funding may allow. Reconstruct toe and slope to stable configuration with fully bioengineered solution, preferably including a vegetated midslope bench. Reconstruct raised levee crest to design flood and freeboard elevation as defined.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
12.78	14.49	R	SR-181: This segment includes a portion of the riverbank adjoining SR 181, with the roadway at its riverward margins effectively acting as the flood containment structure. The bank itself is very steep, intermittently affected by localized sediment deposits and their subsequent erosion or slumping, and the integrity of the toe structure is questionable.	Clear establishment of flood and highway management responsibilities here is essential to flood risk mitigation planning and actions. To the extent that embankment stability and 500-year flood risk management policy decisions may require levee modifications to protect other uses in affected floodplain areas, survey and geotechnical evaluation of the river embankment should be performed as an initial step, and a plan for stabilizing the riverbanks defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties and easements as needed, and as conditions and funding may allow. Purchase of the single family home may be required in this context. Reconstruct toe and slope to stable configuration with fully bioengineered solution, preferably including a vegetated midslope bench. Provide a uniform riparian buffer. Modify the roadway and reconstruct a raised levee crest to design flood and freeboard elevation as defined. A separate levee structure may be required.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
13.11	13.23	R	SR-181 / Nelson: This segment includes a portion of the riverbank adjoining SR 181, with the roadway and a raised floodwall at its riverward margins effectively acting as the flood containment structure. The downstream end of this reach includes a single family residence riverward of the roadway, perched directly at the top of the steep riverbank, which is overgrown with invasive bamboo. The riverbank serves as the immediate structural support for the road over the upstream half of this segment, with the "back yard" of the home bordering the river at the downstream end. The lower bank supports invasive blackberries and reed canarygrass. The bank itself is very steep, intermittently affected by localized sediment deposits and their subsequent erosion or slumping, and the integrity of the toe structure is questionable. County maintenance easements may be present for some portion of the reach. The riverward (southbound) driving lane adjoining the bank shows clear indications of settlement, with the formation of a continuous series of arcuate scarps and cracks visible in the asphalt.	Clear establishment of flood and highway management responsibilities here is essential to flood risk mitigation planning and actions. To the extent that embankment stability and 500-year flood risk management policy decisions may require levee modifications to protect other uses in affected floodplain areas, survey and geotechnical evaluation of the river embankment should be performed as an initial step, and a plan for stabilizing the riverbanks defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties and easements as needed, and as conditions and funding may allow. Purchase of the single family home may be required in this context. Reconstruct toe and slope to stable configuration with fully bioengineered solution, preferably including a vegetated midslope bench. Provide a uniform riparian buffer. Modify the roadway and reconstruct a raised levee crest to design flood and freeboard elevation as defined. A separate levee structure may be required.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
13.78	14.49	R	SR-181: This extensive segment includes multiple portions of the riverbank adjoining SR 181, with the roadway and raised floodwall segments at its riverward margins effectively acting as the flood containment structure. The riverbank serves as the immediate structural support for the road over much of this length, with some intermittent floodplain bench deposits also present here and there between the roadway and the actual riverbank. The lower bank supports invasive blackberries and reed canarygrass. The bank itself is very steep, intermittently affected by localized sediment deposits and their subsequent erosion or slumping, and the integrity of the toe structure is questionable. The riverward (southbound) driving lane adjoining the bank shows some indications of settlement, with some cracks visible in the asphalt. A thriving stand of native willows covers the slope just upstream from the S 180th St bridge. These willows were installed as mitigation for widening of the bridge. Except for the riverbank itself, no riparian buffer area is present. The highway is at the top of bank through most of this reach.	Clear establishment of flood and highway management responsibilities here is essential to flood risk mitigation planning and actions. To the extent that embankment stability and 500-year flood risk management policy decisions may require levee modifications to protect other uses in affected floodplain areas, survey and geotechnical evaluation of the river embankment should be performed as an initial step, and a plan for stabilizing the riverbanks defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties and easements as needed, and as conditions and funding may allow. Reconstruct toe and slope to stable configuration with fully bioengineered solution, preferably including a vegetated midslope bench. Provide a uniform riparian buffer. Modify the roadway and reconstruct a raised levee crest to design flood and freeboard elevation as defined. A separate levee structure may be required.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
12.85	13.11	R	Homewood Suites / Burnaby's: This reach consists of a small inside meander bend adjoining the Homewood Suites hotel units downstream from Strander Bridge and Burnaby's Restaurant just upstream from Strander Bridge. The banks are locally steep, and erosion and slumping have been observed. A jet fuel conveyance pipeline passes under the riverbed here just upstreamfrom Strander Bridge, , and then along the area riverward of Burnaby's Restaurant.(Green River, City of Tukwila)	To the extent that embankment stability and 500-year flood risk management policy decisions may require levee modifications to protect other uses in affected floodplain areas, survey and geotechnical evaluation of the river embankment should be performed as an initial step, and a plan for stabilizing the riverbanks defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties and easements as needed, and as conditions and funding may allow. Reconstruct toe and slope to stable configuration with fully bioengineered solution, preferably including a vegetated midslope bench. Provide a uniform riparian buffer. Modify the trail and reconstruct a raised levee crest to design flood and freeboard elevations as defined.
5.2	5.98	L	Boeing Oxbow: The Boeing employee parking lot, recreational center, and trail sit at edge of a steep, eroding bank. Partial rip-rap repairs, older debris (car chassis), and slumps are present. Vegetation is sparse, non-native, and inadequate to stabilize slopes. Revetment toe is founded on deep, soft mud deposits, which are also subject to shifting, slumping, and erosion, with little large woody debris structure present. Buffer width is uniformly inadequate	Duwamish Revetment Setbacks and Shallow Water Habitat Creation: Revetment setbacks, bank restoration, and shallow water habitat creation. Rehabilitate steep, older, deteriorating revetments, establish stable slopes, restore native vegetation, and provide opportunity for shallow water habitat creation. Channel edge habitat creation will include reconstruction and stabilization of substandard toe buttress structures serving existing maintained facilities. (Green River, Cities of Tukwila and Seattle)

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
5.98	6.11	L	Postal Service: Partially treed slopes border narrow ledge of salt-tolerant sedges and mud deposits along the aquatic edge. Debris (decaying catamaran) is present. Slopes are steep; buffer width is inadequate in places.	Duwamish Revetment Setbacks and Shallow Water Habitat Creation: Revetment setbacks, bank restoration, and shallow water habitat creation. Rehabilitate steep, older, deteriorating revetments, establish stable slopes, restore native vegetation, and provide opportunity for shallow water habitat creation. Channel edge habitat creation will include reconstruction and stabilization of substandard toe buttress structures serving existing maintained facilities. (Green River, Cities of Tukwila and Seattle)
6.11	6.21	L	City Light/Postal Parking: Steep, older rip rap flood protection facility (City Light) borders edge of deep pool formed D/S of North Winds' Weir. Toe slope is unstable; slope is too steep, invasive vegetation is present, parking lot crowds inadequate buffer width.	Duwamish Revetment Setbacks and Shallow Water Habitat Creation: Revetment setbacks, bank restoration, and shallow water habitat creation. Rehabilitate steep, older, deteriorating revetments, establish stable slopes, restore native vegetation, and provide opportunity for shallow water habitat creation. Channel edge habitat creation will include reconstruction and stabilization of substandard toe buttress structures serving existing maintained facilities. (Green River, Cities of Tukwila and Seattle)
6.21	6.28	L	Cecil Moses Park: Steep, older revetment with invasive vegetation and some tree cover borders rock outcropping at North Winds' Weir. Park include constructed off-channel connection to river, but only connects at high flows or high tides. Lower slopes are slumping and eroding, toe structure appears inadequate.	Duwamish Revetment Setbacks and Shallow Water Habitat Creation: Revetment setbacks, bank restoration, and shallow water habitat creation. Rehabilitate steep, older, deteriorating revetments, establish stable slopes, restore native vegetation, and provide opportunity for shallow water habitat creation. Channel edge habitat creation will include reconstruction and stabilization of substandard toe buttress structures serving existing maintained facilities. (Green River, Cities of Tukwila and Seattle)

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
6.28	6.29	L	Rubber Tire Revetment: Steep, bizarre rubber tire pile covers the riverbank at a City of Seattle waterline crossing location.	Duwamish Revetment Setbacks and Shallow Water Habitat Creation: Revetment setbacks, bank restoration, and shallow water habitat creation. Rehabilitate steep, older, deteriorating revetments, establish stable slopes, restore native vegetation, and provide opportunity for shallow water habitat creation. Channel edge habitat creation will include reconstruction and stabilization of substandard toe buttress structures serving existing maintained facilities. Concrete restraining structure at pipeline location would require relocation to allow slopes to be reconstructed in a stable and environmentally responsible manner. (Green River, Cities of Tukwila and Seattle)
6.29	6.54	R	Boeing / Old Duwamish Drive-In: The river bank here was reconstructed at a 2H:1V slope angle in connection with construction of the office towers at this site Unconsolidated sediments deposits along the channel edge form a broad shallow shelf along the toe of the slope. Large woody debris placed during bank reconstruction is also present.	A careful survey and structural evaluation of the embankment and supporting toe is needed, due to inadequate construction of the original slope stabilization measures by the property owner. Slope reconstruction would provide an opportunity to restore riparian vegetation and shallow water habitat.
6.29	6.55	L	SR 599 embankment: Steep, unstable rip-rap slope covers riverbank along shoulder of SR-599. Minor amounts of invasive vegetation are present. Soft mud deposits along the toe slope are apparently restrained by the remnants of a series of old wooden pilings. Overall slope integrity is suspect. Road embankment may be at risk of failing.	Perform soil investigations and embankment survey to define physical and structural parameters. Evaluate road stability with geotechnical study. Define slope stability and structural needs. Acquire any lands needed. Reconstruct toe and slope to stable configuration with fully bioengineered solution, preferably including a vegetated midslope bench. Setback and reconstruct roadway as needed.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
6.54	6.83	R	Gateway Lowest Right/Duwamish Gardens: This steep eroding and slumping bankline shows no evidence of previous stabilization measures. A narrow shelf of unconsolidated sediments forms the toe slope along the channel edge. The upstream portion of this reach is under acquisition by the City of Tukwila for eventual funding and construction of the Duwamish Gardens habitat restoration project.	Duwamish Revetment Setbacks and Shallow Water Habitat Creation: Revetment setbacks, bank restoration, and shallow water habitat creation. Rehabilitate steep, older, deteriorating revetments, establish stable slopes, restore native vegetation, and provide opportunity for shallow water habitat creation. Channel edge habitat creation will include reconstruction and stabilization of substandard toe buttress structures serving existing maintained facilities.
6.55	6.84	L	Gateway North (Lowest): Bank has been reconstructed with a midslope bench supporting a City of Tukwila Trail. Slumping of the lower embankment indicates that initial efforts to secure the integrity of this inter-tidal feature as toe support to the slope may not have been adequate. A slump has also developed at the upstream end of this reach, near a culvert outfall. Slopes supporting the trail at this location have been compromised.	Duwamish Revetment Setbacks and Shallow Water Habitat Creation: Revetment setbacks, bank restoration, and shallow water habitat creation. Rehabilitate steep, older, deteriorating revetments, establish stable slopes, restore native vegetation, and provide opportunity for shallow water habitat creation. Channel edge habitat creation will include reconstruction and stabilization of substandard toe buttress structures serving existing maintained facilities.
6.84	7.5	L	Interurban South/Residential: Steep, generally poorly vegetated slopes adjoin houses and back yards, are slumping in places, and include a number of bank modifications such as boat haul-outs, rubber tire revetments, rip-rap placement by end-dumping over the slope, and other homeowner modifications. Toe slopes are founded in soft mud with natural imbedded large woody debris. Some native species are present. Generally these embankments support the back yards, some houses that are built very close to the edge of the embankment, and associated outbuildings, all of which remain at moderate risk of slope failures.	Acquire at-risk properties as market conditions and funding allow. Restore aquatic edge, inter-tidal, and riparian habitat over time.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
6.83	7.85	R	S 115th St / 42nd Ave S: Paved streets (some of which lack road shoulders) are located at the top of bank in many portions of this intertidal segment. A high pressure water main is located at the top of bank in the road shoulder along portions of 42nd Ave S. Several previous slumps have been stabilized with large rock or piling and log toe structures and biotechnical stabilization measures, including the 42nd Ave S bridge abutment at the upstream end of this reach. Large woody debris was installed at several previous repairs sites, and has locally induced sediment deposition, helping to stabilize the toe of the slope. The roadway remains at risk of continued settlement of the bank and cracking of the asphalt road pavement.	Perform soil investigations and embankment survey to define physical and structural parameters. Evaluate road stability with geotechnical study. Define slope stability and structural needs. Acquire any lands needed. Reconstruct toe and slope to stable configuration with fully bioengineered solution, preferably including a vegetated midslope bench. Setback and reconstruct roadway as needed.
7.88	8.8	L	Codiga Left /Gateway Lower & Upper /Seattle-LA Freight: The Tukwila Trail system sits immediately next to the top-of-bank, adjoining parking lots and commercial properties. The bank is steep, covered with some rip-rap in places, especially near the upstream end, and slumping in several places, especially near the downstream end, where rip-rap is largely absent. A pronounced slump is present ar RM 7.95. Local bank failure has also affected the trail where it crosses a pumped storm outfall system at RM 8.5.	Perform soil investigations and embankment survey to define physical and structural parameters. Evaluate trail stability with geotechnical study. Determine design flood and freeboard elevations. Define slope stability and structural needs. Acquire any lands needed. Reconstruct toe and slope to stable configuration with fully bioengineered solution, preferably including a vegetated midslope bench. Evaluate the use of driven untreated wooden pilings to reinforce and stabilize the toe of slope within the soft sediments present. Setback and reconstruct trail as needed.
7.85	8.85	R	Banchero Right / Tukwila Community Center / S 125th St / Codiga Farm / Steel Hill Bridge / 9.6 Revetment Right: This segment includes an older riprap revetment and riprap fills that cross the river over a King County sewer line, an asphalt trail with a concrete retaining wall along the channel edge at the Tukwila Community Center, a steep, riprapped road shoulder embankment along S 125th St, several residential properties bordering the top of bank, an off-channel constructed wetland in Codiga Farm Park and an additional steep riprap embankment bordering 50th Pl S. The Community Center trail is occasionally submerged during exceptionally high tides and high flows, or both. Where riprap embankments are present, they are steep, the toe structure is questionable and local evidence of slope settlement and erosion is visible.	Perform soil investigations and embankment surveys to define physical and structural parameters. Evaluate road, trail and bank stability with geotechnical study. Define slope stability and structural needs. Acquire any lands needed. Reconstruct toe and slope to stable configuration with fully bioengineered solution, preferably including a vegetated midslope bench. Evaluate the use of driven untreated wooden pilings to reinforce and stabilize the toe of slope within the soft sediments present. Setback and reconstruct trail and roadway as needed.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
8.88	9.28	L	I-5 /Interurban Ave. S: The I-5 freeway, the adjoining Tukwila Trail, a warehouse and parking lot, and Interurban Avenue crowd a narrow buffer, which is completely absent in some locations. Next to the warehouse, the river bank is occupied by a vertical steel sheetpile wall, which replaced an earlier, failing log crib-wall. Steep rip-rap slopes abut Interurban Avenue So. Slopes are steep, prone to slumping, poorly vegetated, and founded on questionable toe structures along a truncated outer bend. (Green River, City of Tukwila)	Perform soil investigations and embankment surveys to define physical and structural parameters. Evaluate road, trail and bank stability with geotechnical study. Define slope stability and structural needs. Acquire any lands needed, including the warehouse and parking lot, as market conditions and funding permit. Reconstruct toe and slope to stable configuration with fully bioengineered solution, preferably including a vegetated midslope bench. Setback and reconstruct trail and roadway as needed.
8.85	9.6	R	Allentown: A number of residential properties border steep eroding banks. Many of the backyards and outbuildings are located within the mapped 100-year floodplain, and portions of several lots are within the mapped floodway of the Green River. Bank erosion and slumping are evident, including the occasional recruitment of cottonwoods into the channel. (Green River, City of Tukwila)	Flood risk management actions are currently up to individual owners. Any attempts at riparian restoration would need general agreement among these owners, along with the acquisition of easements, or would require the incremental acquisition of parcels as market conditions and funding may allow.
9.28 10.25	10.45 10.75	L R	Foster Golf Course (Foster Lower, Middle, Upperand Right): Much of the golf course is mapped within the 100-year floodplain, which extends to Interurban Avenue to the west, and to and several commercial properties upstream as well. Portions of the site have been identified for placement of piling-anchored logs and plantings as mitigation for clearing of trees and other native vegetation from levee slopes elsewhere in Tukwila, as part of eligibility and compliance with the Corps of Engineers PL-99 Levee Rehabilitation and Inspection Program.(Green River, City of Tukwila)	Develop a plan for stabilizing the riverbanks along the margins of the golf course in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Reconstruct toe and slope to stable configuration with fully bioengineered solution preferably including a vegetated midslope bench, preferably including a vegetated midslope bench.. Reconfigure tees, fairways, and greens along channel margins as needed. Establish uniform riparian buffer with native vegetation.
9.6	10.14	R	Rendering Works Lower and Middle The toe structure is questionable throughout. The banks remain locally steep and minor erosion and slumping is visible in places. Portions of the site are mapped within the 100-year floodplain, and the margins of the site are within the mapped floodway. (Green River, City of Tukwila)	Consider long term acquisition and restoration of the site as market conditions and funding may allow, including floodplain reconnection.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
10.4 5	10.54	L	Riverside Inn /Candy Factory /Casinos: Slopes are steep, toe structure is questionable, buffer widths are narrow to absent, vegetation is discontinuous and poorly established in places, and poorly maintained overall. Commercial buildings and parking areas in this reach are mapped within the 100-year floodplain, extending throughout this reach and westward to Interurban Avenue. .. (Green River, City of Tukwila)	The desirability and feasibility of siting flood containment structures in this reach should be investigated with a feasibility study. Define extents of raised flood containment structures needed, together with any interior drainage controls indicated. Survey and geotechnical evaluation of the river embankment should be performed as an initial step, and a plan for stabilizing the riverbanks defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Evaluate bank stability with geotechnical study. Determine design flood and freeboard elevations. Define slope stability and structural needs. Acquire needed properties and easements as needed, and as market conditions and funding may allow. Reconstruct toe and slope to stable configuration with fully bioengineered solution, preferably including a vegetated midslope bench. Establish uniform riparian buffer with native vegetation.
10.54	10.99	L	Tukwila Trail: The lower end of the Tukwila Trail is setback from the river along a stormwater swale occupying a midslope bench with a row of mature cottonwoods along the riverbank. The trail more closely abuts the bank in upstream areas, and previous slumping is present right up to the trail edge in at least one location. Cottonwoods are also present near the upstream terminus by the bridge, as well. The bank is generally steep, but some naturally occurring large woody debris is present near the downstream end, and vegetation is surprisingly dense in several locations. Areas landward from the trail are mapped within the 100-year floodplain. (Green River, City of Tukwila)	Survey and geotechnical evaluation of the river embankment should be performed as an initial step, and a plan for stabilizing the riverbanks defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Evaluate bank stability with geotechnical study. Determine design flood and freeboard elevations. Define slope stability and structural needs. Acquire needed properties and easements as needed, and as market conditions and funding may allow. Reconstruct toe and slope to stable configuration with fully bioengineered solution, preferably including a vegetated midslope bench. Establish uniform riparian buffer with native vegetation. Reconstruct and raise the trail for flood containment as determined.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
10.95	12.2	R	Fort Dent to Tukwila Bend A steep levee with older riprap armor present in places borders Fort Dent Park. Slopes remain steep overall, and toe structure has not been confirmed to be adequate. Localized erosion and slumping is present in places. Freeboard is variable and inadequate in places, and portions of the reach are within the mapped 100-year floodplain	Survey and geotechnical evaluation of the river embankment should be performed as an initial step, and a plan for stabilizing the riverbanks defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Evaluate bank stability with geotechnical study. Determine design flood and freeboard elevations. Define slope stability and structural needs. Acquire easements as needed. Reconstruct toe and slope to stable configuration with fully bioengineered solution. Establish uniform riparian buffer with native vegetation. Reconstruct and raise the trail for flood containment as determined. Restore the failing toe buttress structure and rehabilitate aquatic habitat along the channel edge with large woody debris placement. Replant the riverbank and midslope bench areas with native trees and shrubs to restore riparian habitat conditions. (Green River, City of Tukwila)
12.3	12.41	L	White Swan Left: Varied levels of native and invasive vegetation cover a very steep, locally eroding and slumping slope along the edge of a paved trail. A high pressure waterline is also present in or near the trail. A previous repair of a slope washout due to earthquake-induced waterline failure is present near the downstream end, with native willow layers and other plantings placed in live geogrid layers. Toe structure remains questionable. (Green River, City of Tukwila)	To the extent that embankment stability or structural support to the trail may be desired, here, survey and geotechnical evaluation of the river embankment should be performed as an initial step, and a plan for stabilizing the riverbank defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Evaluate bank stability with geotechnical study. Determine design flood and freeboard elevations. Define slope stability and structural needs. Acquire easements as needed. Reconstruct toe and slope to stable configuration with fully bioengineered solution, preferably including a vegetated midslope bench. Establish uniform riparian buffer with native vegetation. Reconstruct trail as determined.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
12.6	12.65	L	Tukwila 205 /Christensen Road: Toe structure remains questionable. The margins of the road are supported on the riverbank with rock-filled gabion wire baskets. Local settling is present, as evidenced by separation along the adjoining sidewalk and curbing .	Survey and geotechnical evaluation of the river embankment should be performed as an initial step toward slope and roadway stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration Perform soil investigations and embankment surveys to define physical and structural parameters. Evaluate bank stability with geotechnical study. Determine design flood and freeboard elevations. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and roadway to stable configuration with fully bioengineered solution, preferably including a vegetated midslope bench. Establish uniform riparian buffer with native vegetation.
12.44	12.56	R	I-405 This segment includes levees built in connection with the relocation of the Green River during construction of I-405. A small relict portion of the original channel is present behind the levee together with a hotel property and an historic farmhouse. Mature native deciduous trees occupy a narrow strip confined to the riverbank at the downstream end, and along the margins of the I-405 off-ramp. Native woody shrubs also grow around the margins of the abandoned channel segment. Blackberries and other invasive species dominate the steep face of the levee at the upstream end of this segment Although there is no constructed outfall from the relict channel to the existing river, high flows in the river appear to seep through the intervening berm and fill the wetlands. Portions of the adjoining site are mapped within the 100-year floodplain.	IDefine flood containment requirements around the margins of the abandoned channel. Construct these measures to secure adjoining properties from any flooding, and remove that portion of the existing riverbank levee which is separating the old channel from the current river. Re-connect the abandoned river channel to the existing mainstem as a side channel habitat area. Set back remaining portions of the steep, eroding levee, and increase flood storage and conveyance capacity. Stabilize and rehabilitate the channel edge with large woody debris installations, and restore riparian and wetlands habitat areas with a uniform buffer of native tree and shrub plantings.
12.65	12.8	L	Tukwila 205 /Van Warden Park: The levee crest is narrow, and side slopes are steep in places. A paved trail is also present. Since this segment is located on an inside bend, erosion along the toe is not likely. That said, the nature of any toe buttress or other supporting structure has not been confirmed. Various restoration actions have been proposed at this site.	Continue to explore floodplain restoration opportunities riverward of the levee.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
12.8	12.84	L	Tukwila 205 /Van Warden: A paved trail sits on the narrow levee crest at the edge of a relatively steep river bank slope. Toe structure is questionable. It is likely the riverward embankment slopes are marginally stable at best. Vegetation consists of invasive blackberries and reed canarygrass, while occasional native tree species naturally established over the past 18 years were cut to the ground in 2006. Existing commercial office buildings closely border the landward margins of the trail, substantially at grade with the levee crest elevation., to a few deciduous trees and mixed native and invasive shrubs, to a recently constructed stormwater outfall near Strander Bridge, which is stabilized with willow cuttings and other native plantings in live geogrid layers. Two pieces of installed large woody debris are imbedded into the bankline, right at the outfall. The levee and trail abut closely placed commercial and office buildings and parking areas, with no buffer present)	Riverward embankment slopes here should be carefully monitored. Survey and geotechnical evaluation of the river bank should be performed as an initial step toward slope and levee stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest and trail to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench. Establish a uniform riparian buffer with native vegetation.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
12.84	12.85	L	Tukwila 205 /Van Warden/Pipeline Crossing Location: A gas pipeline crossing under the river and through the levee embankment was completed just prior to 1990 at this location. The open trench through the levee was stabilized against surface erosion with placement of light rip-rap and quarry spalls cover, joint planted with willow stakes. .A drainage swale is present at the landward margins of the levee.Recently the City of Tukwila has proposed a pedestrian bridge crossing structure here.	Riverward embankment slopes here should be carefully monitored. Survey and geotechnical evaluation of the river bank should be performed as an initial step toward slope and levee stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest and trail to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench. Establish a uniform riparian buffer with native vegetation. Ensure through adequate design, engineering, and permitting review that any proposed bridge structure preserves adequate flood patrol and maintenance equipment access, together with provisions to ensure implementation of any levee modifications indicated by the outcome of the structural and geotechnical evaluation described above..

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
12.85	12.99	L	Tukwila 205 /Van Warden: The levee is located at the crest of an extremely steep segment of river bank along an outside bend. Older rip-rap is visible along the toe and in lower portions of the slope, while minor sediment deposits and overgrowth of blackberries and reed canarygrass obscure direct observation of the rip-rap that is likely also present in mid-slope areas. Some minor sloughing of these deposits is visible in places. The character and extent of any toe buttress structure is in question. The levee crest is located essentially at grade with adjoining property elevations, and the landward margins of the levee and trail are closely encroached with existing commercial office buildings and associated landscaping.	Riverward embankment slopes here should be carefully monitored. Survey and geotechnical evaluation of the river bank should be performed as an initial step toward slope and levee stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest and trail to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench. Establish a uniform riparian buffer with native vegetation.
12.99	13.02	L	Tukwila 205 / Strander Park: The levee here passes through a small City of Tukwila municipal park. The levee crest supports a narrow portion of the paved trail, about 12 feet wide, and the levee itself is raised above adjoining grades about 3 to 4 feet with interlocking vertical masonry units, originally designed to avoid large trees, one of which has subsequently been removed. Riverward slopes are moderate with some midslope sediment deposits and associated minor slumping of these deposits in places. Toe structure is unconfirmed.	Riverward embankment slopes here should be carefully monitored. To the extent that slope settlement and deterioration of Survey and geotechnical evaluation of the river bank should be performed as an initial step toward slope and levee stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest and trail to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench. Establish a uniform riparian buffer with native vegetation.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
13.02	13.04	L	Tukwila 205 / Strander Pump Outfall: The levee here is penetrated by an outfall pipe serving a pump station located within the small City of Tukwila municipal park at this location. The outfall invert is located just above the OHWM, and daylights over the original rock toe structure. The outfall pipe was placed in a trench excavated through the levee prism, then backfilled and compacted by City of Tukwila contractors. King County reconstructed the embankment slope at the outfall location with live geogrid structures consisting of native plantings and willow cuttings placed in layers between compacted lifts of coarse gravel fill materials wrapped with coir fabric. Since the toe rock was not reconstructed, and the bioengineered slope reconstruction may have been compromised by the repeated mowing, the overall slope needs to be carefully monitored for any signs of distress.	Riverward embankment slopes here should be carefully monitored. Survey and geotechnical evaluation of the river bank should be performed as an initial step toward slope and levee stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest and trail to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench. Establish a uniform riparian buffer with native vegetation.
13.05	13.11	L	Tukwila 205 / Christensen Road: The levee crest sits only a few feet above the landward grades here, and is bordered on the landward side by parking and access areas serving commercial offices, with a moderately vegetated area between the asphalt and the levee. Riverward slopes are moderate with some midslope sediment deposits and associated minor slumping of these deposits in places Toe structure is unconfirmed. A gasline crossing, a waterline crossing, and at least one storm outfall penetrate the levee.	Riverward embankment slopes here should be carefully monitored. Survey and geotechnical evaluation of the river bank should be performed as an initial step toward slope and levee stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest and trail to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench. Establish a uniform riparian buffer with native vegetation.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
13.11	13.20	L	Tukwila 205 / Christensen Road: The riverward levee embankment supports a narrow midslope bench, which nonetheless supports several mature cottonwood trees in a small grove. The riverward edge of the bench falls away steeply to the river along the downstream portions of an inner bend, with shallow sediment deposits just below the OHWM along the bank and extending into the channel. Some naturally occurring wood structure is visible in this sediment bar feature here. Toe structure remains unconfirmed.	Riverward embankment slopes here should be carefully monitored. Survey and geotechnical evaluation of the river bank should be performed as an initial step toward slope and levee stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest and trail to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench. Establish a uniform riparian buffer with native vegetation.
13.20	13.30	L	Tukwila 205 /Christensen Road: The levee here is locally very steep, and overall toe structure is highly questionable. Lower slopes are dominated by reed canarygrass and blackberries, with some localized minor sediment deposits in midslope areas. Toe rock is visible in some areas, but appears to have locally eroded or settled into the channel to some extent.	Riverward embankment slopes here should be carefully monitored. Survey and geotechnical evaluation of the river bank should be performed as an initial step toward slope and levee stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest and trail to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench. Establish a uniform riparian buffer with native vegetation.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
13.3	13.34	L	Tukwila 205 / Christensen Road: The levee crest elevation is several feet above the adjoining landward areas. This elevation difference is especially pronounced at the excavated ditch that extends perpendicularly to the levee along the Union Pacific Railroad from the bridge at the upstream end of this segment. Apparent seepage has previously been observed within this ditch by flood patrols during prolonged high flows in the Green River. The riverward slope includes a narrow, mowed "bench" area, with actual park benches and a few small non-native tree plantings. Lower levee slopes fall steeply from this bench to the channel, with some toe rock visible at low flows.	Riverward embankment slopes here should be carefully monitored. Survey and geotechnical evaluation of the river bank should be performed as an initial step toward slope and levee stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest and trail to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench. Establish a uniform riparian buffer with native vegetation.
13.35	13.41	L	Tukwila 205 / Christensen Road: The landward edge of the levee is constructed as a vertical rock wall, nearly ten feet in height, to accommodate a parking lot and access for a commercial warehouse. The levee does have some modest width here to offset the clear seepage potential this presents, and in fact seepage has not been observed during flood patrols. The riverward portions of the slope drops rather steeply from the bench to the OHWM. The nature of the toe and the extent of any rock toe buttress is unconfirmed.	Both landward and riverward embankment slopes here should be carefully monitored. Survey and geotechnical evaluation of the river bank should be performed as an initial step toward slope and levee stabilization. A plan for stabilizing the landward slopes or riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest and trail to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench. Establish a uniform riparian buffer with native vegetation.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
13.41	13.6	L	Tukwila 205 / Christensen Road: Landward levee slopes adjoin asphalt access and parking for several commercial structures, and support non-native, sparsely spaced "landscaping" trees. Some of these have been cut in 2006 and 2009 to comply with Corps directives. Levee crest elevations rise some six to eight feet above landward grades. The riverward slope in this reach occupies the outside margins of a sweeping bend; slopes are significantly steep here. Rock armor is visible in places along the lower slopes and at the toe, and shows some evidence of minor erosion and settlement in places. Minor sediment deposits occur in places along the midslope, and show occasional slumping.	Riverward embankment slopes here should be carefully monitored. Survey and geotechnical evaluation of the river bank should be performed as an initial step toward slope and levee stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest and trail to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench. Establish a uniform riparian buffer with native vegetation.
13.6	13.68	L	Tukwila 205 / Tukwila Maintenance Shops: The levee crest is widened here to support access from the adjoining Tukwila Maintenance Shops. Landward slopes and elevation differences between the levee crest and adjoining ground are less pronounced than just downstream. A modest midslope "bench" is present on the riverward slopes. Lower embankment slopes fall steeply from the riverward margins of this bench and support a mixture of native and non-native vegetation. Sediment deposits are present in midslope areas, and are visible at low-water along the toe. Any rock toe buttress structure here is largely obscured by these sediments, and therefore remains generally unconfirmed.	Riverward embankment slopes here should be carefully monitored. Survey and geotechnical evaluation of the river bank should be performed as an initial step toward slope and levee stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest and trail to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench. Establish a uniform riparian buffer with native vegetation.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
13.68	13.75	L	Tukwila 205 / P-17 Pump Station: The landward margins of this segment are occupied by the County-maintained P-17 Pump Station and slope down to the storage forebay pond serving the Southcenter area. The outfall from the pump station passes through the levee, and sits in a narrow opening maintained for this purpose in the middle of a bench formed from depositional sediments. Riverward slopes are dominated by these sediment deposits, which are overgrown with reed canarygrass and blackberries throughout. Visual confirmation of toe buttress structure cannot be confirmed.	Riverward embankment slopes here should be carefully monitored. Survey and geotechnical evaluation of the river bank should be performed as an initial step toward slope and levee stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest and trail to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench. Establish a uniform riparian buffer with native vegetation.
13.75	13.95	L	Tukwila 205 / P-17 Pond: Landward levee slopes descend at a moderate angle to the P-17 storage pond. The pond is essentially an urban wetland with a surrounding stand of native riparian forest cover, except on the levee slopes themselves. Riverward levee slopes are steep at the upper end, then transition to the depositional bench which continues downstream. Midslope sediment deposits exhibit minor slumping in places. Toe rock is present but shows some indications of erosion and settlement in places, and its overall extent and character is difficult to determine.	Riverward embankment slopes here should be carefully monitored. Survey and geotechnical evaluation of the river bank should be performed as an initial step toward slope and levee stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest and trail to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench. Establish a uniform riparian buffer with native vegetation.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
13.95	14.1	L	Tukwila 205 / Costco Segment: The levee crest is from 8 to 10 feet above the adjoining grade, which supports a parking lot and access for the Costco warehouse store here. Landward levee slopes are relatively gentle, and are covered with ivy, pruned shrubs, and non-native shade trees. Riverward slopes occupy a curving outer bend and are extremely steep. Some minor midslope sediment deposits are present, and show signs of minor slumping in places. Toe rock is exposed at low flows, and shows signs of erosion and settlement in many places.	Riverward embankment slopes here should be carefully monitored. Survey and geotechnical evaluation of the river bank should be performed as an initial step toward slope and levee stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest and trail to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench. Establish a uniform riparian buffer with native vegetation.
14.1	14.16	L	Tukwila 205 / Christensen Road: . Riverward slopes support a narrow midslope “bench” of sediment deposits, which is mowed and managed in a “park-like” setting. Riverward levee slopes are steep at the upper end, then transition to the depositional bench which continues downstream. Midslope sediment deposits exhibit minor slumping in places. Toe rock is present but shows some indications of erosion and settlement in places, and its overall extent and character is difficult to determine.	Riverward embankment slopes here should be carefully monitored. To the extent that slope settlement and deterioration of the levee embankment may become more problematic with time, survey and geotechnical evaluation of the river bank should be performed as an initial step toward slope and levee stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest and trail to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench. Establish a uniform riparian buffer with native vegetation.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
14.16	14.26	L	Tukwila 205 / Home Depot: The levee crest elevation here is from 8 to 10 feet above adjoining grades. Landward slopes are moderately steep and adjoin an access roadway next to the Home Depot warehouse store. Landward slopes support dense non-native landscaping shrubs and smaller trees. Riverward slopes have previously been reconstructed, both by King County and by the Corps, following episodes of pronounced slumping involving the entirety of the slope, extending to the levee crest. Repairs have been constrained by the steep slopes present, and have involved the construction of large rock toe buttress structures, incorporating only a few log elements, and bioengineered slope stabilization measures using layers of native willow cuttings. Previously these plantings have thrived; in 2006 and 2009 they have been extensively "thinned" into sparsely spaced clumps pursuant to Corps' directives.	Monitor and maintain as required. Retain lower slope structures and incorporate upper slopes into any reach-length levee setback reconstruction efforts that may be necessary for stable long-term flood protection in the reach, including consideration of revised 500-year flood elevations forthcoming from current Corps' investigations.
14.26	14.31	L	Tukwila 205 / S. 180th Street Bridge Trail Ramp North: The levee crest is set back here to tie into the Strander bridge abutments, adjoining a parking lot for trail users. The riverward slopes are moderate here and support a ramp for the trail to pass underneath the bridge. Riverward margins of the slope are subject to repeated episodes of sediment deposition and slumping. Due to the pervasive sediments present, toe structure cannot be confirmed.	Monitor and maintain as required. In particular, eradication of knotweed stands and replacement with native vegetation would be a good idea.
14.32	14.35	L	Tukwila 205 / S. 180th Street Bridge Trail Ramp South: The levee here consists of a vertical concrete wall adjoining the landward edge of the trail ramp descending beneath the bridge. A steeply inclined earthen berm is present along the landward side of the wall, next to a parking lot and access for the adjoining commercial structure.	The transitions here from an earthen levee to a concrete wall with a steep earthen backslope, both tied-in to the bridge abutments and approach fills, will require special attention during and following flood events. In the event that more reach-long levee reconstruction efforts may be undertaken here in the future, this feature should be considered for re-design and reconstruction as well, preferably with the same gentle slopes as immediately downstream.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
14.35	14.55	L	Tukwila 205 / Lily Pointe:. Unstable levee slopes were reconstructed here by the Corps of Engineers in 2008, in a setback configuration facilitated by Tukwila and utilizing property acquisitions funded by the King County Flood Control District. This reconstruction involved the placement of a series of instream, rock-anchored logs along the toe, the construction of a large launchable rock toe at the margins of the summer low-flow channel, the construction of a rock-armored slope, and revegetation of all exposed rock armor and launchable toe structure areas. The future of this vegetation remains in some question with respect to current Corps clearing directives.	Monitor and maintain as needed. Some minor adjustment of several rock-anchored logs may be needed in the near future.
14.55	14.76	L	Tukwila 205 / Ratolo: The levee crest elevation here is from 3 to 8 feet above the adjoining landward parking lots and access grades. Significant cracking and settlement of the levee crest trail and landward parking lot grades has previously been observed near River Mile 14.74. Riverward slopes are extremely steep. Rock armor is visible along the toe and lower slope areas during low-water conditions, and shows signs of erosion and settlement in places. Midslope areas support minor sediment deposits, which are subject to minor localized slumping.	Riverward embankment slopes here should be carefully monitored. To the extent that slope settlement and deterioration of the levee embankment may become more problematic with time, survey and geotechnical evaluation of the river bank should be performed as an initial step toward slope and levee stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest and trail to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench. Establish a uniform riparian buffer with native vegetation.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
14.76	14.9	L	Tukwila 205 / Ratolo / So. 180th Street Wall: The levee crest trail here sits about 9 feet above the adjoining South 180th Street roadway. The landward edge of the levee consists of a vertical concrete wall adjoining the edge of the road. The landward margins of the levee crest trail are provided with a safety fence. Riverward slopes drop very steeply from the edge of the trail. Rock armor is visible along the toe and lower slope areas during low-water conditions, and shows signs of erosion and settlement in places. Midslope areas support minor sediment deposits, which are subject to minor localized slumping.	Riverward embankment slopes here should be carefully monitored. To the extent that slope settlement and deterioration of the levee embankment may become more problematic with time, survey and geotechnical evaluation of the river bank should be performed as an initial step toward slope and levee stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest and trail to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench. Establish a uniform riparian buffer with native vegetation.
14.9	15.09	L	Tukwila 205 / Segale Floodwall: The levee crest here is located at an elevation about 10 to 11 feet above the adjoining asphalt parking lot. The landward margins of the levee crest access roadway are provided with a safety fence. The landward levee edge consists of a vertical concrete floodwall, set on a spread footing. This levee segment was reconstructed in a setback configuration by the Corps of Engineers in 2008. Portion of the segment were provided with placement of instream logs anchored with rocks along the toe. A large emplacement of launchable toe rock was constructed at the margins of the summer low-flow channel, incorporating one to two layers of native willow cuttings. Levee slopes were also armored with rock. The launchable toe structure was subsequently planted with native vegetation. The treatment of this vegetation remains in some question as it matures, due to current Corps directives regarding clearing.	Monitor and maintain as needed. Special attention should be directed to the area along the toe of the concrete floodwall, as the reach upstream has experienced repeated seepage-related stability problems.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
15.09	15.36	L	Tukwila 205 / Segale Repair Segment Landward portions of the levee in this reach have all experienced extensive, seepage-related stability problems during flood events, with a series of repairs made to address these as follows; seepage and piping of the landward levee toe were experienced in1983 and 1984, and were repaired with a filter blanket installed along the base of the slope. Ground heaving, liquefaction, and sand boils were experienced in 1990 and addressed by construction of an emergency landward toe drain trench and a raised landward buttress structure. Additional sand boils and liquefaction of landward levee slopes were experienced at the upstream end of this reach in 1996, and were addressed by an extension of these measures. The central portion of this segment was rebuilt with drilling of a series of relief wells connected to a drainage manifold and discharging to a large concrete vault, to be pumped to the river through the crest of the levee freeboard by an automated system. And finally, the landowner raised the upstream portions of the landward grades adjacent to the levee with fills, effectively providing a counterweight to potential heaving of previously excavated areas. All landward areas are routinely treated with herbicides by the landowner, and are barren. Riverward slopes are steep, and not quite even 2H:1V in inclination. These have experienced repeated instability and have been repaired in 1991 by the Corps, and in 1995 and 2003 by King County. Corps repairs included extensive slope excavation and rock placement. County repairs provided a rock toe buttress and bioengineered slope reconstruction, with rock-anchored logs along the toe in two locations. All bioengineered slope areas established robust growth of native plant species, which were extensively "thinned" into sparsely scattered clumps by Tukwila pursuant to Corps directives in 2010, which cost was then reimbursed by the King County Flood Control District.	Riverward embankment slopes here should be carefully monitored. To the extent that slope settlement and deterioration of the levee embankment may become more problematic with time, survey and geotechnical evaluation of the river bank should be performed as an initial step toward slope and levee stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench. Establish a uniform riparian buffer with native vegetation.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
15.36	15.51	L	Tukwila 205 / Segale Headquarters Bend: This segment of the levee occupies an inside bend. Grades landward of the levee have been raised with fill and range from 1 to 4 feet below the levee crest elevation. Landward areas include a planted "landscaping" strip with small non-native trees. Riverward levee slopes are moderately steep, and covered generally with sediment deposits, These form a poorly defined, irregular bench of sorts, which drops off steeply in its lower margins to the low-flow channel. The sediment deposits here are barren except for reed canarygrass and blackberries, which are mowed at intervals. Some rock is visible along the toe at low water, but is somewhat abscured by the sediments present.	Riverward embankment slopes here should be carefully monitored. To the extent that slope settlement and deterioration of the levee embankment may become more problematic with time, survey and geotechnical evaluation of the river bank should be performed as an initial step toward slope and levee stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench. Establish a uniform riparian buffer with native vegetation.
15.51	15.75	L	Tukwila 205 / Segale Headquarters: The levee crest here varies from one to three feet above adjoining grades, and abuts a truck loading access area behind a commercial building. Upstream portions of the levee support a chain-link fence placed along the landward margins of the levee crest, hindering access and use bymaintenance vehicles and equipment. A sparse row of smaller non-native trees is present along the landward edge of the levee in its downstream portions. Riverward slopes are extremely steep, and have been surveyed at up to 1.4H:1V. Some rock is visible along the levee toe and the lower embankment slopes at low water, but shows signs of erosion and settlement. Minor sediment deposits are present in midslope areas, with slumps visible from time to time. Only an occasional native tree has ever established in this reach, but these few have been removed pursuant to Corps directives. The slope is largely barren, except for invasive reed canrygrass and blackberries, which are severely mowed.	Riverward embankment slopes here should be carefully monitored. To the extent that slope settlement and deterioration of the levee embankment may become more problematic with time, survey and geotechnical evaluation of the river bank should be performed as an initial step toward slope and levee stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench. Establish a uniform riparian buffer with native vegetation.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
15.75	15.88	L	Tukwila 205 / Gaco Western / Gunter: The levee crest here is raised from 4 to 8 feet above landward grades. Landward levee slopes range from dense plantings of non-native landscaping shrubs and trees at the downstream end of this segment to blackberries and grasses near the upstream end. The corner of a commercial concrete warehouse protrudes into the landward margins of the levee near River Mile 15.82. Riverward slopes are very steep. Rock is visible along the toe and lower slopes during low water conditions, including some larger rock near River Mile 15.83. With the exception of several well-established native willows along the water line in the midpoint of this outside bend, slopes are largely barren except for invasive reed canrygrass and blackberries, which are severely mowed.	Riverward embankment slopes here should be carefully monitored. To the extent that slope settlement and deterioration of the levee embankment may become more problematic with time, survey and geotechnical evaluation of the river bank should be performed as an initial step toward slope and levee stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench. Establish a uniform riparian buffer with native vegetation.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
15.88	16.5	L	Tukwila 205 / Gunter: The landward area is presently an undeveloped former agricultural site, but has been annexed into the City of Tukwila as part of a major proposed development. The levee crest elevation is from 4 to 7 feet above adjoining landward grades. Riverward slopes range from steep to very steep, especially in the upstream half of this segment. Toe rock is visible along the toe and in lower slope areas at low water, and shows some signs of erosion and dislocation. Intermittent sediment deposits are present in lower slope and midslope areas, especially in the downstream half of the reach, and show signs of slumping along their margins. These deposits and all riverward slope areas in general are covered with invasive reed canarygrass and blackberries, which are severely mowed. A single 4-inch diameter volunteer native alder established once, near River Mile 16.48, but was promptly cut pursuant to Corps directives, leaving the slopes barren.	King County has requested additional easement areas be provided in connection with future site development, sufficient in width to accommodate stable levee slopes and adequate buffers supporting native riparian vegetation. This entire reach has been identified as a habitat restoration project element in the Green River Salmon Recovery Plan. Riverward embankment slopes here should be carefully monitored. To the extent that slope settlement and deterioration of the levee embankment may become more problematic with time, survey and geotechnical evaluation of the river bank should be performed as an initial step toward slope and levee stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench. Establish a uniform riparian buffer with native vegetation.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
16.5	16.61	L	Tukwila 205 / Gunter / Gopher Hole Reach: The landward area is presently an undeveloped former agricultural site, but has been annexed into the City of Tukwila as part of a major proposed development. The levee crest elevation is from 4 to 7 feet above adjoining landward grades. Riverward slopes are very steep. Toe rock is visible along the toe and in lower slope areas at low water, and shows some signs of erosion and dislocation. Intermittent sediment deposits are present in lower slope and midslope areas and show signs of slumping along their margins. These deposits and all riverward slope areas in general are covered with invasive reed canarygrass and blackberries, which are severely mowed. Two outfall culverts were partially reconstructed here near River Mile 16.52, and have previously shown signs of general rusting and leakage. Seepage from these outfalls could weaken or otherwise adversely affect levee subgrade and foundation conditions. Extensive "potholes" were observed here in areas landward from the levee, and were suspected as having been created by upwelling sandboils related to pipe seepage of this nature. Access to affected areas was not provided by the landowner to facilitate County foundation inspection and pinpoint failure mechanisms; instead, the landowner's private consultants concluded in writing that the extensive "pothole" development was the result of gopher holes. King County has been unable to confirm this finding and remains concerned that sand boils may be present. The landowner subsequently both repaired the affected outlet culverts and then placed a gravel buttress structure along the landward toe in this segment.	King County has requested additional easement areas be provided in connection with future site development, sufficient in width to accommodate stable levee slopes and adequate buffers supporting native riparian vegetation. This entire reach has been identified as a habitat restoration project element in the Green River Salmon Recovery Plan. Areas landward from the levee should be monitored during all high water events and evaluated for development of sand boils or generalized seepage and ground heaving conditions. Riverward embankment slopes here should be carefully monitored. To the extent that slope settlement and deterioration of the levee embankment may become more problematic with time, survey and geotechnical evaluation of the river bank and landward foundations should be performed as an initial step toward slope and levee stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench. Establish a uniform riparian buffer with native vegetation.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
16.61	16.71	L	Tukwila 205 / Frager Road & Hillside Tie-In: The levee here consists of a raised portion of Frager Road, together with a raised earthen levee berm extending to high ground along the hillside to the west.. Frager Road itself is proposed to be replaced by a new access roadway serving this future development, leaving the disposition of the existing roadway and the existing levee geometry in some question.. Riverward slopes are occupied by significant sediment deposits, eroded and slumping in places along their lower margins. With these sediments in place, slopes are moderate. Slumping sediments obscure the lower slopes and toe, and rock is not visible during low water conditions. Therefore the presence of a rock toe buttress structure is unconfirmed.	King County has requested additional easement areas be provided in connection with future site development, sufficient in width to accommodate stable levee slopes and adequate buffers supporting native riparian vegetation. Riverward embankment slopes here should be carefully monitored. To the extent that slope settlement and deterioration of the levee embankment may become more problematic with time, survey and geotechnical evaluation of the river bank and landward foundations should be performed as an initial step toward slope and levee stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench. Establish a uniform riparian buffer with native vegetation.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
16.71	16.83	L	Frager Road Lowest: The existing roadway shows signs of arcuate crack formation within the existing asphalt, indicating possible initiation of large-scale slumping failures. Riverward slopes are very steep. Toe rock is visible along the toe and in lower slope areas at low water, and shows some signs of erosion and dislocation. Intermittent sediment deposits are present in lower slope and midslope areas and show signs of slumping along their margins.	King County has requested additional easement areas be provided in connection with future site development, sufficient in width to accommodate stable levee slopes and adequate buffers supporting native riparian vegetation. This entire reach has been identified as a habitat restoration project element in the Green River Salmon Recovery Plan. Riverward embankment slopes here should be carefully monitored. To the extent that slope settlement and deterioration of the levee embankment may become more problematic with time, sSurvey and geotechnical evaluation of the river bank and landward foundations should be performed as an initial step toward slope and levee stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench. Establish a uniform riparian buffer with native vegetation.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
16.83	16.99	L	Frager Road Setback: Frager Road serves as the levee in this reach, with a crest elevation some 3 to 6 feet above adjoining grades. A detention pond serving South 200th Street abuts the landward margins of Frager Road just downstream from the bridge. Remaining landward areas were formerly undeveloped agricultural sites and wetlands, but have been annexed into the City of Tukwila as part of a major proposed development and are in the process of being raised with placement of fill materials. Frager Road itself is proposed to be replaced by a new access roadway serving this future development, along with a new levee structure. Riverward areas are occupied by a modest bench, also formerly used as an agricultural site, with the edge of this bench falling steeply down to the edge of the low flow channel. Upstream portions of this bench were formerly used as a mitigation planting site for bridge construction. The bench is currently occupied by roadway fill, serving as a construction access route underneath the South 200th Street Bridge just upstream. Renewed slumping in early 2012 extends to the margins of this temporary road near River Mile 16.87. The temporary access roadway will be removed following construction, and the entire area currently occupied by the bench and Frager Road will be excavated to form a hydraulic sanctuary in the lee of the bridge to serve as instream and riparian habitat. A new levee will be sited along the landward margins of the excavated area	. A request by the landowner and the City of Tukwila to add this levee reach as a modification to the existing Tukwila 205 federally authorized levee downstream was denied by the Corps of Engineers.King County has requested additional easement areas be provided in connection with future site development. The nature and extent of County involvement in review, approval, construction, maintenance, or operation of the new levee structure to be constructed here remains to be determined.
17.0	17.12	L	Frager Road: Frager Road serves as the levee here with its crest elevation raised some 2 to4 feet above landward areas. These areas were formerly undeveloped agricultural sites and wetlands, but have been annexed into the City of Tukwila as part of a major proposed development and are in the process of being raised with placement of fill materials. Frager Road itself is proposed to be replaced by a new access roadway serving this future development, leaving the disposition of the existing roadway and the existing levee geometry in some question. Sediment deposition is present throughout this midslope bench, and is pronounced in places. Some slumping and erosion is also evident along the riverward margins of the bench. Lower slopes and the instream toe are obscured by the sediments present, with the result that the presence of any rock toe buttress structure remains unconfirmed.	A request by the landowner and the City of Tukwila to add this levee reach as a modification to the existing Tukwila 205 federally authorized levee downstream was denied by the Corps of Engineers.King County has requested additional easement areas be provided in connection with future site development, sufficient in width to accommodate stable levee slopes and adequate buffers supporting native riparian vegetation. This entire reach has been identified as a habitat restoration project element in the Green River Salmon Recovery Plan. The nature and extent of County involvement in review, approval, construction, maintenance, or operation of the levee structure here remains to be determined.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
17.12	17.2	L	Frager Road: Frager Road serves as the levee here with its crest elevation raised some 3 to 6 feet above landward areas. These areas were formerly undeveloped agricultural sites and wetlands, but have been annexed into the City of Tukwila as part of a major proposed development and are in the process of being raised with placement of fill materials. The current levee has previously been abandoned as a vehicular roadway and established as a trail. It appears that easements for this trail usage may have also expired. Frager Road itself is proposed to be replaced by a new access roadway serving this future development, leaving the disposition of the existing roadway and the existing levee geometry in some question. The current raised levee structure is located immediately at the margins of very steep slopes covered with blackberries, reed canarygrass, and sparsely scattered willows along the water line. Sediment deposition is present in midslope areas, and some slumping and erosion is also evident in lower slope areas. Instream toe rock is visible under low water conditions, but shows signs of erosion and dislocation here and there.	A request by the landowner and the City of Tukwila to add this levee reach as a modification to the existing Tukwila 205 federally authorized levee downstream was denied by the Corps of Engineers.King County has requested additional easement areas be provided in connection with future site development, sufficient in width to accommodate stable levee slopes and adequate buffers supporting native riparian vegetation. This entire reach has been identified as a habitat restoration project element in the Green River Salmon Recovery Plan. The nature and extent of County involvement in review, approval, construction, maintenance, or operation of the levee structure here remains to be determined.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
17.2	17.28	L	Tukwila South Pond / Johnson Creek Outlet: Frager Road formerly served as the levee in this reach, but has been replaced with the excavation of a new outlet for a relocated portion of Johnson Creek, together with a new outlet for a large detention pond. This pond serves areas which were formerly undeveloped agricultural sites and wetlands, but which have been annexed into the City of Tukwila as part of a major proposed development and are in the process of being raised with placement of fill materials. Both the pond and the newly relocated Johnson Creek channel have been excavated into native alluvial soils along the landward margins of the levee prism, effectively increasing the height of the overall flood containment prism. Green River flood elevations in this reach are up to 20 feet in elevation above portions of Johnson Creek and upstream wetland areas, including portions of South 204th Street. The levee also effectively serves as the riverward containment for the detention pond, as well as containment for river flooding, potentially increasing seepage gradients in either direction, depending on stage differentials between the two. The newly modified levee structure in this reach has been raised with placement of additional levee fill, and outlet structures provided with rock armor facing. No modifications to the overall riverward slope geometry have been made in this context, and the slopes remain very steep and covered with blackberries and reed canarygrass in areas not affected by the newer rock. Older toe rock is visible along the toe and in lower slope areas during low water conditions, and shows evidence of dislocation and erosion in some places. Midslope areas are affected by shallow sediment deposits subject to slumping in places. A request by the landowner and the City of Tukwila to add this levee reach as a modification to the existing Tukwila 205 federally authorized levee downstream was denied by the Corps of Engineers.	King County has requested additional easement areas be provided in connection with future site development, sufficient in width to accommodate stable levee slopes and adequate buffers supporting native riparian vegetation. Additional analyses of areas subject to excavation of the landward levee toe have also been requested. This entire reach has been identified as a habitat restoration project element in the Green River Salmon Recovery Plan. The nature and extent of County involvement in review, approval, construction, maintenance, or operation of the levee structure here remains to be determined.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
17.28	17.52	L	Frager Road Lower / Omlid / O'Connell: This reach borders four residential homes with barns and a number of agricultural outbuildings set in close proximity to the landward edge of the road. The elevation of the roadway serves as the levee crest, and is from 2 to 4 feet above adjacent landward grades; however, protected areas to the west along the Johnson Creek wetlands, within adjoining agricultural fields, and along South 204th Street itself are up to 20 feet below Green River flood elevations in this reach. Riverward slopes here are extremely steep, and the riverward margins of Frager Road show evidence of extensive cracking and settlement of slopes along the road shoulder. Toe rock is visible under low water conditions, but shows some evidence of scour and dislocation. Midslope areas experience intermittent deposits of flood-borne sediments to shallow depths over the slopes, which experience recurrent slumping. Findings in the January 27, 2012 Green River Geotechnical Investigation of Frager Road Levee show that reliance on the existing river bank for the structural stability of the road and associated flood containment functions is highly questionable at present	.. Riverward embankment slopes here should be carefully monitored. To the extent that slope settlement and deterioration of the levee embankment may become more problematic with time, further survey and geotechnical evaluation of the river bank should be performed as an initial step toward slope and levee stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench. Establish a uniform riparian buffer with native vegetation.
17.52	17.72	L	Frager Road: Frager Road serves as the levee crest here, and is from 2 to 4 feet above adjacent landward grades. However, protected areas to the west along the Johnson Creek wetlands, within adjoining agricultural fields, along South 204th Street, and extending to South 212th Street itself are up to 20 feet below Green River flood elevations in this reach. Riverward of the road fill a midslope floodplain "bench" is present, up to 200 feet wide in places. The bench and these lower slopes experience sediment deposition, especially on downstream portions of the bench, and periodic slumping occurs along the margins of the bench. Sediments obscure the lower slope and toe areas, and therefore the presence of any toe rock remains unconfirmed. Findings in the January 27, 2012 Green River Geotechnical Investigation of Frager Road Levee show that reliance on the existing river bank for the structural stability of the road and associated flood containment functions is highly questionable at present.	Depending on decisions taken with regard to the location and need for future defined flood containment structures in this general reach, or for stabilization of the road and its additional function as a recreational trail, further survey and geotechnical evaluation of the existing road should be performed as an initial step toward levee stabilization. A plan for utilizing the existing riverward bench should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench. Establish a uniform riparian buffer with native vegetation.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
17.72	17.84	L	Frager Road: Frager Road serves as the levee crest here, and is from 2 to 4 feet above adjacent landward gradesRiverward slopes are moderate to steep, and are characterized by dynamic episodes of sediments depositing and slumping. Lower embankment slopes are especially prone to slumping, despite the presence of rather well-developed thickets of native dogwood and some willows in places. The low flow channel here is uncharacteristically deep for the lower Green River, up to 20 feet in places, and a long pool extends downstream from the bridge crossing as a result of flow modulation by old bridge piers and entrained debris forming a "sill" of sorts in the riverbed just upstream. Findings in the January 27, 2012 Green River Geotechnical Investigation of Frager Road Levee show that reliance on the existing river bank for the structural stability of the road and any associated flood containment functions is highly questionable at present.	Depending on decisions taken with regard to the location and need for future defined flood containment structures in this general reach, or for stabilization of the road and its additional function as a recreational trail, further survey and geotechnical evaluation of the existing road should be performed as an initial step toward levee stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench. Establish a uniform riparian buffer with native vegetation. The deep channel bottom here must be considered as part of any levee planning and design decisions made in the future.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
17.86	18.0	L	Frager Road Nursery: Frager Road abuts several homes and a former nursery site here, where it ties in to South 212th Street and serves as a levee raised from 3 to 6 feet above the landward areas. The upstream portions of this short segment abut a setack area established as part of a newer development by the Polygon Corporation. Despite theis setback, the roadway sits immediately at the top of a moderately steep riverbank, with significant sediment deposits present in the midslope and along the lower slope areas Slumps are visible along the lower slopes, involving the riverward margins of the sediment deposits. Toe rock is visible in a few places, but is largely obscured by the sediments. It is likely that any toe rock is affected by bed scour and settlement here. The northerly portion of the riverbank supports a trail ramp passing under south 212th Street. Findings in the January 27, 2012 Green River Geotechnical Investigation of Frager Road Levee show that reliance on the existing river bank for the structural stability of the road and any associated flood containment functions is highly questionable at present.	Depending on decisions taken with regard to the location and need for future defined flood containment structures in this general reach, or for stabilization of the road and its additional function as a recreational trail, further survey and geotechnical evaluation of the existing road should be performed as an initial step toward levee stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed, including use of the setback area provided by the Polygon development. Reconstruct toe, slope and levee crest to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench.
18.0	18.22	L	Frager Road / "216th Street": Frager Road serves as the levee here, and is located immediately at the top of an extremely steep, actively sloughing riverbank. Distress cracks are visible within the asphalt pavement along the riverward edge of the roadway throughout the reach. River bank slopes are characterized by minor sediment deposits overgrown with reed canarygrass. These form and then slough in a continuously dynamic pattern, and have been monitored over a span of some 20 years. Localized shallow failure scarps from 20 to 150 feet long have repeatedly been observed here. Wholesale failure of the slope has not occurred to date, but may be expected at any time. Findings in the January 27, 2012 Green River Geotechnical Investigation of Frager Road Levee show that reliance on the existing river bank for the structural stability of the road and any associated flood containment functions is highly questionable at present.	Depending on decisions taken with regard to the location and need for future defined flood containment structures in this general reach, or for stabilization of the road and its additional function as a recreational trail, further survey and geotechnical evaluation of the existing road should be performed as an initial step toward levee stabilization.. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed, including use of the setback area provided by the Polygon development. Reconstruct toe, slope and levee crest to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
18.22	18.31	L	Frager Road / Eagle Scout Park: Frager Road serves as the levee here, near its intersection with South 216th Street. The road crest elevation is raised from 2 to 3 feet above adjoining grades. . Sediments deposit along the margins of the bench, and slump into the channel from time to time. Due to the presence of these sediments toe structure remains unconfirmed. Overall, the integrity of the slope is only slightly higher than elsewhere in the overall Frager Road reaches, due to the flatter slope angles established by the modest setback of the roadway, and perhaps also by the rooting structure of the cottonwood stand along the bench. Findings in the January 27, 2012 Green River Geotechnical Investigation of Frager Road Levee show that reliance on the existing river bank for the structural stability of the road and any associated flood containment functions is highly questionable at present.	Depending on decisions taken with regard to the location and need for future defined flood containment structures in this general reach, or for stabilization of the road and its additional function as a recreational trail, further survey and geotechnical evaluation of the existing road should be performed as an initial step toward levee stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed, including use of the setback area provided by the Polygon development. Reconstruct toe, slope and levee crest to a stable configuration with a fully bioengineered solution preferably including a vegetated midslope bench.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
18.31	18.55	L	Frager Road Lower / 216th Street Upstream: The downstream portions of this segment abut several older residential homes set relatively closely behind the curve in the road Flood patrol access through this reach is hindered by the presence of locked bollards which are not provided with County locks. The roadway upstream from these bollards is used strictly as a bicycle and hiking trail and as access for maintenance vehicles. The river bank is extremely steep throughout, with a thin cover of rip rap supporting reed canarygrass and blackberries, and with intermittent sediment deposits mobilizing as localized slumps in places. The riverward margins of Frager Road at the top of bank show pronounced settlement and cracking along nearly the entire edge of the asphalt paving, and a pronounced slump extends right to the top of bank and for nearly 200 feet along the slope near River Mile 18.54.Sediments routinely deposit within this scarp area, partially vegetate with reed canarygrass, and then slump again. A relatively deep pool abuts the base of this slump, and is sustained by the presence of a pronounced back eddy feature at the upstream end of the outer bend here. Findings in the January 27, 2012 Green River Geotechnical Investigation of Frager Road Levee show that reliance on the existing river bank for the structural stability of the road and any associated flood containment functions is highly questionable at present.	Depending on decisions taken with regard to the location and need for future defined flood containment structures in this general reach, or for stabilization of the road and its additional function as a recreational trail, further survey and geotechnical evaluation of the existing road should be performed as an initial step toward levee stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed, including use of the setback area provided by the Polygon development. Reconstruct toe, slope and levee crest to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
18.55	18.71	L	Frager Road Lower: This segment of Frager Road also abuts the 200-foot-wide open space area adjoining the Polygon Corporation development. It differs from segments upstream and downstream due to the presence of a relatively broad midslope "bench," covered for the most part with reed canarygrass along its upper surface and native dogwood shrubs along the riverbank itself. This feature flattens the overall slope, which is much less steepened relative to the position of the roadway itself. Sediment deposits along the channel margins below the bench seem to be aggrading over the years, but no rock structure is visible under low water conditions.. Findings in the January 27, 2012 Green River Geotechnical Investigation of Frager Road Levee show that reliance on the existing river bank for the structural stability of the road and any associated flood containment functions is highly questionable at present.	Depending on decisions taken with regard to the location and need for future defined flood containment structures in this general reach, or for stabilization of the road and its additional function as a recreational trail, further survey and geotechnical evaluation of the existing road should be performed as an initial step toward levee stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed, including use of the setback area provided by the Polygon development. Reconstruct toe, slope and levee crest to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
18.71	19.0	L	Frager Road Lower: This reach of Frager Road consists of a relatively straight reach with consistently steep embankment slopes characterized by midslope sediment deposits, intermittent slumps in these sediments,. The downstream end of this reach abuts the Polygon open space setback area and an associated sewage lift station. The rest of the reach borders largely undeveloped open space formerly used as a sand quarry, and which now supports both former sediment ponds now reverting to wetlands, together with natural floodplain wetlands at the base of the west valley hillside. All these wetland areas are cut off from river flooding by the presence of the raised roadway fill. The roadway here is used strictly as a bicycle and hiking trail and as access for maintenance vehicles. A pedestrian footbridge supporting utility crossings of the river is present at River Mile 18.81. Findings in the January 27, 2012 Green River Geotechnical Investigation of Frager Road Levee show that reliance on the existing river bank for the structural stability of the road and any associated flood containment functions is highly questionable at present.	Depending on decisions taken with regard to the location and need for future defined flood containment structures in this general reach, or for stabilization of the road and its additional function as a recreational trail, further survey and geotechnical evaluation of the existing road should be performed as an initial step toward levee stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed, including use of the setback area provided by the Polygon development. Reconstruct toe, slope and levee crest to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench, while considering appropriate re-connection of higher flows to the floodplain wetlands present.
19.0	19.16	L	Frager Road Lower: This segment of Frager Road sits immediately at the top of bank along a pronounced outer bend. The roadway here is used strictly as a bicycle and hiking trail and as access for maintenance vehicles. Shallow sediment deposits cover a rock layer still visible along the toe at low water, and intermittently slump in blocks or clumps held together with reed canarygrass. The landward margins of the road abut a narrow fringing of forested wetlands at the base of the equally well-forested hillside defining the west valley wall nearby. Overall stability of the steep embankment here is highly questionable. Other than perhaps confining a possible flow route affecting the upstream margins of the Polygon housing development downstream, the roadway serves no essential flood containment function by keeping higher flows out of the floodplain wetlands here.	Depending on decisions taken with regard to the location and need for the road, a trail, or future defined flood containment structures in this general reach, further survey and geotechnical evaluation of the existing road should be performed as an initial step toward bank stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed, while considering appropriate re-connection of higher flows to the floodplain wetlands present. Reconstruct toe, slope and levee crest to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
19.16	19.27	L	Frager Road Lower / South 231st Street Bridge Mitigation: The roadway here abuts a narrow fringing of forested wetlands at the base of the equally well-forested hillside defining the west valley wall, together with the bridge abutment fill nearby. The riverward embankment occupies an inner bend with sediment deposits present. The bulk of this riverward area is occupied with a mitigation project area constructed by King County for the City of Kent as partial mitigation for impacts associated with bridge construction. The embankment was re-sloped at a relatively flat angle, between 2.5 H:1V and 3H:1V for the most part, and was replanted with native riparian trees and shrubs. Areas closer to the bridge were not re-sloped, but have been cleared of blackberries and planted as well. A number of logs with rootwads were chained to buried rock anchors just above the water line, and interact with flows at intermediate river levels. Sediments continue to recruit along the lsopes near the downstream end of this reach, which was not included in the restoration work.	While the road embankment in this reach is largely stable and supports no obvious flood containment function, consideration should be given to appropriate re-connection of floodplain wetlands to higher river flows as part of any longer-term project actions involving downstream segments of Frager Road.
19.3	19.44	L	Stoneway Lower: Frager Road follows closely along the base of the adjoining west valley hillside here, and is located immediately at the top of the very steep river embankment. The riverward margins of the roadway show numerous arcuate cracks generally indicative of instablilities and settlement in the slope below. Rock is visible along the lower slopes and at the toe during low water conditions. Several discontinuous rows of old wooden pilings are also visible in the water along the toe in places. Due to the proximity of the adjoining hillside and the bridge abutment at the downstream end here, no flood containment function is associated with this segment. Stability of the road embankment appears highly questionable.	Depending on decisions taken with regard to the location and need for the road, a trail, or stabilization of the leachate line in this general reach, further survey and geotechnical evaluation of the existing road should be performed as an initial step toward bank stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Reconstruct toe, slope and levee crest to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
19.44	19.48	L	Stoneway Lower Slope Repair: The entire roadway embankment in this reach failed in a slump extending up to the centerline of the pavement following flood discharge in 2009. Funding assistance was provided by FEMA through the City of Kent, acting as the local sponsor. Roadway reconstruction was completed by King County using piling anchored log deflectors along the toe, geotextile reinforcement of crushed stone fill layers integrated with bio-engineered slope reconstruction of the face slope, and a full reconstruction of the failed roadway. The adjoining hillside immediately abuts the roadway here, together with the City of Seattle's Midway landfill leachate line, also buried along the landward edge of the pavement. To help flatten to very steep slope angle here to the maximum allowd by these landward constraints, the pavement width was reduced from two lanes down to a single lane, and the road shoulder was replaced with a guardrail.	Due to the use of piling anchored logs along the toe to expedite construction permitting, as compared with instream rock buttress construction, and also due to the remaining overall steepness of the slope involved, careful monitoring of this construction will be needed over time. Monitor, repair, or reconstruct as needed.
19.48	19.73	L	Stoneway Lower / Midway Creek: The roadway here is set back from the low flow channel margins by the presence of a relatively wide midslope bench deposited along an inner bend. Midway Creek discharges to the Green River here beneath a bridge at River Mile 19.53. Landward areas flood during high river flow events, and are largely characterized by forested floodplain wetlands. The City of Settle maintains a seepage impoundment barrier at the mouth of a filled ravine now serving as the Midway landfill near the valley wall west of these wetlands, with an enclosed aeration pond and pump system treating and conveying leachate in an enclosed forcemain also present. Because the mouth of Midway Creek is open to the river here, no essential flood containment function is provided by the roadway.	The broad bench located riverward from the roadway here should be included in any systematic restoration efforts within this general reach, including replacement of invasive vegetation with native riparian plantings. A more general re-connection of the river to its floodplain might also be achieved through setback of the roadway/trail system to the base of the valley wall, west of the floodplain wetlands.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
19.73	19.9	L	Stoneway Upper: Frager Road Lower: This segment of Frager Road sits immediately at the top of bank along a pronounced outer bend. Shallow sediment deposits cover a rock layer still visible along the toe at low water, and intermittently slump in blocks or clumps held together with reed canarygrass. The landward margins of the road abut wetlands at the base of the hillside defining the west valley wall nearby. Overall stability of the steep embankment here is highly questionable. Other than perhaps confining a possible flow route affecting the upstream margins of the Polygon housing development downstream, or in curtailing backwater effects possibly affecting driveway access to scattered residential uses just upstream, the roadway serves no obvious or essential flood containment function by keeping higher flows out of the floodplain wetlands here.	Further survey and geotechnical evaluation of the existing road should be performed as an initial step toward bank stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed, while considering appropriate re-connection of higher flows to the floodplain wetlands present. Reconstruct toe, slope and levee crest to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench. .
19.9	20.55	L	Teufel Nursery: This reach is situated along an elongated inner bend, and together with the segment just upstream defines the former Teufel Nursery site purchased in 2010 by the Flood District to provide a mitigation site Preliminary site investigations reveal the presence of slightly elevated levels of herbicides and possibly other horticultural chemical residues in soil samples obtained from limited portions of the site. Significant sediment deposits are present along the bend, and sloughing is visible in places. Vegetation includes some mature native and non-native tree species, occasional stands of dense native willow and dogwood clumps, and broad distribution of invasive blackberries and reed canarygrass along the riverbank.	Perform a detailed site survey. Identify, characterize, treat and remove contaminated soils from the site as appropriate under applicable state and federal statutes. Define a site grading plan sufficient to re-connect a lowered floodplain surface to the range of elevations defined by currently managed flows as discharged by Howard A. Hanson Dam, and to provide for access along the riverbank for placement of required log mitigation structures. Consider the magnitude and extent of possible channel re-alignment likely as a consequence of removing bank armor along the segment immediately upstream. Consider alternatives for incorporating identified channel dynamics into the restoration plan outcomes. Select a preferred alternative. Develop a wood placement and anchoring plan. Develop a site revegetation plan sufficient to accomplish mitigation planting requirements. Obtain all necessary construction permits and approvals. Construct site mitigation measures.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
20.55	20.81	L	Teufel Nursery: Slopes are very steep in places, with slopes flattening due to sediment accumulations as flows proceed downstream.	Perform a detailed site survey. Identify, characterize, treat and remove contaminated soils from the site as appropriate under applicable state and federal statutes. Define a site grading plan sufficient to re-connect a lowered floodplain surface to the range of elevations defined by currently managed flows as discharged by Howard A. Hanson Dam, and to provide for access along the riverbank for placement of required log mitigation structures. Consider the magnitude and extent of possible channel re-alignment likely as a consequence of removing bank armor and concrete rubble along this segment. Consider alternatives for incorporating identified channel dynamics into the restoration plan outcomes. Select a preferred alternative. Develop a wood placement and anchoring plan. Develop a site revegetation plan sufficient to accomplish mitigation planting requirements. Obtain all necessary construction permits and approvals. Construct site mitigation measures.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
20.81	20.92	L	Frager Road / Corps GR 1-75: This reach segment appears to be named after a long-ago Corps repair along this outer bend, with rock armor still visible along the toe and lower bank at low water. An accumulation of wood and sediment is also present near the downstream end, forming a deflector of sorts. Interior runoff from a neighboring wetland flows seasonally over the lower slope from an open culvert. A long residential driveway crosses the adjoining wetland near the upstream end of the reach, which borders the left bank portions of the City of Kent's Riverbend Golf Course. Slopes range from steep to very steep, and Frager Road sits right at the crest of the slope with no particular road shoulder present next to the guardrail. A back-eddy at the upstream end of this segment has deepened the channel and undermined the slope, with the formation of sharply defined arcuate settlement cracks in the asphalt paving extending to the centerline of the road showing evidence of previous slope settlement and potential continuing local instability.	The structural stability of the road and any associated flood containment functions is highly questionable at present. Depending on decisions taken with regard to the location and need for the road, a trail, or future defined flood containment structures in this general reach, further survey and geotechnical evaluation of the existing road should be performed as an initial step toward bank stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed, while considering appropriate re-connection of higher flows to the floodplain wetlands present. Reconstruct toe, slope and levee crest to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench.
20.92	21.13	L	Frager Road / Kent Golf Left: This relatively straight reach provides a perfect example of long-term bank stability supported by a mixed overstory of mature native riparian trees on a broad midslope floodplain bench present here, combined with dense stands of shade-tolerant native dogwood species along the riverbank itself. Frager Road is set back from the riverbank along the margins of this bench, separating it from the balance of the floodplains serving as the left bank portions of the City of Kent's Riverbend Golf Course here. No toe structure appears to be present, other than natural wood accumulations and the velocity attenuation provided by the overhanging dogwood stands. The long-term stability of this feature is evidenced by the age of the vegetation present. Frager Road is quite secure in this setting. Other than for the golf links, the driveway downstream, and a residential structure, the roadway here does not appear to serve an obvious or essential flood containment function.	Monitor. Document as a naturally stable vegetated riverbank and floodplain bench. Consider additional research opportunities to evaluate the use and performance of native vegetation in stabilizing riverbanks..

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
21.13	21.28	L	Frager Road / Maddox /Kent Golf Left: This segment is incredibly steep along the river bank. Toe rock is visible at lower flows along the base of the slope. The left bank portions of the City of Kent's municipal golf course abut the landward margins of Frager Road, which sits right at the crest of the slope with no particular road shoulder present next to the guardrail. A pool extends downstream from the "chute" at the bridge, deepening the channel and undermining the slope. Sharply defined settlement cracks in the asphalt paving along the margins of the road show evidence of previous slope settlement and potential continuing local instability.	The structural stability of the road and any associated flood containment functions is highly questionable at present. Depending on decisions taken with regard to the location and need for the road, a trail, or future defined flood containment structures in this general reach, further survey and geotechnical evaluation of the existing road should be performed as an initial step toward bank stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed, while considering appropriate re-connection of higher flows to the floodplain wetlands present downstream. Reconstruct toe, slope and levee crest to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
21.29	21.5	L	Frager Road /Leber Brothers: This reach of Frager Road along an outer bend extends from the Meeker Street Bridge upstream to the bridge over Mullen Slough at its confluence with the Green River. The landward side of the road is raised from 3 to 12 feet above adjoining grades, which include lands owned and managed by the City of Kent. These lands include a recreational fishing pond at the downstream end of this segment, a ditch-contained, seasonally flowing outlet of a wall-based tributary from the base of the western valley wall bordering the Mullen Slough floodway areas upstream from State Route 516 to the west and south, and undeveloped open space between Frager Road and SR 516. The tributary outlet discharges over a concrete splash pad embedded in rip-rap in the midslope of the steep riverbank, making it inaccessible to fish under nearly all flow conditions; despite this limitation, Stickelbacks have been observed in upstream areas. The mouth of Mullen Slough at the upstream end of this reach is open to the combined Mill Creek / Mullen Slough floodway of the Green River here, and backwater flooding of both Mullen Slough and the tributary culvert assure that the fishing pond and tributary outlet channel are both under several feet of floodwaters under higher river flow conditions. No practical flood containment is present. Toe rock of variable integrity is visible at low flows. Banks are very steep, with scattered immature native riparian trees present here and there. Shallow sediment deposits covered with blackberries and reed canarygrass are visible in midslope areas and are prone to localized minor slumping.	The structural stability of the road embankment is highly questionable at present. Depending on decisions taken with regard to the location and need for the road, a trail, or any future defined flood containment structures in this general reach, further survey and geotechnical evaluation of the existing road should be performed as an initial step toward bank stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed, while considering appropriate, fish-passable re-connection of the wall base tributary to either the Mainstem Green River, or to Mullen Slough. Reconstruct toe, slope and levee crest to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench. .
21.5	22.05	L	Frager Road / Downey Property / PD & J Packing No.1: Frager Road borders a steep, slump-prone embankment here with no obvious prior flood management structures incorporated into the riverbank, with the exception of a short segment of bank armor historically placed at the site of the former PD & J Packing CompanyFrager Road itself does not presently serve as a containment structure for floodwaters, as areas landward from the roadway are wholly within the combined Mill Creek / Mullen Slough floodway of the Green River, with the exception of the fill embankment for State Route 516. The extent to which Frager Road will be modified as a flood management structure or as a stable boundary to the site restoration area remains to be determined, as does its future maintenance.	Determine future flood management and channel boundary functions associated with Frager Road in connection with future modification of the site by the City of Kent as a salmon habitat restoration project. Determine flood management structure maintenance requirements and commitments as appropriate.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
22.07	22.15	L	Frager Road Upper / PD & J Packing No. 2: Frager Road sits immediately at the top of a steep riverbank here. Adjacent lands are enrolled in the Farmland Preservation Program within King County's Lower Green River Agricultural Protection District. The road crest is raised 2 to 3 feet above adjoining grades. A narrow strip of land along the road is just above the 100-year flood elevation here, within the combined Mill Creek / Mullen Slough floodway of the Green River. Therefore, while the roadway itself confines the adjacent river, it serves no overall flood containment function. The steep riverbank supports scattered immature native trees and some shrubs, with blackberries and reed canrygrass rooted in shallow sediment deposits. These deposits are visible and locally slumping in midslope areas. Older rock armor is visible here and there along the toe and lower slope areas under low water conditions. Overall the structure is marginally suited to its purpose of securing the roadway alignment.	The structural stability of the road and any associated local flood containment functions is questionable at present. Depending on decisions taken with regard to the location and need for the road, a trail, or future defined flood containment structures in this general reach, further survey and geotechnical evaluation of the existing road should be performed as an initial step toward bank stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed, while providing appropriate offsets for any resulting impacts affecting properties enrolled in the Farmlands Preservation Program. Reconstruct toe, slope and levee crest to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench.
22.15	22.27	L	Frager Road Upper: A relatively narrow depositional bench is present along the riverward slope of Frager Road, which is raised only a few feet above adjoining landward grades here. A narrow strip of dry land along the landward edge of the road supports several homes and farm outbuildings, all raised just above the mapped 100-year flood elevation, which otherwise occupies the combined Mill Creek/Mullen slough floodway of the Green River here. Adjacent lands are enrolled in the Farmland Preservation Program within King County's Lower Green River Agricultural Protection District. No visible toe structure is evident here, and sediment deposits alternatively form and slump along the bank in places.	Restoration of the midslope bench present along the riverward embankment should be considered for appropriate incorporation into any comprehensive modification of the roadway to achieve stabilization of the embankment within the overall reach extending both upstream and downstream from this segment. Appropriate offsets should be provided for any resulting impacts affecting properties enrolled in the Farmlands Preservation Program.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
22.27	22.6	L	Frager Road Upper: Frager Road sits immediately at the top of an extremely steep riverbank here. The combined Mill Creek / Mullen Slough floodway of the Green River regularly inundates nearly the entirety of the valley bottom and farm fields landward from the homes. Therefore, while the roadway itself locally confines the adjacent river and provides access to the homes, it serves no overall flood containment function. Shallow sediment deposits are visible and locally slumping in midslope areas. Older rock armor is visible here and there along the toe and lower slope areas under low water conditions, and as exposed by the heavy use made of the riverbank in this location for fishing accessHere and there along the toe and lower slopes rock has dislocated and settled into the channel due to undercutting scour along this sharp outer bend. Overall the structure is marginally suited to its purpose of securing the roadway alignment.	The structural stability of the road and any associated local flood containment functions is questionable at present. Depending on decisions taken with regard to the location and need for the road, a trail, or future defined flood containment structures in this general reach, further survey and geotechnical evaluation of the existing road should be performed as an initial step toward bank stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed, while providing appropriate offsets for any resulting impacts affecting properties enrolled in the Farmlands Preservation Program. Reconstruct toe, slope and levee crest to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
22.6	22.66	L	Frager Road Upper: The roadway here sits immediately at the top of a very steep embankment. The road crest elevation is only one or two feet above landward grades. The upstream end of this segment does not appear to have been modified from the natural riverbank with any previous structural modifications. Older toe rock is visible in the downstream portions at low water, but does not appear to be in good order due to settlement and dislocation caused by localized scour along the sharp outer bend that initiates at this location. The riverbank here has previously slumped into the channel along a distance of some 300 feet. It has not been reconstructed. The slump is obscured by subsequent deposition of sediments. Some settlement cracks are visible along the margins of the asphalt. Overall stability of the riverbank is highly questionable.	The structural stability of the road and any associated local flood containment functions is highly questionable at present. Depending on decisions taken with regard to the location and need for the road, a trail, or future defined flood containment structures in this general reach, further survey and geotechnical evaluation of the existing road should be performed as an initial step toward bank stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed, while providing appropriate offsets for any resulting impacts affecting properties enrolled in the Farmlands Preservation Program. Reconstruct toe, slope and levee crest to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
22.66	22.74	L	Frager Road Upper: The road crest elevation is only one or two feet above landward grades. Landward areas are all farm properties enrolled in the Farmlands Preservation Program within the Lower Green River Agricultural Protection District, and are routinely inundated within the combined Mill Creek/Mullen Slough floodway of the Green River. Therefore, while the roadway itself locally confines the adjacent river and provides local access, it serves no overall flood containment function. This segment does not appear to have been modified from the natural riverbank with any previous structural modifications. The bank geometry remains very steep overall. Cracks extend along nearly the full length of the roadway asphalt in this segment, indicating possible slope settlement. Midslope and lower slope areas are dominated with episodic sediment deposits. Localized slumping is widely visible.	The structural stability of the road and any associated local flood containment functions is questionable at present. Depending on decisions taken with regard to the location and need for the road, a trail, or future defined flood containment structures in this general reach, further survey and geotechnical evaluation of the existing road should be performed as an initial step toward bank stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed, while providing appropriate offsets for any resulting impacts affecting properties enrolled in the Farmlands Preservation Program. Reconstruct toe, slope and levee crest to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench.
22.74	22.84	L	Frager Road Upper: The road crest elevation is only one or two feet above landward grades. Landward areas are all farm properties enrolled in the Farmlands Preservation Program within the Lower Green River Agricultural Protection District,and are routinely inundated within the combined Mill Creek/Mullen Slough floodway of the Green River. Therefore, while the roadway itself locally confines the adjacent river and provides local access, it serves no overall flood containment function. This segment does not appear to have been modified from the natural riverbank with any previous structural modifications. Together with the Left Bank segment at River Mile 21, this segment provides a perfect example of long-term slope stabilization with natural riparian vegetation, involving no known prior construction of stabilization measures, and no history of maintenance costs or repair needs.	Monitor and maintain as needed. Include in future studies evaluating slope stability and vegetative interactions.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
22.84	22.92	L	Frager Road Upper: The roadway here is set back from the channel margins at a relatively modest overall slope angle along an inside bend. The road crest elevation is only one or two feet above landward grades. While overall geometry from the channel to the roadway is likely quite stable, midslope areas fall off steeply along the channel margins with episodic sediment deposits and slumping present. This may be exacerbated at the very downstream end of this segment, where a back-eddy feature may locally undermine the margins of the sediment deposits and accentuate slumping.	Monitor and maintain as needed. Consider restoration or mitigation use of the midslope and lower slope margins as needs and opportunities may present themselves. It is unlikely this segment will require structural remediation.
22.92	23.18	L	Frager Road Upper: The roadway here closely borders the crest of a moderately steep embankment. Residential homes and agricultural outbuildings closely border the landward margins along the downstream end of the road. The road crest elevation is only one or two feet above landward grades. Landward areas in the downstream half of this segment are all farm properties enrolled in the Farmlands Preservation Program within the Lower Green River Agricultural Protection District, while upstream agricultural and horticultural lands are located within the City of Kent. All these lands are routinely inundated within the combined Mill Creek/Mullen Slough floodway of the Green River. Therefore, while the roadway itself locally confines the adjacent river and provides local access, it serves no overall flood containment function. This segment does not appear to have been modified from the natural riverbank with any previous structural modifications. The riverbank, is subject to pervasive and repetitive slumping throughout. To date, these slumps do not appear to have affected the roadway itself, but recur here and there throughout the lower and midslope areas. Slumping is especially pronounced near the upstream end of this segment, just downstream from the Washington Avenue South Bridge.	The structural stability of the road and any associated local flood containment functions is questionable at present. Depending on decisions taken with regard to the location and need for the road, a trail, or future defined flood containment structures in this general reach, further survey and geotechnical evaluation of the existing road should be performed as an initial step toward bank stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed, while providing appropriate offsets for any resulting impacts affecting unincorporated King County properties enrolled in the Farmlands Preservation Program. Reconstruct toe, slope and levee crest to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
23.41	23.71	L	Koch/Corps Revetment/Bradley: This short reach along an outer bend is defined by three individual bank stabilization locations apparently constructed separately at different times in the distantly fading past. The downstream third of this composite reach consists of the Koch Revetment, which borders the farmhouse occupying the Dahlia Farm segment just downstream. The middle third of this reach is defined as the Corps Revetment, and borders a short segment of the West Valley Highway located immediately at the top of the very steep embankment present. The road is barely raised above adjacent grades, and is bordered by small farms along the margins of the combined Mill Creek/Mullen Slough floodway of the Green River. Recent flood studies have shown both the roadway and the adjoining paroperties just at or below the 100-year water surface elevation here. The upstream third of this reach is named Bradley, and borders a residential home with scattered outbuildings and a small farmed plot of floodplain. All three riverbank features are markedly steep. The central portion along the highway includes variously sized concrete rubble along with the rip-rap rock armor also visible in the other two features.. Despite the apparent longevity of the features here, erosion and undercutting of the toe rock is also visible in places, especially in the upstream and downstream portions. Overall stability is certainly in question.	Depending on decisions taken with regard to the location and need for the road or future defined flood containment structures in this general reach, further survey and geotechnical evaluation of the existing road and riverbank should be performed as an initial step toward bank stabilization. Previous discussions with the City of Kent have included some consideration of including adjoining properties in a larger restoration effort now underway just upstream, at the mouth of Mill Creek. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
23.71	23.8	L	Mill Creek Restoration Site: This segment includes the mouth of Mill Creek and extends along a more or less densely vegetated riverbank extending upstream to the State Route 167 Bridge abutment. It is highly likely that the embankment was structurally modified at some point in the past, and the top of the slope supports what appears to be a modestly raised berm. No known flood management structure is documented here, however. The adjoining site has been acquired by the City of Kent, and is intended to be modified through floodplain excavation and revegetation to serve as an off-channel floodplain restoration project funded in part by the State of Washington's Salmon Recovery Funding Board. These areas are part of a much larger extent of flood-prone areas affected by Green River flood flows exiting the Mainstem Green River channel and flowing "upstream" at the mouth of Mill Creek into the combined Mill Creek/Mullen Slough floodway of the Green River. Several residential homes border Mill Creek and the proposed restoration site, and the mapped 100-year floodplain extends southerly along both State Route 167 and the West Valley Highway, south of South 262nd Street. This reach provides no flood containment function. The extent to which the proposed restoration efforts may eventually modify the riverbank has not yet been determined.	Monitor and maintain as required. Any future actions taken here need to be fully coordinated with the City of Kent's Salmon Recovery Funding Board project outcomes on adjacent properties.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
13.23	13.78	R	Nelson / N.C. Machinery / SR-181: Industrial and commercial buildings, parking lots, and equipment storage areas occupy a small inside meander bend. Riprap repairs have been made to the river bank at the upstream end of this segment. . A few narrow floodplain benches are present, but most of the segment is characterized by older riprap Slope stabilization is discontinuous, the toe structure is highly questionable, and highly visible, intermittent sediment deposition, bank erosion and slumping are present. Except for a few isolated trees, a narrow band of native riparian trees and shrubs downstream from the railtoad bridge, some of which have recently been toppled into the channel, and a row of Lombardy poplars at the very downstream end of this segment, the bank vegetation consists almost entirely of a blackberry-reed canary grass biculture. A railroad bridge with concrete abutments bisects the reach at RM 13.35. Although it is not within the mapped 100-year floodplain, localized shallow flooding has previously been observed just upstream from the railroad bridge,and along SR 181 near the downstream end here. No uniform flood containment or freeboard elevation is present. These areas and sites to the east and north across from SR-181 may therefore be at risk for flooding during the 500-year event, based on recent estimated by the Corps of Engineers that the storage reservoir at Howard A. Hanson Dam may not be able to control flow releases for events larger than the one-in-140-year event. (Green River, City of Tukwila)	. To the extent that embankment stability and 500-year flood risk management policy decisions may require levee modifications to protect other uses in affected floodplain areas, survey and geotechnical evaluation of the river embankment should be performed as an initial step, and a plan for stabilizing the riverbanks defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties and easements as needed, and as conditions and funding may allow. Reconstruct toe and slope to stable configuration with fully bioengineered solution, preferably including a vegetated midslope bench.. Provide a uniform riparian buffer. Reconstruct a raised levee crest to design flood and freeboard elevation as defined

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
13.78	14.48	R	State Route 181 / West Valley Highway: The state highway here performs the levee containment function, even though it is not a formal part of the levee system. No easements or agreements exist with the State of Washington Department of Transportation to operate the roadway as a part of the flood containment system, or for the County or the Flood District to manage this function here. That said, several portions of the reach include vertical steel walls along the upper margins of the riverbank to support the road grade, and roadway elevations are generally high enough to confine 100-year flows. Questions remain however about the ability of the roadway to serve as a containment system for floods up to the 500 year event, with appropriate freeboard. Therefore areas to the north and east may be at risk of flood inundation, based on recent estimates by the Corps of Engineers that the storage reservoir at Howard A. Hanson Dam may not be able to constrain flow releases from the dam for floods exceeding the one-in-140-year event. Based on current FEMA floodplain mapping standards, a Preliminary Digital Flood Insurance Rate Map prepared as part of the 2006 Green River Flood Study includes much of this area within a mapped floodway of the Green River. As FEMA is currently considering revisions to its levee evaluation procedures, revisions to this mapping result may be forthcoming in the near future.	Clear establishment of flood and highway management responsibilities here is essential to flood risk mitigation planning and actions. Depending on policy decisions to maintain historic containment of 500-year flooding in the lower Green River valley, additional levee containment and freeboard elevation increases may in fact be required as well, based on newer estimates of 500-year flows now being confirmed by the Corps of Engineers. To resolve these concerns and questions, interlocal agreements will need to be negotiated between the Washington DOT, the City of Tukwila, King County, and the Flood District to define roles, responsibilities, and mutually agreed-upon outcomes. To the extent that embankment stability and 500-year flood risk management policy decisions may require levee modifications to protect other uses in affected floodplain areas, survey and geotechnical evaluation of the river embankment should be performed as an initial step, and a plan for stabilizing the riverbanks defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties and easements as needed, and as conditions and funding may allow. Reconstruct toe and slope to stable configuration with fully bioengineered solution, preferably including a vegetated midslope bench. Provide a uniform riparian buffer. Modify the roadway and reconstruct a raised levee crest to design flood and freeboard elevation as defined. A separate levee structure may be required.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
17.86	19.27	R	Russell Road Lowest / Holiday Kennel / Russell Road Lower: This segment is severely confined almost throughout by the close proximity of Russell Road S to the top of bank. Steep banks and slumping an issue in this reach.	Setback the Levee, Road, and Trail to a minimum stable slope inclination of 3H:1V, and integrate them into an overall solution meeting the design standards and performance requirements for each. Acquire all lands needed to this end,. Additional survey and geotechnical evaluation of the river embankment should be performed as an initial step, and a plan for stabilizing the riverbanks defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Evaluate bank stability with a geotechnical study. Define slope stability and structural needs. Acquire properties and easements as needed. Provide a uniform riparian buffer. Reconstruct a stable levee toe, and a fully stabilized, bioengineered slope, preferably including a fully vegetated midslope bench.
22.06	23.18	R	Signature Pointe Lower / Signature Point Upper / County Road #8: This mostly armored revetment segment extends from the State Route 516 Bridge at the downstream end up to the Washington Avenue Bridge at its upstream end. A sharp inner meander bend is wholly occupied by the Signature Pointe Apartments. The toe structure is questionable throughout these steeper areas and historical slumping has occurred.	New estimates of 500-year flow elevations may require addition of freeboard in this reach. Recognizing that large-scale slope failures have been in evidence along both the upper and lower segments of this reach, any additions of freeboard should also address a reconstruction of the steeper slopes present, targeting stable slope geometries based on studies of soil strength properties and river scour depth potentials. Additional survey and geotechnical evaluation of the river embankment should be performed as an initial step, and a plan for stabilizing the riverbanks defined in concert with riparian buffer restoration.
23.82	24.4	L	Kent Airport: Toe structure is questionable throughout. A significant slump has previously been observed in the upstream third of the site. Slopes remain steep and unstable, and no functional buffer is present. (Green River, City of Kent)	Riverward embankment slopes here should be carefully monitored. To the extent that slope settlement and deterioration of the levee embankment may become more problematic with time, survey and geotechnical evaluation of the river bank should be performed as an initial step toward slope and levee stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
.23.82	24.04	R	Milwaukee #1 / Foster Park: The original levee is steep and armored with older riprap, the toe structure is questionable, and localized bank erosion is visible in slumps dominated by reed canary grass and blackberries, with some scattered willows also present along the waterline. The trail along the crest of the old levee here shows cracking and settlement of the asphalt throughout, possibly indicating settlement or instability in the underlying levee embankment. The City of Kent has used funding provided by the Washington Department of Ecology to construct a "secondary" levee tied in to SR167 at its downstream end, along the southerly margins of South 259th Street, at the north end of the pond. This alignment leaves the detention pond on the riverward side of the levee containment structure.Neither the old levee along the riverbank or the new secondary levee provides freeboard above the currently estimated elevation of the 500-year flood, based on currently revised estimates from the Corps of Engineers.	Any investigations of the old levee here should include further survey and geotechnical evaluation of the existing trail and riverbank as an initial step toward bank stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and trail alignment to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench.
24.16	25.0	L	Wrecking Yards /78th Ave. S: Several existing and former wrecking yard sites adjoin either the steep riverbank or 78th Avenue So., along the steep, unstable riverbank, throughout the downstream 2/3 of this segment. The riverbank is steep and lacking any previous structural modifications downstream from the bridge. Littering and garbage dumping is a chronic issue here. Toe structure is questionable throughout. Localized erosion and slumps are visible. A modest depositional bench is present within the midslope areas near River Mile 24.73. Slumping near the upstream end of the roadway frontage has previously been observed, and was repaired with end-dumped rip-rap, in 1991. 78th Ave S may not provide adequate freeboard above newly estimated flow elevations for events exceeding the once-in-140-year event, including the 500-year flood elevation, or even above the 100-year base flood elevation. Based on the overall steepness of the road embankment, its long-term stability is highly questionable.	A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
25.1	25.22	L	Rent-A-Row Reach: No bank armor is visible. Some slumping is present. Green River floodwaters may not directly overtop the bank, but local flooding due to Northeast Auburn Tributary flows passing under East Valley Highway at the upstream end may affect these county-owned lands.	To the extent that existing structures at the southerly end of the site may be at risk due to revised estimates of 500-year flood elevations, now in preparation by the Corps of Engineers, they may require reconsideration or re-scheduling of potential actions within a more immediate time frame. Any flood management actions affecting lands enrolled within the Farmlands Preservation Program would need to fully provide for offsets to any impacts involved.
25.32	25.7	L	Carpinito Farm Downstream / Northeast Auburn Creek: This reach is characterized by steep natural banks along an outside bend. In the middle portions of this reach, slopes are extremely unstable and prone to channel migration and related erosion and slumping failures. Entire clumps of trees have caved into the river near RM 25.7, and with them, a former access roadway along the previous top of bank	Relocate deteriorating access roadway to landward to protect future King County trail corridor from bank erosion and channel migration, and to conserve productive agricultural soils with respect to channel migration hazards As part of the trail relocation and bank stabilization effort, replace non-compliant flood closure flapgate with fish-passable structure at the mouth of Northeast Auburn Creek and restore stream habitat with large woody debris and native tree and shrub plantings. Stabilize channel migration, regrade steep, failing riverbanks to stable angles of repose, excavate midslope benches/buttresses, and restore and stabilize mid-slope benches, riverbanks, and reconnected floodplain, side channel and wetland habitat areas with native riparian tree and shrub plantings.
26.9	27.3	L	Carpinito Farm Intermediate: This area is within a mapped Severe Channel Migration hazard Zone. Ongoing erosion of the central outer bend margins is evident, but appears to be progressing at a slower pace than elsewhere in the same overall river channel migration setting nearby.	Integrate any structural response to channel migration here with plans for recreational trail placement. Consider use of engineered log structures for control of ongoing channel migration, and include overall river channel morphology and dynamics in the design and placement of any structures thus determined. Integrate any such planning with consideration of appropriate setback relocations of the Green River Road Lower and Neilson revetments of the Lower Green River Road along the opposite bank in this reach.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
27.3	27.62	L	Carpinito Farm Upstream/Rubble Fill: This rapidly eroding and migrating channel segment adjoins the Carpinito Farm buildings, where the channel has moved over 175 feet to the west in the past 20 years, in a rapidly advancing and active outer meander bend. This segment is entirely within a mapped Severe Channel Migration Hazard Zone.	Several proposals have been advanced for addressing the pronounced meander bend development here, with respect to its impacts on the County's trail corridor and adjoining agricultural uses. Consider the entire context established by the dynamic river processes present, including the new floodplain being excavated by the river in response to controlled release of flows from Howard A. Hanson Dam over the past 50 years, and the contributing effects of the Mallory Revetment at the south 277th Bridge abutment along the opposite bank upstream. A long-term solution to accommodate this dynamism and corresponding habitat recovery and maintenance within the reach will be central to achieving the more localized goals of securing the trail corridor and protecting preserved agricultural soils from future erosion.
27.63	28.22	L	Reddington Extension / Green River Trail Corridor / Port of Seattle: The reach is entirely within a mapped Severe Channel Migration Hazard Zone, and channel migration has advanced over 150 feet into the reach along a broad outer bend over the past twenty years. Active bank erosion and undercutting is ongoing, and is particularly evident at River Mile 27.85.	Implement the Second phase of the Reddington Levee Extension Project, to include negotiation of future easements affecting the Port of Seattle property. Construct a setback levee. Modify the margins of the river channel with placement of wood structures to interact with flows and stabilize the remaining riparian corridor against destructive loss of property potentially affecting the new levee structure. Restore and re-plant the entire riverward corridor area.
28.5	28.6	L	Labrador Spoils Pile: An existing 3 acre capped pile of pesticide-contaminated soil abuts the alignment of the proposed Reddington Levee Setback and Extension project, which is designed to protect the area, including the spoils pile, from flood flows and damages.	Remediation or removal of the contaminated soil would reduce the risk of pesticide migration to the river, and could facilitate further setback of the levee alignment.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
26.5	28.43	R	Titus Boat Ramp / Titus Pit / Green River Road Lower/ Neilson / Mallory / Malnati The road embankment along the river is uniformly steep, unstable, eroding, slumping, covered with deteriorating and undercut riprap. The toe structure is highly questionable throughout these road locations. A poorly functioning flood closure structure is present at the outlet of the culvert discharging tributary flows from the Cooter Pond wetlands to the river under the roadway near River Mile 27.28. A common feature of all the road revetments is that they appear to be involved in deflecting flows downstream and across the channel, and are likely involved in the development and progression of active bank erosion and channel migration in affected locations. The depositional bends between the road revetments show clear evidence of meander advance, and can be characterized as new river floodplains formed in response to altered flows resulting over the past 50 years form active management of flood peaks by Howard A. Hanson Dam.	The flood closure system at the Cooter Pond outlet should be upgraded and reconstructed with a fish-passable closure device, and a backup closure in a flood accessible manhole structure. To the extent that road shoulder embankments may continue to deteriorate, riverward embankment slopes here should be carefully monitored. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and roadway to a stable configuration with a fully bioengineered solution, preferably including a midslope bench. Establish a uniform riparian buffer with native vegetation.. A long-term solution to accommodate this dynamism and corresponding habitat recovery and maintenance within the reach will be central to achieving the more localized goals of both securing the roadway on the right bank, and the levee and trail corridor and agricultural soils across the river from future erosion.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
28.45	30.0	R	Auburn Golf & Olson / Isaac Evans Park / Valentine's Road Protection: Portions of the roadway near the downstream end of the golf course have previously been closed due to flooding, and extensive flooding is frequently present throughout much of the golf course. Flooding affects large areas of the Isaac Evans park where this older confinement system has been breached for recreational beach access to the river. The roadway and adjoining residential areas just upstream from the golf course and landward from the park may be at risk of flooding for river elevations exceeding the newly estimated once-in-140 year flood, including newly calculated 500-year flood levels.	To the extent that road and residential areas may be found to be at risk of flooding for larger future flood events, a uniform containment system defining the margins of the residential area could be proposed in this reach. This might entail raising of the Green Valley Road and an accompanying berm along the upstream margins of the golf course. To the extent that road shoulder embankments may continue to deteriorate, riverward embankment slopes here should be carefully monitored. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and roadway to a stable configuration with a fully bioengineered solution, preferably including a midslope bench. Establish a uniform riparian buffer with native vegetation. The densely vegetated older levee structure within Isaac Evans Park might also serve as an element in future analysis of the effects of vegetation of levee and slope stability, as it has likely been present since the early portions of the 20th Century.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
30.18	30.4	R	104th Road Protection / 30.5 Road Protection: The 104th Avenue Southeast roadway here is placed right at the top of a steep rock armored riverbank. The road has no shoulder in the majority of this segment, but is bordered with a jersey barrier set right at the edge of the riverbank. A dense growth of vigorous immature alders and willows occupies most of the riverbank.	To the extent that road shoulder embankments may continue to deteriorate, riverward embankment slopes here should be carefully monitored. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and roadway to a stable configuration with a fully bioengineered solution, preferably including a midslope bench. Establish a uniform riparian buffer with native vegetation.
29.5	29.68	L	Galli's Section: Nearly the entire reach adjoins residential properties, with a mix of single and multifamily homes present. Where rip-rap armor is present, as between RM 29.54 and 29.75, and again between RM 30.1 and 30.85, it is frequently over steepened, with localized erosion, and toe structure is questionable throughout. The exceptions here are limited to several local areas where the levee was reconstructed with large toe buttress rock, large woody debris deflectors, and with willow and dogwood cuttings installed in live geogrids.	Feasibility and technical analysis required.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
29.49	29.68	L	Galli's Section: This entire flood management structure was repaired in-situ by the Corps of Engineers in 2008 for $2.8 Million. Initial placement of broken boulders for use as large armor rock proved problematic, and led to dislocation of some face armor during flooding in 2009, which was subsequently re-built. Several anchored logs were included in places along the reconstructed rock toe. Two layers of willow cuttings were included along the waterline, within the rip-rap armor facing layers. While these efforts have no doubt improved toe stability and scour resistance along the bank, the proximity of the existing homes has precluded a reconstruction of the riverbank to a flatter slope angle more in keeping with long-term slope stability requirements based on underlying soil strength limitations.	The underlying limitations posed by soil strength limitations will require that access areas along the top of bank be closely monitored for indications of deeper seated slope instabilities. To the extent that future deterioration of these slopes may become problematic, further survey and geotechnical evaluation of the existing road and riverbank should be performed as an initial step toward bank stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench.
29.68	30.8		Dykstra: Portions of the Dykstra Levee from RM 30.0 to 30.2 were repaired in-situ by the Corps of Engineers in 2008 for $1.6 Million. Several anchored logs were included in places along the reconstructed rock toe. There are two active, vegetated mid-channel bars near RM 30.2, which recruit natural large woody debris deposits, and which may influence flow direction and velocities affecting the Dykstra Levee. In addition, a low spot in the levee near River Mile 29.87 was raised by King County in 2009 to provide a uniform freeboard elevation at least two feet above the 100-year flood elevation. Substantially more freeboard is present in upstream areas near River Mile 30.6, and several earlier repairs dating the 1990's are present in upstream levee areas as well.	The underlying limitations posed by soil strength limitations will require that access areas along the top of bank be closely monitored for indications of deeper seated slope instabilities. To the extent that future deterioration of these slopes may become problematic, further survey and geotechnical evaluation of the existing levee crest and riverbank should be performed as an initial step toward more robust levee embankment stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
30.8	30.9	L	Lone's 3rd Addition: Long term stability of the riverbank remains questionable, especially with these practices present. Since adjacent homes were constructed about one foot or so above the estimated 100-year flood elevations, no freeboard is provided for levee containment here. Homes may therefore be at risk for newly estimated 500-year flood events, based on current estimates by the Corps of Engineers that Howard A. Hanson Dam may not be able to contain flooding for events larger than the one-in-140-year flood.	To the extent that future deterioration of these slopes may become problematic, further survey and geotechnical evaluation of the existing levee crest and riverbank should be performed as an initial step toward more robust bank stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench.
30.9	31.08	L	Downstream From Porter Bridge Left: No flood management structures are present in this segment. Adjacent apartment buildings and residential homes are raised just above the 100-year flood elevation, but no freeboard allowance is provided. Homes may therefore be at risk for newly estimated 500-year flood events, based on current estimates by the Corps of Engineers that Howard A. Hanson Dam may not be able to contain flooding for events larger than the one-in-140-year flood.	To the extent that future flood containment needs are identified within this segment, as may be likely to secure downstream areas with consistent freeboard provisions, design flood and freeboard elevations should be defined. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Construct toe, slope and levee crest to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
30.4	31.09	R	Porter Bridge / Pig Farm: The Porter Bridge Levee at the upstream end is discontinuous, with homes built right down to the base flood elevation in the middle portions of this segment. Slopes are steep, toe structure is questionable, and flood closure and freeboard is discontinuous or absent. Residential homes may be at risk of inundation during the 500-year flood event, based on current estimates by the Corps of Engineers that Howard A. Hanson Dam may not be able to contain flooding for events larger than the one-in-140-year flood.	Based on concerns with future deterioration of the levee structure here, or with decisions to provide residential areas in this reach with 500-year flood confinement plus freeboard, acquisition of one or two homes near the upstream end of the Porter Levee may allow for it to be set back to a more stable angle and integrated with a raising of 102nd Avenue Southeast. A continuous containment structure could then be sited along the same setback corridor used for placement of temporary flood containment "Supersack" levees in 2009, which would then continue to the east along the southerly margins of the Pig Farm open space and tie into the hillside or a raised portion of 104th Avenue Southeast at its downstream terminus.
30.09	33.26	R	North Green Valley Wall: Just upstream from 8th St NE, several single-family homes are located along the top of bank. These homes may be at risk of flooding for newly calculated flow events larger than the once-in-140 year event, including newly estimated 500-year flow elevations.	To the extent that long term risk reduction may be desired for homes potentially at risk for newly estimated flood elevations corresponding to the 500-year event, the feasibility of their raising, floodproofing, or acquisition and removal should be evaluated. Acquiring homes nearest the bridge might also allow for staging emergency equipment as needed to remove any future log accumulations potentially affecting the structure.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
31.12	31.33	L	Matson /Barnett /Porter Gauge /Auburn Residential: A series of idiosyncratic, individual attempts at bank protection are present in this reach, especially just upstream from the Porter Bridge (8th St. NE Bridge, Lea Hill Bridge). These use varying elements such as rip rap, concrete blocks, and concrete rubble, usually placed at near-vertical slope angles. . Any toe structures present are highly questionable. The Green River's Auburn Gauge is also in this reach, and is secured by a County-maintained revetment (Porter Gauge Though floodwaters do not appear to overtop the yards in this segment, no raised freeboard structure is provided. Homes may therefore be at risk for newly estimated 500-year flood events, based on current estimates by the Corps of Engineers that Howard A. Hanson Dam may not be able to contain flooding for events larger than the one-in-140-year flood.	To the extent that future deterioration of these slopes may become problematic, or the need for enhanced levels of flood containment and freeboard become evident within this reach, further survey and geotechnical evaluation of the existing levee crest and riverbank should be performed as an initial step toward more robust bank stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench.
33.41	34.61	L	Porter /Neely: The entire Porter site is subject to flooding on a nearly annual basis, with higher flow events extending to the SE Green Valley Road and seeping up through the gravel shoulder to flow across the asphalt near the Green Valley Meats Company. The river in this reach shows active channel migration, with the Neely levee acting as a training levee here. Nearly the entire area" floods on a nearly annual basis. Toe buttress structure is questionable, overtopping of the Neely Levee is a repeated phenomenon, flood containment is not provided for intermediate flow events, and a functional vegetative buffer is not present.	Relocate deteriorating levees to the edge of the floodway within the adjoining agricultural areas at the Neely site, and to the Green Valley Road at the Porter site. Appropriate mitigation must be provided to offset any impacts to properties enrolled in the Farmlands Preservation Program. Address chronic roadway flooding and associated flooding of the Green Valley Meats site across the road from Porter. Restore old side-channel connections and re-activate the former channel migration areas. Restore and stabilize the aquatic edge of the channel with large woody debris installations, reconnect and restore isolated floodplain wetlands, and plant all disturbed areas with native riparian and wetlands vegetation, as appropriate.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
34.54	37.65	R	Horath / Kaech / Hamakami / Ross / Turley / Lone's: The Green River is bordered by several older levees and revetments which truncate a set of formerly active meanders along the margins of several agricultural properties that occupy the adjacent floodplain terrace. In other locations the bank is actively and rapidly eroding as at the Ross Farm near RM 36.15 at the Hamakami Farm near RM 35.7, and at the Lone's Levee near River Mile 37.5. Much of the old levee face and all of the armor has been eroded from the embankment at this latter location.. Bank stabilization of the active meander at the Hamakami flood protection facility was accomplished with installation of large woody debris and native riparian plantings. This location has subsequently developed extremely complex and natural large woody debris accumulations with multiple, highly dynamic side channels, active vegetated gravel bars, and extremely complex instream habitat. Burns Creek enters the Green River around the upstream end of the Loans Levee at the very upstream end of this segment. Overbank flooding is frequent in lower lying areas throughout this reach. The pattern of flooding is complex, and involves a network of older chanel alignments passing through the valley floor. Several residential structures are affected, most notably those just upstream from Hamakami.	Horath-Kaech Levee Setback and Floodplain Reconnection at RM 34.55 to 35.22: Relocate deteriorating levee to edge of agricultural area, restore side-channel connection, channel migration, aquatic edge, floodplain wetlands, and riparian habitat. Hamakami Levee Setback at RM35.28 to 35.7: Relocate deteriorating levee to edge of agricultural terrace, restore side-channel connection, channel migration, aquatic edge, floodplain wetlands, and riparian habitat. Turley Levee Setback at RM36.6 to 36.9: Relocate deteriorating levee to edge of agricultural terrace, restore side-channel connection, channel migration, aquatic edge, floodplain wetlands, and riparian habitat. Lone's Levee Setback at RM37.36 to 37.7: Relocate deteriorating levee to edge of agricultural terrace, restore side-channel connection, channel migration, aquatic edge, floodplain wetlands, and riparian habitat.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
34.62	35.06	L	Neely /Pre-1959: The levee embankment is very steep, and the levee crest is currently inaccessible to vehicles due to its overgrown condition. Flood mapping completed in 2006 to FEMA standards shows that flows are likely to proceed through areas landward of these substandard levees, including around the farm buildings and home, and then pass around the left bridge abutment at the downstream end.	Raising and reconstructing the existing access roadway in its current setback alignment would allow re-location of the existing levee landward, while retaining the existing toe structure location and the greater portion of the extremely healthy volunteer vegetation now present along the lower slopes of the existing levee intact. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and levee crest to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench.
38.2	40.06	R	Burns' Creek / Naglich / Cooke (Kruger) / Metzler-O'Grady: Overbank flows in this reach form a complex pattern of distribution within the floodplain to the north, with a significant portion passing across the Metzler Park area and private lands to frequently inundate portions of the Green Valley road where this adjoins Burns' Creek. Burns Creek itself distributes flows from higher stage events, shich exit the river into the creek channel near river Mile 39.7. This flooding is exacerbated by the presence of an active alluvial fan entering Burns' Creek from the valley wall and pinning the channel to the margins of the roadway with sediment deposits. Deposition and flooding in Burns' Creek also affect driveways crossing to residential homes and small farms at several locations. At least one additional home remains affected by fan building, in addition to the several driveways.	Middle Green Floodplain Acquisition: Monitor and maintain the home acquisition sites as restored natural riparian habitat. Consider purchase of at least one additional flood-prone property at the alluvial fan along Burns' Creek. Work with King County Roads division to set flooding and eroding portions of the Green Valley Road back from the stream margins, and raise the roadway over a series of box culverts to allow for safe passage of floodwaters under the roadway and across the Right-of –Way to the creek. Restore the stream margins as natural riparian habitat. Replace and raise affected driveways along the creek, downstream from the fan, to provide safe access to residential homes north of the creek and relieve pressure on dredging initiatives.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
40.27	41.2	R	Crisp Creek / Margerite Hansel / Meyer Dike / Imhoff / Whitney Bridge: Any major landslide that might occur here could easily re-direct flows right through this neighborhood. It is likely that under this scenario a new channel would be cut in the present location of Crisp Creek. Even though this may be considered a very rare event with only a small probability of occurrence, the hazards associated with any such occurrence would be severe. Absent any major potential channel altering events like this, flood flows are consistently contained within the channel , which is both relatively steep in gradient and modestly incised within its banks.	Perform a thorough geological and geotechnical evaluation of potential landslide risks along the hillside across the channel at the downstream end of this reach. Consider the magnitude and likelihood of potential slide events, and potential impacts on river channel conveyance and flow patterns in the floodplain along the opposite bank. Consider both upstream (backwater) and downstream impacts likely from the range of potential events considered. Determine alternative actions and a recommended appropriate course of action based on findings delivered. Perform a detailed site assessment of the condition of the older and infrequently maintained revetments present, and determine a long-term management strategy with respect to their continued maintenance, or abandonment.
40.1	440.2	L	Landslide Potential Reach: The river along the left bank flows right along the base of a steep, nearly vertical hillside that has previously produced small-scale landslides directly into the river channel. A major slide here is certainly possible, and would block the existing mainstem channel, similar to what occurred in the Elliot Reach of the Cedar River during a large earthquake. At this Green River location, this slide event would re-route the flows directly through a large-lot residential area immediately across the river, along Crisp Creek and the distributary inlet to Burns Creek, potentially causing extensive property damage and posing a potential safety threat to residents.	Perform a thorough geological and geotechnical evaluation of potential landslide risks along the hillside in this reach. Consider the magnitude and likelihood of potential slide events, and potential impacts on river channel conveyance and flow patterns in the floodplain along the opposite bank. Consider both upstream (backwater) and downstream impacts likely from the range of potential events considered. Determine alternative actions and a recommended appropriate course of action based on findings delivered.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
40.2	42.2	L	Newaukum Creek /Green River Waterway /Whitney Bridge / "Soapstone": The Newaukum Creek confluence is near the downstream end of this segment, forming a partial alluvial fan at the outlet of a small, densely wooded ravine. The downstream 2/3 of the fan has been restored as riparian habitat by King County, while cleared pastures extend uopstream. There do not appear to be any flood containment facility or actively maintained revetments in this reach, though older farming activity may have constructed some, now covered with trees and brush. Floodwaters do not appear to overtop the banks, as this reach is relatively straight, steep, and somewhat incised. Gravel bars are present, as are two prominent vegetated mid-channel bars downstream from the bridge, which recruit large wood deposits from time to time.	No defined mainstem river project is present in this reach, with the exception of maintaining the bridge abutments. The restoration area at the Newaukum Creek alluvial fan needs to be monitored and maintained as needed, especially with respect to minimizing flooding and fan-building episodes on the agricultural pastures just immediately upstream.
41.2	41.78	R	Whitney Bridge /Green Valley Road Protection: This short segment extends upstream from Whitney Bridge past another portion of the replanted County Park property to the gravel shoulder along Green Valley Road. The bank here is steep, armored with rip-rap, and unstable. Flows are relatively high velocity and strike the road embankment at a sharp angle, with erosion present.	To the extent that continuing erosion of the rad shoulder embankment may become a concern here, further survey and geotechnical evaluation of the existing roadway and riverbank should be performed as an initial step toward more robust bank stabilization. A plan for stabilizing the riverbank should be defined in concert with riparian buffer restoration. Perform soil investigations and embankment surveys to define physical and structural parameters. Determine design flood and freeboard elevations. Evaluate bank stability with geotechnical study. Define slope stability and structural needs. Acquire properties as needed. Reconstruct toe, slope and roadway to a stable configuration with a fully bioengineered solution, preferably including a vegetated midslope bench.

GREEN RIVER (WRIA 9)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
42.2	42.3	L	Flaming Geyser Landslide: The river here forms a wide outer bend along the base of a steep, wooded hillside at the downstream end of Flaming Geyser State Park. The center of this segment is occupied by a landslide, covering perhaps three or four acres of hillside. Sediments from this slide are periodically released into the river, including a great deal of fine sediments which may impact spawning gravel quality and salmonid survival downstream. The slide mass is large enough, and active enough, that a complete blockage of the existing channel is quite possible. If this were to occur, the river would likely cut a new course through wooded, undeveloped parklands on the meander bend directly across the current channel from the slide location	Some previous interest has been expressed in managing the input of fine sediments from the slide here into downstream spawning areas. Though the scale of the slope stabilization measures needed would be quite substantial, simply isolating the base of the slide from undercutting along the channel margins may be somewhat helpful in this regard. This could be done by periodic replenishment of a wide berm constructed of sacrificial spawning gravels placed along the margins of the channel where the river intersects the toe of the slide deposits.
43.1	45.0	L	Flaming Geyser Left: Much of the riverbank within the State Park is covered with old rip-rap armored revetments, including portions along the road shoulder and a densely vegetated older rip-rap levee structure entering the picnic area. These revetments are steep, toe structure is questionable where it borders on the active flow area of the channel, , and local evidence of erosion and rip-rap dislocation is visible.	Several proposals for setback road reconstruction, channel restoration, and floodplain reconnection have been advanced here over the years. Bridge and road stability would be carefully considered and secured in any such proposal.

VASHON ISLAND (WRIA 15)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
N/A	N/A	N/A	Parcel Number 0823039006: This existing home has repeatedly experienced damage from flood events in King County. Repetitive damage to this structure was determined by FEMA based on existence of a flood insurance policy and claims paid by that policy. Based on the amount and number of claims that have been paid, this property is identified as being at high risk for future flood damage. (Vashon Island, Unincorporated)	Vashon Island Early Action Residential Flood Hazard Mitigation: Purchase and remove structure, or otherwise mitigate flood risks to repetitive loss properties. (Vashon Island, Unincorporated)
N/A	N/A	N/A	Parcel Number 0823039033: This existing home has repeatedly experienced damage from flood events in King County. Repetitive damage to this structure was determined by FEMA based on existence of a flood insurance policy and claims paid by that policy. Based on the amount and number of claims that have been paid, this property is identified as being at high risk for future flood damage. (Vashon Island, Unincorporated)	Vashon Island Early Action Residential Flood Hazard Mitigation: Purchase and remove structure, or otherwise mitigate flood risks to repetitive loss properties. (Vashon Island, Unincorporated)

WHITE RIVER, GREEN WATER RIVER AND RED CREEK (WRIA 10)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project

WHITE RIVER, GREEN WATER RIVER AND RED CREEK (WRIA 10)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
6.40	6.60	L	A-Street Bridge Channel Constriction: The channel is constricted by reveted banks that narrow the flow area into and through the bridge opening. Buffers are degraded, resulting in a lack of cohesive vegetation which may reduce erosion protection on the bank face and overbank areas. (White River, City of Auburn)	Bridge is within jurisdiction of and maintained by the City of Auburn. Adjacent bridge is owned by Burlington Northern Santa Fe Railroad. King County could potentially partner with other jurisdictions, agencies and organizations on a project to address potential flood risks in this location. Feasibility and technical analysis required.
22.40	22.45		SR 410 Bridge at Enumclaw Potential Scour: The SR 410 bridge lies within the historic active channels area indicating some potential for exposure to erosive flows and channel migration. Overtime, the flow constriction through this bridge may result in abutment scour. The channel is constricted by the bridge; however, no known significant scour problems are evident at this time. (White River, Unincorporated)	Bridge is within jurisdiction of the City of Buckley and unincorporated King County, but owned and maintained by the Washington State Department of Transportation. King County could potentially partner with other jurisdictions, agencies and organizations on a project to address potential flood risks in this location. Feasibility and technical analysis required.
23.90	24.10	R	Kahne Levee Potential Overtopping: The river flows directly into the north valley wall bluff and impinges perpendicularly into this rock levee built in 1974. The county maintenance file indicates repetitive maintenance at this site prior to the 1990's. The upstream end of the flood protection facility protects the toe of the bluff upon which lies Mud Mountain Road. The downstream end is now the Hatchery Levee, not a county flood protection facility, that levee protects the upper portion of the White River Fish hatchery property. During the 1995/96 flood event, an emergency sandbag effort was conducted to block off flows that threatened to overtop the levee. An existing wall base channel and historic floodplain channel lie in the right overbank, landward of the hatchery levee. (White River, Unincorporated)	Feasibility and technical analysis required. The best solution here may be to consider abandoning this facility and allowing the State to take over ownership of the facility.
45.60	45.65	R	Slippery Creek Bridge Flow Blockage: The abandoned concrete highway bridge the crosses Slippery Creek lies remains in place but the 1995 and 1996 flood events destroyed the commercial building on the right bank of Slippery Creek on the upstream side of the bridge. The old bridge is an obstacle, causing sediment and debris to block the bridge's small clearance area and potentially directing flood flows onto SR 410. Also, the mainstem of the White River is immediately adjacent to SR 410. (White River, Unincorporated)	Bridge is within jurisdiction of unincorporated King County but lies within State right-of-way. Bridge should be removed from the floodplain and restoration options considered. Feasibility and technical analysis required.

WHITE RIVER, GREEN WATER RIVER AND RED CREEK (WRIA 10)

DS RM	US RM	Bank	Flood or Channel Migration Risk	Proposed Project
39.00	45.80	R	SR410 Channel Encroachment: The road alignment of SR410 encroaches into the channel and floodplain area of the White River in several locations along this reach above Mud Mountain Dam. Protection measures, (i.e. rock riprap) have been implemented by Washington State Department of Transportation following major flood events, most recently in 1995 and 1996. The rock placement impacts channel habitat and is not a permanently solution to the actively migrating channel. (White River, Unincorporated)	The Washington State Department of Transportation has SR 410 right-of-way ownership along the White River. Pierce County FHMP has identified the need to address flood risks at approximately River Mile 43. King County could potentially partner with other jurisdictions, agencies and organizations on a project to address potential flood risks in this location. Feasibility and technical analysis required.
0.05	0.10	L, R	SR410 Bridge Debris Blockage: The SR 410 bridge has a center pier which has repeatedly accumulated log jams. In the flood of record in 1977, the debris blockage at the bridge caused a backwater condition that flooded and damaged buildings in the Greenwater community. Some maintenance work has been completed by Washington State Department of Transportation to place a concrete scour pad around the channel and the center pier, however, debris accumulation during flood events is still likely and could cause flooding of SR410 and the adjacent commercial and residential structures. Although the scour pad protects the pier from being undermined, pool habitat in the bridge area was eliminated. (Greenwater River, Unincorporated)	Bridge is owned and maintained by the Washington State Department of Transportation. King County could potentially partner with other jurisdictions, agencies and organizations on a project to address potential flood risks in this location. Feasibility and technical analysis required. A more comprehensive, multi-objective project may be possible should the county acquire the parcels at the confluence of the White and Greenwater Rivers.