3.10 FLOODPLAINS

This section addresses floodplains, floodplain attributes, functions, existing conditions, and potential impacts to floodplains resulting from the I-405 Corridor Program. Impacts to fish and aquatic habitat are discussed in Section 3.8. Impacts to wetland habitats are discussed in Section 3.6.

3.10.1 Studies and Coordination

Floodplains are lowlands that are relatively flat and are subject to flooding in any given year. The 100-year floodplain is defined as the area adjacent to a stream or lake that is subjected to inundation by waters having a flood probability in exceedence of one percent in any given year, as determined by standard statistical and hydrologic methods. The 100-year flood is a statistical concept to describe, over the long term, how frequently a “100-year” size flood event occurs; in the short term, a 100-year flood may occur more frequently.

Floodplains are divided into three parts: the Federal Emergency Management Agency (FEMA) floodway, the zero-rise floodway, and the flood fringe. The FEMA floodway is the channel of a river or other watercourse and the adjacent land areas that must be unconfined or unobstructed either vertically or horizontally to provide for the discharge of the base-year flood. The zero-rise floodway is that portion of the floodplain outside the floodway that is inundated by floodwaters and in which encroachment is permissible as long as it doesn’t change the flood storage volume or flood elevation. The flood fringe is that portion of the floodplain that tends to collect standing water rather than rapidly flowing water. Development in the FEMA floodway is to be avoided, and structures in the remainder of the floodplain and the flood fringe should be avoided or minimized. In cases where the FEMA floodway is relatively narrow, it can be spanned by a bridge to avoid impacts.

Counties and cities in the region bear the primary responsibility for the regulation of activities in floodplains. Comprehensive plans seek to reduce the number of people exposed to flood hazards by designating major river floodplains primarily for low-density agricultural and other compatible uses. The intent of this approach is to protect public safety and reduce long-term public costs and damage to the environment. The 100-year floodplain is designated as a flood hazard area in sensitive area ordinances.

3.10.2 Methodology

FEMA flood insurance rate maps for King and Snohomish counties were used to identify 100-year floodplains on the major rivers, lakes, and streams for the study area. Much of this information is in the King County GIS database and was available to plot as an overlay on maps of each of the alternatives. Because revisions to some of the FEMA maps have been made since the King County database was developed, maps that were revised since 1995 were inspected to see if changes in the 100-year floodplain had been made in the study area. Locations where proposed transportation improvements and the 100-year floodplains intersected were then evaluated using conceptual plans and USGS 7.5-minute topographic maps so that the potential impacts could be estimated in terms of linear feet of floodplain.

In this evaluation, floodway refers to the designated FEMA floodway, and floodplain is the remainder of the mapped floodplain that is assumed to be equal to the zero-rise floodway. In King County, flood fringe impacts are inside the mapped floodplain and difficult to estimate accurately without a survey and plans, so these specific impacts have not been quantified.

Floodplains for minor streams, wetlands, and closed depressions are not mapped, but according to King County code, they should be determined on an individual project basis. Impacts to these minor floodplains are not included in this study.

In addition to review of the FEMA maps, individual jurisdictions' sensitive areas ordinances were examined in order to gain an understanding of the local controls in effect for floodplain management.

It is expected that all projects would avoid floodway areas. Any projects passing through a floodplain would meet each of the local jurisdiction and FEMA requirements for locating in the floodplain, such as no obstruction in the floodway that would raise the flow height above the zero rise of the flood elevation.

The park-and-ride and transit center alternatives were not evaluated since sites have not been selected. It is assumed that these projects would be developed in full conformance with local floodplain and sensitive areas ordinances.

The floodplains analyses in this section are based on the *I-405 Corridor Program Draft Floodplain Expertise Report* (DEA, 2001), herein incorporated by reference.

3.10.3 Affected Environment

The following sections describe the floodplains located in the study area, and address the floodplains' attributes and functions and the existing conditions in the study area.

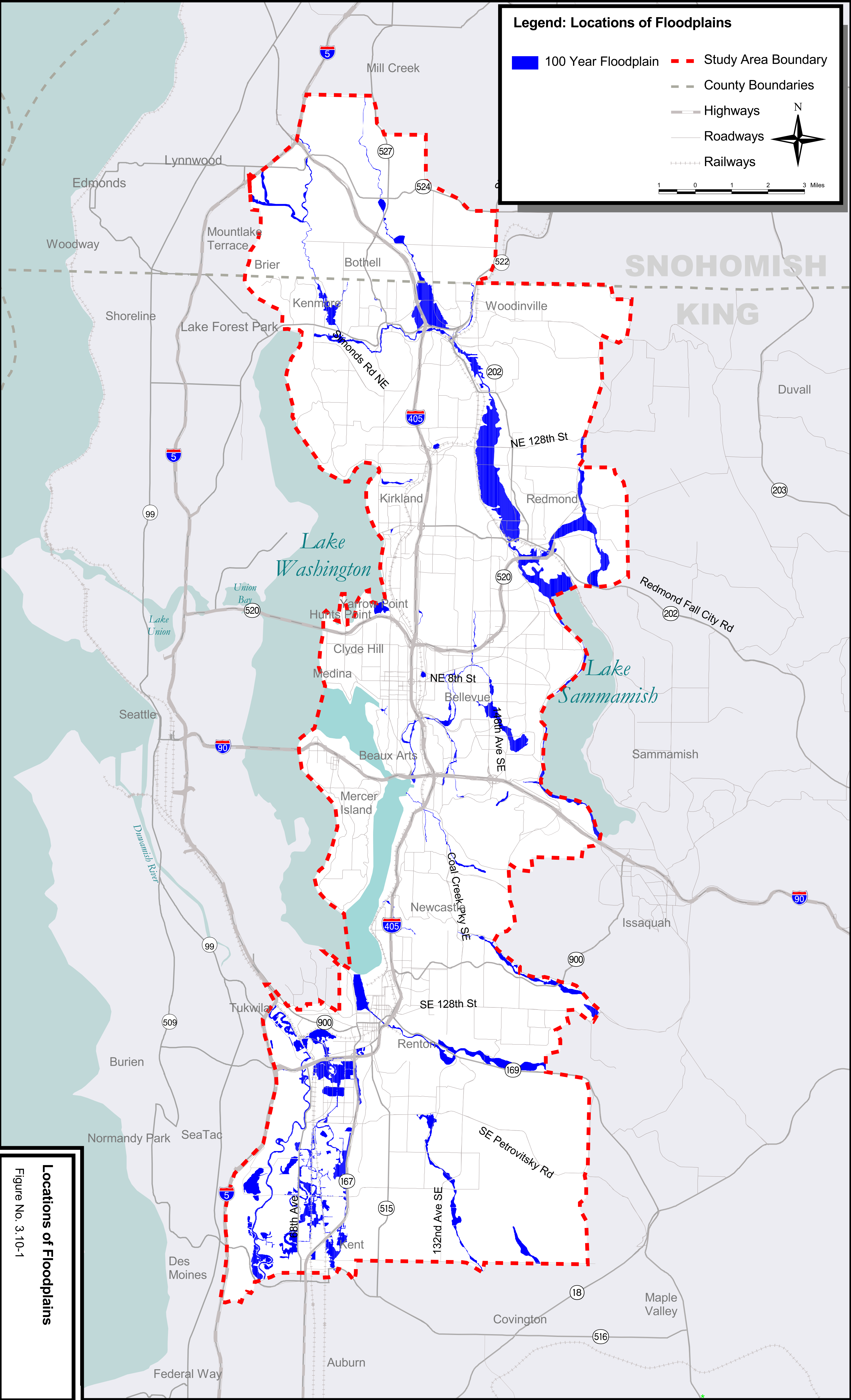
3.10.3.1 Floodplain Attributes and Functions

Floodplains have many important functions. The primary feature is that they carry peak flows of the river or creek. Floodplains allow a river to increase in width to carry the peak flow, reducing the velocity and resulting in less erosion. They also provide an area for deposition and renewal of sediment during flood events. Commonly, wetlands develop in the floodplains due to the silty soils and lack of drainage back to the river or creek. Floodplains are frequently riparian zones with large trees that provide shade and habitat. Even if the floodplain is grassland or pasture, it provides habitat for birds and small mammals. Other sections of this EIS provide more information on the ecological functions provided by floodplains:

- Wetlands, Section 3.6
- Wildlife, Habitat, and Upland Threatened and Endangered Species, Section 3.7
- Fish and Aquatic Habitat, Section 3.8

3.10.3.2 Floodplains and River Systems

Within the project study area there are 18 floodplains that are either crossed or are adjacent to I-405, potential high-capacity corridors, and the arterials being evaluated by this analysis (Figure 3.10-1). In situations where the floodway area of the floodplain is crossed, the floodway would be spanned or bridged so that flows are not impeded. In the Snohomish County portion of the study area, Swamp Creek, Bear Creek, and North Creek each have 100-year floodplains that are crossed by roadways. In the northern part of the study area in King County, North Creek, Swamp Creek, Bear Creek, Little Bear Creek, Evans Creek, the Sammamish River, Kelsey Creek, Mercer Slough, Tibbetts Creek, and Richards Creek, all have 100-year floodplains that are near major roadways or are crossed by bridges. In the southern portion of the study area, Big



Locations of Floodplains

Figure No. 3.10-1

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Soos Creek, May Creek, Tibbetts Creek, Springbrook Creek, the Green River, the Duwamish River, and the Cedar River have 100-year floodplains that are near roadways or are crossed by bridges. Over the years, as information about the location and importance of floodplains has increased, roads have been designed to avoid the floodway and ensure a zero-rise of the flood elevation. Table 3.10-1 lists the floodplains that are currently crossed or are adjacent to highways and/or arterials in the study area.

Table 3.10-1: Floodplains Crossed or Adjacent to I-405 and Arterials in the Study Area

Floodplain	Roadway
Swamp Creek	Crossed by NE Bothell Way
North Creek	Crossed by I-405, SR 522, NE 195th Street, and Bothell Everett Highway (SR 527)
Sammamish River	Crossed by I-405 and SR 520 Adjacent to NE Bothell Way and SR 522 Crossed by NE 124th Street, NE 175th Street and NE 145th Street (SR 202)
Bear Creek and Little Bear Creek	Adjacent to and crossed by Avondale Road Adjacent to and crossed by Redmond – Fall City Road Adjacent to SR 520
Evans Creek	Adjacent to and crossed by Redmond – Fall City Road
Kelsey Creek	Crossed by Lake Hills Connector, NE 8th Street, 148th Avenue NE Adjacent to SE 8th Street and Bellevue-Redmond Road
Mercer Creek	Crossed by I-90 and I-405 Adjacent to Bellevue Way SE and SE 8th Street
Richards Creek	Crossed by I-90 Adjacent to Richards Road
Coal Creek	Crossed by I-405 Adjacent to and crossed by Coal Creek Parkway
May Creek	Crossed by I-405 Crossed by Lake Washington Boulevard N, Coal Creek Parkway, and SR 900
Tibbetts Creek	Adjacent to and crossed by I-90
Green River	Crossed by I-405 and SR 516 Crossed by Southcenter Blvd., Interurban Avenue, and S 180th Street Adjacent to West Valley Highway
Cedar River	Crossed by I-405 Crossed by Logan Avenue and Bronson Way Adjacent to and crossed by Maple Valley Road
Rolling Hills Creek	Adjacent to Interchange of I-405 and SR 167
Springbrook Creek	Crossed by I-405 Crossed by Grady Way and SW 43rd Street Adjacent to and crossed by SR 167
Mill Creek	Crossed by SR 167
Unnamed Flood Area	Adjacent to I-405 east of I-5
Duwamish River	Crossed by I-5 Adjacent to Interurban Avenue
Issaquah Creek	Crossed by I-90
Black River	Crossed by Monster Road SW

The major rivers in the study area have been channelized as development has occurred in the floodplains. These rivers typically have levees along both banks and limited amounts of existing floodplains in the project area. The exception is the Sammamish River, which still has a large undeveloped floodplain in the project area. All roadways would cross these major rivers on bridges with few or no piers in the floodway. These major rivers include Duwamish River, Green River, Cedar River, and Sammamish River.

Some of the creeks have been channelized, but they do not have levees as extensive as the major rivers. Most of the large floodplains in the project area are due to these creeks. Major roadways such as I-405 typically have bridge crossings of major creeks; however, there are some large culverts. Arterial roadways have both bridge and culvert crossings. These creeks include Springbrook Creek, Mercer Creek, North Creek, and Bear Creek.

Some of the creeks are still fairly natural channels with little channelization and few or no levees. These creeks have larger floodplains where the ground is level and little floodplain where the creek is in a ravine. Most roadway crossings are currently in culverts, although some, such as I-405 and Lake Washington Boulevard over May Creek, are bridges. These creeks include Rolling Hills Creek, May Creek, Coal Creek, Kelsey Creek, Evans Creek, and Swamp Creek.

3.10.4 Impacts

If a river or creek is crossed by a bridge or a culvert, the floodway may be reduced. In a narrower floodway, the meandering zone could be lost and water velocities could increase, creating additional scour and erosion.

A potential impact to floodplains is the permanent loss of flood storage caused by the road fill, additional pavement, and storm drainage treatment areas. In addition, there may be a loss of ecological functions related to wetlands, vegetation, and wildlife. These are both types of potential permanent losses associated with new development. There also may be temporary losses in the construction area, primarily losses of ecological functions due to soil compaction and lost vegetation.

Table 3.10-2 provides a summary of the potential impacts for each of the alternatives.

Table 3.10-2: Summary of Potential Impacts to Floodplains in the Study Area

Alternative	Floodplains Affected	Potential Floodway Crossings[a,b]	Potential Impact Length (ft)[a]	Potential Mitigation
No Action	6 projects affect 5 floodplains	5 (4)	13,950	Walls, bridges, storage, overflow channel
1[a]	23 projects affect 14 floodplains	22 (5)	31,650	Walls, bridges, storage, overflow channel
2[a]	37 projects affect 14 floodplains	41 (51)	48,025	Walls, bridges, storage, overflow channel
3[a]	36 projects affect 14 floodplains	40 (5)	48,125	Walls, bridges, storage, overflow channel
4[a]	36 projects affect 14 floodplains	41 (40)	39,175	Walls, bridges, storage, overflow channel
Preferred Alternative	Approximately 43 projects affect approximately 14 floodplains	Approximately 45 (5)	Approximately 50,000	Walls, bridges, storage, overflow channel

[a] The impacts in the action alternatives include the No Action Alternative.
[b] The number in parentheses indicates new crossings.

In each situation where there is potential for impacts to a floodplain, projects can be designed using conventional engineering techniques so that the floodway is avoided and there is a zero rise in flood elevation. Because restrictions to the meandering of natural streams can usually be avoided, no associated effects on floodplains are expected. Localized loss of flood storage can be compensated for by designing additional flood storage in nearby parts of the floodplain and by complying with compensatory storage requirements for filling of the floodway. Very few of the floodplain crossings identified in Table 3.10-2 are new, and none of the I-405 crossings are new (see the *I-405 Corridor Program Draft Floodplain Expertise Report* [DEA, 2001]). Each culvert and bridge that would be modified or replaced represents an opportunity to evaluate design options that could improve conveyance of floodwaters. As a result, each alternative could be constructed and operated so that substantial direct impacts on floodplains in the study area are avoided.

Flood fringe is that portion of the floodplain outside of the zero rise floodway which is covered by floodwaters during a flood. Generally the flood fringe is associated with standing water as opposed to rapidly flowing water (King County, 2000). Typically flood fringe areas are not individually mapped but rather are included within a jurisdiction's floodplain mapping. In addition, floodplains for small streams, wetlands, and closed depressions are not included in FEMA floodplain mapping. During the design phase, engineering plans, hydrologic models, and surveys accepted by applicable jurisdictions would be used to assess fill in the floodplain, and the hydrology in the study area. Any fill in the floodplain would comply with FEMA and other local regulatory requirements. Required analyses could include floodplains for smaller streams, wetlands, and closed depressions that may occur within the specific project area. In addition, localized flooding conditions will be analyzed on a project-specific basis.

3.10.4.1 No Action Alternative

Under the No Action Alternative there are six projects that would potentially impact five floodplains. These include five culvert or bridge crossings of the floodway. The potential length of floodplain impact is 13,950 feet. Two of the projects are new roads across the Samammish River floodplain that should include flood storage mitigation in the design to avoid storage impacts. Another project is a road across the Springbrook Creek floodplain that would also need to include flood storage mitigation in the design to avoid storage impacts.

Construction Impacts

During construction, no impacts to floodplain storage capacity are anticipated. There may be impacts to floodplain ecological functions that are discussed in other sections. In the event that flooding occurs, equipment would need to be moved out of the floodplain.

Operational Impacts

The operational impacts of the No Action projects are, or will be, addressed in the environmental analysis, documentation, and review conducted for those projects.

3.10.4.2 Alternative 1: HCT/TDM Emphasis

The evaluation of the action alternatives assumes that all of the No Action Alternative projects will be implemented. Estimates of impacts include those of the No Action Alternative. Twenty-three of the Alternative 1 projects would either enter or cross 100-year floodplains. Fourteen different floodplains are either crossed or are adjacent to the projects proposed in Alternative 1. There are 22 floodway crossings by culverts or bridges that would be lengthened or replaced, with a potential for 31,650 linear feet of floodplain impacts. The potential impact on floodplains would be relatively low.

Construction Impacts

During construction, no impacts to the floodplain storage are anticipated. There may be impacts to floodplain ecological functions. The discussion of impacts to ecological functions can be found in Section 3.6 (Wetlands) and Section 3.8 (Fish, Aquatic Habitat, and Threatened and Endangered Fish Species). In the event that flooding occurs, equipment would need to be moved out of the floodplain.

Operational Impacts

No operational impacts are anticipated, since the roadway can be designed to avoid the floodway and structural design requirements would result in a zero rise in flood elevation.

3.10.4.3 Alternative 2: Mixed Mode with HCT/Transit Emphasis

The evaluation of Alternative 2 assumes that all of the No Action Alternative projects will be built; estimates of impacts include the No Action Alternative. Thirty-seven of the Alternative 2 projects would either enter or cross 100-year floodplains. Fourteen floodplains are either crossed or are adjacent to the projects proposed in Alternative 2. There are 41 crossings of the floodway by culverts or bridges that would be lengthened or replaced, with a potential for 48,025 linear feet of floodplain impacts. The potential impact on floodplains would be moderate.

Construction Impacts

During construction, no impacts to the floodplain storage are anticipated. There may be impacts to floodplain ecological functions. The discussion of impacts to ecological functions can be found in Sections 3.6 and 3.8. In the event that flooding occurs, equipment would need to be moved out of the floodplain.

Operational Impacts

No operational impacts are anticipated, since the roadway can be designed to avoid the floodway and structural design requirements would result in a zero rise in flood elevation.

3.10.4.4 Alternative 3: Mixed Mode Emphasis

The analysis of Alternative 3 impacts assumes that all of the No Action Alternative projects will be implemented, and estimates of the impacts include the No Action Alternative. Thirty-six of the Alternative 3 projects would either enter or cross 100-year floodplains. Fourteen floodplains are either crossed or are adjacent to the projects proposed in Alternative 3. There would be 40 crossings of the floodway by culverts or bridges that would be lengthened or replaced, with a potential for 48,125 linear feet of floodplain impacts. The potential impact on floodplains adjacent to I-405 would be similar to Alternative 2.

Construction Impacts

During construction, no impacts to the floodplain storage are anticipated. There may be impacts to floodplain ecological functions. The discussion of impacts to ecological functions can be found in Sections 3.6 and 3.8. In the event that flooding occurs, equipment would need to be moved out of the floodplain.

Operational Impacts

No operational impacts are anticipated, since the roadway can be designed to avoid the floodway and structural design requirements would result in a zero rise in flood elevation.

3.10.4.5 Alternative 4: General Capacity Emphasis

The evaluation of Alternative 4 impacts assumes that all of the No Action Alternative projects will be implemented, and estimates include the No Action Alternative. Thirty-six of the Alternative 4 projects would either enter or cross 100-year floodplains. Fourteen floodplains are either crossed or are adjacent to the projects proposed in Alternative 4. There are 41 crossings of the floodway by culverts or bridges that would be lengthened or replaced, with a potential for 39,175 linear feet of floodplain impacts. The potential impact on floodplains adjacent to I-405 would be similar to Alternative 2.

Construction Impacts

During construction, no impacts to the floodplain storage are anticipated. There may be impacts to floodplain ecological functions. The discussion of impacts to ecological functions can be found in Sections 3.6 and 3.8. In the event that flooding occurs, equipment would need to be moved out of the floodplain.

Operational Impacts

No operational impacts are anticipated, since the roadway can be designed to avoid the floodway and structural design requirements would result in a zero rise in flood elevation.

3.10.4.6 Preferred Alternative

The analysis of Preferred Alternative impacts assumes that all of the No Action Alternative projects will be implemented. Estimates of impacts for the Preferred Alternative include the effects of the No Action Alternative improvements. The Preferred Alternative is similar to Alternative 3. Approximately 43 of the Preferred Alternative projects would either enter or cross 100-year floodplains. Fourteen floodplains are either crossed or are adjacent to the improvements proposed in the Preferred Alternative. There would be approximately 45 crossings of the floodway by culverts or bridges that would be lengthened or replaced, with a potential for slightly more than 48,125 linear feet of floodplain impacts. The potential impact on floodplains adjacent to I-405 would be similar to Alternatives 2 and 3. Floodplain impacts of the Preferred Alternative are greater than those of Alternative 4 because the projects removed to create the Preferred Alternative were either condensed existing projects or were projects that did not impact floodplains. Projects added to create the Preferred Alternative were arterial projects from Alternative 4 which had a greater impact on floodplains. This results in a net increase in floodplain impacts that exceeds Alternative 4.

Construction Impacts

During construction, no impacts to the floodplain storage are anticipated. There may be impacts to floodplain ecological functions. Discussions of impacts to ecological functions can be found in Sections 3.6 and 3.8. In the event that flooding occurs, equipment would need to be moved out of the floodplain.

Operational Impacts

No operational impacts are anticipated, since the roadway can be designed to avoid the floodway and structural design requirements would result in a zero rise in flood elevation.

3.10.5 Mitigation Measures

The best type of mitigation is to limit the amount of fill in floodplains. The amount of fill in the floodplain will be limited by building walls or steep engineered fill slopes adjacent to the floodplain rather than standard fill slopes where practicable. When crossing a river, a longer bridge can be used to span the entire floodway. For a wide floodplain, the effect of the fill on the flood elevation would be analyzed. If there is a detrimental effect, a causeway-type bridge or overflow bridges will be built where practicable. If floodplain storage is lost, an equal volume will be replaced in the same floodplain by excavation, demolition of a structure, or transfer of density rights. The loss of ecological functions is usually accompanied by a loss of riparian or wetland area and will be mitigated by enhancement, restoration, or replacement. Other possible mitigation measures include widening existing bridges, increasing existing culvert sizes, or replacing existing culverts with bridges. Mitigation anywhere along the stream system, including purchase of development rights, will be considered when addressing mitigation to reduce flood flows and limit the rise in the floodplain.

All stream crossing widenings or new crossings will be designed in accordance with WSDOT *Hydraulics Manual* (WSDOT, 1997) for flow passage and the Washington Department of Fish and Wildlife (WDFW) *Fish Passage Design at Road Culverts* (WDFW, 1999) for fish passage. Compensatory storage requirements for filling of the floodway will also be met. The design and construction plans and specifications will be prepared in conjunction with biologists to reduce impacts on the natural stream bed and, when appropriate to the given project, impacts will be mitigated by placing gravel in the culverts, planting riparian trees, and using other natural features such as log weirs, boulders, and other types of woody debris. Where practicable, construction will be done during low flow periods that are least likely to harm fish and other wildlife in accordance with WDFW requirements.

Maintenance of stream crossing structures will be reduced by selecting materials with long lives and low maintenance requirements and by selecting larger sizes of culverts or bridges with more clearance. These large sizes would have less tendency to plug with floating debris or sediment deposition. When maintenance is required, it will be done during low flow and/or with the least obtrusive processes possible.

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