ENVIRONMENTAL ASSESSMENT

SKAGIT RIVER – DIKING DISTRICTS 1, 3, 12, 17, AND 22 LEVEES REHABILITATION OF FLOOD CONTROL WORKS SKAGIT COUNTY, WASHINGTON

May 2011

US Army Corps of Engineers®
Seattle District

Skagit River Diking District 1, 3, 12, 17, and 22 Levees
Rehabilitation of Flood Control Works –
Environmental Assessment
May 2011

Responsible Agency: The responsible agency for the completed and proposed rehabilitation of flood control works on the Skagit River is the U.S. Army Corps of Engineers, Seattle District.

Abstract:
This Environmental Assessment (EA) evaluates the potential environmental effects of the repair and replacement of 57 non-continuous sections of the Diking District 1, 3, 12, 17, and 22 levees on the Skagit River. This includes section 33 of Township 35N, Range 4E; sections 4, 7, 8, 18, and 19 of Township 34N, Range 4E; sections 12, 13, 24, 25, and 36 of Township 34N, Range 3E; sections 7, 19, and 30 of Township 33N, Range 4E; and sections 1, 13, 25, and 26 of Township 33N, Range 3E, Willamette Meridian, in Skagit County, Washington. Diking District 1 sustained non-continuous damages between river mile (RM) 10.1 and 14.6 along the right bank near the city of Mount Vernon. Diking District 3 sustained non-continuous damages between RM 2.5 and 7.8 along the left bank of the South Fork of the Skagit River. Diking District 12 sustained non-continuous damages between RM 13.1 and 21.5, along the right bank near the city of Burlington. Diking District 17 sustained non-continuous damages between RM 13.0 and 17.5, along the left bank near the city of Mount Vernon. Diking District 22 sustained non-continuous damages between RM 19.0 and 6.20 on the North Fork, and between RM 19.0 and 5.25 on the South Fork of the Skagit River. The levees protect residential, commercial, agricultural, and public land.

The Skagit River crested well above the zero-damage flood stage during a sustained event in November 2006 resulting in damages to the levee system. Skagit County Diking Districts 1, 3, 12, 17, and 22 requested assistance under the U.S. Army Corps of Engineers, Seattle District (Corps) PL 84-99 Program, in implementing repair projects at these locations. The Corps determined that the levees were in need of repair to restore the pre-damage level of flood protection for the neighboring residences, farmland, businesses, and associated public infrastructure. The Corps constructed repairs on 32 of these sites in 2007 (16,253 ft), with five of these sites having abbreviated construction that needs to be completed and three sites being deferred. Additional high water events in November 2008, January 2009, December 2010, and January 2011 resulted in further damage. During summer 2011, repairs to 28 sites (11,430 ft) will be constructed. The total project length for all repairs considered in this EA is 27,683 linear feet (5.2 miles). The proposed project, with the mitigation efforts, will not constitute a major Federal action significantly affecting the quality of the human environment and preparation of an environmental impact statement is not required.

The official comment period for this document was April 1, 2011 to April 30, 2011.

Please send comments, questions, and requests for additional information to:

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1.0 PROPOSAL FOR FEDERAL ACTION

The Council on Environmental Quality (CEQ) regulations, 40 CFR § 1500.1(c) and 40 CFR § 1508.9(a)(1), interpreting the National Environmental Policy Act of 1969 (as amended) (NEPA) require Federal agencies to "provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement or a finding of no significant impact" on actions authorized, funded, or carried out by the Federal government to ensure such actions adequately address "environmental consequences, and take actions that protect, restore, and enhance the environment." This assessment evaluates environmental consequences for the implementation of flood risk management actions carried out by the U.S. Army Corps of Engineers (Corps) in cooperation with Diking Districts 1, 3, 12, 17, and 22 in response to flood events described in this document.

Major flooding occurred on the Skagit River in November 2006. Upper Baker Dam, Darrington, and Marblemount experienced peak 24-hour rain totals of 4.8, 3.6, and 5.0 inches, respectively. The Skagit River exceeded its flood stage of 28.0 feet (~62,000 cfs) at Concrete (USGS 12194000) cresting at 39.7 feet (145,000 cfs; 20-year flood event) on November 6 at 20:00 hours. The Skagit River at Mount Vernon (USGS 12200500) exceeded its flood stage of 28.00 feet (~67,400 cfs) cresting at 33.8 feet (122,000 cfs; 15-year flood event) on November 7 at 20:00 hours. The river stayed above flood stage for 66 hours and damaged many levees throughout the diking districts. Additional high water events occurred in November 2008 and January 2009, cresting just below flood stage. On 8 November 2008, the Skagit River at Mount Vernon (USGS 12200500) crested at 24.6 feet (52,100 cfs), and on 13 November 2008, the river rose again to 26.5 feet (60,000 cfs). On 8 January 2009, the river reached 27.7 feet (72,900 cfs) at Mount Vernon. The following flood season had flood events as well. On 13 December 2010, the river crested at 29.25 feet (83,500 cfs) and on 17 January 2011, the river rose to 29.21 feet (74,700 cfs).

In 2007, the Corps, with Skagit County Diking Districts 1, 3, 12, 17, and 22 as the non-Federal sponsors, has completed some emergency repairs on sections of the levees within Diking Districts 1 (DD1), 3 (DD3), 12 (DD12), 17 (DD17), and 22 (DD22) (Figure 1). Additional sites are scheduled for repair in 2011, including several sites deferred from the 2007 construction, sites partially completed in 2007 that are slated to be "reworked," and newly identified sites from the 2008/2009 high water events. The Corps has scheduled these repairs to occur within the recommended window for in-stream construction, 15 June through 31 August. Each of these levee segments was designed and constructed for flood control to provide protection from periodic, recurring floods.

1.1. Location of damaged levees

All of the diking district repair projects are located on the Skagit River in Skagit County, Washington (Figure 1). Diking District 1 sustained non-continuous damages between river mile (RM) 10.1 and 14.6 along the right bank near the city of Mount Vernon. Diking District 3 sustained non-continuous damages between RM 2.5 and 7.8 along the left bank of the South Fork of the Skagit River. Diking District 12 sustained non-continuous damages between RM 13.1 and 21.5, along the right bank near the city of Burlington. Diking District 17 sustained non-continuous damages between RM 13.0 and 17.5, along the left bank near the city of Mount Vernon. Diking District 22 sustained non-continuous damages between RM 19.0 and 6.20 on the North Fork, and between RM 19.0 and 5.25 on the South Fork of the Skagit River. The Skagit River levees protect residential, commercial, agricultural, and public lands.

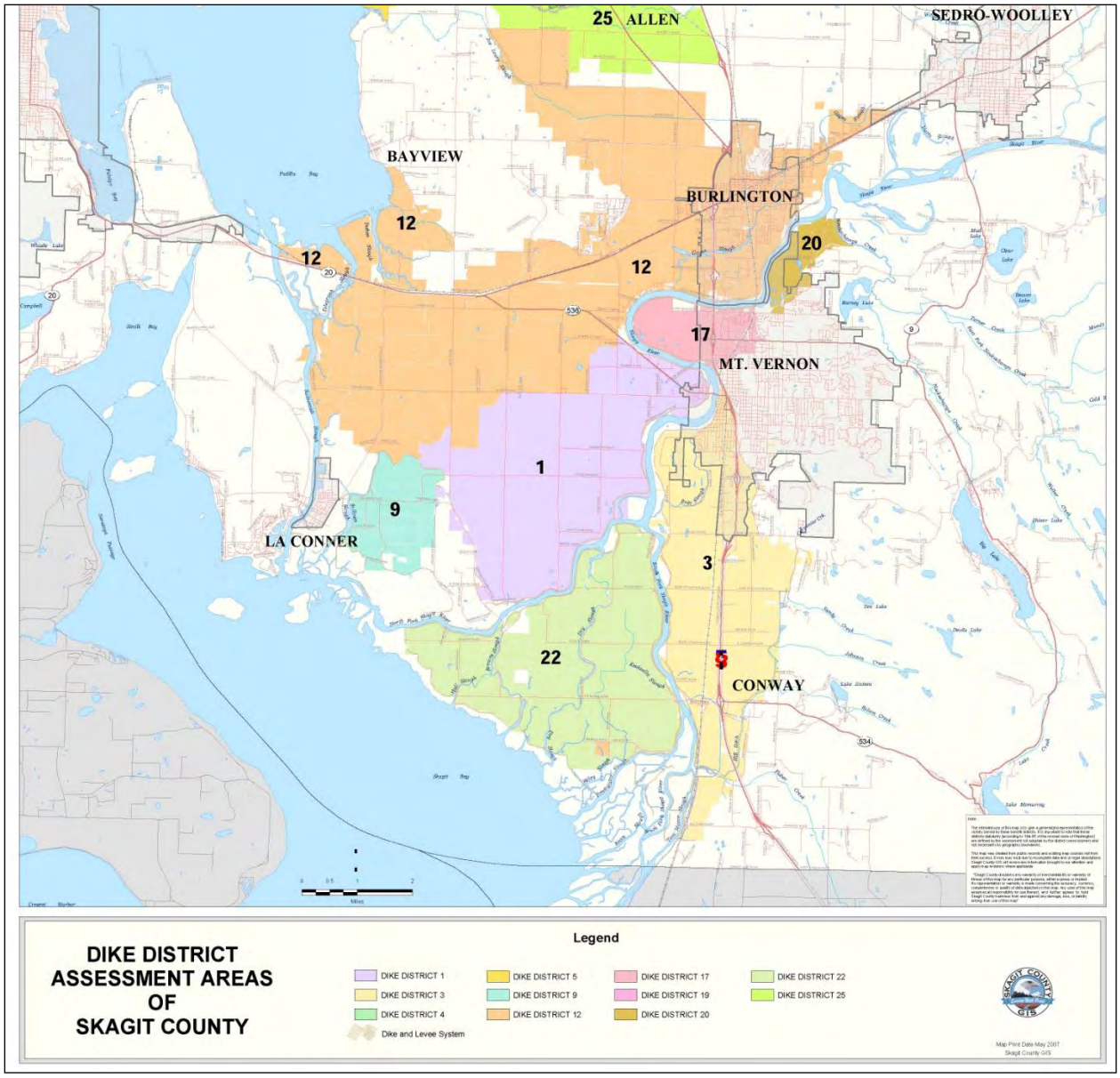

Figure 1: Diking Districts of Skagit County

1.2. Authority to repair damaged levees

The repairs to the damaged levees on the Skagit River in DD1, DD3, DD12, DD17, and DD22 are authorized by the PL 84-99 Program (33 USC 701n). The PL 84-99 Program allows the Corps to rehabilitate or restore eligible flood control works damaged by flooding. The rehabilitated structures are designed to provide the same level of protection as the original structure. Following the flooding in 2006, the Corps determined that 32 damage sites required reconstruction before the next flood event as they posed an imminent threat of loss of private and/or public property. Therefore, the Corps completed repairs at 32 sites in 2007 prior to completion of NEPA documentation. Three sites (1-3, 12-4A, and 22-7) that did not pose an imminent threat were to be monitored through the flood season with delayed construction to allow time for completion of environmental compliance documents. Five sites (3-6, 12-6, 22-3, 22-8, and 17-6) received abbreviated or incomplete repair in 2007 and were scheduled to be completed with the deferred repairs. An additional 20 sites sustained damage in the 2008-09 flood season as well as in early

2011. These sites are eligible for repair under the PL 84-99 program and occur within the same river miles as described in Section1.1. In pre-flood condition, each of the undamaged levees provided a level of protection ranging between 10-year and 25-year flood elevations.

2.0 PURPOSE AND NEED

The purpose of the proposed project is to repair the damaged portions of the Skagit River levees to restore and maintain adequate and reliable flood protection for the residences, businesses, and public infrastructure at the same level provided prior to the 2006 flood event. Levees that have been repaired or are scheduled for repair are addressed in this Environmental Assessment (EA) as a result of requests for Corps of Engineers assistance from DD1, DD3, DD12, DD17, and DD22 (see Appendix D for requests for Corps assistance). These levees are integral to protecting life and property, including public facilities and private residences in the floodplain. The Corps has determined that failure to repair these levee sites greatly increases the risk of levee failure, thereby increasing the probability of injury, loss of life, severe economic damage, and disruption of commercial, agricultural, and governmental practices and services .

3.0 PROPOSED ACTION LOCATIONS AND DESCRIPTIONS

Construction during the 2007 season repaired flood damage that occurred during the 2006 flood event. Construction scheduled for 2011 is to rework a few sites from 2007 and repair sites that were damaged due to high water events in 2008 and 2009 as well as the flood events in December 2010 and January 2011. Flood damage reduction benefits are based on restoring the project performance back to the level that existed prior to the damaging event.

The majority of the work at each site occurred or will occur above the ordinary high water elevation (OHW). Excavation, clearing, and grubbing generally did not occur below the water line at the time of construction but it did occur on portions of the bank that were lower than OHW and erosion protection material was placed at the toe of the levee. Work above OHW consisted of excavation of slope material and deposits of sand and silt. The general construction process was and will be as follows: clear and grub, reshape the slope, spall the slope, and install the armor rock. Willow lifts were or will be installed during the construction process and all disturbed sites were or will be hydroseeded at the end of construction. Descriptions of the repairs performed in 2007 and scheduled for 2011 are listed below and summarized in Table 1 (page 20, see Appendix A for a summary table of damages and reconstruction of all sites; see Appendix C for as-built drawings of sites repaired in 2007 and design drawings of repairs scheduled for 2011).

Because of the long history of modification of riverbanks within the lower Skagit valley, the habitat is quite degraded, yet the Skagit River remains critical for many salmonids including stocks listed as threatened. Due to the extent of recent past and upcoming necessary repairs to the Skagit River levees and the time lag for newly repaired sites to provide edge habitat functions, as well as to avoid affecting salmon recovery, the Corps is proposing environmental measures to mitigate for lost functions of the riverine edge habitat. Mitigation measures to be installed at each site are detailed below and further information on the overall mitigation strategy is provided in Section 5.0.

3.1. Diking District 1 Levee

DD1 had seven non-continuous locations damaged, all of which were located on the riverward slope (Figure 2). The sites of levee repair within DD1 are located between RM 10.1 and 14.6 along the right bank near the city of Mount Vernon. The levee is constructed of earthen material with armor rock on the riverward side. Between 15 September and 16 October 2007, repairs were completed in 2007 at all sites except for sites 1-3, 1-13, and 1-14. These three sites will be completed in 2011.

Levees within Diking District 1 are typically well maintained with a grassy surface that is mowed regularly. There are several vegetated benches where the levee is set back from the river, but the majority of the levee follows along the river channel. Typically, this rural district does not maintain its revetments as extensively as other urban Skagit diking districts, such that vegetation along the revetment grows in wider tracts with larger trees. At the repair sites, the levee crown, backslope, and riverward slope are maintained as grassy surfaces. Any vegetation, detailed below by site, occurs in a narrow band along the revetment face.

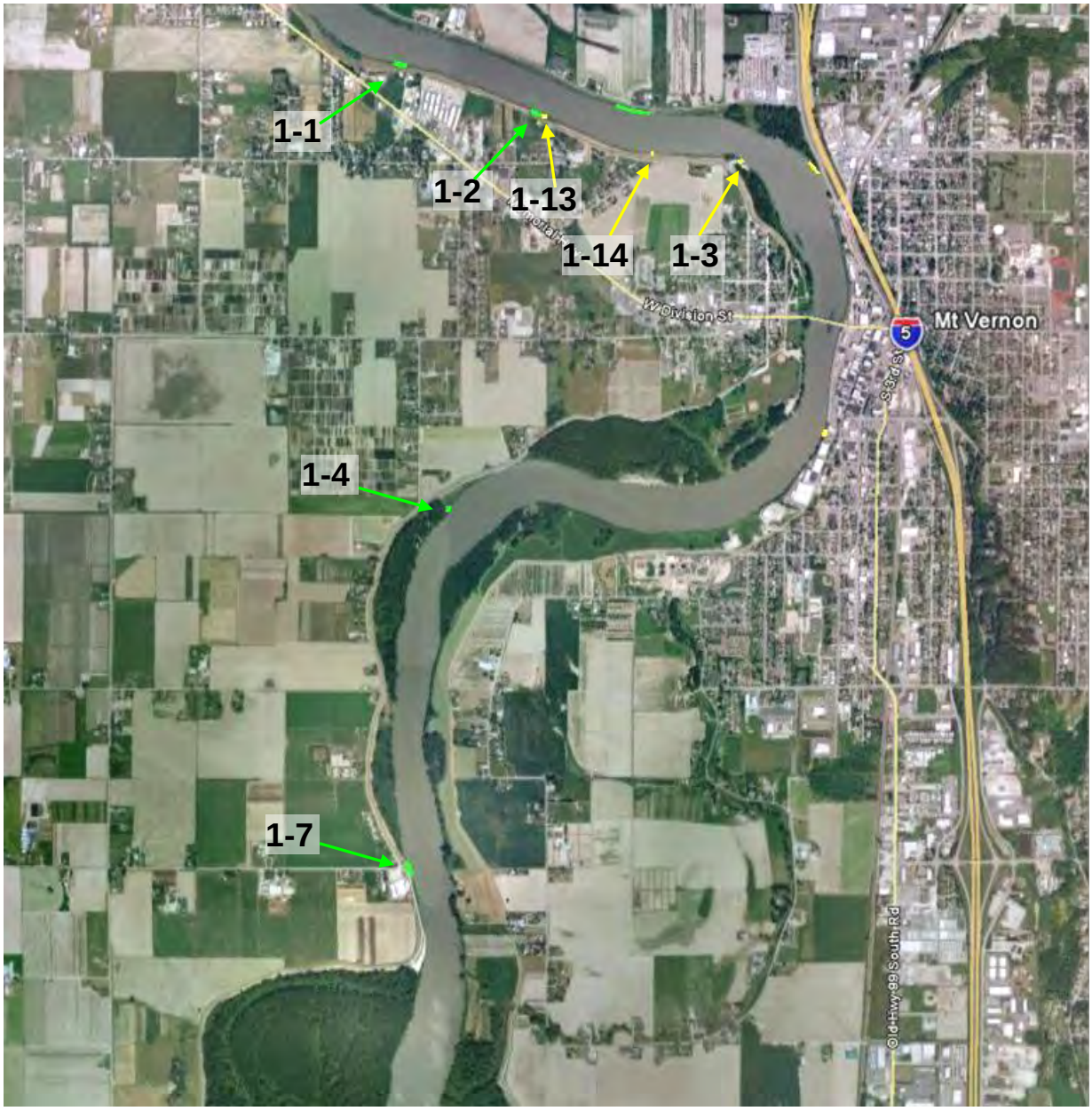

Figure 2: Location of Repairs in Diking District 1.
Sites shown in green were constructed in 2007. Sites in yellow are to be completed in 2011.

- Site 1-1: The Corps repaired 207.5 linear feet (LF) of levee in 2007. The riverward slope was reshaped and armored with a three-foot blanket of class IV riprap at a 2H:1V slope. The levee crown was topped with crushed gravel providing a driving surface. Vegetation removed from the revetment face consisted of 160 LF of grass, five short brushy alders and willows, 47 LF of four-

to six-inch diameter at breast height (dbh) alders (10 to 12 trees), and a blackberry understory. Mitigation options installed at this site include one willow lift 196 LF long (400 willows) 3.5 feet below the levee top, approximately 4 feet above OHW.

- Site 1-2: The Corps repaired 200 LF of levee in 2007. The riverward slope was reshaped and armored with a three-foot blanket of class IV riprap at 2H:1V. The levee crown was topped with crushed gravel providing a driving surface. Vegetation removed from the revetment face consisted of approximately 30 percent shrubby alders and willows four to ten feet tall with an understory of various species. Mitigation options installed at this site include one willow lift 163 LF long (330 willows) at 6.5 feet below the levee top on the levee face, three feet above OHW.

- Site 1-3: This site is scheduled for repair in 2011. The damaged section of levee is 75 LF long on an inside bend of the river, adjacent to an armored section. The downstream end of the armored area is experiencing erosion that could continue behind the armor and unravel the levee. Continued erosion would lead to levee failure and loss of access to Young's Bar. Engineers recommend that the repair include re-grading and armoring the slope to tie in the armored revetment to high ground. Vegetation that will be removed from the revetment face consists of a few alders four to eight inches dbh, with willows, blackberry, and dogwoods in the understory. Mitigation options included in the design for this repair include a double willow lift starting at OHW, anchored rootwads off the levee toe, and placement of soil and hydroseed over the top of the riverward face and the bench.

- Site 1-4: The Corps repaired 108 LF of levee in 2007. The riverward slope was reshaped and armored with a three-foot blanket of class IV riprap at a 1.5H:1V slope. A large scour hole approximately 20 feet into the revetment was filled with spalls and riprap. Access to the riverward side of the levee was via an existing ramp; a spall road 147 feet long by 12 feet wide was constructed to provide access to the site. Vegetation removed from the revetment face consisted of blackberries on the levee and a single row of small shrubby willows and alders along the levee face at OHW, and eight trees that were four to six inches dbh. The mitigation option installed at this site is a double willow lift spanning 105 LF (~210 willows) at 4.3 and 8.7 feet below the levee top, with the lowest lift at approximately 0.5 foot above OHW.

- Site 1-7: The Corps repaired 257 LF of levee in 2007. The riverward slope of 2H:1V was reshaped and armored with a three-foot blanket of class IV riprap. The piles at the toe were not disturbed. Vegetation removed from the revetment face consisted of one locust tree less than four inches dbh, five small brushy alders, and a dense blackberry understory. The mitigation option installed at this site in 2007 include one willow lift (400 willows) spanning 153 LF was installed 8.6 feet below the levee top, approximately six feet above OHW. In 2011, 100 LF of woody debris will be placed as further mitigation along the toe intertwined in the piles.

- Site 1-13: This site will be constructed in 2011. The damaged section of levee is 50 LF long and is scheduled to be repaired in 2011. This section of levee is adjacent to and downstream of the 2007 repair site 1-2 and has erosion resulting in displaced riprap due to scour around overgrown willows. A scalloped bank has formed as a result, and continued erosion would lead to further damage of the levee prism. The proposed repair will fill the scour hole and regrade the embankment slope at a 2H:1V slope with a three-foot blanket of class IV riprap. Mitigation options included in the designs for the proposed repair include a single willow lift at OHW and placement of soil and hydroseed over the top of the riverward face and the bench.

- Site 1-14: This site will be constructed in 2011. The damaged section of the levee is 30 LF long and is within a 2004 repair site. Floodwaters displaced riprap near the top of the embankment slope. Proposed repair will regrade the embankment slope with a three-foot blanket of class IV riprap at a 2H:1V slope and avoid in-water work. The mitigation option included in the designs for the proposed repair is to cover exposed rock above OHW with soil and hydroseed.

All repair sites within the DD1 levee project were and will be accessed via existing access ramps and the levee crown, which are accessible from public rights-of-way at several locations throughout the length of the project. Excavated materials were/will be used within the previously established levee footprint.

3.2. Diking District 3 Levee

All nine sites in DD3 except site 3-7 are along the riverward slope. Site 3-7 had repair of the back slope of the levee only. Repairs were completed at all sites except 3-6, 3-8, and 3-11 in 2007. Although the majority of construction at site 3-6 was completed in 2007, additional work is scheduled for 2011. Sites 3-8 and 3-11 are new damages from the 2008/2009 high water event, to be repaired in 2011.The sites of levee repair within DD3 are located between RM 2.5 and 7.8 along the left bank of the South Fork of the Skagit River. Reconstruction on the DD3 levee occurred between 29 August and 12 October 2007.

Levees within this district are typically well maintained with a grassy surface that is mowed regularly along the crown and side slopes. Along the Skagit mainstem, most of the levee in this district is setback from the river; however, along the South Fork of the Skagit River and along Tom Moore Slough, the levee generally follows the river's edge with only a few riverward vegetated benches. Typically, this rural district does not maintain its revetments as extensively as other urban Skagit districts, such that vegetation along the revetment grows in wider tracts with larger trees. At the repair sites, the levee crown, back slope, and riverward slope are maintained as grassy surfaces. Any vegetation, to be detailed below by site, is found in a narrow band along the revetment face. Ingress and egress to the repair sites within the DD3 Levee Project was/will be gained through use of existing DD3 levee access ramps and the levee-top road. These are accessible from public rights-of-way at four locations along the length of the DD3 Levee Project.

- Site 3-1: The Corps repaired 382 LF of levee in 2007 on the South Fork Skagit River. The riverward slope was reshaped and covered with a spall blanket on the bench and slopes. The riverward face was armored with a three-foot blanket of class IV riprap. The levee crown was topped with crushed gravel to provide a driving surface. Vegetation was removed from half the revetment face, which included brushy alders less than 15 feet tall and grass with some blackberries. For mitigation, one willow lift (~600 willows) was installed in 2007 at 5.8 feet below the levee top, approximately 2.5 feet above OHW. In 2011, soil and hydroseed will be placed as mitigation over the riprap above the 2007 willow lifts and three rows of shrubs will be planted along the top of the riverward bank.

- Site 3-2: The Corps repaired 436 LF of levee in 2007 on the South Fork Skagit River. The riverward slope was reshaped, covered with spall rock, and armored with a three-foot blanket of class IV riprap. The levee crown was topped with crushed gravel, providing a driving surface. Vegetation removed from the site was grass, blackberries, and seven alders smaller than four inches dbh that were growing along the river. Mitigation at this site included one willow lift (~238 willows) installed throughout the project area. The willow lift elevation changes through the repair area with 391 LF at 3.6 feet below the levee crown (3 feet above OHW) and 45 LF at 6.6 feet below the levee crown (at OHW).

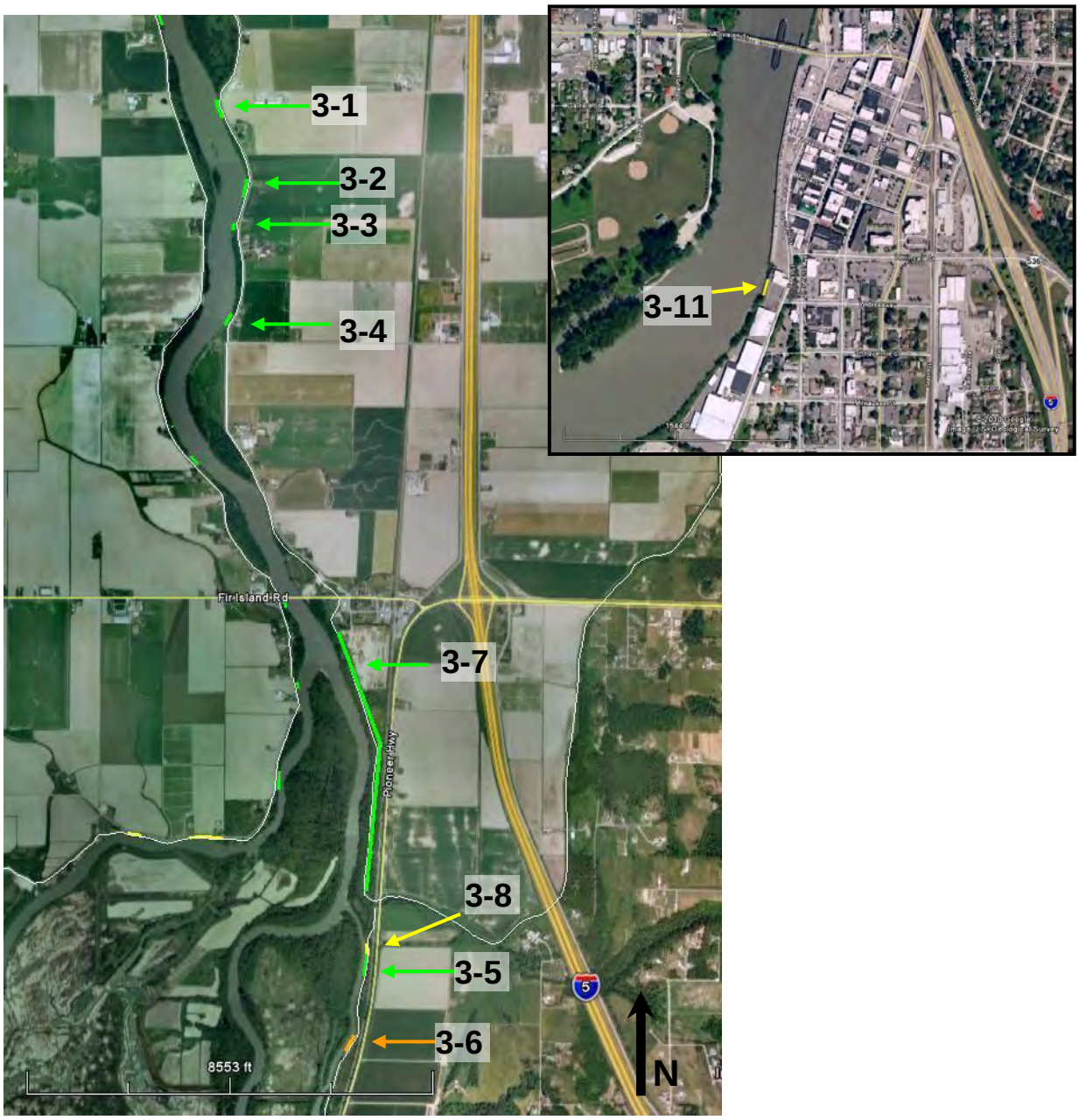

Figure 3: Location of Repairs in Diking District 3.

Sites shown in green were constructed in 2007. Sites in orange were built in 2007 but require rework in 2011. Sites in yellow are to be completed in 2011.

- Site 3-3: The Corps repaired 139 LF of levee in 2007. The riverward slope was reshaped to 2H:1V, covered with spall rock, and armored with a three-foot blanket of class IV riprap. The levee crown was topped with crushed gravel to provide a driving surface. Vegetation removed from the site consisted of six alders ranging from 12 to 15 feet tall and less than four inches dbh, which were present along the riverbank. Various grasses dominated the rest of the repair area. For mitigation, one willow lift spanning 106 LF was installed (~121 willows). The height of the lift changes within the repair area, with 34 LF at 3.2 feet below the levee crown (4.5 feet above OHW) and 72 LF at 7.7 feet below the levee top (at OHW).

- Site 3-4: The Corps repaired 287 LF of levee in 2007 on the South Fork of the Skagit River. The riverward slope was reshaped to 2.5H:1V, covered with spall rock, and armored with a three-foot blanket of class IV riprap. Vegetation removed from the site consisted of seven alders less than 15 feet tall and shrubs along the revetment. As-built drawings show several logs and woody debris remaining at the riverward toe. At least one of these logs is still visible at the upstream end of the project in 2010 aerial photos. These preserved or placed woody structures increase habitat function to the site and were added to the mitigation calculations for the project. One willow lift (~678 willows) was installed as mitigation at 5.2 feet below the levee top (1 foot above OHW).

- Site 3-5: The Corps repaired 460 LF of levee in 2007 on the South Fork of the Skagit River. The riverward slope was reshaped to 2H:1V, covered with spall rock, and armored with a three-foot blanket of class IV riprap. The levee crown was topped with crushed gravel. Vegetation removed was various shrubs on the revetment and bench, ranging from two to ten feet tall, and groundcover dominated by grass. The mitigation option installed in 2007 included one willow lift (~700 willows) along 350 LF of the repair at 1.4 feet below the levee top (6.6 feet above OHW). In 2011, the Corps will add mitigation by installing anchored rootwads along this entire site.

- Site 3-6: This 2007 levee rehabilitation site is scheduled to be reworked in 2011. The 2007 repair was 375 LF. The riverward slope was reshaped to 3.5H:1V and armored with a three-foot blanket of class IV riprap. The section to be constructed in 2011 is 150 LF. Excess riprap was placed on the upper slope during the 2007 construction season to prevent erosion during a flood, but the weight increased the load on the slope. This can cause rotational failure of the levee. The excess rock will be excavated and reused on the downstream end of the site to tie the levee into the bank. A spall layer will be placed below the riprap, and the riprap will be replaced at the toe. Vegetation removed in 2007 consisted of Nootka rose, thimbleberry, salmonberry, shrubby willows, and blackberry on the riverward face that ranged from two to ten feet tall. Similar vegetation will be removed by the 2011 repair. The rootwads removed from within the levee during 2007 construction were placed onto the riverward face of the levee post-construction, shading the rock, increasing organic inputs to the river, and diversifying the bank line. Any rootwads removed for the 2011 repair will be staged during construction and placed on the levee face post-construction. The mitigation option installed in 2007 included one willow lift (~800 willows) at 10.2 feet below the levee top, at approximately 0.5 foot above OHW. Further mitigation options to be installed in 2011 will include a double willow lift and placement of anchored logs with rootwads throughout the full 3-6 repair site (525 LF). The riverward face above the willow lifts will be covered with soil and seeded with native grasses.

- Site 3-7: This 2007 repair site had no in-water or riverward work. The repair was 6,110 LF on the grassy backside of the levee. The Corps removed a layer of clay from the backslope and replaced it with soil and spalls. The disturbed area was hydroseeded after construction. No mitigation was required at this site as the work was limited to the backside of the levee.

- Site 3-8: This site will be constructed in 2011. This site is an un-armored earthen levee segment along Tom Moore Slough and requires 225 LF of repair due to an over-steepened bank. It is adjacent to the 2007 repair at site 3-5. The landward side of the levee is a forested wetland. Vegetation to be removed includes grasses, blackberry, Nootka rose, red osier dogwood, multiple willow clumps, and alders. The riverward slope will be reshaped to 2H:1V, covered with spall rock, and a three-foot blanket of class IV riprap The levee crown will be topped with crushed gravel to create a driving surface for inspections. Construction will not disturb the landward slope or wetland. Several mitigation options will be installed at this site. Any rootwads removed for the 2011 repair will be staged during construction and placed on the levee face post-construction. A

double willow lift will be installed with the lowest lift at OHW. Anchored logs with attached rootwads will be placed along the toe of the repair to replace lost fish habitat. The riverward face above the willow lifts will be covered with soil and seeded with native grasses.

- Site 3-11: This site will be constructed in 2011. The site includes 200 LF of repair due to an over-steepened bank, loss of face rock, and several large sinkholes. This site is within the City of Mount Vernon. Vegetation to be removed includes blackberry, alders, and several young dogwood plantings at the top of the levee. The riverward slope will be reshaped to 2H:1V and covered with spall rock and a three-foot blanket of class IV riprap. Two mitigation options will be implemented at this site including a triple willow lift installed with the lowest lift at OHW, and the riverward bank above the willow lifts will be covered in dirt and hydroseeded following construction.

3.3. Diking District 12 Levee

The 17 sites of levee repair within DD12 are located between RM 13.1 and 21.5 along the right bank near the city of Burlington. Repair of sites 12-1, 12-2, 12-3, 12-5, 12-7, and 12-8 on the DD12 levee occurred between 4 September and 18 October 2007. Initial work was completed on site 12-6, but this site requires a small amount of reworking. Sites 12-4A and 12-4B were deferred for maintenance later when work could be completed during a fish work window. Sites planned for construction in 2011 include 12-9, 12-11, 12-12, 12-13, 12-14, 12-15, 12-16, 12-17; site 12-6 will be reworked (Figure 4).

Levees within this district are well maintained with a grassy surface that is mowed regularly along the crown and side slopes. Levees within this district typically follow the river's edge with narrow grassy benches less than 75 feet wide. At the repair sites, the levee crown, backslope, and riverward slope are maintained as grassy surfaces. Any shrubby vegetation, detailed below by site, is in a narrow band along the revetment face.

- Site 12-1: The Corps repaired 109 LF of levee in 2007. The riverward slope was reshaped to 2H:1V and armored with a three-foot blanket of class IV riprap, extending 22 feet from OHW to the top of the bank. After construction, spalls and gravel were placed on the levee crown and access ramps to provide a driving surface. Removed vegetation consisted of willow and alder brush ranging from ten to 15 feet tall along the revetment face and grass across the levee bench.

- Site 12-2: The Corps repaired 261 LF of levee in 2007. The riverward slope was reshaped to 2H:1V and armored with a three-foot blanket of class IV riprap, extending from OHW to the top of the bank. A spall blanket was extended 33 feet landward from the top of bank. Spalls and gravel were placed on the levee crown and access ramps to provide a driving surface for maintenance and inspection. Lost vegetation consisted of one row of short scrubby willows mixed with grass along the river. Four large cottonwoods stand near the repair. These trees were retained during the repair, though the roots may have sustained some damage. A total of 275 willows were installed as mitigation option in two lifts, one at 11 feet below the levee top and the other 14 feet below the levee top (at OHW).

- Site 12-3: The Corps repaired 512 LF of levee in 2007. The riverward slope was reshaped to 2H:1V and armored with a three-foot blanket of class IV riprap. A spall blanket was extended 29 feet landward from the top of bank. Removed vegetation consisted of mostly grass with several small native willows less than three feet tall. One corkscrew willow was retained through construction. Mitigation options installed in 2007 at this site include two willow lifts beginning at OHW, specifically 8.5 and 6.5 feet below the levee top with 1,845 willows. In 2011, further

mitigation will be installed including placing soil and hydroseed to the top of the bank above the willow lifts and planting three rows of native shrubs.

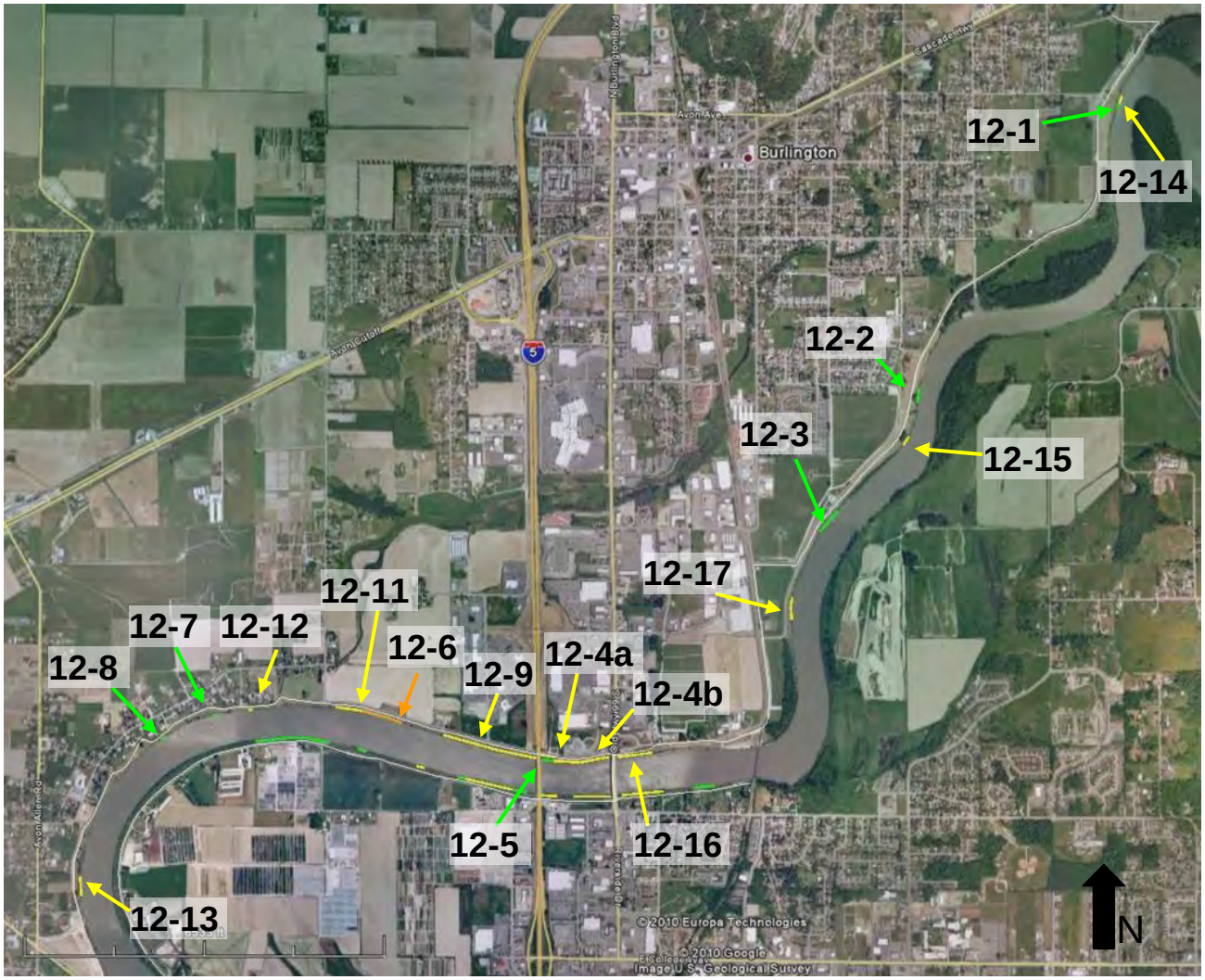

Figure 4. Location of Repairs in Diking District 12.
Sites shown in green were constructed in 2007. Sites in orange were built in 2007 but require rework in 2011. Sites in yellow are to be completed in 2011.

- Site 12-4A: This site was deferred from the 2007 construction season. The repair spans 250 LF of levee along Whitmarsh Road. The landward side of the levee is experiencing sloughing and material movement below Whitmarsh Road, which appear to be the effects of seepage. Ground-penetrating radar has shown an anomaly below the levee that may be causing or exacerbating the issue. If left unrepaired, the levee could fail, potentially resulting in the flooding of Burlington. The site is within the three-bridge corridor (a confined river section containing bridges for I-5, Riverside Drive, and Burlington Northern Railroad). The levee will be excavated to below the level of the adjacent road to explore the anomaly, and will be rebuilt in compacted lifts. The repair will not include any in-water work but will include work on the riverward side of the levee behind the bench. The site is a mowed grassy area. The disturbed area will be hydroseeded after construction and will quickly return to pre-repair habitat condition. Hydroseeding is the only mitigation option installed at this site.

- Site 12-4B: This site will be constructed in 2011. The site includes 970 LF of riverward repair due to loss of face rock. The toe rock appears to be intact, so in-water work should be minimal. Vegetation to be removed includes grass and blackberry with some bushy willows. The riverward slope will be reshaped to 2H:1V, spall rock will be placed, and a three-foot blanket of class IV riprap will be placed. As mitigation a triple willow lift will be installed with the lowest lift at OHW and the riverward bank above the willow lifts will be covered in dirt and hydroseeded.

- Site 12-5: The Corps repaired 236 LF of riverward levee in 2007. The riverward slope was reshaped to 2H:1V and armored with a three foot blanket of class IV riprap. A spall blanket was extended approximately 44 feet landward from the top of the bank. Spalls and gravel were placed on the levee crown and access ramps were created to provide a driving surface. Cleared vegetation consisted of short blackberry bushes, grasses, and one alder.

- Site 12-6: The Corps completed initial repairs in 2007 with a rework expected in 2011. In 2007, 651 LF of levee was repaired in two separate sections, with a 160 LF span between the two constructed areas. This 160 LF area will be constructed in 2011. The riverward slope was reshaped to 1.5H:1V and armored with a three-foot blanket of class IV riprap. The spall blanket extended approximately 21.5 feet landward from the top of the bank. Cleared vegetation consisted of brushy alders and willows ranging from eight to 15 feet tall that covered 50-70% of the shoreline. Blackberries dominated the groundcover. Mitigation options installed in 2007 included two willow lifts beginning at OHW, 7.6 and 11.6 LF below the levee top with 220 willows. The 2011 construction will include further mitigation. A double willow lift will be installed beginning at OHW or lower, similar to those installed in 2007. The riverward bank above the willow lifts will be covered in dirt and hydroseeded throughout the entire 12-6 repair site of 811 feet. Two rows of upper bank plantings will be planted along 250 feet of the site.

- Site 12-7: The Corps repaired 170 LF at this site in 2007. The riverward slope was reshaped to 2H:1V and armored with a three-foot blanket of class IV riprap. The spall blanket extended approximately 37 feet landward from the top of bank. The disturbed area included very little vegetation, mostly grasses, with extensive woody debris deposited on the riverbank. A double willow lift was installed as mitigation at OHW and at 4 feet above OHW.

- Site 12-8: The Corps repaired 124 LF of the riverward side of the levee in 2007. The riverward slope was reshaped to 2.5H:1V and armored with a three-foot blanket of class IV riprap. The spall blanket extended 18.5 feet landward from the top of bank. Cleared vegetation consisted of mostly short blackberry bushes with a few short, scrubby alders and willows less than four feet tall. The mitigation option installed at this site included the installation of two willow lifts at 7 and 11 feet below the levee top (the lowest lift was at OHW) with approximately 375 willows.

- Site 12-9: This site will be constructed in 2011. The site includes 1,850 LF of riverward repair due to seepage, toe scour, and loss of face rock. Blackberry and grass with some horsetail and Nootka rose dominate the project area. Vegetation to be removed includes scattered woody species along the length of the repair including red osier dogwood, alder, and small willows. The riverward slope will be reshaped to 2H:1V; spall rock and a three-foot blanket of class IV riprap will be placed. Mitigation to be implemented at this includes installing a triple willow lift with the lowest lift at OHW or below, covering the riverward bank above the willow lifts with dirt and hydroseeded, planting a double row of native shrubs at the top of the revetment, and installing 1,575 LF of anchored rootwads.

- Site 12-11: This site will be constructed in 2011. The site includes 600 LF of riverward repair due to toe scour and loss of face rock. This site is adjacent to a 2007 repair (site 12-6). Grass and blackberry dominate the project area. Young willows grow at OHW and approximately 10 alders, 2 mature willows, and some red-osier dogwood stand along the revetment. Several pilings stand at the toe and an outfall flows 20 to 30 feet downstream of the project site. The riverward slope will be reshaped to 2H:1V; spall rock and a three-foot blanket of class IV riprap will be placed. Mitigation at this site will include a triple willow lift installed with the lowest lift at OHW, the riverward bank above the willow lifts will be covered in dirt and hydroseeded, and a single row of native shrubs will be planted at the top of the revetment three feet on center.

- Site 12-12: This site will be constructed in 2011. The site includes 50 LF of riverward repair due to toe scour and loss of face rock. Vegetation to be removed is predominantly blackberry. A small dock is in front of the levee. The riverward slope will be reshaped to 2H:1V, spall rock will be placed, and a three-foot blanket of class IV riprap will be placed. The top two-thirds of the riverward bank and the bench will be covered in dirt and hydroseeded as mitigation.

- Site 12-13: This site will be constructed in 2011. The site includes 350 LF of riverward repair due to toe scour and loss of face rock. Vegetation to be removed includes two large alders, some young willows, and blackberry. Six large cedars stand along the riverward bench behind the repair area. Various mitigation options will be installed at this site. A fish bench will be installed at this site that will be 9 feet wide and will slope from two feet above OHW at the upstream end to two feet below OHW at the downstream end, and will slope riverward at a 2% grade to avoid fish stranding. The riverward levee slope will be reshaped to 2H:1V, spall rock will be placed, and a three-foot blanket of class IV riprap will be placed. A double willow lift will be installed with the lowest lift at OHW. The riverward bank above the willow lifts will be covered in dirt and hydroseeded following construction. A single row of native shrubs will be planted along the top of the riverward bank. With the installation of the fish bench, it is likely that some of the cedars will be removed. They will be reused as anchored woody debris at nearby repair sites.

- Site 12-14: This site will be constructed in 2011. The repair site includes 250 LF of riverward repair due to loss of face rock. This site is a gap between two project areas constructed in 2007. The Corps will minimize in-water work as the toe rock appears to be mostly intact, though it may need to be supplemented in some areas. Vegetation to be removed includes grass and some bushy willows. The riverward slope will be reshaped to 3H:1V; spall rock and a three-foot blanket of class IV riprap will be placed. Mitigation at this site includes laying back the slope, as described, as well as other features added to the design. A double willow lift will be installed with the lowest lift at OHW. The riverward bank above the willow lifts will be covered in dirt and seeded with native grasses following construction. A single row of native shrubs will be planted at the top of the revetment three feet on center. To layback the slope throughout the repair area, a transition zone will be built to connect the layback to the upstream and downstream slopes. The transitions at each end of the layback section will be gradual to avoid scour and will be approximately 40 feet at each end.

- Site 12-15: This site will be constructed in 2011. The site includes 180 LF of riverward repair due to toe scour and loss of face rock. The site is downstream of a 2007 repair (site 12-2). This site has a wide grassy bench with one large cedar and six large big leaf maple trees, which will remain. Vegetation to be removed includes 18 alders, 3 large snags, one large big-leaf maple, 5 mature willows, many immature willows, and an understory of blackberry. The riverward slope will be reshaped to 2H:1V; spall rock and a three-foot blanket of class IV riprap will be placed. Mitigation at this site will include a triple willow lift installed with the lowest lift at OHW,

covering the riverward bank above the willow lifts in dirt and hydroseed, and planting a double row of native shrubs at the top of the revetment, three feet on center. A layback was considered at this site, but a layback would require the removal of the large trees on the bench. As there are very few trees on the right bank in this reach of the river, the layback option was rejected so that these trees could be preserved.

- Site 12-16: This site will be constructed in 2011. The site includes 670 LF of riverward repair due to an over-steepened bank. This site has a grassy bench with the revetment including scattered alder, grass, blackberry, and horsetail. All vegetation on the revetment will be removed for the repair. The riverward slope will be reshaped to 2H:1V; spall rock and a three-foot blanket of class IV riprap will be placed. Mitigation at this site includes a triple willow lift installed with the lowest lift at OHW and covering the riverward bank above the willow lifts and hydroseed.

- Site 12-17: This site will be constructed in 2011. The site includes 450 LF of riverward repair due to an over-steepened bank. This site has a grassy bench with the revetment including alder, grass, and blackberry. All vegetation on the revetment will be removed for the repair. The riverward slope will be reshaped to 2H:1V; spall rock and a three-foot blanket of class IV riprap will be placed. Mitigation at this site will include a triple willow lift with the lowest lift at OHW and dirt and hydroseed on the riverward bank above the willow lifts.

3.4. Diking District 17 Levee

The 12 sites of levee repair within DD17 are located between RM 13.0 and 17.5 along the left bank near the city of Mount Vernon. Repair of sites 17-1, 17-2, 17-3, 17-4, 17-5, and 17-6 on the DD17 levee occurred between 16 September and 19 October 2007. The Corps plans to repair sites 17-7, 17-9, 17-10, 17-12, 17-15, and 17-16 in 2011 (Figure 5).

Levees within this district are well maintained with a grassy surface that is mowed regularly along the crown, side slopes, and short grassy bench. The levee follows the river channel with no setback beyond a short maintained bench. At the repair sites, the levee crown, backslope, and riverward slope are maintained as grassy surfaces. Any shrubby vegetation, detailed below by site, occurs in a narrow band along the revetment face.

- Site 17-1: The Corps repaired 400 LF in 2007 on the riverward side of the levee. The riverward slope was reshaped to 1.5H:1V and armored with a three-foot blanket of class IV riprap with a spall blanket extending landward of the top of the bank. Cleared vegetation consisted of nine cottonwoods less than 20 feet high interspersed with extensive blackberries. Two willow lifts of 230 LF were installed as mitigation at 4.3 and 8.4 feet below the levee top with approximately 460 willows.

- Site 17-2: The Corps repaired 275 LF of levee in 2007. The riverward slope was reshaped to 2H:1V and armored with a three-foot blanket of class IV riprap. A spall blanket was extended landward from the top of the levee bank. Cleared vegetation consisted of blackberries and one or two short willows and/or alders less than four feet tall. Two willow lifts were installed in 2007 as mitigation at 5.9 and 9.2 feet below the levee top with the lowest lift at 6 feet above OHW; 460 willows were planted. In 2011, further mitigation will be installed at this site. The pilings that stand just off the levee toe will be used to intertwine woody debris as a 100-foot habitat feature.

- Site 17-3: The Corps repaired 159 LF of levee in 2007. The riverward slope was reshaped to 1.5H:1V and armored with a three-foot blanket of class IV riprap. A spall blanket was extended landward from of the top of bank. Cleared vegetation consisted of five brushy alders less than

eight feet tall, one tall alder approximately ten inches dbh, and grasses and blackberry throughout the area. Two willow lifts totaling 130 LF were installed as mitigation at 10.7 and 13.3 feet below the levee top (lowest lift at 3.6 feet above OHW); 276 willows were planted.

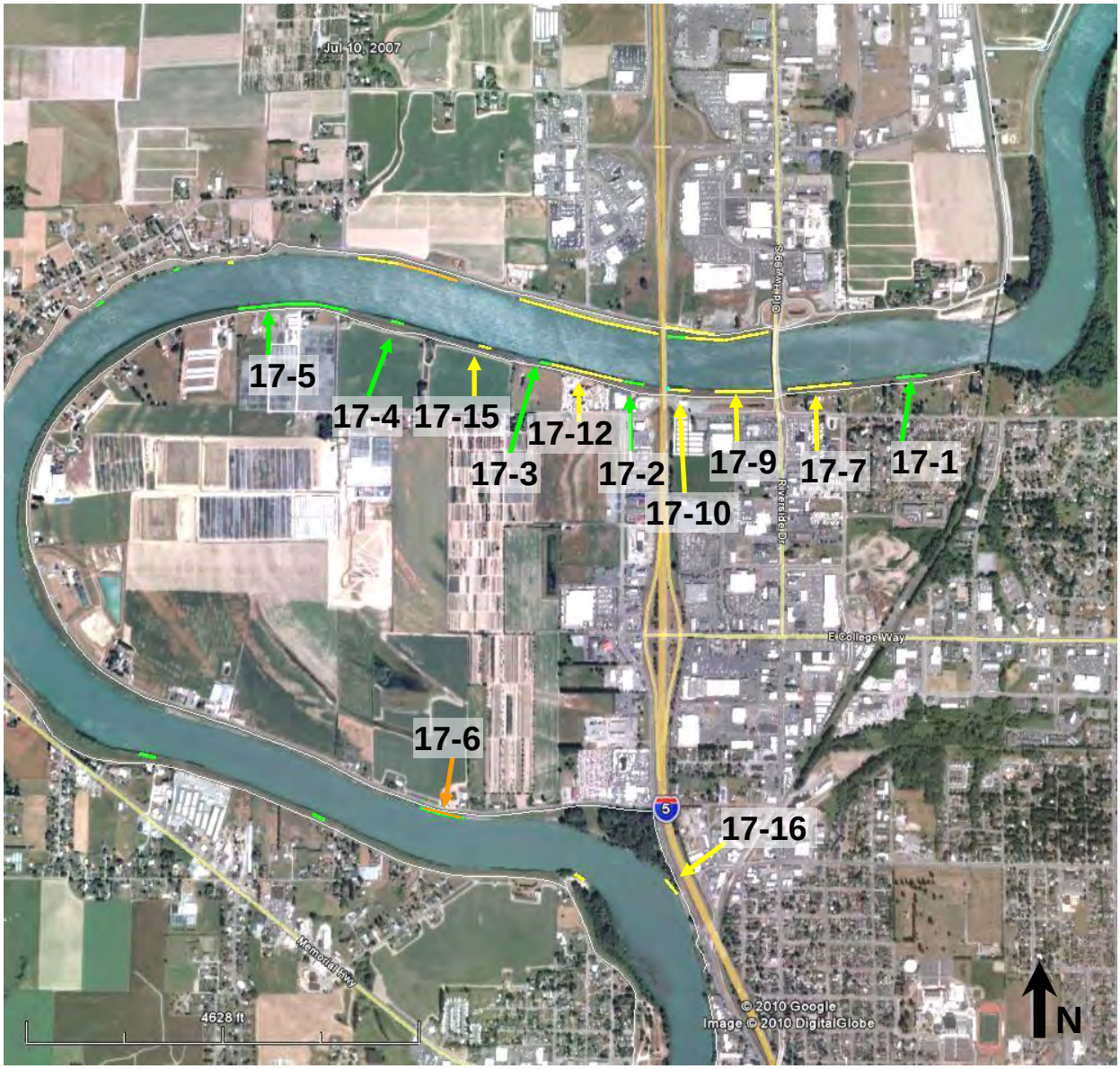

Figure 5. Location of Repairs in Diking District 17.
Sites shown in green were constructed in 2007. Sites in orange were built in 2007 but require rework in 2011. Sites in yellow are to be completed in 2011.

- Site 17-4: The Corps repaired 170 LF of levee in 2007. The riverward slope was reshaped to 2H:1V and armored with a three-foot blanket of class IV riprap. A spall blanket was extended landward of the top of the bank. After construction, spalls and gravel were placed on the levee crown and access ramps to provide a driving surface. Cleared vegetation consisted of seven scrubby willows and/or alders less than six feet high, grasses, and some blackberries. Three willow lifts were installed as mitigation at 3.6, 7.4, and 10.4 feet below the levee top (lowest lift at 2.4 feet above OHW); 326 willows were planted.

- Site 17-5: The Corps repaired 1,350 LF of levee in 2007. The riverward slope was reshaped to 2H:1V and armored with a three-foot blanket of class IV riprap. The spall blanket extended landward from the top of the bank. Spalls and gravel were placed on the levee crown and access ramps to provide a driving surface. Cleared vegetation consisted of a row of willows and alders four to ten feet tall along the river's edge, and grasses and blackberries on the levee face. A willow lift of 494 willows spanning 425 LF was installed as mitigation at 10.3 feet below the levee top (4 feet above OHW).

- Site 17-6: The Corps repaired 522 LF of levee in 2007. In 2007, the riverward slope was reshaped to 2H:1V and armored with a three-foot blanket of class IV riprap. The spall blanket was extended landward from the top of the bank. Spalls and gravel were placed on the levee crown and access ramps to provide a driving surface. Cleared vegetation consisted of one clump of willows that were four feet tall. Blackberries dominated approximately 45% of the revetment with grasses dominating the remainder. Mitigation installed in 2007 included two willow lifts spanning 305 LF at 4.3 and 8.0 feet below the levee top (lowest lift at one foot above OHW); 740 willows were planted. In 2011, further mitigation work will be completed at this site including 400 LF of placement of soil and hydroseed on the bench and top of the riverward face and placement of anchored rootwads at the toe for 400 LF.

- Site 17-7: This site is to be constructed in 2011. The site includes 800 LF of riverward repair due to loss of toe protection and face rock. This site has sinkholes along the entire length and is adjacent to the Riverside Drive Bridge within the three-bridge corridor. The revetment within the project area has blackberry with some snowberry and immature willows. Trees are scattered along the revetment including alders, willow saplings, holly, and rose. All vegetation on the revetment will be removed for the repair. The riverward slope will be reshaped to 2H:1V, spall rock will be placed, and a three-foot blanket of class IV riprap will be placed. Mitigation options will be installed at the site. A triple willow lift will be installed with the lowest lift at OHW. The riverward bank above the willow lifts will be covered in dirt and hydroseeded following construction. A single row of native shrubs will be planted at the top of the revetment three feet on center.

- Site 17-9: This site is to be constructed in 2011. The repair site includes 700 LF of riverward repair. This site has sinkholes and multiple stress cracks along the top of the revetment. The revetment within the project area has blackberry and reed canary grass. Trees are scattered along the revetment including mature willows, alder, and willow saplings. All vegetation on the revetment will be removed for the repair. The riverward slope will be reshaped to 2H:1V, spall rock will be placed, and a three-foot blanket of class IV riprap will be placed. Mitigation options will be installed at this site including a triple willow lift with the lowest lift at OHW. The riverward bank above the willow lifts will be covered in dirt and hydroseeded and a single row of native shrubs will be planted at the top of the revetment three feet on center.

- Site 17-10: This site will be constructed in 2011. The repair site includes 200 LF of riverward repair between a small rock groin and the I-5 bridge. Sinkholes and sloughing are occurring at the site, with loss of toe rock and face rock. The revetment within the project area includes snowberry and reed canary grass, willow saplings, blackberry, cluster rose, and maple saplings. All vegetation on the revetment will be removed for the repair. The riverward slope will be reshaped to 2H:1V, spall rock will be placed, and a three-foot blanket of class IV riprap will be placed. A triple willow lift will be installed as mitigation with the lowest lift at OHW. Further mitigation at the site will include covering the riverward bank above the willow lifts with dirt and hydroseed following construction and planting a single row of native shrubs at the top of the revetment three feet on center.

- Site 17-12: This site will be constructed in 2011. The repair site includes 925 LF of repair due to toe scour and loss of face rock. The revetment has blackberry and reed canary grass with scattered snowberry, willow, holly, red osier dogwood, alders, and big leaf maple saplings. All vegetation on the revetment will be removed for the repair. The riverward slope will be reshaped to 2H:1V, spall rock will be placed, and a three-foot blanket of class IV riprap will be placed. Mitigation at the site will include installing a triple willow lift with the lowest lift at OHW and covering the riverward bank above the willow lifts with dirt and hydroseed.

- Site 17-15: This site will be constructed in 2011. The site has an over-steepened bank that requires toe and face rock repair along 125 LF of the revetment. The site is near an old Public Water Supply well that will not be modified by the repair. Vegetation to be removed includes blackberry, grasses, and two mature alders. The riverward slope will be reshaped to 2H:1V, spall rock will be placed, and a three-foot blanket of class IV riprap will be placed. Mitigation at the site will include installing a triple willow lift with the lowest lift at OHW and covering the riverward bank above the willow lifts with dirt and hydroseed.

- Site 17-16: This site will be constructed in 2011. The over-steepened bank requires toe and face rock replacement along 250 LF of the revetment. DD17 reported a very deep scour hole at the toe. The site is near Freeway Drive and I-5 and is adjacent to a 2004 levee repair site. This site is forested with large trees and an understory of snowberry and blackberry. There are nine large big leaf maples and a few saplings of the same species, two mature alders, two *Prunus* species, and five very large cottonwoods, three of which are dying presumably from being undercut by the bank scour. All vegetation on the revetment will be removed for the repair. The riverward slope will be reshaped to 2H:1V, a one-foot blanket of spall rock will be laid, and a three-foot blanket of class IV riprap will be placed. Multiple mitigation options will be installed at this site, including the following. A triple willow lift will be installed with the lowest lift at OHW. The riverward bank above the willow lifts will be covered in dirt and hydroseeded following construction. Two rows of native shrubs will be planted at the top of the revetment three feet on center and a row of tree plantings (15 feet on center) will be completed between the repair area and Freeway Drive. The Corps will add a habitat weir to the upstream end of this site. The weir will be a pyramidal rock structure with a 2H:1V face slope, which will extend 10 feet from the face of the levee. It will extend above OHW to provide hydraulic complexity at many river stages. In section view of the groin, the side slopes that are roughly angled toward upstream and downstream will have a 1H:1V profile. The weir will not change the thalweg of the river or change river dynamics within the reach, but will create localized changes that include velocity slowing upstream of the structure and pool creation downstream. Both of these effects improve rearing habitat.

3.5. Diking District 22 Levee

The 12 sites of levee repair within DD22 are located between RM 6.20 and 19.0 on the North Fork of the Skagit River and between RM 5.25 and 19.0 on the South Fork of the Skagit River. Reconstruction at DD22 occurred between 29 August and 16 October 2007. Three additional sites and five sites to be reworked are scheduled for repair in 2011. General Characteristics of DD22 Levees: Levees within this district are typically well maintained with a grassy surface that is mowed regularly along the crown and side slopes. There are several large vegetated benches where the levee is set back from the river. Typically, this rural district does not maintain its revetments as extensively as other Skagit districts, such that vegetation along the revetment grows in wider parcels with larger trees. At the repair sites, the levee crown, backslope, and riverward slope are maintained as grassy surfaces. All vegetation, to be detailed below by site, is found in a narrow band along the revetment face.

- Site 22-1: The Corps repaired 395 LF of levee in 2007. The riverward slope was reshaped to 2H:1V and armored with a three-foot blanket of class IV riprap, with the spall blanket extending landward from the top of the bank. Spalls and gravel were placed on the levee crown and access ramps to provide a driving surface. Cleared vegetation consisted of approximately 30 cottonwoods, alders, and willows less than 40 feet tall that were located along the river. Half of these trees were between four and six inches dbh and half had diameters less than two inches dbh. Grasses and blackberry dominated the understory. One willow lift was installed as mitigation at 5.4 feet below the levee top (1.5 feet above OHW); 678 willows were planted.

- Site 22-2: The Corps repaired 118 LF of levee in 2007. The riverward slope was reshaped to 2H:1V and armored with a three-foot blanket of class IV riprap. The spall blanket was extended landward from the top of the bank. After construction, spalls and gravel were placed on the levee crown and access ramps to provide a driving surface. Cleared vegetation consisted of approximately 50 LF of grass intermixed with blackberries. The remaining area (~68 LF) had mature riparian forest; including four to five moderate to large cottonwoods and alders with a dense understory. As mitigation, one willow lift of 226 willows was installed one foot above OHW, five feet below the levee top.

- Site 22-3: This 2007 levee rehabilitation site is scheduled to be reworked in 2011. The 2007 repair spanned approximately 273 LF of levee. The riverward slope was reshaped to 2H:1V and armored with a three-foot blanket of class IV riprap. The spall blanket was extended landward from the top of the bank. Spalls and gravel were placed to provide a driving surface on the levee crown and access ramps. The section scheduled to be reworked in 2011 is 110 LF. Excess rock was placed at this site during the 2007 repair, staged for this construction effort. The overburden will be removed and used to tie in the downstream end of the 2007 work. Cleared vegetation in 2007 consisted of 75 LF of predominantly blackberry and approximately 200 LF of mature riparian vegetation (cottonwoods and alders) with a dense understory. The 2011 work will remove 110 LF of mature riparian vegetation (cottonwoods and alders). In 2007, mitigation at the site included installation of one willow lift at 0.5 foot above OHW; 500 willows were planted. Mitigation in 2011 will include a double willow lift and two rows of native shrubs planted at the top of the riverward bank throughout the entire project reach (383 LF). The 2011 construction area as well as the 2007 repair will be covered with soil and hydroseeded.

- Site 22-4: The Corps repaired 246 LF of in 2007. The riverward slope was reshaped to 2H:1V and armored with a three-foot blanket of class IV riprap. The spall blanket was extended landward from the top of the bank. Spalls and gravel were placed on the levee crown and access ramps to provide a driving surface. Cleared vegetation consisted of four or five small brushy alders, a dense stand of Japanese knotweed, and grasses. Mitigation included a single willow lift of 482 willows spanning 239 LF installed three feet above OHW. As-built drawings show a single log at the toe.

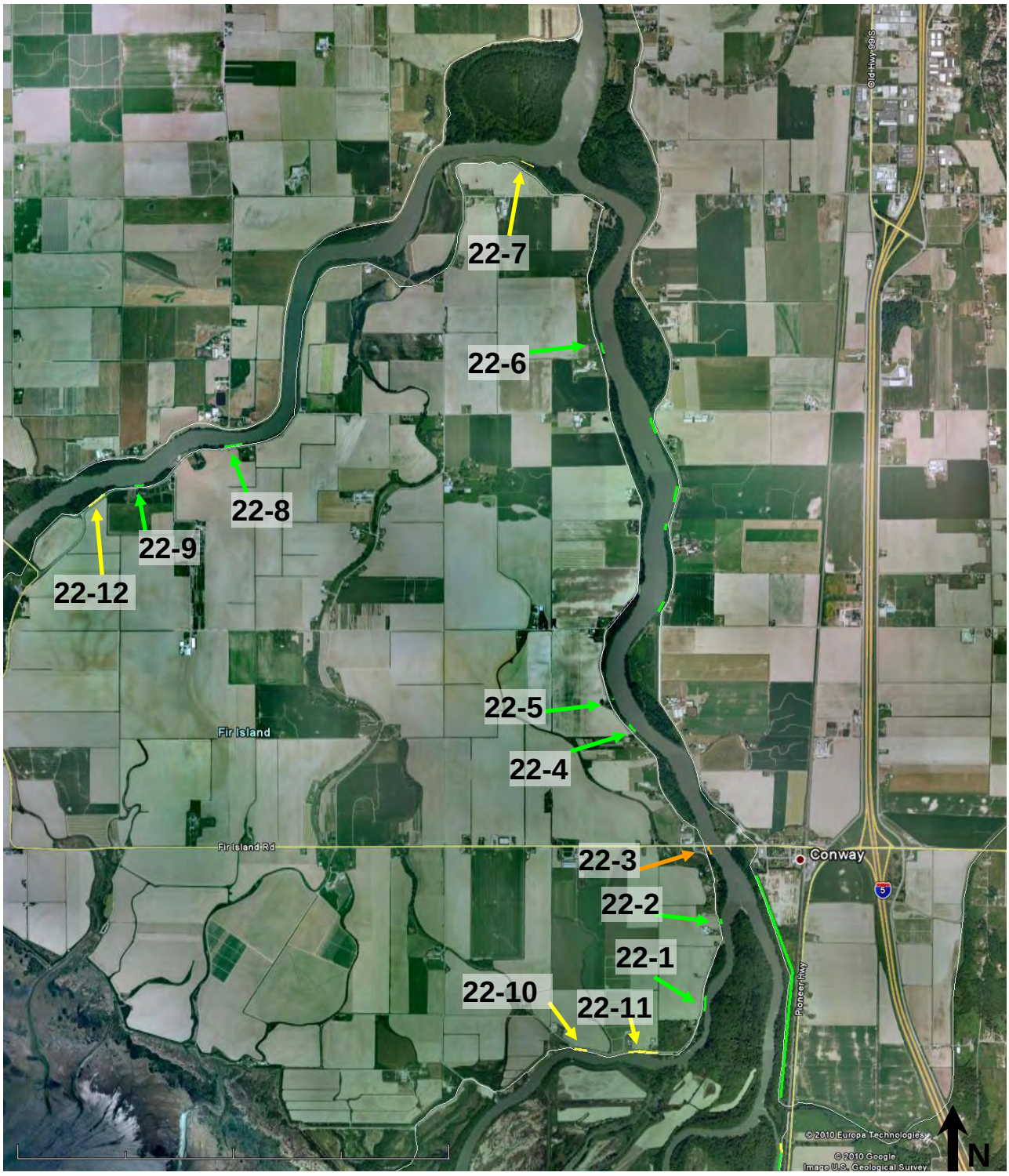

Figure 6. Location of Repairs in Diking District 22.
Sites shown in green were constructed in 2007. Sites in orange were built in 2007 but require rework in 2011. Sites in yellow are to be completed in 2011.

- Site 22-5: The Corps repaired 70 LF of levee in 2007. The riverward slope was reshaped to 2H:1V and armored with a three-foot blanket of class IV riprap. The spall bench was extended landward from the top of the bank. Spalls and gravel were placed on the levee crown and access

ramps to provide driving surfaces. Cleared vegetation consisted of approximately 30 LF of mixed yarrow and purple loosestrife, 40 LF of mixed-age riparian vegetation dominated by four larger cottonwoods and alders up to 45 feet tall. One unanchored log at the toe of the levee was included as a mitigation offset for this site. As-built drawings show unanchored logs at the toe. Reviews of 2010 aerial images do not show these logs still in place.

- Site 22-6: The Corps repaired 359 LF of levee in 2007. The riverward slope was reshaped to 2H:1V and armored with a three-foot blanket of class IV riprap. The spall blanket was extended landward from the top of the bank. Spalls and gravel were placed on the levee crown and access ramps to provide a driving surface. Cleared vegetation consisted of eight to nine cottonwoods, alders, and willows ranging from 30 to 50 feet tall. Grasses dominated the understory. Two willow lifts were installed as mitigation, the first at 1.5 feet above OHW; 704 willows were planted. As-built drawings show unanchored woody debris at the toe. Reviews of 2010 aerial images do not show the woody debris.

- Site 22-7: This site was deferred from the 2007 construction season, and will be repaired in 2011. The damaged section is 350 LF at the northern point of Fir Island, where the Skagit River splits into the North and South Forks. The site has scoured at the toe and into the revetment face. Continued bank erosion would lead to levee failure. The levee will be repaired by re-grading the slope to 3H:1V, placing a spall blanket filter layer and riprap armor to create a toe and provide erosion protection. Several mitigation options will be added to the design at this site. A double willow lift and anchored rootwads will be installed throughout the project site, with the lowest willow lift at OHW. Overstory trees will be planted along the riverward bench. The Corps will clear seven large cottonwoods and five mature alders greater than 12 inches dbh on the bench, ten to twelve smaller alders, and willows less than four inches dbh with a brushy understory along the revetment. Trees removed for the repair will be salvaged and used as anchored woody debris. To layback the slope throughout the repair area, a transition zone will be built to connect the layback to the upstream and downstream slopes. The transitions will be gradual to avoid scour and are expected to be approximately 40 feet on each side.

- Site 22-8: The Corps repaired 554 LF of levee in 2007. The riverward slope was reshaped to 2H:1V and armored with a three-foot blanket of class IV riprap and extended to the top of the levee. Spalls and gravel were placed on the levee crown and access ramps to provide a driving surface. Cleared vegetation consisted of a row of ten to twelve willows less than twenty-five feet tall, brush on river edge to a width of approximately 25 feet measured from the river, and grasses located upstream of the willows. In 2011, excess rock placed on the bench during the 2007 repair will be removed as the additional weight of this rock could cause rotational failure. This excess rock will be reused at other repair sites. Two willow lifts spanning 429 LF were installed as mitigation at 2.5 feet above OHW; 838 willows were planted. As built drawings show unanchored logs and debris at the toe.

- Site 22-9: The Corps repaired 338 LF of levee in 2007. The riverward slope was reshaped to 1.5H:1V and armored with a three-foot blanket of class IV riprap. The spall blanket was extended landward from the top of the slope. Cleared vegetation consisted of three small brushy willows and/or alders approximately four feet tall, a variety of small shrubs, and grasses. Two willow lifts were installed as mitigation spanning 208 LF in length and beginning at 1.5 feet above OHW; 408 willows were planted. As built drawings show unanchored debris at the toe.

- 22-10: This site will be constructed in 2011. The site includes 300 LF of repair due to seepage through the levee and an over-steepened bank with missing toe rock. The revetment has

approximately 40 clumps of willows and alders that have been cut and regrown many times so they have large trunks but small stems (1/2 to 1" dbh). All vegetation on the revetment will be removed for the repair. The riverward slope will be reshaped to 1.5H:1V, spall rock will be placed, and a three-foot blanket of class IV riprap will be placed. Additionally an impermeable core will be excavated and built along the centerline of the levee to reduce seepage. Mitigation at this site will include a double willow lift installed with the lowest lift at OHW and placing dirt and hydroseed on the riverward bank above the willow lifts.

- 22-11: This site will be constructed in 2011. The site includes 800 LF of backslope repair due to seepage through the levee. Most of this site is behind a vegetated bench; only approximately 100 feet is adjacent to the river. No work along the riverward bank will be done. The repair will be completed through installation of a keyway (impermeable core) along the center of the levee by excavation and placement of a clay layer through the center of the levee. The bench will not need to be cleared or grubbed. Disturbance will occur to the levee crown, which is maintained as a grassy area. Following construction, the disturbed areas will be hydroseeded. No mitigation will be required at this site as the work is limited to the backside of the levee.

- 22-12: This site will be repaired in 2011 and is behind a wide forested bench. No in-water work is needed. There is sloughing along the riverward face. The riverward face is soil, except for a length (124 ft) that was patched with rock. The levee face is dominated by blackberry and grass with no woody species. Many woody species are growing in the bench near the toe of the levee, some of which will be removed during construction. These include many willow saplings, three large cottonwoods (15" dbh), and six alders (2-12" dbh). Total length of repair area is 162 LF (including a 124-foot section that was repaired during the 2008-09 high water events). The riverward face will be re-sloped and covered in spall rock. As mitigation, the spall rock will be covered with topsoil and hydroseeded.

Table 1. Site Lengths and Repair Status

Site	Repair status	Total length (LF)
1-1	2007 complete	207.5
1-2	2007 complete	200.0
1-4	2007 complete	108.0
1-7	2007 complete in 2011 adding woody debris	257.0
3-1	2007 complete in 2011 adding soil and plantings	382.0
3-2	2007 complete	436.0
3-3	2007 complete	139.0
3-4	2007 complete	287.0
3-5	2007 repair complete - 2011 add LWD	460.0
3-6	partial repair in 2007, rework in 2011	375.0
3-7	2007 complete	6110.0
12-1	2007 complete	109.0

Site	Repair status	Total length (LF)
1-3	2011 repair	75.0
1-13	2011 repair	50.0
1-14	2011 repair	30.0
3-6	partial repair in 2007, rework in 2011	150.0
3-8	2011 repair	225.0
3-11	2011 repair	200.0
12-4A	2011 repair	250.0
12-4B	2011 repair	970.0
12-6	partial repair in 2007, rework in 2011	160.0
12-9	2011 repair	1850.0
12-11	2011 repair	600.0
12-12	2011 repair	50.0

12-2	2007 complete	261.0
12-3	2007 complete in 2011 adding soil and plantings	511.5
12-5	2007 complete	236.0
12-6	partial repair in 2007, rework in 2011	651.0
12-7	2007 complete	170.0
12-8	2007 complete	124.0
17-1	2007 complete	400.0
17-2	2007 complete in 2011 adding woody debris	275.0
17-3	2007 complete	159.0
17-4	2007 complete	170.0
17-5	2007 complete	1350.0
17-6	2007 repair complete - 2011 add LWD	522.0
22-1	2007 complete	395.0
22-2	2007 complete	118.0
22-3	partial repair in 2007, rework in 2011	273.0
22-4	2007 complete	246.0
22-5	2007 complete	70.0
22-6	2007 complete	359.0
22-8	2007 complete	554.0
22-9	2007 complete	338.0
Total repair in 2007 = 16,253 ft (3.08 mi)		

12-14	2011 repair	250.0
12-13	2011 repair	350.0
12-15	2011 repair	180.0
12-16	2011 repair	670.0
12-17	2011 repair	450.0
17-7	2011 repair	800.0
17-9	2011 repair	700.0
17-10	2011 repair	200.0
17-12	2011 repair	925.0
17-15	2011 repair	125.0
17-16	2011 repair	250.0
22-3	partial repair in 2007, rework in 2011	110.0
22-7	2011 repair	350.0
22-10	2011 repair	300.0
22-11	2011 repair	800.0
22-12	2011 repair	360.0
Total repair in 2011 = 11,430 ft (2.16 mi)		

4.0 ALTERNATIVE ACTIONS

4.1. No-Action Alternative

Under the No-Action Alternative, the Corps would not provide assistance to the Skagit County Diking Districts under the PL 84-99 Program, which means no project features would be implemented by the Corps. All levees would be left in damaged condition for the near future; however, the Diking Districts may elect to use their own funding to repair the damages of most urgent need. The No-Action Alternative was rejected due to increased risk to health and safety due to potential for additional flood damage and the associated economic damages that would occur if the levee were to fail in the near future without Corps assistance. The probable environmental effects of the No-Action alternative are presented in this document per NEPA requirement.

4.2. Repair In Kind Alternative

This alternative would include repairing the damaged sites to their pre-flood condition such that the repairs would create the typical cross section design of a levee including a 2H:1V riprap bank with no environmental enhancement features added. Due to the extensive repairs required throughout the lower

Skagit River, this would have lead to a significant effect to the environment, particularly to threatened salmonids, and as such, this alternative was rejected.

4.3. Preferred Alternative

The Preferred Alternative was implemented in 2007 as an emergency action prior to the next flood season, and more work under this alternative is proposed to be implemented in 2011 as described in Section 3 (Proposed Action Locations and Descriptions). The completed 2007 repairs and the proposed 2011 repairs returned or will return the levees to the pre-damage level of protection within the pre-flood footprint using materials equivalent to those present prior to the damage and will include mitigation options to offset environmental effects. Site-specific construction design details are provided in Section 3 above and in Appendix C. Environmental enhancement features have been incorporated into the construction to offset effects to riverine edge habitat. The features are designed to enhance juvenile salmonid rearing habitat that is lost or degraded due to levee repair. Throughout the environmental coordination of this proposed Federal action, Corps technical staff consulted with the National Marine Fisheries Service (NMFS), the U.S. Fish and Wildlife Service (USFWS), and Washington Department of Fish and Wildlife (WDFW), and the local Tribes to find ways to reduce the negative effects of levee repair on ESA-listed salmonids. This mitigation plan is described in detail in Section 5 and is included in the comparison of alternatives in Section 7.

4.4. Alternatives considered but not selected

Two other alternatives initially were considered to meet the project need. The first alternative would relocate all residences, commercial structures, utilities, and other infrastructure within the areas protected by the damaged sections of levees to a location outside of the floodplain. The high cost and complicated logistics associated with this alternative were not proportional to the increased level of benefit associated with this alternative. In addition, relocating infrastructure is outside the scope of the PL 84-99 Program. The second alternative would set back the levee from its footprint in the damaged areas to reduce cost of relocations and decrease environmental effects. Because of the fragmented nature of the levee damage locations, constructing a new levee would result in an increased project cost associated with the amount of embankment material required. Furthermore, the Diking Districts do not own adjacent land, and the time and cost associated with obtaining the necessary lands would incur additional expense and would delay levee repairs past the next flood season. The Diking Districts are considering locations where levees can be set back; however, this work is outside the scope of the repairs proposed in this document.

5.0 MITIGATION FOR ENVIRONMENTAL EFFECTS OF THE PROPOSED ACTION

Because of the long history of modification of riverbanks within the lower Skagit valley, the habitat is quite degraded, yet the Skagit River remains critical for many sensitive salmonid species. Due to the extent of recent past and upcoming necessary repairs to the Skagit River levees and the time lag for newly repaired sites to provide edge habitat functions, as well as to avoid affecting salmon recovery, the Corps is proposing environmental measures to mitigate for lost functions of the riverine edge habitat.

The Corps initiated formation of a technical working group to develop a strategy for assessing the effects of the levee repairs and developing measures to offset those effects. The Technical Working Group included representatives from the Diking Districts, NMFS, USFWS, the Skagit River System Cooperative, and the Corps. Through multiple meetings and discussions as well as site visits, the working group created and further developed a tool for assessing effects and benefits of different types of work on salmonid habitat.

The parameters for tool development were to 1) accurately assess effects of levee repairs, 2) provide options for on-site compensation for effects, 3) use a target number for fish benefits in fish numbers or area of habitat, 4) move away from a previous assessment that incentivized vegetation removal, 5) allow

evaluation of off-site mitigation options, and 6) rely heavily on published scientific data of fish usage of different bank habitat types to define the potential mitigation options. The result is a new assessment tool that focuses on habitat capacity degradation due to levee repairs and the increase in capacity expected to result from the mitigation options. The idea for creation of the tool came from literature describing density dependence of juvenile salmon and the estimated carrying capacity of the rearing habitat in the lower Skagit River. Using a target quantity of habitat capacity is intended to compensate for effects to juvenile salmon rearing habitat that result from levee repair.

To provide compensatory mitigation for detrimental effects of levee repair on edge habitat, many mitigation options were considered that can be applied in various combinations to achieve the greatest on-site reduction of effects, and evaluate off-site mitigation options. A typical levee repair excavates the bank to a 2H:1V slope, places a one-foot spall blanket and then a three-foot riprap blanket. The mitigation options deviate from that norm to create edge habitat benefits. These mitigation offset options include:

- Layback: A layback is the creation of a shallower riverward slope. The slope must be no steeper than a 3H:1V slope, though if space allows an even more gradual slope is preferred. The slope should begin below OHW and continue above to the top of the riverward bench or the top of the levee, depending on the site characteristics. The wider the horizontal slope of the layback within the levee footprint, the larger the benefit. This option requires either a riverward bench or potential landward movement of the levee crown to allow enough space for the slope change without moving the levee toe riverward. This option creates a more stable bank that is expected to require fewer repairs and creates shallower depths of water along the shoreline, as preferred by juvenile salmon (Beechie et al. 2005). It increases river conveyance and may decrease river velocities along the bank.

- Layback transition zones: Layback alternatives require transition from the laid back 3H:1V slope to the upstream and downstream conditions (usually 2H:1V). These transitions must be gradual to avoid scour and maintain levee stability. The transition zone will not provide the same benefits as the full layback but do provide hydraulic complexity over the typical levee.

- Single logs in a line: This is straight logs with minimal or no rootwads and little or no branching remaining. These logs are attached end to end and anchored parallel to the toe of the levee at or below OHW, in a continuous line throughout the site. Single logs create a moderate gain in habitat and hydraulic complexity at the toe.

- Woody debris piles: This is unanchored complex woody debris at OHW. These piles are not expected to remain in place during a high water event, but will shift and remain available to create habitat downstream. Woody debris piles create a significant gain in habitat and hydraulic complexity at the toe. Woody debris piles will be a minimum of 4 feet wide and will be placed in a relatively continuous band at the OHW level throughout the site. The piles consist of smaller diameter woody debris such as branches and small trunks in a random, intertwined configuration. Debris piles will be keyed into pilings or other stable structures at the toe whenever possible to increase their longevity at the repair site.

- Anchored rootwads: Rootwads will be a minimum of three feet in diameter attached to a 20–foot length of bole (trunk) of at least 12 inches diameter. The rootwads will be chained to a boulder with a cable anchored to the rock. The boulder will be sized appropriately, in consideration of the anticipated buoyancy and shear stress, so that it will be expected to remain on site. Rootwads of a larger size will be accepted and encouraged. The rootwads will be placed at or below OHW with 10 feet between each rootwad/bole structure to take advantage of the full extent of the anticipated

hydraulic complexity. Rootwads create a significant gain in habitat complexity at the toe and begin to function immediately after placement.

- Anchored single logs with rootwads: This mitigation option combines the "single logs in a line" option and the "anchored rootwads" option as discussed above. This option applies the rootwad multiplier only to the area of effect of the rootwad itself. The area of effect used for quantifying linear feet of mitigation credit is twice the diameter of the rootwad. If a five-foot rootwad attached to a 20 foot bole were placed in the river, this option allows for the rootwad multiplier to be used for 10 feet (5 feet upstream and 5 feet downstream of the rootwad) and the single log multiplier to be applied for the remaining 15 feet of the bole.

- Setback levees: A levee setback is the placement of the toe of the levee away from the river edge. This must include removal of all bank armoring adjacent to the river, creating a natural bank. This option improves edge habitat by removing the hydromodification and allowing natural processes to take place. This option increases river conveyance and floodplain connectivity. This can result in not only significant improvement of edge habitat but also an increase in total habitat available to salmonids through some reclamation of the flood plain.

- Remove bank armoring: This option removes riprap from the riverbank above and below OHW. The levee remains in the same location, but the bank becomes a natural soil bank. In general, this will be applicable where the revetment to a riverward bench is armored and the levee is set back from the river's edge. Depending on site conditions, this may require armoring the levee itself including a buried toe, but removal of the armoring from the river's edge allows natural river processes such as channel migration, undercut banks, backwater creation, and other benefits.

- Fish bench: This option includes the creation of a bench or ledge within the levee face below OHW. Fish benches create shallower water at a decreased velocity along the shoreline. Beechie et al. (2005) found that juvenile salmonids show a significant preference for slower velocity habitats. One criticism of fish benches has been that a horizontal bench is useful to fish only at certain river stages. If the river is low, the bench may be above the water level, and in high water events, the bench would be too deep to provide any fish benefit. Design modifications have been developed that will increase the useful range of this mitigation option. Fish benches will be installed at an angle, two feet above OHW at the upstream end and two feet below OHW at the downstream end. The bench will be a minimum of 9 feet wide and will have a 2% grade toward the water to allow drainage and prevent fish stranding.

- Habitat weir: A habitat weir is a protrusion of rock riverward from the levee face at a 30-degree angle pointing upstream to create hydraulic diversity. The weir will be a pyramidal rock structure with 2H:1V slopes that face upstream and downstream; starting at the toe, it will extend five feet from the face of the levee into the river up to a few feet above OHW. It will extend above OHW to provide hydraulic complexity at many river stages. Designing a weir into a site will require a reach analysis to avoid movement of the thalweg or change to the river dynamics within the reach. The weir is designed to create localized changes that include reduction of velocities upstream of the structure and pool creation downstream. Both of these effects improve rearing habitat.

- Willow lifts: A willow lift is the horizontal placement of a layer of soil and live willow stakes (3/4 to 1 inch dbh) into the face of the levee. Lifts can be placed singly, or with multiple lifts up the levee face. Due to the rock size, lifts are roughly four feet apart vertically. The lowest lift should be as low as possible and no higher than OHW. Willows can withstand significant periods

of inundation, and lower lifts will create greater fish benefits. Willows create shade, insect habitat, and edge diversity, and as they mature, the stems create refugia during high-water events. Multiple lifts have the added benefits of increased refugia across a wide range of water levels, and increasing recruitment capability, should there be damage to any plantings.

- Top of bank plantings: This option is the placement of topsoil over the riprap and planting small native shrub species such as Nootka rose (*Rosa nutkana*) and snowberry (*Symphoricarpos occidentalis*) along the top of the riverward face. Placing soil over the riprap reduces the sun's heating effect on the stones, increases the chance of natural recruitment of plants, and creates habitat for insects along the bank. Once established, at high water these plants will provide refuge and hydraulic diversity along the top of the riverward bank. Plantings will be three feet on center and can include one or more rows, as space allows.

- Soil and hydroseed: This option, similar to that above, is the placement of topsoil over the riprap and seeding with native grasses. If space at the top of the bank does not allow shrub species or if the bank must be kept clear for inspections, this option still reduces the heating effect on the rock, increases the chance of natural recruitment of plants, and creates limited habitat for insects along the bank.

- Landward tree plantings: This option involves planting trees on the landward side of the levee crown that will grow tall enough to shade the river. If a wide enough bench is available so that trees will not decrease levee safety, tree plantings riverward of the levee are preferred; however, landward plantings that are close enough to provide shade and recruitment potential will benefit the overall health of the riparian corridor.

- Invasive plant removal and replacement: The Skagit valley has multiple invasive plant species, including Japanese knotweed, Himalayan blackberry, and English ivy. Each species has different removal requirements that often require several years of monitoring and treatment. Invasive plant removal with planting of native species benefits the overall health of the riparian corridor by removing monocultural stands and allowing a diverse native plant population that will provide better shade and insect habitat. Success requires irrigation for at least the first two summers, and semi-annual weeding for at least the first five years.

- Conservation Easements: This option will allow credit for the perpetual protection of river edge habitat from development, logging, or other human disturbance. No easements are under consideration in the 2011 repair. Conservation easements will be considered on a case-by-case basis, depending on the unique characteristics of each potential site and its benefits to salmon habitat.

- Mitigation banks: Mitigation banks that have available fish or conservation credits, as established through the banking credit process, with a service area that includes the project area will be considered. Mitigation banks are highly regulated. The choice of restoring habitat in an established mitigation bank ensures success of the mitigation measures and long-term restoration of these habitat functions. Bank credits will be considered on a case-by-case basis depending on the applicability of the credits to the type of effects expected from levee repairs. Mitigation bank credits are not proposed to offset the effects of the 2011 repairs as no banks in the area have fish credits to sell, but these banks may be considered in the future.

- Other off-site projects: Several restoration projects are being planned for the Skagit River Valley, such as the reconnection of Cottonwood Slough, or have been identified in the Skagit Chinook

Recovery Plan. These projects have a great potential to improve riverine edge habitat function and improve overall conditions of the lower Skagit River for salmon. These projects may be developed as restoration projects and may have opportunities to be expanded with mitigation funds. These projects will need to be under construction before or concurrently with the levee repairs, so that mitigation will be simultaneous with or prior to the effect. The Corps does not expect to use this option to offset effects of the 2011 repairs as no restoration projects are expected to meet this deadline.

Using WDFW (2008) and the Skagit Chinook Recovery Plan (SRSC and WDFW 2005), current carrying capacity of the river was established as well as a target capacity for the river. Using published data, the team established offset multipliers for different design options that could be used at the numerous sites that will provide bank complexity, vegetation, and other characteristics that are expected to improve forage, rearing, and refuge functions of the bank over the existing condition. Appendix A is a detailed description of the Lower Skagit River Levee System Habitat Capacity Mitigation Tool (HCMT).

The majority of environmental compensation has been or will be completed on site with these design modifications. Many 2007 repairs were completed with willow lifts installed and some sites included LWD or woody debris at the toe. As-built drawings were used to establish proper offset multipliers for the 2007 repairs. The 2011 repairs have been designed to include as many mitigation options as feasible when considering the individual characteristics of each location. The site descriptions in Section 3 above give information about the designs and as-built construction at each location. Appendix A provides detail on the equations used to calculate effects and offsets at each site as well as the spreadsheet showing the calculations for the 2007 repairs and proposed 2011 repairs.

6.0 CONTEXT FOR ANALYZING ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES – EXISTING ENVIRONMENT

The Skagit River, located in northern Puget Sound, drains westward from the Cascade Mountains. The river basin encompasses over 3,100 square miles of watershed area. The project area is located in western Skagit County, near the confluence of the Skagit River and Puget Sound. The Cities of Mount Vernon and Burlington, two sizable urban areas, and the smaller towns of Rexville and Conway are located within the project area. Land use outside the city limits is largely agricultural.

The mainstem Skagit River within the project area is a large low-gradient channel ranging from 550 to 750 feet wide. The river is predominantly a run or glide throughout this area, with few sand-gravel bars. About 2.5 miles downstream of Mount Vernon, the river splits around Fir Island into the North and South Forks. Both forks further divide into smaller sloughs before flowing into Puget Sound. This portion of the Skagit River provides migratory and rearing habitat for all of the salmon species that use the Skagit River system, as well as habitat for a diversity of other aquatic and terrestrial species. Salmonid species in the project area include Chinook, pink, chum, steelhead, coho, sockeye, bull trout, rainbow trout, cutthroat trout, and likely whitefish. The Skagit River, with its 2,900 tributaries, is the only river system outside of Canada and Alaska that supports all five species of salmon (Ecology 2010a). This section describes the affected environment of all damaged levee sections of the Skagit River in the five diking districts, unless individual sections are otherwise specified.

6.1. Topography, Hydrology, and Soils

The topography of the Skagit Basin varies greatly due to its mountainous origins. Elevations range from sea level to over 3,000 feet at its headwaters. Elevation at the project sites is near sea level. Precipitation is highly variable across the basin. Average annual precipitation ranges from approximately 80 inches per year in the eastern portion of the basin to 32 inches per year in Mount Vernon near the project location (Western Regional Climate Center 2007).

Total runoff from the basin averages approximately 12 million acre/feet per year (USGS 2007). The annual runoff pattern has two peaks, one occurring in November through January and the second in June. The peaks are driven by a combination of high rainfall or snowmelt and reservoir management operations. Major tributaries to the Skagit River include the Sauk and Suiattle Rivers. The headwaters of the Sauk are in the Henry Jackson Wilderness Area. The Suiattle lies to the north of the Sauk and drains from Glacier Peak. Neither the Sauk nor the Suiattle is regulated by dams. The Skagit River originates in British Columbia. Its flows are regulated by Ross Dam and two smaller dams (Gorge Dam and Diablo Dam, downstream of Ross Dam) near the town of Newhalem and by Baker Dam on the Baker River, which is a major tributary to the Skagit River.

Six soil groups cover the majority of the watershed area. Several other soil groups are present in smaller quantities. The soil group present in the project area is the Skagit Sumas Field (Klungland and McArthur 1989). The Skagit floodplain area is dominated by Skagit Sumas Field soils, which are composed of alluvium and volcanic ash. The soils are very deep and naturally poorly drained, but have been artificially drained and protected in most areas. Undrained areas of Skagit soils are high in salt content. These soils formed in recent alluvium and volcanic ash. The soils are silt loam, silty clay loam, and very fine sandy loam to roughly 60 inches deep.

6.2. Vegetation

The project sites lie in the Eastern Puget Riverine Lowlands ecoregion (EPA 1996). This ecoregion is composed of floodplains and terraces. Western red cedar forest, western hemlock forest, and riverine and wetland habitat were common prior to settlement. Pastures, cropland, and urban centers now dominate the landscape.

Vegetation on levees is highly managed to maintain levee safety standards and inspectability. The majority of the trees in the project area are small to medium size and tend to be one of three species: black cottonwood (*Populus trichocarpa*), willows (*Salix* spp.), and red alder (*Alnus rubra*). Non-native species dominate many of the project areas. Species such as Himalayan blackberry (*Rubus armeniacus*), reed canary grass (*Phalaris arundinacea*), Scotch broom (*Cytisus scoparius*), Japanese knotweed (*Polygonum cuspidatum*), and butterfly bush (*Buddleja davidii*) are common. Other plants found in the project area are salal (*Gaultheria shallon*) and yarrow (*Achillea millefolium*).

Levees within the city limits of Mount Vernon and Burlington typically have grassy benches. Grasses, invasive blackberry, and short brushy trees (alder and willow) dominate levee faces. Larger trees are more common outside the city limits. Levees in DD1, DD3, and DD22 typically have more shrubby vegetation and larger trees than do their upstream neighbors.

6.3. Fish and Wildlife

The Skagit River system supports six stocks of Chinook salmon (*Oncorhynchus tshawytscha*), three stocks of chum salmon (*O. keta*), one stock of coho salmon (*O. kisutch*), one population of pink salmon (*O. gorbuscha*), one population of sockeye salmon (*O. nerka*), summer and winter steelhead (*O. mykiss*), bull trout (*Salvelinus confluentus*), and other salmonid and non-salmonid species (WDFW 2004; 2005). Chinook, steelhead, and bull trout in the Skagit River are listed as threatened under the Federal Endangered Species Act (ESA), and coho salmon is a Federal species of concern.

The portion of the river that flows past the levee provides migration habitat for all anadromous species. At the time of the 2007 construction, species migrating upstream in the project vicinity included Chinook, steelhead, pink, sockeye, coho, and bull trout (Myers, et al. 1998; WDFW 2004; 2005). Rearing juvenile coho, steelhead, Chinook, and bull trout use the area as well. Skagit coho may have been spawning near all of the repair sites upstream of the forks (WDFW 2005) during the 2007 construction. All other

anadromous stocks generally spawn upstream of the project area (WDFW 2005), although other species may spawn occasionally in the project area.

The urban and rural areas surrounding the project sites are frequented by a variety of wildlife species. Mammals include black-tailed deer (*Odocoileus hemionus*), coyote (*Canus latrans*), raccoon (*Procyon lotor*), opossum (*Didelphis virginiana*), skunk (*Mephitis mephitis*), beaver (*Castor canadensis*), muskrat (*Ondatra zibethicus*), river otter (*Lutra canadensis*), red fox (*Vulpes vulpes*), and harbor seals (*Phoca vitulin*a) (WDFW 2007).

The Skagit Delta is one of the major waterfowl wintering areas in the Pacific Flyway (WDFW 2007). At least 180 species of birds have been documented in the project area (Audubon 1997). A diverse group of shorebirds found near the project sites includes dunlin, western sandpiper, black-bellied plover, greater yellowlegs, Wilson's phalarope, and various waterfowl such as ducks, geese, and swans (Audubon 1997). Birds of prey include osprey, bald eagle, northern harrier, red-tailed and rough-legged hawks, short-eared and barn owls, and the occasional golden eagle. In addition, a diverse assemblage of smaller upland birds occurs in the project area.

Small rodents such as various species of mice, shrews, voles, and moles are numerous (WDFW 2007). Reptiles that occur in the area include garter snake and painted turtle, while amphibians include several species of frogs and salamanders.

6.4. Threatened and Endangered Species

In accordance with Section 7(a)(2) of the ESA of 1973, as amended, Federally funded, constructed, permitted, or licensed projects must take into consideration effects to Federally listed and proposed threatened or endangered species. Seven species listed as threatened or endangered are potentially found in the broad scope of the action area (Table 2). A Biological Assessment has been submitted to USFWS and NMFS regarding effects to these species.

Table 2. ESA-Listed Species in Potentially Found in the Project Vicinity

Species	Listing Status	Critical Habitat
Marbled murrelet *Brachyramphus marmoratus*	Threatened	Designated, does not include project area
Northern Spotted Owl *Strix occidentalis caurina*	Endangered	Designated, does not include project area
Eulachon *Thaleichthys pacificus*	Threatened	Under Review
Coastal/Puget Sound bull trout *Salvelinus confluentus*	Threatened	Designated, including the project area
Puget Sound steelhead *Oncorhynchus mykiss*	Threatened	Under Review
Puget Sound Chinook salmon *Oncorhynchus tshawytscha*	Threatened	Designated, including the project area
Southern resident killer whale *Orcinus orca*	Endangered	Designated, does not include project area

Other listed species including the grizzly bear (*Ursus arctos horribilis*), Canada lynx (*Lynx canadensis*), and gray wolf (*Canis lupus*) may occur or historically occurred in Skagit County, but are not expected to occur in the project area (USFWS 2007). The wolverine (*Gulo gulo luscus*) is a candidate species that may occur in Skagit County. The proposed projects will have no effect on grizzly bear, Canada lynx, or

gray wolf or their designated critical habitat, or to wolverine, as they are not expected to use the project areas due to their requirement for specialized habitat that does not exist in the project area, sensitivity to human encroachment, or both.

6.4.1. Marbled Murrelet

Marbled murrelets are small seabirds that feed on fish and invertebrates usually within two miles of shore and nest in stands of mature and old growth forest. The marbled murrelet typically forages for prey in sheltered marine waters during the day and visits its nest site at dawn or dusk (USFWS 1997). The loss of old growth forests to logging and development has contributed to the decline of this species. This species is vulnerable to fishing nets and oil spills. Marbled murrelet critical habitat includes 11 units in Washington State, but no critical habitat has been identified in the project area.

6.4.2. Northern Spotted Owl

Northern spotted owls are medium-sized owls that rely on older forested habitats with moderate to high canopy closure of large overstory trees and a high incidence of tree deformities such as cavities or broken limbs. These forests provide thermal cover, nesting habitat, and protection from predators. The loss of old growth forests to logging and development has contributed to the decline of this species. The expansion of the home range of a competitor species, the barred owl (*Strix varia*) is being studied as a potential cause of the decline of spotted owl populations. The larger barred owl is better suited to younger forests and competes with the spotted owl for food. Northern spotted owl critical habitat includes six units in Washington State, including within the Cascade Mountains in Skagit County, but no critical habitat has been identified in the project area.

6.4.3. Eulachon

The Southern Distinct Population Segment (DPS) of eulachon were listed as threatened on March 18, 2010. Commonly called Columbia River smelt, Pacific smelt, candlefish, or hooligan, eulachon are a small anadromous fish endemic to the northeastern Pacific Ocean. The most significant threat to eulachon is climate change (Drake et al. 2010). Climate change is expected to change water and air temperatures, decrease snowpack, cause retreat of glaciers, and change peak flow timing. In the U.S., most eulachon production occurs in the Columbia River and its tributaries. Historic records of eulachon in Puget Sound are difficult to track due to the frequent misidentification of the species and conflicting reports of eulachon within Skagit Bay exist (Drake et al. 2010). NMFS found no record of eulachon spawning stocks occurring in Puget Sound or its tributaries (NOAA 2010a).

6.4.4. Coastal Puget Sound Bull Trout

The Skagit River system hosts anadromous, fluvial, and resident life history forms of bull trout (USFWS 2004). Adult bull trout move through the project area from February through March as they ascend the river to upstream spawning grounds, and again from May through June as they return to saltwater/estuarine habitats. Juvenile anadromous bull trout use the project area in winter, entering freshwater in August through November where they remain until April or May. Sub-adults move in and out of the project area year round. The peak movement from fresh to saltwater environments occurs in May and June (USFWS 2004). Bull trout use spawning and early rearing habitat in the upper portion of the Skagit River Basin from late August to early or mid-November (USFWS 2004). Designated critical habitat for bull trout includes all portions of the mainstem and extends upstream of Interstate-5. All the project sites are located within designated critical habitat. Combinations of factors including habitat degradation, warming water temperatures, expansion of exotic species, and exploitation have contributed to the decline and fragmentation of indigenous bull trout populations.

6.4.5. Puget Sound Steelhead

The Skagit River supports populations of summer- and winter-run steelhead (WDFW 2005). Spawning occurs from January to mid-June, with peak spawning occurring from mid-April through May. The usual

spawning area includes locations adjacent to several sites in DD12. The rest of the project sites are located downstream of all known spawning areas, although some potential exists for the presence of spawning fish lower in the river outside of their ordinary range, especially near sites in DD12 and DD17. Smoltification and seaward migration occur from April to mid-May. The project area is used as a migration corridor for upstream migrating adults and downstream movement of juveniles migrating to saltwater environments. Multiple age classes of steelhead are present in the river year-round.

6.4.6. Puget Sound Chinook

The Skagit River Chinook populations include spring, summer, and summer/fall-runs. The Salmon and Steelhead Stock Inventory defines six stocks of Chinook that use the project reach: 1) Upper Skagit Mainstem/Tribs Chinook, 2) Lower Skagit Mainstem/Tribs Chinook, 3) Lower Sauk Chinook, 4) Upper Sauk Chinook, 5) Suiattle Chinook, and 6) Upper Cascade Chinook (WDFW 2005). The Lower Skagit Mainstem/Tribs Chinook spawn from the confluence of the Nookachamps River upstream to the confluence with the Baker River; this spawning area includes the river adjacent to site 12-1. Spawning may occur, at least occasionally, adjacent to other sites, particularly in locations adjacent to DD12 and DD17. All other populations of Skagit River Chinook spawn further upstream in the Skagit River and its tributaries. Juvenile Chinook in the Skagit River move downstream February through July into the Skagit Bay or Skagit Delta. A portion of these runs move to the delta and rear for a few months prior to entering saltwater in June and tends to prefer slower moving waters in sloughs, backwaters, and eddies (Beamer *et al.* 2005). The spring-run Chinook rear for over a year in freshwater before moving into saltwater in March through May (Beamer *et al.* 2005). The work window avoids the spawning period and the majority of outmigrating juveniles, but coincides with the timing of upstream migration for all Skagit Chinook stocks.

6.4.7. Southern Resident Killer Whale

Southern resident killer whales range within about 200 miles surrounding the San Juan Islands and specialize in salmon as preferred prey (NMFS 2008b). The Southern Residents' customary range is thought to be primarily within Puget Sound, and the Georgia and Johnstone Straits. Within Puget Sound, the southern residents are piscivorous, concentrating their predation on adult salmonids, especially Fraser River Chinook (Hanson et al. 2010). Among the threats to killer whales are contaminants such as organochlorines (includes PCBs and DDT residues) and other chemical compounds and heavy metals (NMFS 2006). Prey availability has been noted as a potential limiting factor to species recovery. The third major effect to killer whales comes from noise and vessel operations.

6.5. Cultural Resources

The Corps has determined that the proposed rehabilitation projects (Preferred Alternative) are an undertaking of the type that could affect historic properties and must comply with the requirements of Section 106, as amended through 2004, of the National Historic Preservation Act of 1966, as amended through 2000 (NHPA) (16 USC 470). Section 106 requires that Federal agencies identify and assess the effects of Federal undertakings on historic properties and to consult with others to find acceptable ways to resolve adverse effects. Historic properties are defined as those properties that are listed or are eligible for listing in the National Register of Historic Places (NRHP). Eligible properties must generally be at least 50 years old, possess integrity of physical characteristics, and meet at least one of four criteria for significance. Regulations implementing Section 106 (36 CFR Part 800) encourage maximum coordination with the environmental review process required by NEPA and with other statutes.

To comply with Section 106 of the NHPA, a Corps archaeologist completed archival and background research, a search of the Washington Department of Archaeology and Historic Preservation (DAHP) Electronic Historic Sites Database, and a pedestrian survey of all 57 levee repair locations (Kent 2007; Kent 2007a; Kent 2008; Storey 2011). Cultural resource inventories occurred on May 16-18, 2007, August 7-9, 2007, February 17-22, 2010, February 17, 2011, and March 14 2011. Levees were first

constructed along the Skagit River beginning in 1895; however, they have been extensively modified over the years. In the 1970s, the Diking Districts raised the levee heights and in the 1990s, a clay barrier was buried along sections of the levee revetments. At this stage, it is difficult to determine if any segments of the original levees are still present. A Corps archaeologist will monitor part of the repair efforts in order to determine if older levee segments are still identifiable in the levees' cross sections. A Historic Property Inventory Form (HPIF) will be completed during monitoring and construction information gained during monitoring will be included on the HPIF. No other cultural resources were located during the inventory. The Corps required monitoring the following 2007 repair locations: 12-7, 12-8, and 17-5; and will require monitoring at the following 2011 repair locations: 3-8, 12-12, 12-13, 12-16, 12-17, 22-7, and 22-12.

6.6. Water Quality

The Skagit River is designated for aquatic life uses as core summer salmonid habitat (WAC 173-201A-602). The core summer habitat designation is characterized by the river's use from June 15 to September 15 as either salmonid spawning or emergence, adult holding, use as important summer rearing habitat by one or more salmonids, or as foraging habitat by adult and sub-adult native char. Other common characteristic aquatic life uses for waters in this category include spawning outside of the summer season, rearing, and migration by salmonids. Water quality standards (i.e., temperature, dissolved oxygen, and turbidity) are established based on this aquatic life use designation. In addition, the Skagit River is designated for primary contact recreational uses, all water supply uses, and all miscellaneous uses.

In general, the upper reaches of the Skagit meet state water quality standards. Most of the substandard water quality conditions occur in tributaries to the Skagit River and in the Samish Basin, while the Skagit River itself meets standards on most occasions (Skagit County 2008). Two areas in the upper Skagit basin are on the Ecology's 303d list for temperature and fecal coliform. Several tributaries to the lower Skagit have a total maximum daily load (TMDL) requirement established for temperature. These tributaries do not meet the state water quality standard during the summer due to lack of vegetative cover for shading (Ecology 2008). Removal of native trees and other vegetation has increased exposure to sunlight. Small farms and rural residential development dominate the lower Skagit landscape, and many water bodies in the western portion of the watershed have been diked, dredged, or otherwise channelized. These modifications have resulted in extensive stream and river reaches with little or no riparian vegetation capable of shading the water.

The lower Skagit River downstream from Sedro Woolley did not meet water quality standards for fecal coliform bacteria and a TMDL was established in 1994. Sources of this pollution are stormwater runoff from urban areas, failing septic systems, agricultural waste, and effluent from wastewater treatment plants. Since the implementation of a variety of measures to reduce pollution from these sources, these waters are expected to meet bacteria standards by 2015. Other water quality parameters, including pH, dissolved oxygen, and ammonia-N, either meet state water quality standards or have not been assessed (Ecology 2007).

Much of the Skagit River adjacent to the project sites is listed as Category 2 for total PCBs under the Washington State Department of Ecology's water quality assessment program conducted in compliance with the Clean Water Act (Ecology 2007). This category is for waters where there is some evidence of a water quality problem, but not enough evidence to require production of a TMDL for PCBs. Tissue samples from anadromous or nonresident fish taken within this segment had elevated levels of PCBs but information on the likely source of the pollutant is lacking and may not relate to the waterbody segment. Since no evidence is available to connect the pollutant to the segment, it has been placed in the Waters of Concern Category.

6.7. Air Quality and Noise

Air quality in the Skagit Basin is within the Environmental Protection Agency's (EPA) standards for all air quality parameters (EPA 2007). Construction vehicles and personal vehicles will release greenhouse gases during the construction of this project. The EPA creates regulations as required by the Clean Air Act. Areas of the country where air pollution levels persistently exceed the national ambient air quality standards are designated as "non-attainment" areas. The EPA has set *de minimis* threshold levels (100 tons/year for carbon monoxide and 50 tons/year for ozone) for non-attainment areas; however, there have been no standards set for green house gas emissions in Washington State. In Washington, the Seattle-Tacoma area is the only designated non-attainment area and this is due to particulate matter (PM2.5) levels (EPA 2011a). The project area is rural-agricultural or on the outskirts of small cities. Typical noises consist of those generated by agricultural machinery, trucks, automobiles, aircraft, and other internal combustion engines.

6.8. Economy

Agriculture, fishing, wood products, tourism, international trade, and specialized manufacturing make up the economy of Skagit Valley. The Skagit floodplain and delta include alluvial soils that create highly productive farmland. Skagit County is one of the richest agricultural areas in the world, a major producer of cabbage, table beet, and spinach seeds (WSU 2008). More tulip, daffodil, and iris bulbs are produced in Skagit County than in any other county in the United States (WSU 2008).

The upstream portion of the levee on DD1 protects West Mount Vernon, a highly developed urban area across the river from downtown Mount Vernon. Land use is predominantly agricultural, with rural and suburban development. The protected area behind the DD1 levee includes 2007 residential structures, 81 nonresidential structures, and approximately 9,370 acres of agricultural land.

The DD 3 levee protects the southern portion of the city of Mount Vernon. Land use in this area is intense commercial development at the upstream end of the district and agricultural and rural development downstream. The land protected by the DD3 levees includes 2,487 residential structures, 257 nonresidential structures, and approximately 4,412 agricultural acres.

The DD 12 levee protects the city of Burlington and the State Route 20 and Interstate 5 corridors. The protected area includes 4,790 residential structures, 357 nonresidential structures, and approximately 19,032 acres of agricultural land.

Diking District 17 includes portions of downtown Mount and the area referred to as Big Bend. The protected area is over 1,200 acres with the Anacortes Water Treatment Plant, 88 residential structures, and at least 29 non-residential structures, which include shopping malls, car dealerships, two large manufacturing firms, and other commercial establishments.

The levee on Diking District 22 protects the Fir Island. Land use is primarily agricultural, with rural development. The protected area includes over 197 residential structures, 420 nonresidential structures, and approximately 4,617 acres of harvested agricultural use.

6.9. Utilities and Public Services

The levees provide protection for residences, commercial properties, state and local roads and highways, and associated public infrastructure. Roads are located directly behind the levees at most of the damaged sites. Power lines and phone lines are strung along those roads either at the landward base of the levee or, more commonly, across the road from the levee.

6.10. Land Use

Land use around DD3 and DD22 is primarily agricultural, rural residential, and urban fringe. The small towns of Skagit City and Conway are located in the lower portion of the project area. The upstream diking districts (DD1, DD12, and DD17) run through the City of Mount Vernon and the City of Burlington. Land use here is predominantly urban and urban fringe.

6.11. Recreation

Fishing is a major activity in and along the Skagit River. One location (site 12-12) includes a small private dock used for recreational fishing and boating, and site 1-3 is a WDFW public access area on the river. The Skagit Wildlife Area, located near the mouth of the South Fork Skagit River and the nearby valley, is the most heavily hunted waterfowl area in western Washington (WDFW 2007). Hiking, birdwatching, photography, bicycling, golfing, rafting, and canoeing are popular activities in the area. Birdwatching, including raft trips to view eagles, is particularly popular and brings thousands of visitors each year (WDFW 1999). In addition to these traditional outdoor recreational activities, the Skagit Valley Tulip Festival draws about 350,000 visitors each April who spend roughly $14 million annually while visiting the area each spring (Dean Runyan Associates 2000). The major tulip growing areas are protected by the DD1 levee system.

6.12. Hazardous Toxic and Radioactive Waste

According to Ecology (2011), there are 45 sites identified in the Skagit County as Hazardous Sites. Of these, 15 sites are located in the general project area, all of which are in Mount Vernon. Most are associated with fuel or diesel pollutants, such as leaky tanks or pipelines at gas stations or similar. The majority of sites are awaiting remedial action or in the process of clean up but are not yet complete. No US EPA superfund sites are located in the Skagit River Basin.

7.0 ISSUES FOR COMPARISON OF ALTERNATIVES

This section will describe the probable environmental effects of taking no action toward repairing the damaged levees (No-Action Alternative) and the probable environmental effects of repairing all the damaged sections of the Skagit River levees without any environmental features added (Repair in Kind Alternative) and with the proposed environmental enhancement features (Preferred Alternative). The proposed 2011 repairs will have the same construction access, staging, materials, and methods as the already completed 2007 repairs; the environmental effects are therefore analyzed for all of this work combined.

7.1. Topography, Hydrology, and Soils

No-Action Alternative

Continued erosion on the banks and levees of the Skagit River and a higher risk of damage from flooding of the river would persist under the No-Action Alternative. The soil conditions and topography would not be affected. The levees would not be repaired and the possibility of failure would increase. In the event of a levee breach during a flood event, the river channel could migrate into developed areas, changing the hydrology in the immediate area of the breach and throughout the affected reach of the river. This is unlikely, however, as emergency flood fight measures would be initiated to protect lives and property to maintain the current river channel to the extent possible. Effects of flood fight activities would be similar to those discussed below for the Repair in Kind Alternative, though rock placement during flood events could require more rock placement and require the use of larger rocks, depending on the specific events at the time of the emergency.

Repair In Kind Alternative

Repairs of the damaged sections of the levees have minimized/would minimize the erosion of the banks on the river. The Corps typically performs repairs by reshaping and armoring the damaged vertical

riverward levee slopes over the damaged lengths. The armor rock is designed to catch at the river bottom; thus, no buried toe is constructed.

Loss of conveyance may have occurred throughout all five diking districts during the flood event when erosion of the levee moved the armor rock from the levee into the riverbed. Much of this rock has been lost and, to limit unnecessary effects to the river, would not be removed. The introduction of rock to the riverbed likely had some effect on the overall water conveyance capability of the river, but this effect is not quantifiable. Compaction of the soil in the immediate area of construction has occurred/would occur due to operation of heavy equipment.

Preferred Alternative
This alternative will have similar effects as the Repair In Kind Alternative. Overall project effects to hydrology, soils, and topography are insignificant.

7.2. Vegetation

No-Action Alternative
Depending upon the magnitude and duration of future flood events, the levee at some or all of the damaged sites may start to fail. Under these circumstances, a flood fight would likely be conducted to try to save the levee and protect properties, facilities, and lives from threat as is authorized under the PL 84-99 Program or other non-Federal capacity. Construction during a flood event is difficult and is completed as quickly as possible; therefore, vegetation would be removed as needed to accomplish the levee rescue under difficult construction conditions, regardless of the type of vegetation. Levees typically are not manually revegetated following the repairs during a flood event.

The No Action alternative would not affect vegetation unless a flood fight was required to protect lives and property. If flood fight activities were required at each of the damage locations, effects to the quantity and quality of riparian vegetation would be substantial.

Repair In Kind Alternative
The Repair in Kind Alternative would remove all vegetation on the riverward face and would not include any plantings to expedite revegetation. Disturbed areas on the bench and tops of levees would be hydroseeded with native grasses to control erosion. Removed vegetation would include removal and proper disposal of invasive species; however, without continued monitoring it would be expected that these species would become established again post-construction. The quality and quantity of the vegetation removed varies with the site. Based on photographs and aerial images of the sites, roughly 50% of the length of repair sites (approximately 13,842 LF) included low quality habitat; typically grass or blackberry dominated with very few or only immature shrubs and sometimes a small number of scattered young trees. Medium quality habitat was or would be removed from approximately 30% of the sites (approximately 8,305 LF), typically a patchy mix of grass, with mature shrubs, and sometimes a few smaller diameter trees. Roughly 20% of the sites (approximately 5,537 LF) include stands of mature overstory trees that were or would be removed. Implementation of the Repair In Kind alternative would have a significant long-term effect on the quantity and quality of vegetation in the riparian corridor of the lower Skagit River.

Preferred Alternative
Vegetation at the project sites was removed during the 2007 repairs or will be removed in 2011 for construction of the new re-sloped levee sections (see Appendix B for photos of the construction sites). As noted in the Repair In Kind Alternative, quality and quantity of vegetation varies at the different sites. The Preferred Alternative did or will include plantings at most sites to offset this effect. As many trees as possible were or will be preserved through careful construction around vegetation when possible and limiting the length of construction sites to only the necessary length for repair of the damage. This

alternative includes removal of invasive species and continued monitoring to allow the establishment of native plants.

Most sites were or will be constructed with willow lifts. These are layers of soil laid near OHW where willow stems have been placed every six inches. Willow lifts help to restore some of the lost vegetation and the lost habitat function more quickly than relying on sediment deposition and natural repopulation. The repair areas with immature vegetation are expected to recover to their pre-flood condition in three to seven years. Willow lifts planted at most sites will speed recovery. Stands of larger trees will take decades to become re-established; however, due to maintenance by the Diking Districts, presence of larger trees on levees is limited, particularly within these repair areas. Effects will be further offset by planting overstory trees at sites where there is sufficient space and planting native shrubs along many of the riverbanks. Efforts to remove invasive plant species at these sites will improve habitat diversity and function throughout the area. Riparian vegetation is important for recruitment of large woody debris (LWD) in the river, shading, cover, complexity of shoreline, and as perching and nesting habitat for birds. Mitigation efforts will expedite the recovery of these functions such that the overall effect of the Preferred Alternative on vegetation will not be significant.

7.3. Fish and Wildlife

No-Action Alternative
Implementing the No-Action Alternative would likely lead to levee failure, necessitating flood fights and emergency repairs that would result in a more detrimental design than would occur if the repair occurred under low-flow conditions. During the winter storm season, coho may be spawning adjacent to all sites except possibly 22-1, 22-2, 22-8, and 22-9 and chum could be spawning near site 12-1 (and possibly near 12-2 and 12-3). Emergency actions would disrupt spawning, displacing adults from redds and potentially reducing spawning success. During the winter storm season, eggs would be incubating in the gravel. Lower mainstem Chinook and mainstem chum eggs would likely be present adjacent to site 12-1 and coho eggs could be present adjacent to all sites except possibly 22-1, 22-2, 22-8, and 22-9. Emergency actions have potential to negatively affect redds at these locations. Sediment inputs during emergency actions would not add substantially to the sediment deposition in redds due to the natural turbidity of high flows during a major storm event. Effects to riparian areas may be greater due to the rapid emergency response; therefore, cover may be reduced relative to current condition. Willow lifts are not included in construction design during emergency repairs. The exact effect to fish and wildlife with emergency flood actions is difficult to quantify or predict but does have the potential to be significant if the flood event warrants repairs at many or all of the known damage sites.

Repair In Kind Alternative
Fish are affected by loss of riparian habitat through loss of cover and shade as well as reduced nutrient input from overhanging vegetation and the decay of forest litter (Naiman et al. 1992; Franklin 1992; Beamer and Henderson 1998; Fischenich 2003). Water temperatures are expected to increase locally due to heat reflection from the bare rock on the face of the levee (Satterlund and Adams 1992), although the extent of increase is unknown. The lower Skagit River meets state water quality standards for temperature, and the localized increases in temperature are not expected to result in an overall increase in river temperature; therefore, the effects of temperature increases on fish are likely to be minimal. At the sites with larger trees in riparian stands or dense shrubby vegetation on the banks, the reduction in natural nutrient runoff processes may reduce available prey and beneficial inputs to the river (Murphy and Meehan 1991). This reduction may have an unquantified effect on fish production in the Skagit River.

The loss of large riparian vegetation would reduce LWD recruitment; LWD provides crucial cover and holding areas during high flow events when large trees are washed into the river and become lodged in the bank or incorporated into debris jams (Chamberlin et al. 1991). Such debris jams provide optimal habitat for juvenile anadromous fish (Bjornn and Reiser 1991); reduction of LWD can adversely affect all

anadromous species. The loss of mature forest stands results in a reduction in nearshore habitat complexity, particularly during high flow events. Inundated vegetation during flood events provides lower flow areas that can be used as refuge areas (Naiman et al. 1992). The overall effects of the reduction in riparian habitat may result in a significant reduction in habitat quality in the lower river.

Loss of large riparian trees would affect wildlife habitat by reducing cover, perching, foraging, and nesting opportunities. The effect would be most pronounced in the areas where larger trees are removed. Although the total area of affected riparian habitat is small relative to the surrounding area, the amount of perching and foraging cover that is lost may locally affect foraging or reproduction rates of avian species in this area.

Implementation of the Repair In Kind alternative would remove vegetation and create bare riprap banks along over 5 miles of the lower Skagit River. This would create a significant long-term negative effect on the habitat of this riparian corridor.

Preferred Alternative
The completed 2007 work and the proposed 2011 construction activities resulted in or will result in the temporary reduction of riparian vegetation and the loss of nearshore roots and undercut banks, which will reduce fish and wildlife habitat. Repairs in 2007 were conducted outside the approved in-water work window so that the damage could be repaired prior to the winter flood season. The in-water work window is 15 June through 31 August. In-water work windows are established to avoid sensitive periods, particularly for Federally listed or proposed fish species and their prey, and protect unlisted salmonids that have similar life histories. Work in 2011 will be completed within the fish window.

Both 2007 and 2011 are pink salmon run years. Pink salmon spawn in odd years in the Skagit River, between RM 23 to 93 (especially above RM 77) and in the Sauk River up to RM 40 (NMFS 1996). Maturing fish returning to streams in northern Puget Sound generally arrive at these areas between mid-August and late September. The earliest run appears to occur to the Nooksack River, the latest to the Skagit River. The Skagit River levee repairs occur up to RM 21.5 and are unlikely to affect spawning but may affect migrating adults. These adults would likely avoid the area of construction.

Adding mitigation features restores fish habitat values by providing rearing, refuge, and forage habitat functions. Plantings help restore riparian corridor function for terrestrial species as well. Larger trees will be removed and short-term effects were or will be unavoidable. Plantings and invasive species removal protocols are expected to expedite recovery of the habitat function of the repair sites. Implementation of the Preferred Alternative will not have significant effect on fish and wildlife.

7.4. Threatened and Endangered Species

No-Action Alternative
The No-Action Alternative would likely lead to additional levee failure at an unknown date resulting in increased flooding frequency and flood damages to infrastructure. Levees that are in disrepair during flood events receive attention through flood fight actions. Emergency flood fight actions would likely result in the disruption of spawning adults and could cause greater physical injury because rock is often end-dumped into the river rather than individually placed. Emergency repair actions would likely occur during a time when more eggs are in the gravel; therefore, effects on listed species may be greater. Effects to riparian areas may be greater due to the rapid emergency response; therefore, cover may be further reduced relative to other alternatives. Willow lifts or other mitigation options are not included in construction design during emergency repairs. Likely widespread emergency repairs associated with the No Action Alternative could have significant impacts on threatened and endangered species.

Repair In Kind Alternative

The Repair in Kind Alternative would have a significant impact on endangered salmonids in the Lower Skagit River. The removal of vegetation and the placement of bare riprap with no plantings or environmental features would be expected to severely limit edge habitat function throughout one fifth of the Skagit River downstream of Sedro Woolley for the foreseeable future. In addition, this would adversely modify critical habitat for Chinook and bull trout.

Preferred Alternative
A Biological Assessment, assessing the effects of the 2007 completed repairs and the proposed 2011 repairs, has been submitted to NMFS and USFWS. Table 3 summarizes the effect determinations made in the Biological Assessment for each of the species potentially occurring in the project vicinity.

Table 3. ESA Effects Determination Summary

Species	Effect Determination	Critical Habitat Determination
Marbled Murrelet	Not likely to adversely affect	Not designated in project area
Northern Spotted Owl	No effect	Not designated in project area
Eulachon	No effect	Not designated
Puget Sound Steelhead	Likely to adversely affect	Not designated
Coastal/Puget Sound Bull Trout	Likely to adversely affect	Likely to adversely affect
Puget Sound Chinook	Likely to adversely affect	Likely to adversely affect
Southern Resident Killer Whale	Not likely to adversely affect	Not designated in project area

No marbled murrelet habitat exists within the project area. Marbled murrelets may move between inland forest habitat and the estuary near the mouth of the Skagit River to feed. Their movements typically occur near dawn and dusk; therefore, murrelets likely were not/will not fly over the sites during construction hours. The project *may affect, but is not likely to adversely affect* marbled murrelets or their habitat.

No spotted owl habitat exists in or near the project area and no owls have been reported in the project vicinity. Therefore, the project had and will have *no effect* on spotted owls.

No effects to eulachon are anticipated from these levee rehabilitations. Eulachon are sensitive to water temperature and, as discussed above, the placement of rock and removal of vegetation along the river's edge could incrementally increase water temperature within the Skagit River; however, the limited use of Puget Sound by eulachon minimizes potential effects to the species.

The project is *likely to adversely affect* Chinook, steelhead, and bull trout and the designated critical habitat of Chinook and bull trout. Removal of riparian vegetation will have long-term effects on listed salmonids. All of the larger trees that were and will be cleared from riparian areas are located at sites that are adjacent to designated critical habitat. The loss of vegetation will result in localized increases in water temperature, loss of high flow refuge habitat, and loss of LWD recruitment, which reduces rearing habitat, cover, and high flow refuge (Murphy and Meehan 1991; Franklin 1992; Naiman, et al. 1992; Satterlund and Adams 1992; Beamer and Henderson 1998; Fischenich 2003). Placement of rock along the channel likely introduced sediment into the river. This effect was and will be limited to areas along the shore within a short distance downstream of each project site. Increased sediment may locally affect feeding efficiency of juvenile salmonids present in the area (Bjornn and Reiser 1991; Bash et al. 2001). Juvenile Chinook are more likely to be found near natural stream banks with large quantities of in-stream wood than they are near rock riprap; during this time, they tend to select areas of slower moving water (Beamer, et al. 2005). In-water construction in 2007 may have disturbed juveniles at all sites and upstream adult migrants along the sites in DD22. Upstream migrants were in the project area during the 2007 construction period. This disturbance likely displaced fish to the opposite side of the river.

Construction in 2011 will be completed during the approved in-water work window to limit effects to Chinook, steelhead, and bull trout and will include mitigation features designed to offset effects to edge rearing habitat. As discussed in Section 5.0, the Habitat Capacity Mitigation Tool was developed by the Corps, the Diking Districts, the Skagit Cooperative, the USFWS and the NMFS to design mitigation options to offset the effects to salmonids. Overall, by using best management practices and including plantings, placement of anchored rootwads, and other environmental features, effects of this repair project will be below significant levels.

No direct effects to killer whales are anticipated from these levee rehabilitations. Indirect effects include effects to prey species, particularly Chinook. Effects to killer whales are likely to be insignificant, particularly due to the small role that Puget Sound salmon have in the southern residents' diet, and the even smaller role of Northern Puget Sound salmon, and in particular Skagit River Chinook stocks. The *project may affect but is not likely to adversely affect* killer whales. No critical habitat is in the project area.

7.5. Cultural Resources

No-Action Alternative
Under this alternative, the Corps would not repair the levees, and the threat of future levee failures would increase. Future flooding events could result in the erosion or destruction of eligible sites located within the floodplain of the Skagit River including known prehistoric villages, shell middens, and historic era sites such as those associated with the historic town of Avon.

Repair In Kind Alternative
All 57 levee repair locations were inventoried in 2007 and 2010-2011. Since the levees were first constructed in 1895, they have been extensively modified through the years and it is not known if any intact portions of levee still exist along the Skagit. No additional cultural resources were located during the inventories. The repair work at the levees will involve the replacement of "in-kind" material, e.g. rock and earth will replace rock and earth. The levee alignment and profile will not be significantly altered; hence, the appearance of the levee will not be affected.

The Corps initiated consultation with State Historic Preservation Officer (SHPO) and the Swinomish Tribe with a letter soliciting knowledge and concerns on June 21, 2007. The Corps reconsulted for the additional repairs on April 8, 2011 with the SHPO, the Swinomish Tribe and the Upper Skagit Indian Tribe (Appendix F). The Corps has determined that the project will result in no adverse effect and the SHPO has concurred. As of the date of this EA, the Swinomish Tribe and the Upper Skagit Indian Tribe has not identified any cultural resource concerns.

The Corps' determination that the project will result in no adverse effect is based on the stipulation that monitoring occurred at the following 2007 repair locations: 12-7, 12-8, 17-5 and would occur at the 2011 repair locations 3-8, 12-12, 12-13, 12-16, 12-17, 22-7, and 22-12. These sites were selected for monitoring based on their proximity to known archaeological sites, the potential for intact historic levee segments, or for geomorphologic conditions favoring site preservation.

Preferred Alternative
Effects of the Preferred Alternative on Cultural Resources are the same as the effects from the Repair in Kind Alternative.

7.6. Water Quality

No-Action Alternative
Under this alternative, the damaged sections of the levee system may fail during the upcoming flood season resulting in an increase in erosion, turbidity, and sedimentation. Emergency repairs may be

required. These repairs could create turbidity, though this effect may be minimal in relation to background levels of turbidity associated with flood levels. Flood fight activities would be expected to remove riparian vegetation, which could limit shading and natural detritus inputs to the river. Effects of the No Action Alternative and any emergency flood response on water quality would not be significant.

Repair In Kind Alternative
Long-term effects to water temperature would be expected with this alternative. The removal of trees without any plantings would reduce shade and thereby cause increases in river temperature. The placement of rock along the river would further increase temperatures through thermal retention and light reflection of the rocks. The increase in water temperature may locally reduce dissolved oxygen levels in the water. No measurable effects to pH or dissolved oxygen would be expected. No pollutants are expected to be introduced to the river from levee repairs.

Preferred Alternative
During 2007 construction activities, there may have been temporary and localized water quality effects such as an increase in turbidity, which may occur in 2011 as well. Equipment did not and will not enter the water, remaining on dry ground at all times. Rocks were placed or will be placed in the stream by an excavator rather than being end-dumped. Best management practices for construction activities were and will be employed.

During the 2007 construction, the Department of Ecology issued a warning letter for violations of the Washington State water quality law due to excessive sediment inputs into the river. This occurred while placing woody debris that had been pulled out of the riverbank in the river. This woody debris still had soil trapped in the root mass, which caused turbidity when it entered the water. No further in-stream wood placement occurred following receipt of the letter. If grubbed vegetation will be placed in the aquatic environment during 2011 repairs, the Corps will ensure that dirt has been shaken or removed from the root masses to avoid unnecessary turbidity. Ecology has determined that the general water quality certification associated with NWP 3 or NWP 27 covers this project, and that individual water quality certification is thus not required.

Removal of vegetation, as noted for the Repair in Kind Alternative, will reduce shading to the river and could cause small increases to local water temperature; however, the effect of warming the rocks will be mitigated at sites where willows and other native plantings are included. Growth of the plants is expected to shade the riprap within five years, thereby reducing the thermal effect. As with the Repair In Kind Alternative, the Preferred Alternative will have no measurable effects to pH or dissolved oxygen and no pollutants are expected to be introduced to the river. Effects to water quality due to the Preferred Alternative will last no more than a day and will not be a significant portion of the water column.

7.7. Air Quality and Noise

No-Action Alternative
The No-Action Alternative would mean the Corps would not repair the damaged sections of the levees; this alternative, therefore, would have no effects to air quality or noise. Emergency actions may be required to protect lives and property in the event of a flood. These actions would likely have similar air emissions and noise effects as the Repair In Kind and the Preferred Alternatives. Effects to air quality and noise would not be significant.

Repair In Kind Alternative
The Repair In Kind Alternative would have similar effects on noise and air quality as those described below for the Preferred Alternative. The installation of the environmental features in the Preferred Alternative would require more equipment than installing only riprap and as such, the Repair In Kind

Alternative would be expected to have slightly lower emissions. Impacts to air quality and noise would not be significant.

Preferred Alternative
During construction activities of 2007 and 2011, there was and will be a localized increase in ambient noise levels from construction equipment operating, but no sensitive receptors were identified during field visits, and based on the types of machinery in use, ambient noise levels at greater than 50 yards will likely not exceed 80 decibels. Equipment will only operate during daylight and typical construction hours.

Machinery and vehicles employed for the proposed repair work will release greenhouse gases. For every gallon of diesel fuel burned, 22 pounds of CO_2 are produced, and every gallon of gasoline produces 19.4 pounds of CO_2 (EPA 2011b). Based on the amount of equipment needed for construction, including but not limited to compactors, graders, front end loaders, cranes, and excavators, operating varying hours, an estimated 2,083.5 tons of CO_2 will be emitted using a construction emissions spreadsheet model for non-road equipment from the Sacramento Metropolitan Air Quality Management District (SMAQMD; 2008). Carbon monoxide (CO); reactive organic gases (ROGs), which are ozone precursors; nitrogen oxides (NOx); particulate matter (PM); and sulfur oxides (SOx) are calculated for non-road construction equipment. In addition, emissions were calculated for loaded dump trucks and water trucks, as well as personal vehicles. Table 4 outlines assumed emissions based on EPA (2011b) and SMAQMD (2008).

Table 4. Estimated emission (tons) of air pollutants and green house gases

Source	tons CO	tons ROG (ozone precursors)	tons CO_2	tons NO_X	tons PM	tons SO_X
Non-road emissions *	3.5	2.0	2,083.5	21.4	4.6	0.0
Truck emissions **			161.7			
Personal vehicle emissions ***			77.6			

* Construction equipment; based on spreadsheet model from SMAQMD (2008); assumes both 50 and 500-hp diesel engines working 18 hrs per day, modeling data.
** Assumes 5 mpg diesel, traveling 73,500 total miles; data not available for pollutants other than CO_2.
*** Assumes 20 mpg gasoline, traveling 100,235 total miles; data not available for pollutants other than CO_2

7.8. Economy

No-Action Alternative
Under the No-Action Alternative, a higher risk exists for flood damage to residences, agricultural land and buildings, commercial properties, roads, and other infrastructure. If levees are not repaired and flooding occurs due to breaches in weak sections of levees, the local economy could be greatly affected. Total expected annual flood damage reduction benefits that would accrue through levee rehabilitation of all damages are $14,301,870. Flood fight actions may be needed to protect lives and property and to diminish immediate economic effects. This alternative would have an unknown level of effect on the Skagit River fisheries due to edge habitat effects and due to placement of rock during vulnerable life cycle periods for salmon. Skagit River salmon support tribal, commercial, and recreational fisheries. According to the Washington Department of Fish and Wildlife (WDFW; 2011) sport fishing across the state generates $1.1 billion annually and 14,655 jobs in addition to commercial harvest which generates $1.6 billion by the time their catch is processed and distributed through wholesalers. While the Skagit River salmon make up only a portion of the statewide fisheries economy, the river is an important contributor, particularly for the local Tribes.

Repair In Kind Alternative
The Repair in Kind Alternative would restore the levee to pre-damage level of protection. This would restore the protection for the residences, commercial properties, roads, and other infrastructure. This alternative would have an unknown level of effect on the Skagit River fisheries. Skagit River salmon support tribal, commercial, and recreational fisheries. According to the Washington Department of Fish and Wildlife (WDFW; 2011) sport fishing across the state generates $1.1 billion annually and 14,655 jobs in addition to commercial harvest which generates $1.6 billion by the time their catch is processed and distributed through wholesalers. While the Skagit River salmon make up only a portion of the statewide fisheries economy, the river is an important contributor, particularly for the local Tribes.

Preferred Alternative
The Preferred Alternative will restore the levee to pre-damage level of protection. This will restore the protection for the residences, commercial properties, roads, and other infrastructure. This alternative includes mitigation efforts that are designed to offset effects to salmon so that no effects to fisheries are anticipated.

7.9. Utilities and Public Services

No-Action Alternative
Under the No-Action Alternative, a higher risk exists for flood damage to residences, commercial properties, roads, and other infrastructure. If levees are not repaired and flooding occurs due to breaches in weak sections of levees, local area traffic could be greatly affected. This could affect commercial traffic, access to private residences, evacuations, and emergency response services. Emergency flood fight efforts would likely be needed to protect lives and property during a flood event.

Repair In Kind and Preferred Alternatives
Effects to utilities and public services are the same for the Repair In Kind and Preferred Alternatives. The 2007 repairs and implementation of the 2011 repairs did/will prevent disruption of utilities and public services by protecting residences, commercial properties, roads, and other infrastructure from the potential damages resulting from flooding up to the pre-damaged level of protection (10- to 25-year level of protection, depending on the diking district). During construction activities, vehicles and equipment associated with the project may have disrupted or may disrupt local traffic due to merging, turning, and traveling together. Reuse of materials reduced or will reduce the number of truck trips to and from the sites, and traffic controls were used or will be used as needed to ensure public safety. Effects to utilities and public services as a result of these repairs will not be significant.

7.10. Land Use

No-Action Alternative
Implementation of the No-Action Alternative would not be expected to result in any land use changes. Under the No-Action Alternative, a higher risk exists for flood damage to residences, commercial properties, roads, and other infrastructure. Emergency flood fight efforts would likely be needed to protect lives and property during a flood event. These activities and local efforts to maintain the levees would be expected to be sufficient to maintain the existing land use and zoning within the floodplain behind the levee.

Repair In Kind and Preferred Alternatives
Effects to land use are the same for the Repair In Kind and Preferred Alternatives. During 2007 and 2011 construction activities, landowners surrounding the project areas may have been or may be disrupted while equipment and personnel access the construction areas via land easements. After completion of the entire project, residences, commercial properties, roads, and other infrastructure will be protected from the potential damages resulting from floods up to the pre-damaged level of protection (10- to 25-year level of protection, depending on the diking district). No effect to land use is expected.

7.11. Recreation

No-Action Alternative
No effects would result from the No-Action Alternative. Any emergency repairs would occur during flood events when safety conditions would limit recreational opportunities at the repair sites, regardless of construction activities.

Repair In Kind Alternative
Construction sites were or would be closed to the public for safety reasons. This would limit shoreline access and access to the private dock at site 12-12 during the construction of the adjacent repair. This effect would be temporary.

The Repair in Kind Alternative would have longer-term effects to the aesthetic value of the repair sites and recreational fishing opportunities. Presence of riprap along the banks can limit access to the water, as the angular rocks can be unstable and difficult to walk over. Loss of riparian habitat would be expected to limit fish and wildlife use of the sites, further limiting their recreational value for fishing, birdwatching, and other similar activities.

Preferred Alternative
During construction, the quality of fishing on the river near the construction sites may have been or may be reduced due to disturbance of fish, and the quality of bird watching may have been or may be reduced due to displacement of birds. Access to the shoreline and adjacent docks was or will be limited during construction. The longer-term effect on recreation will be the reduced quality of bird watching due to the loss of larger trees at several sites. To ensure public safety, bank access was prohibited during construction at each repair site in 2007 and similarly will be prohibited during construction in 2011. Plantings and placement of anchored rootwads is expected to expedite recovery of the repair sites for fish and wildlife, thereby decreasing effects to the recreational value of the sites. Covering riprap with soil and hydroseed will make river access easier. Implementation of the Preferred Alternative will not have a significant effect on recreation at the repair sites or on the river in general.

7.12. Hazardous, Toxic, and Radioactive Waste

No-Action Alternative
No effects would result from the No-Action Alternative as no construction would occur. Emergency repairs may be required, but these would not be expected to affect hazardous, toxic, or radioactive waste.

Repair In Kind and Preferred Alternatives
No known hazardous, toxic, or radioactive wastes were/are located at the project areas; therefore, no effect resulted or will result from the implementation of the Repair In Kind Alternative or the Preferred Alternative as completed 2007 work or the proposed 2011 construction.

8.0 CUMULATIVE EFFECTS

Council on Environmental Quality (CEQ) regulations implementing NEPA require that the cumulative effects of a proposed action be assessed (40 CFR Parts 1500-1508). A cumulative effect is an "impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions" (40 CFR § 1508.7). Cumulative impacts can result from individually minor but collectively significant actions taking place (40 CFR § 1508.7). CEQ's guidance for considering cumulative effects states that NEPA documents "should compare the cumulative effects of multiple actions with appropriate national, regional, state, or community goals to determine whether the total effect is significant" (CEQ 1997).

8.1. Methodology

CEQ's cumulative effects guidance sets out several different methods to determine the significance of cumulative effects, such as checklists, modeling, forecasting, and economic impact assessment, where changes in employment, income, and population are assessed (CEQ 1997). Cumulative effects may arise from single or multiple actions and may result in additive or interactive effects. Interactive effects may be either countervailing where the adverse cumulative effect is less than the sum of the individual effects, or synergistic where the net adverse cumulative effect is greater than the sum of the individual effects (CEQ 1997). For individual resources, the Region of Influence (ROI) for cumulative effects is often larger than the ROI for direct and indirect effects.

For this cumulative effect assessment, the conditions along the lower portion of the Skagit River system that have existed for a considerable time before the proposed action provide the baseline for the effects analysis. Because much of the lower Skagit River has been diked for the last half-century or longer, establishing past (baseline) conditions has taken into account descriptions of past conditions of the levees in previous reports (Table 5), as well the policies and practices of the agencies maintaining the levees (i.e. diking districts and USACE). Based on field observations documented in pre- and post-project assessments, the predominant conditions along the riverward faces of most or all of the levees being considered have included riprap of various sizes below the OHW, with mixed deciduous shrubs and woody vegetation, grasses, and soil above OHW. Maintenance policies of the diking districts and the Corps include removal of large riparian vegetation (e.g. trees) in favor of smaller, shrubby vegetation. The basis for this policy is that large vegetation such as trees may lead to root intrusion into and through the levee, causing piping or mass wasting due to wind throw, which can contribute to levee failure. On this basis, the baseline conditions along riverward sides of the levees considered in this EA have been determined to generally include riprap of varying sizes below OHW, with shrubby vegetation, invasive grasses, and riparian vegetation growing down to the river's edge above the OHW. The slope of these banks is typically 2H:1V, although some may be shallower or steeper.

Based on review of aerial photographs of before and after conditions at specific project locations on the North and South Forks of the river, as well as the mainstem above Fir Island, (Appendix B), and from notes taken during site visits, it is estimated that approximately 20% of the vegetation at or near the rivers' edge is comprised of mature overstory riparian vegetation, approximately 30% is comprised of shrubby vegetation or grasses, and 50% is dominated by grasses or blackberry.

8.2. Past, Present, or Reasonably Foreseeable Future Projects

This section presents a general discussion of historical development in the project area and identifies numerous projects that could contribute or may have contributed to cumulative effects (Table 5). It is important to note that the projects listed in Table 5 were and are repair projects and in general did not result in construction of new levees.

The Skagit River watershed has been changing since settlement began in the middle 1800s. Much of the watershed has been logged and converted to agricultural or urban development, or is maintained as managed forest. Several major dams on the Skagit River or its tributaries, including Baker, Upper Baker, Diablo, and Ross Dams have modified the hydrology of the system. The vast lowland wetlands and estuary have been diked, drained, and otherwise disconnected from the river. Off-channel and floodplain habitats are scarce in the lower river. Levees and dikes occur along much of the middle and virtually all lower portions of the river, and the floodplain has been developed for urban and agricultural uses.

Long-term effects associated with constructing and repairing levee systems along the river have included loss of floodplain function; loss of riparian function, including streamside cover and nutrient input; scouring; loss of channel and streambank complexity; lower rates of LWD recruitment; and altered

patterns of substrate formation. These effects have occurred throughout the lower Skagit River, and combined with the effects of dam construction in the river and tributaries above the project area, have resulted in a reduction of the quality and quantity of habitat for anadromous and non-anadromous fish. This reach of the river has been subject to numerous levee rehabilitation projects, levee upgrades, and maintenance over the last 25 years (Table 5). In almost all cases, the repairs occurred at areas that were already diked and new structures were installed at only a few locations. Repairs of the type assessed in this EA are likely to reoccur every three to four years; therefore, cumulative effects described here as resulting from the repairs are likely to continue.

The total length of river within the five diking districts is approximately 25 miles (132,000 LF). Table 5 shows that between 1975 and 2011, approximately 62,084 LF (11.8 miles) of the riverward levee faces have been repaired during 137 repair projects, as well as 6,910 LF on the landward faces. Other maintenance and repair projects likely have been undertaken by the diking districts during this period as well. Estimating an average of 20% of the repairs having an effect on mature riparian forest and 80% shrubby habitat and/or grassland, it is assumed that these repairs resulted in temporal loss or permanent conversion to grassland or shrubby habitat of up to 12,417 LF (2.4 miles) of riverward mature riparian vegetation and temporal loss of function over 49,667 LF (9.4 miles) of riverward shrubby habitat and grassland.

Of the totals mentioned above, 27,683 LF (5.2 miles) of repairs will occur in the 2007/2011 construction on the riverward face of the levees. Ecosystem benefits of riparian habitat with mature, overstory trees were or will be lost in the conversion to shrubby or grassland habitat. A temporal loss of function occurred or will occur in areas of shrubby habitat with some smaller diameter trees and grassy areas with few shrubs. Loss of function from effects to shrubby habitat or grassland is assumed to last between three and seven years based on the typical growth rate of the installed willow stakes reaching maturity. Mitigation efforts such as the anchored rootwads will begin to function immediately; the plantings, however, will be expected to increase their function over time as the plants mature.

Table 5. Levee Repair Projects in Lower Skagit River since 1975.

Location	Number of Sites	Linear Feet	Year of Occurrence
Projects from 1975-1989			
Skagit County	1	1,255	1975
DD3	1	90	1979
Skagit County	4	1,630	1979
DD12	2	140	1980
DD9	1	300	1980
Total		3,415	1975-1989
Projects from 1990-1999			
Skagit County	1	2,600	1990
DD1	4	1,000	1995
DD12	2	800	1995
DD22	3	5,680	1996
Total		10,080	1990-1999
Projects from 2000-2008			
DD1	12	8,390	2004
DD12	8	3,405	2004
DD17	19	5,220	2004

Location	Number of Sites	Linear Feet	Year of Occurrence
DD22	13	3,760	2004
DD3	4	1,965	2004
DD1	4	772.5	2007
DD12	5	2,062.5	2007
DD17	5	2,876	2007
DD22	4	2,353	2007
DD3	5	2,079	2007
DD3	1	6,110 (landward face only)	2007
DD1	1	290	2008
DD12	1	350	2008
DD17	1	610	2008
DD22	4	1,420	2008
DD3	2	656	2008
Skagit County	3	1,750	2008
Total		44,069	2000-2008
Projects proposed for 2011			
DD1	1	155	2011
DD3	3	575	2011
DD12	11	5,780	2011
DD17	6	3,000	2011
DD22	4	1120	2011
DD22	1	800 (landward face only)	2011
Total		11,430	Proposed 2011
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Combined Total		68,994	1975-2011

Source: USACE 2010 – see Appendix J

8.3. Summary of Cumulative Effects

All resource areas assessed in previous sections of this document were assessed for cumulative effects associated with the proposed action. Because pre-repair condition for many of the sites identified in Table 5 were not available, cumulative effects from actions at these sites can only be considered as being similar to a typical levee repair project that creates a 2H:1V riprap stabilized riverward bank without environmental features. The Corps' 2004 repairs, however, included willow lifts and some fish bench creation. Some effects were therefore partially offset. Cumulative effects are discussed below for each resource area.

8.3.1. Topography, Hydrology, and Soils

Hydrological features of the project area have been changed throughout the history of the diking program starting in the 19th century. Effects of alterations include tributaries with dams and culverts, lack of connection to the floodplain, and altered flow patterns in the mainstem river. Although these effects would continue under the No-Action, Repair In Kind, and Preferred Alternatives, the level of effect from the completed 2007 repairs or the proposed 2011 action is not considered significant since repairs have occurred or are occurring primarily at sites where these types of alterations have already occurred. Some lack of conveyance may occur at discrete sites due to increased levee prism size, and throughout the

system due to erosion of large rock that is now in the riverbed, but this is not expected to result in a significant cumulative effect.

8.3.2. Vegetation

Cumulative effects on riparian vegetation, such as continued vegetation maintenance for levee safety, would continue to occur under the No-Action Alternative but would not be exacerbated by that alternative. The Repair In Kind Alternative would result in permanent or long-term (up to 20 years) loss of up to 5,537 LF of mature riparian forest and associated function. Based on the estimates given in Section 7.2, this includes approximately 20% of the riverward riparian habitat occurring at the levee repair sites in this EA. This loss occurs in a relatively narrow band at or near the water's edge. It is the riverward riparian forest, however, that contributes most to habitat values for fish by allowing for most recruitment of LWD as well as high-flow refugia. This type of loss would continue to occur since repairs of the type described here would likely reoccur every three or four years. The Preferred Alternative has resulted in or would result in the loss of mature forest; however, the addition of multiple mitigation features will offset the diminished functions by adding LWD to the shoreline, expediting recovery of native plants, and increasing the diversity of the riparian corridor. Implementation of the preferred alternative will not have a significant negative cumulative effect on vegetation in the project area.

8.3.3. Fish and Wildlife

Anadromous and non-anadromous listed fish species have been adversely affected by levee construction, maintenance, and repairs on the Skagit River since diking began in the 19th century. These adverse effects include loss of riparian function, (streamside cover and nutrient input); scouring; loss of channel and streambank complexity; lower rates of LWD recruitment; altered patterns of substrate formation; and damage to spawning beds from sedimentation as damaged levees continue to erode. Following the No Action Alternative would not change the status of cumulative effects that have already occurred.

The Repair In Kind Alternative would continue to exacerbate the degradation of the riparian corridor habitat, which has resulted from the overall diking program and the repairs that have occurred since 1975. Hardening the riverbanks and loss of riparian vegetation has lead to the loss of recruitment of LWD, and decreased high-flow refugia, shading, complexity, and nutrient input since 1975 and would continue to occur over approximately 15 percent of the riverward face of the repair sites periodically due to ongoing repairs. Because anadromous fish stocks in the Skagit River are already severely strained and habitat quality according to most parameters has been diminished, ongoing loss of 15 percent of mature riparian cover constitutes a significant cumulative effect.

The projects completed in 2007 and those proposed for completion in 2011 under the Preferred Alternative have continued and will continue to add to the cumulative effects on anadromous and non-anadromous fish. Revegetation and the installation of various edge habitat features are designed to fully offset the effects of the necessary repairs. Short-term loss of habitat function will be unavoidable; however, within 5 years, many of the lost functions will be restored. Implementation of the Preferred Alternative will not have a major long-term cumulative effect on fish and wildlife in the project area.

8.3.4. Cultural Resources

Under the No-Action alternative, major breaches of the levee would likely occur and depending on the location of the breaches, eligible cultural properties located within the floodplain could be adversely affected. Many of the cultural properties located within the floodplain are historic era homes and structures. After-flood repair efforts could affect the historic quality of these resources, i.e. most repairs would consist of modern materials and would detract from the overall historical character of the structures. This effect is/will be much less likely to occur with the projects completed in 2007 and those proposed for completion in 2011 under the Preferred Alternative or the repairs proposed in the Repair In

Kind Alternative, since the levees have been or will be repaired and breaches are and will be far less likely to occur as long as flooding does not exceed the project design level.

8.3.5. Water Quality

Cumulative effects on water quality would continue to occur under the No-Action Alternative but would not be exacerbated by that alternative. With the Repair In Kind Alternative, the loss of vegetation would have a significant cumulative effect on water quality due to temporal effects to water temperature because of loss of up to 15 percent of the streamside riparian canopy and increased thermal retention in rock surfaces vs. grassy surfaces at or near the water's edge. Under the Preferred Alternative, similar short-term effects to water temperature may occur because of loss streamside riparian canopy; however, the implementation of the mitigation options will limit the severity and duration of any effect. Water temperature may have increased throughout the basin over the life of the historic diking program as a result of loss of large riparian cover and resulting loss of shade, a trend that will continue and will be exacerbated by repair actions that occur on average approximately every three to four years (see Table 5). Although it is not possible to quantify water temperature increases due to thermal retention in rock surfaces, localized increases may occur wherever bare rock surfaces occur throughout the levee system. The implementation of the Preferred Alternative is not expected to exacerbate the cumulative effect on water quality.

8.3.6. Air Quality and Noise

No cumulative effects would occur under the No-Action Alternative because there would be no emissions. Given current air quality conditions, the cumulative effect of emissions associated with the Preferred Alternative or the Repair In Kind Alternative in combination with other construction projects and the continuing emissions from roadway traffic and other sources is not expected to exceed any state or Federal standards. Consequently, cumulative air quality effects from primary pollutants will be less than significant.

Because of the limited spatial range of noise effects, construction sounds are unlikely to be noticed outside of each discrete construction zone. The anticipated cumulative effects of the project alternatives, including the 2007 completed and the 2011 proposed construction, on noise levels and annoyance were or are expected to be minor.

8.3.7. Economy

Under the No-Action Alternative, major breaches of the levee would likely occur at greater frequency during future flood events in the Lower Skagit River Basin. These breaches could damage residences, agricultural land and buildings, commercial properties, roads, and other infrastructure and could create a significant economic burden because of repairing damaged buildings, infrastructure, and property. When put into the context of historic conditions, this would constitute a significant cumulative effect. This effect will be much less likely to occur with implementation of the Repair In Kind Alternative or the Preferred Alternative, since the levees have been or will be repaired and breaches are and will be far less likely to occur. Implementation of the Repair in Kind Alternative would perpetuate the historic effects to edge habitat and could cause a significant cumulative effect on the fish populations, affecting Tribal economies and local recreational and commercial fishing industries. Implementation of the Preferred Alternative includes measures to offset the effects to edge habitat such that no cumulative effect is anticipated.

8.3.8. Utilities and Public Services

Under the No-Action Alternative, major breaches of the levee would likely occur at greater frequency during future flood events in the Lower Skagit River Basin. These breaches could lead to loss of life, inundation of transportation routes, disruption of commercial and governmental activity, and significant economic burden due to repairing damaged buildings, infrastructure, and property. When put into the context of historic conditions, this would constitute a significant cumulative effect. This effect will be

much less likely to occur with implementation of the Repair In Kind Alternative or under the completed 2007 repairs and the proposed 2011 repairs of the Preferred Alternative, since the levees have been or will be repaired and breaches are and will be far less likely to occur as long as flooding does not exceed the project design level (a 20-year event for DD1, DD3, and DD17; a 25-year event for DD12; a 10-year event for DD22).

8.3.9. Land Use

Land use in the valley has been historically altered by the presence of levees as they have reduced flood risk and allowed local zoning for rural and urban development. Land use is not affected under the No-Action alternative, the Repair In Kind Alternative, nor the 2007 and 2011 construction activities of the Preferred Alternative as these alternatives only repair existing structures and do not change local land use regulations. Therefore, no cumulative effects to land use will occur with the implementation of the project.

8.3.10. Recreation

The general aesthetics along the Skagit River system contributes indirectly to the passive experience of recreationists. The construction, maintenance, and repairs of levees that have been occurring since the diking program was initiated have changed the aesthetics of the river. Whether these changes are positive, negative, or neutral is somewhat subjective and based on personal preferences. With the no-action alternative, the aesthetics along the river at the proposed repair sites may become more like the pre-diking conditions, albeit with the accompanying loss of the protection of life and property afforded by the levees. The Repair In Kind Alternative would repair damages with bare riprap, resulting in diminished ease of access to the river, diminished vegetation to provide for wildlife viewing, and potentially decreased recreational fishing opportunities. With the Preferred Alternative, the effects on aesthetics along the river that have been occurring since the initiation of the diking program will be continued; however it is the intention of Corps to restore riparian habitat to the extent possible, while maintaining an adequate level of flood protection. Measures employed by Corps such as the planting of willows, trees, and native shrubs along the banks, and the hydroseeding of the repair sites can help to reduce cumulative adverse effects on aesthetics and riparian habitat for birdwatching to less than significant levels. The mitigation efforts are designed to offset project effects to salmonids, reducing effects to fish populations and thereby decreasing effects to recreational fishing opportunities below significant levels.

9.0 ENVIRONMENTAL COMPLIANCE

9.1. Federal Statutes

9.1.1. American Indian Religious Freedom Act

The American Indian Religious Freedom Act of 1978 (AIRFA) (42 U.S.C. 1996) establishes protection and preservation of Native Americans' rights of freedom of belief, expression, and exercise of traditional religions. Courts have interpreted AIRFA to mean that public officials must consider Native Americans' interests before undertaking actions that might affect their religious practices, including effect on Traditional Cultural Properties.

The project area falls within the traditional territory of the Swinomish Tribe. The Swinomish Tribe was contacted about the project via a letter sent June 21, 2007. As of the date of this EA, the Swinomish Tribe has not expressed any concerns.

9.1.2. Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d) prohibits the taking, possession or commerce of bald and golden eagles, except under certain circumstances. Amendments in 1972 added to penalties for violations of the act or related regulations.

No take of either bald or golden eagles is likely through any of the actions discussed in this EA since no known nests occur closer than 600 yards to any of the work locations; however, if nests are observed, the Corps will consult with USFWS and depending on their advice, construction may be halted until the young fledge.

9.1.3. Clean Air Act

The Clean Air Act (CAA) (42 U.S.C. 7401 et seq.), amended in 1977 and 1990, was established "to protect and enhance the quality of the nation's air resources so as to promote public health and welfare and the productive capacity of its population." The CAA authorizes the EPA to establish the National Ambient Air Quality Standards to protect public health and the environment. The CAA establishes emission standards for stationary sources, volatile organic compound emissions, hazardous air pollutants, and vehicles and other mobile sources. The CAA requires the states to develop implementation plans applicable to particular industrial sources.

This EA analyzes effects on air quality from the two alternatives; effects will be minimal, the project is exempt from the conformity requirements of the CAA because it will not exceed the *de minimis* threshold of emissions.

9.1.4. Coastal Zone Management Act

Under the Coastal Zone Management Act (CZMA) of 1972 (16 USCA 1451-1465), Sec. 307(c)(1)(A), "each Federal agency activity within or outside the coastal zone that affects any land or water use or natural resource of the coastal zone shall be carried out in a manner which is consistent to the maximum extent practicable with the enforceable policies of approved state management programs." Skagit County is considered coastal under the CZMA. The Corps has either general concurrence or is obtaining project-specific concurrence for all the sites discussed above.

Fifty-four (54) of the fifty-seven (57) sites have general concurrence from the State that the activities comply with the CZMA. The following forty four activities (1-1, 1-2, 1-4, 1-7, 1-13, 1-14, 3-1, 3-2, 3-3, 3-4, 3-11, 12-1, 12-2, 12-3, 12-4B, 12-5, 12-6, 12-7, 12-8, 12-11, 12-12, 12-15, 12-16, 12-17, 17-1, 17-2, 17-3, 17-4, 17-5, 17-7, 17-9, 17-10, 17-12, 17-15, 22-1, 22-2, 22-3, 22-4, 22-5, 22-6, 22-8, 22-9, 22-10, 22-11, and 22-12) have a general consistency determination prepared, and fall within the CWA Section 404(f) exemptions to the discharge of dredged or fill material. These activities are functionally analogous to Nationwide Permit (NWP) 3. Pursuant to the NWPs, the State has predetermined concurrence that the activities are consistent with the State's coastal zone management program. The following ten sites (1-3, 3-5, 3-6, 3-8, 12-9, 12-13, 12-14, 17-6, 17-16, and 22-7) have general consistency determination via analogy of NWP 3 or NWP 27. These activities are not exempted under CWA Section 404(f) because of minor deviations to the footprint, profile, construction method, or materials; however, these activities fall within the parameters of NWP 3 or NWP 27, which the State has predetermined concurrence that the activities are consistent with the State's coastal zone management program.

Three sites (3-7, 12-4A, and 22-11) require site-specific concurrence from the State. The Corps prepared a consistency determination and determined that the activities substantively comply with CZMA. The consistency determination found that the proposed activities comply with Skagit County Shoreline Master Program and are exempt from the Shoreline Management Act pursuant to WAC 173-27-040. Moreover, the Corps determined that the activities at the three sites either comply with the remaining five enforceable policies or the policies are not applicable. Ecology provided a concurrence letter with the Corps' findings on 11 May 2011.

9.1.5. Endangered Species Act

The ESA (16 U.S.C. 1531-1544), amended in 1988, establishes a national program for the conservation of threatened and endangered species of fish, wildlife, and plants and the habitat upon which they depend. Section 7(a) of the ESA requires that Federal agencies consult with NMFS and USFWS, as appropriate, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or to adversely modify or destroy their critical habitats. A Biological Assessment documenting the effects of the completed 2007 repairs and the 2011 proposed repairs on listed species has been submitted to the Services for formal consultation.

Due to the urgency of completing repairs prior to the flood season, the Corps chose to proceed with construction in 2007 prior to completion of ESA consultation pursuant to the "emergency circumstances" provisions of the ESA consultation regulation and complete ESA consultation after the fact, rather than delaying the urgent work in order to complete ESA consultation before construction began. The applicable regulation is set out at 50 CFR 402.05(a) and (b) and provides as follows:

1. Where emergency circumstances mandate the need to consult in an expedited manner, consultation may be conducted informally through alternative procedures that the Director determines to be consistent with the requirements of section 7(a)-(d) of the Act. This provision applies to situations involving acts of God, disasters, casualties, national defense or security emergencies, etc.

2. Formal consultation shall be initiated as soon as practicable after the emergency is under control. The Federal agency shall submit information on the nature of the emergency action(s), the justification for expedited consultation, and the impacts to endangered or threatened species and their habitats. The Service will evaluate such information and issue a biological opinion including the information and recommendations given during emergency consultation.

Though consultation was not complete before the 2007 repairs, the Corps had reached an agency determination, based on the best factual and technical information available at the time of decision, and following preliminary coordination with the Services, that the impacts are *likely to adversely affect* ESA-listed fish species at the proposed levee repair sites on the lower Skagit River. The Corps believes that this work is *not likely to jeopardize* the continued existence of the listed species, by reducing appreciably the likelihood of either the survival or recovery of the listed species; however, the work does constitute an adverse modification of critical habitat. As of the date of this EA, consultation under ESA Section 7 remains incomplete. The Preferred Alternative and compensatory environmental features are being coordinated with NMFS and USFWS. The Corps has received draft Terms and Conditions with draft Reasonable and Prudent Measures from both the USFWS and NMFS. Their draft input is aligned with measures discussed and defined during the consultation period. This EA will be reevaluated at the time that consultation is complete.

The Corps will commit to funding and performing all Reasonable and Prudent Alternatives necessary to avoid jeopardy to listed species or destruction or adverse modification of critical habitat, as well as Reasonable and Prudent Measures (RPMs) or Reasonable and Prudent Alternatives (RPAs) necessary and appropriate to minimize the effect of Incidental Take that are described in a Biological Opinion from the Services. The Corps included a proposal for compensatory environmental features as part of the construction project, as outlined in Section 5.0. Representatives from the Diking Districts, NMFS, USFWS, the Skagit River System Cooperative, and the Corps worked together to create and develop the assessment tool and the mitigation option proposed to fully offset effects to edge habitat.

9.1.6. Clean Water Act

The Clean Water Act (CWA) is the primary legislative vehicle for Federal water pollution control programs and the basic structure for regulating discharges of pollutants into waters of the United States. The CWA was established to "restore and maintain the chemical, physical, and biological integrity of the nation's waters." The CWA sets goals to eliminate discharges of pollutants into navigable waters, protect fish and wildlife, and prohibit the discharge of toxic pollutants in quantities that could adversely affect the environment. This EA evaluates possible effects to water quality, primarily with respect to suspended solids, turbidity, and temperature. There are no other water quality effects anticipated.

Three of the project sites (3-7, 12-4a, and 22-11) occur above the ordinary high water mark. Therefore, these activities are not within the jurisdiction of the CWA. They are evaluated under other laws, notably CZMA, as discussed above. The Corps has determined that construction of these three sites will have no effect on water quality.

Under Section 401 of the CWA, an activity involving a discharge into waters of the United States authorized by a Federal permit or license must receive certification from the affected certifying agency or tribe. The issuance of a certification means that the activity will comply with the water quality standards and any established effluent limitations of the certifying agency or tribe. Thus, fill activities not exempt from Section 404 require Section 401 certification from Ecology, EPA, or a 401 certification-authorized tribe. Section 401 certification signifies that the certifying entity has reasonable assurance that the project will comply with all applicable Federal, State, or Tribal effluent limitations and water quality standards, as well as other applicable aquatic resource protection requirements under the certifying entity's authority.

Section 401 certification is not required for projects that do not require Section 404 authorization. The following forty four activities (1-1, 1-2, 1-4, 1-7, 1-13, 1-14, 3-1, 3-2, 3-3, 3-4, 3-11, 12-1, 12-2, 12-3, 12-4B, 12-5, 12-6, 12-7, 12-8, 12-11, 12-12, 12-15, 12-16, 12-17, 17-1, 17-2, 17-3, 17-4, 17-5, 17-7, 17-9, 17-10, 17-12, 17-15, 22-1, 22-2, 22-3, 22-4, 22-5, 22-6, 22-8, 22-9, 22-10, 22-11, and 22-12) fall within the CWA Section 404(f) exemptions to the discharge of dredged or fill material as there is no change to the footprint, profile, construction methods, or materials within the project area in comparison to the pre-flood condition and are exempt from Section 404. Therefore, no section 401 certification is required. These activities are functionally analogous to NWP 3; the State has predetermined that the activities comply with its water quality standards.

NWP 3 and NWP 27 apply to the following ten sites (1-3, 3-5, 3-6, 3-8, 12-9, 12-13, 12-14, 17-6, 17-16, and 22-7). These activities are not exempted under CWA Section 404(f) because of minor deviations to the footprint, profile, construction method, or materials. Three of these sites (3-5, 3-6, 3-8) include a change in materials from the pre-flood condition. The remaining seven include footprint changes or profile changes that have been designed into the project as environmental enhancement features. The Corps has prepared a 404(b)(1) evaluation (Appendix G), which demonstrates compliance with the substantive requirement of the CWA. Moreover, pursuant to NWP 3 or NWP 27 by analogy, the State has predetermined that the activities comply with its water quality standards. Ecology has determined that the general water quality certification associated with NWP 3 or NWP 27 covers this project, and that individual water quality certification is thus not required.

9.1.7. Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act (MSA), (16 U.S.C. 1801 et. seq.) requires Federal agencies to consult with NMFS on activities that may adversely affect Essential Fish Habitat (EFH). The objective of an EFH assessment is to determine whether the proposed action(s) "may adversely affect" designated EFH for relevant commercial or Federally-managed fisheries species within

the proposed action area. The assessment describes conservation measures proposed to avoid, minimize, or otherwise offset potential adverse effects to designated EFH resulting from the proposed action. Effects on EFH are considered in this EA. The Corps has initiated consultation with NMFS on the effects to EFH in conjunction with consultation under Section 7 of the Endangered Species Act. As of the date of this EA, consultation remains incomplete. The Preferred Alternative, along with compensatory environmental features, is being coordinated with NMFS. The Corps has received draft Terms and Conditions with draft Reasonable and Prudent Measures from both the USFWS and NMFS. Their draft input is aligned with measures discussed and defined during the consultation period. This EA will be reevaluated at the time that consultation is complete.

EFH includes those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (16 U.S.C. 1801 et seq.). In order to qualify as freshwater EFH for Pacific salmon, four major components must exist:

- Spawning and incubation
- Juvenile rearing
- Juvenile migration corridors
- Adult migration corridors and adult holding habitat

Important features of EFH for spawning, rearing, and migration include adequate substrate composition, water quality (e.g. dissolved oxygen, nutrients, temperature, etc.), water quantity, depth and velocity, channel gradient and stability, food, cover and habitat (e.g. LWD, pools, channel complexity, aquatic vegetation), space, access and passage, and floodplain and habitat connectivity. The Skagit River is designated as EFH for Chinook, coho, and pink salmon. As discussed above, Chinook use the project areas for migration and their population levels are depressed in the Skagit River (Ecology 2010b). Coho and pink have healthy population levels in the Skagit. Coho use the project area for rearing and pink salmon migrate through the project area (Ecology 2010b).

Effects of the proposed work on EFH will be essentially identical to those discussed in Sections 7.3 and 7.4 above, including temporary turbidity increases and loss of riparian vegetation. Substrate composition is largely unchanged from pre-flood conditions. Most levees along the Skagit River are armored and the repairs replace materials in kind; however, a few sites (3-5 and 3-6) have armored areas that previously were earthen levees. These repairs created a sediment change. Short-term water quality changes may have occurred during construction due to increased turbidity. Overall, this effect is expected to be minimal. Water quantity, depth, velocity, channel gradient, stability, space, access, and passage were unaffected or returned to pre-flood conditions. Levees artificially create channel stability and reduce floodplain connectivity. These levee repairs maintain this diminished habitat function within the Skagit Valley.

These repairs likely affected channel complexity, including LWD recruitment and diminishing pool habitat along the repaired levee toes. As discussed above, these repairs have or will reduce riparian vegetation and long-term woody debris recruitment. Riparian vegetation and LWD play an important role in maintaining proper food, cover, and rearing habitat for salmon. Mitigation options have been added to many sites to offset these effects. As discussed in Section 5.0, the Habitat Capacity Mitigation Tool was developed by the Corps, the Diking Districts, the Skagit Cooperative, the USFWS, and the NMFS to design mitigation options to offset the effects to salmonids. Overall, by using best management practices and including plantings, placement of anchored rootwads, and other environmental features, effects of this repair project on essential fish habitat will be below significant levels.

9.1.8. National Environmental Policy Act

NEPA (42 U.S.C. 4321 et seq.) provides a commitment that Federal agencies will consider the environmental effects of their actions. NEPA requires that an Environmental Impact Statement (EIS) be completed in every recommendation or report on proposals for legislation and other major Federal actions

significantly affecting the quality of the human environment. Major Federal actions determined not to have a significant effect on the quality of the human environment are evaluated through an Environmental Assessment (EA). NEPA documents must provide detailed information regarding the proposed action and alternatives, the environmental effects of the alternatives, appropriate mitigation measures, and any adverse environmental effects that cannot be avoided if the proposal is implemented. Agencies are required to demonstrate that these factors have been considered by decision makers prior to undertaking actions.

This EA evaluates the environmental effects of two Federal actions: completion of levee repairs in 2007 and the execution of proposed repairs in 2011. Of these Federal actions, the first has already taken place as of the finalization of this EA document, and is thus evaluated here retrospectively; the execution of 2011 repairs is prospectively reviewed in this document. The following discussion assesses how the Corps has nevertheless complied with NEPA's requirements.

The 2007 repairs were completed because it was necessary to protect human life and property, and because it was time-critical in light of the ensuing flood season. The agency is required to comply with NEPA to the fullest extent possible (Section 102). The Corps' NEPA regulation regarding "Emergency Actions" does allow for completion of NEPA documentation after the fact in emergency situations. Emergency actions are discussed in 33 CFR 230.8 as follows:

> Section 230.8 - Emergency actions. In responding to emergency situations to prevent or reduce imminent risk of life, health, property, or severe economic losses, district commanders may proceed without the specific documentation and procedural requirements of other sections of this regulation. District commanders shall consider the probable environmental consequences in determining appropriate emergency actions and when requesting approval to proceed on emergency actions, will describe proposed NEPA documentation or reasons for exclusion from documentation. NEPA documentation should be accomplished prior to initiation of emergency work if time constraints render this practicable. Such documentation may be accomplished after the completion of emergency work, if appropriate. Emergency actions include Flood Control and Coastal Emergencies Activities pursuant to Pub. L. 84-99, as amended, and projects constructed under sections 3 of the [Rivers and Harbors] Act of 1945 or 14 of the Flood Control Act of 1946 of the Continuing Authorities Program. When possible, emergency actions considered major in scope with potentially significant environmental impacts shall be referred through the division commanders to HQUSACE (CECW-RE) for consultation with CEQ about NEPA arrangements.

It was infeasible to complete a finalized EA and execute a Finding of No Significant Impact (FONSI) prior to the commencement of construction in August 2007. Federal funding to complete engineering and design (E&D) for this levee project was not available to the Seattle District until June 6, 2007. Only at this point could substantial planning of alternatives and designs for levee rehabilitation prudently take place. Due to the extensive damage during the 2006/2007 flood season, 52 projects throughout the Seattle District were being designed and coordinated simultaneously. The Corps, however, complied with NEPA to the fullest extent possible.

The Corps coordinated with NMFS and Skagit County Diking District Commissioners during the development of the Project Information Report (PIR), and provided a copy of the PIR to those agencies as well as USFWS, Washington Department of Ecology, Samish Indian Nation, Swinomish Tribe, Upper Skagit Tribe, Sauk-Suiattle Tribe, Skagit River Systems Cooperative, and US Forest Service. A second field trip occurred July 18, 2007 to gather multi-agency input as to the applicability and value of fish benches and other environmental features in each of the 2007 rehabilitation projects. Representatives from the Corps, Skagit River System Cooperative, Swinomish Tribe, and NMFS attended this site visit. On August 10, 2007, a Notice of Preparation (NOP) that included information on proposed repairs and

potential effects to the environment was posted inviting comment from interested agencies, Tribes, and members of the public. A preliminary analysis of the probable environmental consequences of the construction within each diking district was completed and presented to the District Commander for his consideration. Colonel McCormick signed the documents on 31 July 2007 for DD1 and DD22, on 10 August 2007 for DD3, and on 13 August 2007 for DD12 and DD17 concurring that the work was (1) an "emergency action" due to the imminent danger to life and property that will be posed if the project was not implemented prior to onset of the flood season, (2) should proceed with project construction prior to the finalization of an Environmental Assessment and FONSI determination, and (3) should proceed prior to completion of consultation under the "emergency circumstances" provisions of the ESA.

As for the proposed 2011 Federal action, this EA has been undertaken specifically in pursuit of NEPA compliance. With implementation of the proposed compensatory conservation measures detailed in section 4.7, the proposed repairs in 2011 have been determined not to have a significant effect on the quality of the human environment. Without the environmental features incorporated into this construction work, this project likely would have a significant effect on the quality of the human environment and the Corps would be compelled to undertake the preparation of an EIS for the 2007/2011 levee rehabilitation work in the lower Skagit River.

As of the date of this EA, consultation under ESA Section 7 remains incomplete. The Preferred Alternative and compensatory environmental features are being coordinated with NMFS and USFWS. This EA will be reevaluated at the time that consultation is complete. The Corps has received draft Terms and Conditions with draft Reasonable and Prudent Measures from both the USFWS and NMFS. Their draft input is aligned with measures discussed and defined during the consultation period. If necessary, this EA will be supplemented with necessary and applicable corresponding modifications to the scope and/or nature of the project, the procedures and practices used to implement the project, and/or the type and extent of compensatory mitigation associated with the project.

Based on this EA, a FONSI has been drafted. Provided that the proposed compensatory environmental work is completed, the proposed action does not constitute a major Federal action significantly affecting the quality of the human environment and therefore, does not require preparation of an environmental impact statement.

9.1.9. National Historic Preservation Act

Section 106 of the NHPA (16 U.S.C. 470) requires that Federal agencies evaluate the effects of Federal undertakings on historical, archeological, and cultural resources and afford the Advisory Council on Historic Preservation opportunities to comment on the proposed undertaking. The lead agency must examine whether feasible alternatives exist that would avoid eligible cultural resources. If an effect cannot reasonably be avoided, measures must be taken to minimize or mitigate potential adverse effects.

In order to comply with Section 106, the Corps has conducted a cultural resource inventory, prepared a report detailing the results of that inventory, and has submitted the report to the SHPO. The SHPO has concurred with the Corps' determination that the preferred alternative will not affect any properties eligible for the NRHP. The Corps has consulted with Swinomish Indian Tribal Community and the Upper Skagit Indian Tribes.

The Corps' determination that the project will result in no adverse effect is based on the stipulation that monitoring occurred at the following 2007 repair locations: 12-7, 12-8, 17-5 and would occur at the 2011 repair locations 3-8, 12-12, 12-13, 12-16, 12-17, 22-7, and 22-12. These sites were selected for monitoring based on their proximity to known archaeological sites, the potential for intact historic levee segments, or for geomorphologic conditions favoring site preservation,

9.2. Executive Orders

9.2.1. Executive Order 11990, Protection of Wetlands

Executive Order 11990 encourages Federal agencies to take actions to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands when undertaking Federal activities and programs. This EA concludes that the project had no effect on wetlands.

9.2.2. Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations

Executive Order 12898 directs every Federal agency to identify and address disproportionately high and adverse human health or environmental effects of agency programs and activities on minority and low-income populations.

The project does not involve establishing a facility that will discharge pollutants or contaminants, so no human health effects will occur. The levee rehabilitation work will not decrease property values in the area, or socially stigmatize local residents or businesses in any way. No interference with Native American Nations' treaty rights will result from the proposed project. The Corps has determined that no disproportional effects will occur for minority or low-income populations.

10.0 MONITORING

CEQ regulations state that "Agencies may provide for monitoring to assure that their decisions are carried out and should do so in important cases" (40 CFR 1505.3); additionally, "a monitoring and enforcement program shall be adopted and summarized where applicable for any mitigation" (40 CFR 1505.2 (c)). The 2007-2011 repairs to the Skagit River levees involve a much higher level of environmental enhancement features than any previous repair. The intensity of this process and commitment of resources from Federal agencies and Tribes to find a solution arguably reaches the level of an "important case" per NEPA regulations, and the features designed into levee repair are considered required mitigation to compensate for negative environmental effects to habitat of ESA-listed species. Therefore, monitoring is required per NEPA regulations.

Corps technical staff will conduct two types of monitoring: implementation monitoring and effectiveness monitoring. Implementation monitoring will determine whether all elements of the environmental enhancement features were installed during construction. As-built drawings will be completed post-construction and will show the environmental features. The Corps will conduct effectiveness monitoring for five years to determine whether the habitat features that were installed are functioning properly. This will not include fish surveys as salmon population numbers can vary widely based on factors outside the scope of this project. Instead, effectiveness will be measured in terms of habitat function. This will include velocity monitoring to establish the amount and width of slower velocities created at different features, plant survival and growth success, and shallow depth areas in various flows (Appendix A). Monitoring will occur at low (10 to 12kcfs), medium (15 to 20kcfs), high (~25kcfs), and highest (30+ kcfs) flows to evaluate functions of these features at various conditions.

11.0 AGENCIES CONSULTED

The Corps contacted the following entities during the environmental coordination of this project:

- National Marine Fisheries Service (NMFS)
- Samish Indian Nation
- Sauk-Suiattle Tribe
- Skagit County Diking District Commissioners
- Skagit River System Cooperative

- Swinomish Tribe
- U.S. Fish and Wildlife Service (USFWS)
- U.S. Forest Service
- Upper Skagit Tribe
- Washington Department of Fish and Wildlife (WDFW)
- Washington Department of Ecology (Ecology)
- Washington State Historic Preservation Officer (SHPO)
- Washington State Department of Archaeology and Historic Preservation (DAHP)
- Washington Department of Emergency Management

Coordination with the above listed agencies and tribes consisted of phone conversations, meetings, field trips, and e-mail exchanges. Topics discussed during this coordination include project design, project construction timing, effects to listed species, and other environmental concerns.

This report was provided as a draft for public review. A Notice of Availability was widely distributed to all known interested parties and sent to the County and State Corps' Regulatory Branch mailing lists. The document was available for viewing on the Seattle District website. The public comment period was open from 1 April to 30 April 2011 and no comments were received. The Notice of Availability is provided in Appendix I.

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APPENDIX A

HABITAT CAPACITY MITIGATION TOOL

Habitat Capacity Mitigation Tool: Background and Analysis of Quantifying Environmental Enhancement Features Incorporated into Levee Rehabilitation on the Skagit River

1.0 INTRODUCTION

As noted in Fischenich (2003), all riverbank stabilization measures affect local habitat conditions within the stabilized reach. Riprap creates a substrate that is unlike the native bank material altering channel geometry, flow characteristics, riparian vegetation conditions, and a host of other habitat elements. Due to the extent of currently planned and recent past levee repairs on the lower Skagit River, the U.S. Army Corps of Engineers (Corps) technical staff have determined that it is necessary to mitigate for the cumulative impacts to the environment for a Finding of No Significant Impact under the National Environmental Policy Act (NEPA), and to comply with the Endangered Species Act (ESA). The following tool was developed within a technical working group consisting of representatives from the Corps, the Skagit Diking Districts, the Skagit River System Cooperative (representing the Swinomish Indian Tribal Community and the Sauk-Suiattle Indian Tribe), the National Marine Fisheries Service, and the US Fish and Wildlife Service to determine impacts and sufficient environmental enhancement features to provide compensatory mitigation.

Effects of bank stabilization on salmonids vary by species, life stage, season, flow condition, fish size, extent of remaining vegetative cover, and the size of the stabilization project (Fischenich 2003). Riprap can create preferential habitat for some organisms at the expense of others. Recognizing this varied response to riprap banks and the multiple species that use the Skagit River for different functions throughout their life cycle, the mitigation tool focuses on salmonids, specifically those listed under the ESA. The Puget Sound Evolutionarily Significant Unit of Chinook salmon was listed as a threatened species under the ESA, as amended, in March 1999. The lower Skagit River is designated as critical habitat for Puget Sound Chinook. The Coastal/Puget Sound bull trout distinct population segment was listed as a threatened species under the ESA in October 1999. The lower Skagit River is designated as critical habitat for bull trout. Puget Sound steelhead were listed as threatened under the ESA in May 2007. Critical habitat was not designated for this species; however, the river supports populations of summer and winter-run steelhead. Other salmonid species in the project area include pink, chum, coho, sockeye, rainbow trout, cutthroat trout, and likely whitefish. The Skagit River is designated as Essential Fish Habitat for Chinook, coho, and pink salmon under the Magnuson-Stevens Fishery Conservation and Management Act. The lower Skagit River provides migratory and rearing habitat for all of the salmonid species within the river. Due to the significance of the Skagit River to these salmonids and as a stock source for salmon populations in other Puget Sound rivers, mitigation efforts focus on the habitat requirements of these species.

The Skagit Chinook Recovery Plan (SCRP) (SRSC and WDFW 2005) acknowledges the variability in marine survival but makes the assumption that the ocean environment is not at carrying capacity; therefore, changes in freshwater and estuarine habitat quality will result in increased juvenile production. The foundation principle of the Habitat Capacity Mitigation Tool (HCMT) is that juvenile Chinook are density dependent, meaning they compete with each other and other fish species for adequate freshwater rearing, forage, and refuge habitat along the shoreline of the river to meet the daily rations of food that are required for the fish to reach maximum growth. Relevant limiting factors listed in the SCRP (SRSC and WDFW 2005) include degraded riparian zones, high water temperatures, hydromodification, availability of prey species, and loss of delta habitat and connectivity. Levee repair degrades edge habitat and exacerbates these limiting factors. Rock placement and loss of vegetation can increase summer water temperatures due to loss of shading and the heating of the exposed armor rock in the sun. Loss of vegetation reduces cover along the banks and decreases organic and nutrient input, and forage opportunity in the form of terrestrial insect deposition for rearing salmon, and reduces the quantity of material

available for large woody debris recruitment. Hydromodification of the banks, as seen on newly repaired levee slopes, simplifies the complexity of edge habitat and increases water velocity at the shoreline, which decreases available rearing, refuge, and forage habitat, and limits the suitability of shoreline habitat for juvenile salmon. Carrying capacity for a community of salmonids at full potential numbers and growth is reduced by these factors. Reduced carrying capacity of Skagit River habitat during an annual outmigration means that capacity is reached at lower thresholds, with the likely result that most fish only achieve low growth rates and will be smaller than average for the species rather than some fish achieving maximum growth rate (Bjornn and Reiser 1991).

To provide compensatory mitigation for detrimental effects of levee repair on edge habitat, the Corps and the project sponsors (Diking Districts 1, 3, 12, 17, and 22) need a tool box of mitigation options that can be applied in multiple combinations to achieve the greatest on-site reduction of impacts, and evaluate off-site mitigation opportunities. The concept of focusing on edge habitat emerged from multiple meetings of the Skagit Technical Working Group by combining the ideas of needing to establish and meet target conditions, density dependence of Chinook, and carrying capacity of the Skagit River, and mitigating for edge habitat impacts. Development of this tool relies heavily on published scientific data of current fish populations in the Skagit and fish usage of different bank habitat types to define potential mitigation options. The HCMT meets the criteria of being based on published scientific literature, focusing on edge habitat, and using options that can be implemented during construction. The foundation inputs to the HCMT are the estimated carrying capacity of rearing habitat, current fish population estimates, and fish usage of various edge habitats relative to their usage of hydromodified banks. The site-specific inputs that are used to generate mitigation credit are the length of repair, the Mitigation Option Offset Multiplier, and the category credit for type of benefit.

Using the HCMT requires several assumptions:

1. A typical levee section on the Skagit River has a 2:1 horizontal to vertical slope with riprap and either grass or some shrubby vegetation. The HCMT uses this starting condition to calculate the functional lift of the mitigation options.
2. All levee repairs are treated as the same level of environmental impact regardless of actual conditions at the individual repair sites. This precludes the need for subjective site evaluations based on pre-repair conditions of the vegetation and edge habitat, and eliminates the incentive to remove mature levee vegetation prior to the evaluation in order to reduce mitigation requirements.
3. Relative fish densities reported in the scientific literature on Skagit River can be recreated through construction of habitat features.
4. Incorporating habitat features that provide only one type of functional benefit has decreasing incremental value at a site.

2.0 FISH DENSITY INPUTS

According to Beamer and Larsen (2004), Chinook experience a maximum habitat capacity in the lower Skagit River such that juvenile Chinook arrive in the estuary less fit or unfit for marine survival. Levee repair exacerbates this limiting factor by simplifying and reducing edge habitat. Thus, increasing complexity and total carrying capacity of the habitat within the lower river is a logical goal.

The population data within the HCMT focuses on Chinook. This is due to the large body of scientific data on population sizes and habitat capacity for Chinook in the Skagit River, relative to other species. Chinook population numbers provide a baseline for establishing existing condition and target condition of edge habitat within the lower river. In the SCRP (SRSC and WDFW 2005), benefits of freshwater restoration projects are counted in terms of parr migrants, provisions for flood refuge and increased productivity. While the input population numbers do not reflect the other salmon species in the river, these numbers provide a relative view of habitat function for the other species as well. Studies that have

looked at habitat use by various salmonids, such as Beamer and Henderson (1998) and Beechie et al. (2005) show preferences for similar habitats across species and life stages.

The scientific literature typically standardizes fish density to the average number of fish per reach, and includes the class of age 0+ Chinook (e.g. Peters et al. 1998, Beamer and Henderson 1998). The SCRP states that current freshwater capacity for parr migrants and yearlings is 1,407,000 fish (SRSC and WDFW 2005). This number of fish along the existing 343,217 linear feet of edge habitat (both banks on the mainstem and major sloughs from Sedro Woolley downstream to the estuary, per GIS analysis) gives a density of 4 fish per linear foot, averaged across the full outmigration period and all habitat types in the lower river. If we use the number of age 0+ Chinook outmigrants from WDFW data (2008) over a total edge habitat length, we can calculate numbers of fish per linear foot of river bank that need to find freshwater rearing habitat. At current population levels measured over the past 15 years, successfully spawning Chinook have been able to produce nearly 8 million outmigrating parr. We selected a population of 7,100,000 (Appendix D SRSC and WDFW 2005) over a total edge habitat distance of 343,217 feet, so we get a potential use of habitat at 21 fish per linear foot as a target number. That means that throughout the outmigration season, the river needs to provide productivity capacity for 21 fish per linear foot that need to find adequate rearing, foraging, and refuge habitat. Therefore, the impacted fish number, those fish that are not finding adequate rearing habitat to achieve their full potential before reaching the estuary, is the lost potential or 21 minus 4, which is 17 fish per linear foot.

Current Chinook populations in the Skagit River are slightly to severely depressed (WDFW 2002). Neither the spawning areas, egg-to-fry survival, nor ocean capacity are significant limitations to the recovery of Skagit Chinook (SRSC and WDFW 2005). The main limiting factor for this species is freshwater rearing habitat; frequent disturbance to edge habitat caused by levee repairs exacerbates this limitation. Therefore, to provide adequate compensatory mitigation for the impacts due to the 2007/2011 levee rehabilitation projects, the target number of fish per linear foot should be 21, derived from the outmigrating population of 7.1 million, to provide as much rearing habitat as can be used in the high population output years.

3.0 FISH HABITAT USAGE INPUTS

The primary method to offset the impacts of levee repairs is to design on-site environmental enhancement features; however, because the purpose of the levees is protection of human lives and property, placement of habitat features must not create vulnerability within the flood control work and must not pose any additional risk of flooding or levee failure. Engineers designing the levee repairs will incorporate the various mitigation options selected in a way that poses no increased risk to the levee system. Additionally, the technical working group included off-site mitigation options such as considering purchase of credits at a mitigation bank or allowing a conservation easement to count as mitigation.

The impact offset multipliers within the HCMT rely heavily on published scientific data, focusing where possible on studies within the Skagit River watershed. The HCMT assumes that attempting to recreate habitat conditions similar to those observed in the studies will produce a similar increase in Skagit River habitat capacity. This relies on statements found in meta-analyses that adding in-stream structure and large woody debris and increasing pool and backwater habitats results in increases in fish abundance and density in those constructed habitats (Roni et al. 2008, Whiteway et al. 2010). Additionally, Missildine et al. (2001) found that Chinook parr used a bioengineered revetment on the Cedar River at a rate of 70% greater than the reach average of a standard riprap bank. In the Willamette River, 71% of sub-yearling Chinook associated with natural bank habitat types (ODFW 2003). While different species do show differing use of edge habitats, this tool assumes that Chinook usage will be representative of the overall productivity of the edge habitat.

As stated earlier, the HCMT focuses on Chinook because of the lack of sufficient information on other salmonids, such as coho and steelhead, to provide the basic information on carrying capacity for these species. The Corps may incorporate habitat features that benefit these species, but calculating an expected increase in productivity as measured in fish density would be difficult. Designing the habitat features that are used as mitigation options in the HCMT requires information on the preferred habitat parameters of Chinook, and this information will be used to establish performance criteria that the Corps will measure post-construction. Beechie et al. (2005) studied juvenile salmonid use of pools, riffles, mid-channel glides, bank edge glides, bar edges, and backwaters in the Skagit River. In this study, Beechie et al. found that microhabitat (velocity, depth, and cover type) influenced edge habitat usage by juvenile salmonids, with most fish occupying areas with a velocity less than 15 centimeters per second (cm/s) and wood cover. Beecher et al. (1993) found that juvenile salmonids prefer velocities in the range of 21 to 27 cm/s.

The technical working group brainstormed a list of 24 mitigation options (see Table 1). When possible, the offset multipliers relied on published peer-reviewed articles or agency-produced documents, but when no published literature existed, the group made decisions based on best professional judgment and assigned values relative to the values gleaned from the peer-reviewed literature. See Sec. 4.0 for how the multipliers are applied.

Table 1. Offset multipliers for various mitigation options.

Primary Function	**Mitigation Options**	**Offset multiplier**	**Source document for fish density improvement**
Rearing	Layback (3:1 or shallower) up to 10 feet wide	3.04	Technical Working Group
Rearing	Layback (3:1 or shallower) 11 feet and wider	4.05	Technical Working Group
Rearing	Single logs in line	1.20	Beamer and Henderson 1998
Rearing	Woody debris piles	6.40	Beamer and Henderson 1998
Rearing	Anchored rootwads	8.70	Beamer and Henderson 1998
Rearing	Anchored single logs with rootwads	8.7 to 1.2	Technical Working Group
Rearing	Setback Levee	10.00	Hayman et al. 1996, p. 33-34
Rearing	Slough (or large backwater) habitat creation	case-by-case	
Rearing	Remove bank armoring	5.40	Beamer and Henderson 1998
Refuge	Layback transition zone	2.03	Technical Working Group
Refuge	Fish Bench that slow velocity and depth up to 30"	1.30	Beechie, Lierman, Beamer, and Henderson 2005
Refuge	Habitat Weirs / groins creating backwater (rock outcropping)	4.00	ODFW - Friesen et al – 2003
Refuge	Willow Lift – double, starting at or below OHW	1.40	Beamer and Henderson1998, Peters, Missildine, and Low 1998 and Technical Working Group input
Refuge	Willow Lift – triple, spanning wide range of flows	1.80	Beamer and Henderson1998, Peters, Missildine, and Low 1998 and Technical Working Group input
Forage	Willow Lift – single, at or below OHW	0.70	Beamer and Henderson1998, Peters, Missildine, and Low 1998 and Technical Working Group input

Primary Function	Mitigation Options	Offset multiplier	Source document for fish density improvement
Forage	Single lift + bank plantings:	1.40	Beamer and Henderson1998, Peters, Missildine, and Low 1998 and Technical Working Group input
Forage	Single row of riverward bench plantings	0.40	Technical Working Group
Forage	Double row of riverward bench plantings	0.60	Technical Working Group
Forage	Triple row of riverward bench plantings	0.70	Technical Working Group
Forage	Spread dirt over riprap and hydroseed (top portion of riverward slope)	0.35	Technical Working Group
Riparian Corridor Improvements	Landward plantings of overstory trees	0.20	Technical Working Group
Riparian Corridor Improvements	Invasive plants replaced with native plants	0.70	Technical Working Group
Case-by-case	Mitigation Banks - only where fish credits available	case-by-case	
Case-by-case	Conservation Easements	case-by-case	
Case-by-case	Cottonwood Slough, other habitat projects	case-by-case	

The operating assumption for the mitigation option offset multipliers is that attempting to recreate habitat conditions similar to those observed in these studies will produce a similar increase in Skagit River habitat capacity as measured in density of juvenile Chinook. Sources of information regarding relative fish densities at different edge habitat types include the following:

a. Beamer and Henderson (1998) state that the expected increase in Chinook sub-yearling use of natural banks is 5.4 times higher than riprap banks.
b. Sub-yearling Chinook in the Willamette River were 4 times more likely to use a rock outcropping than riprap (ODFW 2003).
c. Hayman et al (1996) found that juvenile Chinook preference for natural banks and backwaters is 10 times more than preference exhibited for hydromodified banks.
d. Increasing the percent of wood cover is strongly positively correlated to Chinook abundance at the site level. The relative values of wood cover types are: Rootwads> debris piles or bankroots> single logs or branches (Beamer and Henderson 1998).
e. Rootwads had an increase of approx 8.7 times over the fish density of the reach average; Debris piles had an increase of approx 6.4 times over the reach average, and single logs had an increase of approx 1.2 times over reach average (Beamer and Henderson 1998).
f. Fischenich (2003) provides citations for guidance document regarding spacing of groins according to stream width and bank type (e.g. straight, curved, etc.)
g. Reaches with riparian cover and overhanging vegetation have significantly more juvenile Chinook than do reaches with bare riprap (Peters et al. 1998). Two studies that looked at the difference in fish use for different cover types found that juvenile Chinook were present in aquatic vegetation and anchored brush at a density of 2.1 times more than the reach average (Beamer and Henderson 1998, Beechie et al. 2005). Since much of this habitat was along natural banks rather than hydromodified banks, even though both were included in the study reaches, the working group slightly reduced the multiplier for a triple willow lift to 1.8 to account for the resulting levee repair project still being a hardened bank, but with dense willow planting. The working group scaled the double and single willow lift multipliers to two-thirds and one-third respectively of the initial density of 2.1.

h. Beechie et al. (2005) describe fish densities at bar, bank, and backwater habitats in terms of depth, velocity, and cover compared to mid-channel habitat. The fish density at backwater habitats was 1.3 times more abundant than mid-channel. Bare riprap banks at a 2:1 slope typically have no cover, and the same depth and velocity as mid-channel, so the 1.3 multiplier for increase in fish density could be used for a fish bench as long as the bench has flow that is less than 30" deep so that velocity is slower than the main river. Fish benches must be installed low enough in the banks to be available as habitat for a significant portion of the outmigration season, mid-January through July.

Each of the mitigation options was subdivided into a primary function category. While each mitigation option is likely to perform multiple functions, the technical working group chose the most appropriate primary function. The four categories are Rearing, Refuge, Forage, and Riparian Corridor Improvements. Rearing areas are defined here as the most common type of edge habitat found along the mainstem Skagit and does not imply any particular quality of habitat. Items in this category either can provide whole new linear footage of rearing habitat or can provide some enhancement to existing habitat that benefits the quality so that an increase in fish density would be expected. Refuge are areas that can be used during high velocity river flows so that fish can find low velocity areas and avoid being washed downstream too early. Refuge areas may be used for rearing, but this focuses on the primary function of the particular mitigation option. Some refuge areas may not become available until the river is at much higher than average river flows. Forage items provide some kind of allochthonous inputs to the river. Riparian Corridor Improvements are considered to be good for the overall health of the riverine ecosystem, particularly buffer zones, but so far have no specific research or data showing an increase of Chinook density. These categories are used within the HCMT to encourage construction of a variety of habitat features that provide a lift to multiple habitat functions.

4.0 HABITAT CAPACITY MITIGATION TOOL OUTPUTS

As stated earlier, one of the assumptions for using this tool is that all levee repair sites are a typical 2:1 slope, covered in Class IV riprap with grass or some shrubby vegetation. The only impacts that this tool calculates are based on that assumption. The total length of repair is multiplied by the deficit in habitat capacity as determined by averaging the high population year along the entire river and subtracting the known carrying capacity, resulting in 16.6 fish per linear foot. For example, a 1000-foot repair site impacts roughly 16,600 fish in loss of annual productivity. This number is provided for reference, but is not used in the rest of the mitigation calculations.

The HCMT quantifies capacity of edge habitat resulting from mitigation options installed at levee repair sites or other locations along the mainstem Skagit River. It assumes an average fish density of juvenile Chinook throughout the lower Skagit based on SCRP estimate of carrying capacity and the measured length of existing edge habitat. Then by using studies that show observed fish densities at various habitat features relative to fish densities found along levees, those features can be designed into project plans and given mitigation credit. As such, the ideal output is a design alternative that will be feasible with each site's unique characteristics and that will offset 100% of the projected impact. The tool is essentially several steps, defined below.

Background inputs, as described above in Section 1.0, include the existing fish density, the target fish density, and the affected fish density.

The existing fish density is calculated as:

1,407,000	existing fish capacity	/	343,217	feet of existing edge habitat	=	4.1	fish / LF

The fish density target is calculated as:

7,100,000	Juvenile fish	/	343,217	feet of existing edge habitat	=	21	fish / LF

Affected fish density is calculated as:

21	target fish/LF	-	4.1	existing fish/LF	=	17	affected fish/LF

Calculation of the impact offset through various design alterations is a four-step process.

Step 1. Multiply the Mitigation Option Offset Multiplier by the base fish density.

The following is an example of how to calculate site capacity increase with the inclusion of a single willow lift in the design:

4.1	existing fish/LF	*	0.7	offset multiplier (from Table 1)	=	2.87	fish/lf increase with willow lift

Step 2. Add the product (the fish density increase) to the base fish density. This is done because the source documents for the multipliers stated the relative fish densities as an *increase over* the density observed at hydromodified banks. The sum is the new capacity at the constructed levee site.

The resultant new capacity of a site with a single willow lift is calculated as:

4.1	existing fish/LF	+	2.87	fish/lf increase with willow lift	=	6.97	fish/LF in repair area

Therefore, the installation of a single willow lift increases the capacity of a repair to almost 7 fish/LF. However, this does not fully offset the impact of that repair, calculated to be 17 fish/LF.

Step 3. Divide the increase in capacity (increase in fish density from the mitigation option) by the deficit in capacity (affected fish density) to calculate the percent change at the site.

Percent offset of impact due to the inclusion of a single willow lift at the repair site is calculated as:

2.87	fish/LF increase with willow lift	/	16.6	Impacted fish density	=	17%	offset

Step 4. Multiply the percent change by the length of the mitigation option(s) selected to determine the total linear feet of levee repair capacity improvement, which is the linear footage of impacts that were offset.

For example, Site A is a 1000 LF repair site. If this site includes a single willow lift, this will have offset only about 17% of the impact of that repair. In other words, the willows offset 170 feet of the work, but 830 feet remain to be offset.

1000	feet of repair	*	17%	offset	=	170	feet offset

If a site is suitable for more than one type of habitat enhancement feature, offset multipliers can be combined; however, offset multipliers from the same category are not fully additive. The principle is that there is a decreasing increment of benefit for each additional amount of environmental enhancement from the same category, so the tool applies a reduction factor to account for this. To encourage the installation of features that provide a variety of functions, the offset multipliers from within the same functional

category diminish with each addition from that category. If two features from the same category will be installed, the highest offset is given full credit, but the second from that category is given 90% credit. Any further options used from the same category would be given 80% credit. For example, if a single willow lift (offset 0.7) is installed with dirt spread over the top two-thirds of the bank and hydroseeded (offset 0.35), both of which are in the forage category, then the lower offset would be applied at 90%, meaning the soil with hydroseed would effectively have an offset multiplier of 0.32 in this case. Returning to our Site A example, if we include the installation of a woody debris (rearing category) throughout the repair along with our single willow lift (forage category), we are able to fully add the offset multipliers. However, if we also place soil and hydroseed over the riprap on the riverward face, this is also in the forage category and would be given 90% credit. See Table 2 for further details of this example.

Table 2: Calculation example for a hypothetical repair "Site A"

	Repair length	Affected fish/LF (deficit)	**mitigation option (category)**	Mitigation category credit	Offset Multiplier	Existing fish/LF	Target fish/LF	Fish/LF Increase offsetting deficit	Percent offset of impact	Total length of repair that has been mitigated	Remaining repair length to be offset
Site A	1000	16.6	woody debris (rearing	1.00	6.4	4.1	20.7	26.2	158%	321.3	-581.7
	1000	16.6	single willow lift at OHW (forage)	1.00	0.70	4.1	20.7	2.9	17%	173.0	827.0
	1000	16.6	spread dirt and hydroseed (forage)	0.9	0.315	4.1	20.7	1.3	8%	64.9	935.1
TOTAL	*1000*	*16.6*	*woody debris+single willow lift+hydroseed*			4.1	*20.7*	*30.4*	*183%*	*1832.6*	*-832.6*

In this example, the inclusion of these three mitigation options offsets 183% of the repair impacts. In other words, the expected fish density of the site, as designed, exceeds our target capacity because the increase of 30.4 fish/LF is more than the calculated deficit of 16.6 fish/LF. In this case, this site offsets over 830 ft feet more than its own 1000 ft of repair. This will help to offset other repair sites that are not able to be fully offset onsite due to safety concerns or other restrictions. The repairs within the three-bridge corridor are examples of sites where design criteria are limited. In this reach, the river is very constricted. Historically, the bridge pilings have caught natural debris within the river, causing great stress to the bridge structures and creating safety concerns. Engineers considered the potential to augment that effect to be too high of a risk to include rootwads or other large woody debris at repair sites within the three-bridge corridor. Offset of the impacts of such sites relies on other repair sites having the ability to more than offset their own repair.

The HCMT was implemented to design the expected 2011 repairs, and has been used to evaluate those repairs completed in 2007. In the process of quantifying how much mitigation was completed during the 2007 construction period, Corps technical staff consulted the As-Built drawings. In 2007, many of the repairs included the installation of willow lifts at varying heights along the repair sites. NMFS, USFWS, and SRSC pointed out that when willow lifts are installed high above normal river levels, there is limited in-water benefit to fish for rearing or refuge. The Corps provided the following indices for granting mitigation credit for diminishing benefits:

- if the lowest elevation willow lift is less than 3 ft above OHW it gets full multiplier of 100%
- if the lowest elevation willow lift is 3 to 6 ft above OHW it gets half credit multiplier of 50%
- if the lowest elevation lift is more than 6 ft above OHW it gets quarter credit multiplier of 25%

The intention for reducing the multiplier is to provide a more accurate estimate of the improvement to habitat value or carrying capacity, as measured in potential increase in Chinook density.

5.0 OFF-SITE MITIGATION

On-site mitigation can be limited by site characteristics; therefore, off-site mitigation may be needed to fully offset impacts. The tool allows consideration of credits in mitigation banks, conservation easements, and collaborating with other organizations to complete large off-site projects. These types of projects would be considered on a case-by-case basis so that the technical working group could assess the relative value of each option to edge habitat function; however, other opportunities for small improvements exist throughout the lower river. An example might include a site that is adjacent to the river that includes a monotypic cover of Himalayan blackberry throughout 1000 feet of riparian edge habitat. By removing the invasive species and planting several native species, potentially including overstory trees at certain sites, the corridor would be more diverse. This could increase the diversity of insect use of the area and increase shade benefits to the river. Table 3 shows how this hypothetical mitigation site would offset 346 feet of levee repair.

Table 3: Calculation example for off-site mitigation at a hypothetical site "Site M"

	Mitigation length	Affected fish/LF (deficit)	**mitigation option (category)**	Mitigation category credit	Offset Multiplier	Existing fish/LF	Target fish/LF	Fish/LF Increase offsetting deficit	Percent offset	Total length of repair that has been mitigated
Site M	1000	16.6	Triple bench plantings (forage)	1.00	0.70	4.1	20.7	2.9	17%	173.0
	1000	16.6	Invasive plant removal (rip. corridor improvement)	1.00	0.70	4.1	20.7	2.9	17%	173.0
TOTAL	*1000*	*16.6*	*Plantings + invasive removal*		*1.4*	*4.1*	*20.7*	*5.7*	*35%*	*346.0*

6.0 CONCLUSION

Levee repairs, particularly under the Corps' PL84-99 program, have typically not included mitigation efforts as they, by definition, repair the existing levee to the original design. However, the length of repairs within the Skagit River Valley has been extensive within the recent past, and the disturbance of considerable lengths of riverbank diminishes edge habitat function, particularly for ESA-listed species. Over a few years, riprap banks become somewhat naturalized as they collect sediment and debris and as natural plant colonization occurs, but with each new repair these naturalized banks begin the process anew. The inclusion of HCMT mitigation options will decrease this time lag by including plantings and woody debris that are expected to improve edge habitat function immediately post-construction and help to jump-start the naturalization process.

Performance criteria for these repairs are not defined in observable fish density. While the assessment depends on the consideration of fish density changes, it is recognized that this is the annual productivity of a site, as opposed to an actual number of fish expected to be seen at the site on any single day. The actual measurement of the number of juvenile Chinook using a single willow lift for forage throughout the year, or the use of an anchored rootwad for rearing would be impractical to measure and would rely on a variety of factors outside the control of this project that impact annual fish populations. Performance criteria will instead look at the effectiveness of construction, such as height of willow lifts, survival of bank plantings, and longevity of rootwads.

Overall, the Habitat Capacity Mitigation Tool provides a new way to assess levee repair impacts in the Skagit River and design ways to offset those impacts during construction of the repair. Through careful design and proper construction, HCMT is designed to offset the diminished edge habitat complexity and capacity of levee repairs in the lower Skagit River, and benefit the continued health of this important ecosystem. Project construction without mitigation would lead to significant impacts to riparian

vegetation, and the fish and wildlife that depend on the lower Skagit River riparian corridor. Implementation of the project with the enhancement features in the HCMT will mitigate those impacts below significant levels.

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Repair date	Site	type of repair	Repair status	Total length (LF)	Total length (Miles)
2007	1-1	inwater	complete	207.5	
2007	1-2	inwater	complete	200.0	
2007	1-4	inwater	complete	108.0	
2007	1-7	inwater	complete	257.0	
2007	3-1	inwater	complete	382.0	
2007	3-2	inwater	complete	436.0	
2007	3-3	inwater	complete	139.0	
2007	3-4	inwater	complete	287.0	
2007	3-5	inwater	complete	460.0	
2007	3-6	inwater	needs rework	375.0	
2007	3-7	backslope	complete	6110.0	no mitigation
2007	12-1	inwater	complete	109.0	
2007	12-2	inwater	complete	261.0	
2007	12-3	inwater	complete	511.5	
2007	12-5	inwater	complete	236.0	
2007	12-6	inwater	needs rework	651.0	
2007	12-7	inwater	complete	170.0	
2007	12-8	inwater	complete	124.0	
2007	17-1	inwater	complete	400.0	
2007	17-2	inwater	complete	275.0	
2007	17-3	inwater	complete	159.0	
2007	17-4	inwater	complete	170.0	
2007	17-5	inwater	complete	1350.0	
2007	17-6	inwater	complete	522.0	
2007	22-1	inwater	complete	395.0	
2007	22-2	inwater	complete	118.0	
2007	22-3	inwater	needs rework	273.0	
2007	22-4	inwater	complete	246.0	
2007	22-5	inwater	complete	70.0	
2007	22-6	inwater	complete	359.0	
2007	22-8	inwater	complete	554.0	
2007	22-9	inwater	complete	338.0	
			Total	**16253.0**	**3.08**

Repair date	Site	type of repair	Repair status	Total length (LF)	Total length (Miles)
2011	1-3	slope	2007 deferred site to be done in 2011	75.0	
2011	1-13	slope	2011 repair	50.0	
2011	1-14	inwater	2011 repair	30.0	
2011	3-6	slope	2007 rework	150.0	
2011	3-8	inwater	2011 repair	225.0	
2011	3-11	inwater	2011 repair	200.0	
2011	12-4A	top of slope	2007 deferred site to be done in 2011	250.0	
2011	12-4B	inwater	2011 repair	970.0	
2011	12-6	slope	2007 rework	160.0	
2011	12-9	inwater	2011 repair	1850.0	
2011	12-11	inwater	2011 repair	600.0	
2011	12-12	inwater	2011 repair	50.0	
2011	12-14	inwater	2011 repair	250.0	
2011	12-13	inwater	2011 repair	350.0	
2011	12-15	inwater	2011 repair	180.0	
2011	12-16	inwater	2011 repair	670.0	
2011	12-17	inwater	2011 repair	450.0	
2011	17-7	inwater	2011 repair	800.0	
2011	17-9	inwater	2011 repair	700.0	
2011	17-10	inwater	2011 repair	200.0	
2011	17-12	inwater	2011 repair	925.0	
2011	17-15	inwater	2011 repair	125.0	
2011	17-16	inwater	2011 repair	250.0	
2011	22-3	slope	2007 rework	110.0	
2011	22-7	inwater	2007 deferred site to be done in 2011	350.0	
2011	22-10	inwater	2011 repair	300.0	
2011	22-11	backslope	2011 repair	800.0	no mitigation
2011	22-12	slope	2011 repair	360.0	
			Total	**11430.0**	**2.16**

Grand Total	**27683.0**	**5.24**
	feet	miles
2007 work requiring mitigation	10143.0	1.92
2007 work not requiring mitigation	6110.0	1.16
completed 2007 repairs - total length	16253.0	3.08
2007 rework sites (requiring mitigation)	420.0	0.08
deferred 2007 sites (requiring mitigation)	675.0	0.13
new work requiring mitigation	9535.0	1.81
new work not requiring mitigation	800.0	0.15
proposed 2011 repairs - total length	11430.0	2.16

Primary Function/ Category	Mitigation Options	Offset multiplier (increase of fish density over existing)	Source document for fish density improvement	Notes	Description of primary function	Specs for design criteria
Rearing	Layback (3:1 or shallower) up to 20 feet wide	3.038	(based on Tech Wkg Grp discussion)	Oct 25, 2010 group decision, creates stable bank to limit future repairs, allows natural LWD accumulation, slows flows over the bank	more natural riverbank slope provides shallower depths at wider range of river flows	slope layback needs to start as low on the bank as possible; inundation at 8000 cfs
Rearing	Layback (3:1 or shallower) 21 feet and wider	4.050	(based on Tech Wkg Grp discussion)	75% of the natural bank value with the addition of a willow lift (does not create a condition equal to a natural bank); per group discussion 11-8-2010	more natural riverbank slope provides shallower depths at wider range of river flows	slope layback needs to start as low on the bank as possible; inundation at 8000 cfs
Rearing	single logs in line	1.200	Beamer and Henderson 1998	Table 4, page 13; relative fish use defined on p.6	moderate gain in habitat complexity will increase fish density	straight logs with little to no branching or complexity
Rearing	anchored single log with rootwad	8.7 - 1.2 (see notes)	(based on Tech Wkg Grp discussion)	multiplier is 8.7 for double the rootwad diameter plus 1.2 times the length of stem minus the effective length given for rootwad	fish use of rootwads is for cover while rearing; effective area is roughly double because fish will dart out for food then return to complex woody cover	minimum 3 ft diameter rootwad with minimum 12 in diameter log attached
Rearing	unanchored woody debris piles	6.400	Beamer and Henderson 1998	Table 4, page 13; relative fish use defined on p.6	significant gain in habitat complexity will greatly increase fish density	branches, limbs, sticks; complex collection;
Rearing	anchored rootwads	8.700	Beamer and Henderson 1998	Table 4, page 13; relative fish use defined on p.6	significant gain in habitat complexity will greatly increase fish density	minimum 3 ft diameter rootwads (larger encouraged) spaced 10 feet apart; individually anchored;
Rearing	Setback Levee	10.000	Hayman et al. 1996, p. 33-34	for sampling year 1995, hydromodified banks only produced 1/10 of the amount of Chinook smolts produced by natural banks, backwaters, and bars	significant increase in habitat quantity available, increases floodplain connectivity, allows natural river migration and formation of natural banks	requires removal of all armoring on riverbank for credit
Rearing	Slough (or large backwater) habitat creation	case-by-case			backwater provides highly valuable area of low velocity - increase in both quality and quantity of habitat. Primarily rearing, secondarily refuge	
Rearing	Remove bank armoring	5.400	Beamer and Henderson 1998	natural banks had a higher percent of their area in no cover when compared to hydromodified banks. Relative fish use defined on p.6	significant increase in habitat quantity available, allows formation of natural undercut banks and/or overhanging roots, etc	
Refuge	Layback transition zone	2.025	(based on Tech Wkg Grp discussion)	3:1-2:1 slope for tie-in to existing upstream and downstream of repair area; decided by group 11-8-2010	Transition zone from a layback into a standard 2:1 levee face can provide a slight backwater area at the upstream end, and slight increase to edge complexity at downstream end	
Refuge	Fish Bench - at useful elevation; slow velocity and depth up to 30"	1.300	Beechie, Lierman, Beamer, and Henderson 2005	described preference/selection of lower velocity habitat compared to average velocity of river	slow velocity and shallower area during flows at or above OHW	10kcfs to 12kcfs at center point
Refuge	Habitat Weirs / groins creating backwater (rock outcropping) : reach analysis required	4.000	ODFW - Friesen et al - 2003	Fischenich 2003 provides citations for guidance document regarding spacing of groins according to stream width and bank type (e.g. straight, curved, etc.)	provides slow velocity escape from higher flows	
Refuge	Willow Lift - double, starting @ OHW	1.400	Mainly Beamer and Henderson 1998 table 4, + group input; supported by Peters, Missildine, and Low 1998	document; listed as overhead riparian cover; shown in Table 4 as vegetation overhang and riparian cover, literature considers natural bank so Group decision (10-25-10) discussed that a single	creates slower velocity refuge areas at river bank; secondarily provides leaf/litter fall for aquatic insects, and terrestrial insects falling into water	live willow stakes (3/4 to 1 in. diameter) minimum of 3 ft in length, in lift of minimum 8 in. of soil
Refuge	Willow Lift - triple spanning wide range of flows	1.800	Mainly Beamer and Henderson 1998 table 4, + group input; supported by Peters, Missildine, and Low 1998	this is equivalent to triple lift below, for shallow slopes determined by group (10-25-10)	creates slower velocity refuge areas at river bank; secondarily provides leaf/litter fall for aquatic insects, and terrestrial insects falling into water	live willow stakes (3/4 to 1 in. diameter) minimum of 3 ft in length, in lift of minimum 8 in. of soil
Forage	Willow Lift - single @ OHW	0.700	Mainly Beamer and Henderson 1998 table 4, + group input; supported by Peters, Missildine, and Low 1998	document; listed as overhead riparian cover; shown in Table 4 as vegetation overhang and riparian cover, literature considers natural bank so Group decision (10-25-10) discussed that a single	primarily provides leaf/litter fall for aquatic insects, and terrestrial insects falling into water; secondarily improves complexity and slows velocity	live willow stakes (3/4 to 1 in. diameter) minimum of 3 ft in length, in lift of minimum 8 in. of soil
Forage	single lift + bank plantings: wildrose, ocean spray, snowberry, red osier dogwood	1.400	Mainly Beamer and Henderson 1998 table 4, + group input; supported by Peters, Missildine, and Low 1998	adding diverse plantings above a lift keeps invasives out (decrease maintenance cost over time?), plus add forage (group discussion 10-25-10)	primarily provides leaf/litter fall for aquatic insects, and terrestrial insects falling into water; secondarily improves complexity and slows velocity	
Forage	bank plantings on riverward side; above OHW, inundation tolerant plants	0.2 to 0.7	(based on Tech Wkg Grp discussion)	calculated on specific site conditions. (group discussion 11-8-2010)	insects falling into water; secondarily improves complexity and slows velocity	
Forage	bank plantings on riverward side - single row	0.4		shrubby native species at top of bank, creates forage opportunity (insect and plant input to river), refuge in high water events, decreases invasive species along shoreline	primarily provides leaf/litter fall for aquatic insects, and terrestrial insects falling into water; secondarily improves complexity and slows velocity	
Forage	bank plantings on riverward side - double row	0.6		shrubby native species at top of bank, creates forage opportunity (insect and plant input to river), refuge in high water events, decreases invasive species along shoreline	primarily provides leaf/litter fall for aquatic insects, and terrestrial insects falling into water; secondarily improves complexity and slows velocity	
Forage	bank plantings on riverward side - triple row	0.7		shrubby native species at top of bank, creates forage opportunity (insect and plant input to river), refuge in high water events, decreases invasive species along shoreline	primarily provides leaf/litter fall for aquatic insects, and terrestrial insects falling into water; secondarily improves complexity and slows velocity	
Forage	spread dirt over riprap and hydroseed	0.350	(based on Tech Wkg Grp discussion)	Oct 25, 2010 group decision, relieves heating of water against rock face and allows faster regeneration of plants (= to 0.25 * single lift plus bank plantings)	primarily provides vegetative energy inputs; high flows will pull terrestrial insects into water	
Riparian Corridor Improvements	Landward Plantings, e.g. cedar, big leaf maple	0.200	(based on Tech Wkg Grp discussion)	decided by group. Oct 25, 2010, long term LWD and seed source for river, questionable fate	can provide shading to the river and seed source for natural recruitment in the riparian zone	
Riparian Corridor Improvements	Invasive plants replaced with native plants	0.700	(based on Tech Wkg Grp discussion)	on a setback - high value because allowing lg trees to grow would equate to future LWD, number decided by group (same as single lift) Oct 25, 2010	general improvement of edge habitat	requires removal of invasives with subsequent planting of native species (bank plantings or willow lifts) with long term monitoring
Case-by-case	Mitigation Banks - only where fish credits available	case-by-case				
Case-by-case	Conservation Easements	case-by-case		must actually prevent development or other loss of edge habitat, not merely maintain existing protected riverbank		
Case-by-case	Cottonwood Slough, other habitat projects	case-by-case		Project proposals typically provide an estimate of number of fish that will benefit		

ASSUMPTIONS		
Rearing:	Rearing is defined here as the most common type of edge habitat found along the mainstem Skagit and does not imply any particular quality of habitat. Items in this category can either provide whole new linear footage of rearing habitat OR can provide some enhancement to existing habitat that benefits the quality so that an increase in fish density would be expected.	
Refuge:	Refuge is defined here as areas that can be used during high velocity river flows so that fish can find low velocity areas and avoid being washed downstream too early. Refuge areas may be used as rearing, but this focuses on the primary function of the particular mitigation option. Some refuge areas may not become available until the river is at much higher than average river flows.	
Forage:	Items in this category provide some kind of allochthonous inputs to the river.	
Riparian Corridor Improvements:	Items in this category are considered to be good for the overall health of the riverine ecosystem, but so far have no specific research or data showing an increase of Chinook density.	
Diminishing multiplier value for multiple options from same function category	Multipliers across different functional categories are additive. Multipliers within the same category have diminishing offset, such that the highest offset within a category is given full credit. Any additional offsets within that same function category are credited 90% for the second, and 80% for the third and any further offsets.	
Willow Lift Elevation Offsets	if the lowest elevation willow lift is less than 3 ft from OHW it gets full multiplier	1
	if the lowest elevation willow lift is 3 to 6 ft from OHW it gets half credit multiplier	0.5
	if the lowest elevation lift is more than 6 ft from OHW it gets quarter credit multiplier	0.25

Site	Total length of repairs (LF)	height from OHW on As-Built dwg. to lowest willow lift (ft)	vertical height between lifts (ft)	affected fish/LF	mitigation option selected	willow height multiplier	offset multiplier (increase in fish density over existing)	present capacity	new capacity of repair area (fish/LF): old + increase due to mitigation	capacity change with repair = new capacity - present capacity	Target = capacity + affected	percent capacity increase toward offsetting impact	length offset	length of repair (ft)still requiring offset (negative indicates the site has exceeded the target capacity)	DD remaining totals	DD % remaining
1-1	196	4	-	16.6	single willow lift	0.5	0.4	4.1	5.5	1.4	20.7	9%	16.95	179.0		
1-1	11.5			16.6	none		0.0	4.1	4.1	0.0	20.7	0%	0.00	11.5		
1-2	163	3	-	16.6	single willow lift	1	0.7	4.1	7.0	2.9	20.7	17%	28.20	134.8		
1-2	37			16.6	none		0.0	4.1	4.1	0.0	20.7	0%	0.00	37.0		
1-4	105	0.5	4.4	16.6	double willow lift	1	1.4	4.1	9.8	5.7	20.7	35%	36.33	68.7		
1-4	3			16.6	none		0.0	4.1	4.1	0.0	20.7	0%	0.00	3.0		
1-7	153	6	-	16.6	single willow lift	0.5	0.4	4.1	5.5	1.4	20.7	9%	13.23	139.8		
1-7	104			16.6	none			4.1	4.1	0.0	20.7	0%	0.00	104.0		
								4.1								
DD1 Total	**772.5**												**94.72**		**677.8**	**88%**
				16.6												
3-1	349	2.5	-	16.6	single willow lift	1	0.7	4.1	7.0	2.9	20.7	17%	60.38	288.6		
3-1	33			16.6	none		0.0	4.1	4.1	0.0	20.7	0%	0.00	33.0		
3-2	45	0	-	16.6	single willow lift	1	0.7	4.1	7.0	2.9	20.7	17%	7.79	37.2		
3-2	391	3	-	16.6	single willow lift	1	0.7	4.1	7.0	2.9	20.7	17%	67.64	323.4		
3-3	34	0	-	16.6	single willow lift	1	0.7	4.1	7.0	2.9	20.7	17%	5.88	28.1		
3-3	33			16.6	none		0.0	4.1	4.1	0.0	20.7	0%	0.00	33.0		
3-3	72	4.5	-	16.6	single willow lift	0.5	0.4	4.1	5.5	1.4	20.7	9%	6.23	65.8		
3-4	237	1	-	16.6	single willow lift (forage)+ single logs at toe (rearing)+ unanchored debris at toe (rearing)	1	8.2	4.1	37.6	33.5	20.7	202%	479.13	-242.1		
3-4	50	1		16.6	single willow lift	1	0.7	4.1	7.0	2.9	20.7	17%	8.65	41.3		
3-5	350	6.6	-	16.6	single willow lift (forage)	0.25	0.2	4.1	4.8	0.7	20.7	4%	15.14	334.9		
3-5	110			16.6	none		0.0	4.1	4.1	0.0	20.7	0%	0.00	110.0		
3-6	375	0.5	-	16.6	single willow lift (forage) + layback (rearing)	1	4.8	4.1	23.6	19.5	20.7	117%	440.23	-65.2		
DD3 Total	**2079**												**1,091.06**		**987.9**	**48%**
12-1	109	NA	-	16.6	none		0	4.1	4.1	0.0	20.7	0%	0.00	109.0		
12-2	255	0	3	16.6	double willow lift	1	1.4	4.1	9.8	5.7	20.7	35%	88.23	166.8		
12-2	6			16.6	none		0.0	4.1	4.1	0.0	20.7	0%	0.00	6.0		
12-3	511.5	0	2	16.6	double willow lift	1	1.4	4.1	9.8	5.7	20.7	35%	176.98	334.5		
12-5	236	NA	-	16.6	none		0	4.1	4.1	0.0	20.7	0%	0.00	236.0		
12-6	40	0		16.6	double willow lift (refuge)+ unanchored debris at toe (rearing)	1	7.8	4.1	36.1	32.0	20.7	193%	77.11	-37.1		
12-6	611	0	4	16.6	double willow lift (refuge)	1	1.8	4.1	11.3	7.2	20.7	43%	264.26	346.7		
12-7	170	0	8	16.6	double willow lift	1	1.4	4.1	9.8	5.7	20.7	35%	58.82	111.2		
12-8	22			16.6	none		0.0	4.1	4.1	0.0	20.7	0%	0.00	22.0		
12-8	102	0	4	16.6	double willow lift	1	1.4	4.1	9.8	5.7	20.7	35%	35.29	66.7		
DD12 Total	**2062.5**												**700.69**		**1361.8**	**66%**

Site	Total length of repairs (LF)	height from OHW on As-Built dwg. to lowest willow lift (ft)	vertical height between lifts (ft)	affected fish/LF	mitigation option selected	willow height multiplier	offset multiplier (increase in fish density over existing)	present capacity	new capacity of repair area (fish/LF): old + increase due to mitigation	capacity change with repair = new capacity - present capacity	Target = capacity + affected	percent capacity increase toward offsetting impact	length offset	length of repair (ft)still requiring offset (negative indicates the site has exceeded the target capacity)	DD remaining totals	DD % remaining
17-1	167	4.5	3	16.6	double willow lift	0.5	0.7	4.1	7.0	2.9	20.7	17%	28.89	138.1		
17-1	233	6.3	4	16.6	double willow lift	0.25	0.4	4.1	5.5	1.4	20.7	9%	20.15	212.8		
17-2	225	6	3.3	16.6	double willow lift	0.5	0.7	4.1	7.0	2.9	20.7	17%	38.93	186.1		
17-2	50			16.6	none		0.0	4.1	4.1	0.0	20.7	0%	0.00	50.0		
17-3	159	3.6	2.5	16.6	double willow lift	0.5	0.7	4.1	7.0	2.9	20.7	17%	27.51	131.5		
17-4	162	2.4	3 and 3.8	16.6	triple willow lift	1	1.8	4.1	11.5	7.4	20.7	44%	72.07	89.9		
17-4	8			16.6	none		0.0	4.1	4.1	0.0	20.7	0%	0.00	8.0		
17-5	425	4	-	16.6	single willow lift	0.5	0.4	4.1	5.5	1.4	20.7	9%	36.76	388.2		
17-5	925			16.6	none		0.0	4.1	4.1	0.0	20.7	0%	0.00	925.0		
17-6	305	1	3.7	16.6	double willow lift	1	1.4	4.1	9.8	5.7	20.7	35%	105.53	199.5		
17-6	217			16.6	none		0.0	4.1	4.1	0.0	20.7	0%	0.00	217.0		
DD17 Total	**2876**												**329.84**		**2546.2**	**89%**
22-1	380	1.5	-	16.6	single willow lift	1	0.7	4.1	7.0	2.9	20.7	17%	65.74	314.3		
22-1	15			16.6	none		0.0	4.1	4.1	0.0	20.7	0%	0.00	15.0		
22-2	40	1		16.6	single willow lift + single log	1	1.9	4.1	11.9	7.8	20.7	47%	18.78	21.2		
22-2	73	1	-	16.6	single willow lift	1	0.7	4.1	7.0	2.9	20.7	17%	12.63	60.4		
22-2	5			16.6	none		0.0	4.1	4.1	0.0	20.7	0%	0.00	5.0		
22-3	230	0.5	-	16.6	single willow lift (forage)	1	0.7	4.1	7.0	2.9	20.7	17%	39.79	190.2		
22-3	43			16.6	none		0.0	4.1	4.1	0.0	20.7	0%	0.00	43.0		
22-4	50			16.6	single willow lift (forage)+ single log at toe (rearing)	1	1.9	4.1	11.9	7.8	20.7	47%	23.48	26.5		
22-4	189	3	-	16.6	single willow lift	1	0.7	4.1	7.0	2.9	20.7	17%	32.70	156.3		
22-4	7			16.6	none		0.0	4.1	4.1	0.0	20.7	0%	0.00	7.0		
22-5	45	NA	-	16.6	none		0	4.1	4.1	0.0	20.7	0%	0.00	45.0		
22-5	25	NA	-	16.6	unanchored logs		6.4	4.1	30.3	26.2	20.7	158%	39.54	-14.5		
22-6	269	1.5	3.8	16.6	double willow lift	1	1.4	4.1	9.8	5.7	20.7	35%	93.08	175.9		
22-6	90	1.5	3.8	16.6	double willow lift (refuge)+ unanchored debris at toe (rearing)	1	7.8	4.1	36.1	32.0	20.7	193%	173.50	-83.5		
22-8	329	2.5	3	16.6	double willow lift	1	1.4	4.1	9.8	5.7	20.7	35%	113.84	215.2		
22-8	125			16.6	none		0.0	4.1	4.1	0.0	20.7	0%	0.00	125.0		
22-8	100	2.5	3	16.6	double willow lift (refuge)+ single log (rearing)+ unanchored debris pile at toe (rearing)	1	8.9	4.1	40.5	36.4	20.7	219%	219.47	-119.5		
22-9	208	1.5	5	16.6	double willow lift (refuge)+ unanchored debris at toe(rearing)	1	7.8	4.1	36.1	32.0	20.7	193%	400.97	-193.0		
22-9	130			16.6	none		0.0	4.1	4.1	0.0	20.7	0%	0.00	130.0		
DD22 Total	**2353**												**1,233.50**		**1119.5**	**48%**

Site	alternative site name	Total length (LF)	affected fish/LF (based on high population year)	mitigation option selected	offset multiplier (increase in habitat capacity over existing - as measured in fish density)	present capacity	new capacity of repair area (fish/LF): old + increase due to mitigation	capacity change with repair = new capacity - present capacity	Target = capacity + affected	percent capacity increase toward offsetting impact	length offset	length of repair (ft)still requiring offset (negative indicates the site has exceeded the target capacity)	DD remaining totals	DD % remaining
1-3	none (2007 PIR)	75	16.6	double willow lift (refuge)+ anchored rootwads (rearing) + spread dirt/hydroseed (forage)+ invasive removal (rip corr)	11.2	4.1	49.8	45.7	20.7	276%	206.68	-131.7		
1-13		50	16.6	spread dirt/hydroseed (forage) + single willow lift (forage)	1.0	4.1	8.1	4.0	20.7	24%	12.11	37.9		
1-14		30	16.6	spread dirt/hydroseed (forage)	0.4	4.1	5.5	1.4	20.7	9%	2.60	27.4		
DD1 Totals		***155***									***221.38***		***-66.4***	***-43%***
3-6	none	150	16.6	double willow lift (refuge)+ anchored logs with rootwads (rearing)+ spread dirt/hydroseed (forage)+ invasive removal (rip corr)	11.2	4.1	49.8	45.7	20.7	276%	413.35	-263.4		
3-8	3-10-2	225	16.6	double willow lift (refuge)+ anchored logs with rootwads (rearing)+ spread dirt/hydroseed (forage)+ invasive removal (rip corr)	11.2	4.1	49.8	45.7	20.7	276%	620.03	-395.0		
3-11	3-10-1	200	16.6	triple willow lift (refuge) + spread dirt/hydroseed top of bank (forage)+ invasive removal (rip corr)	2.9	4.1	15.8	11.7	20.7	70%	140.87	59.1		
DD3 Totals		***575***									***1,174.25***		***-599.3***	***-104%***
12-4A	none	250	16.6	spread dirt/hydroseed top of bank (forage)	0.4	4.1	5.5	1.4	20.7	9%	21.63	228.4		
12-4B	12-10-3	970	16.6	triple willow lift (refuge) + spread dirt/hydroseed top of bank (forage)+ invasive removal (rip corr)	2.9	4.1	15.8	11.7	20.7	70%	683.23	286.8		
12-6	none	160	16.6	double willow lift (refuge)+ spread dirt and hydroseed (forage)+ invasive removal (rip corr)	2.5	4.1	14.1	10.0	20.7	61%	96.88	63.1		
12-9	12-10-4	1575	16.6	triple willow lift (refuge) + spread dirt/hydroseed top of bank (forage)+ double row bench plantings (forage)+ rootwads (rearing)+ invasive removal (rip corr)	12.1	4.1	53.8	49.7	20.7	299%	4715.82	-3140.8		
12-9	12-10-4	275	16.6	triple willow lift (refuge) + spread dirt/hydroseed top of bank (forage)+ double row bench plantings (forage)+ invasive removal (rip corr)	3.4	4.1	18.1	14.0	20.7	84%	232.10	42.9		
12-11	12-10-5	600	16.6	triple willow lift (refuge) + spread dirt/hydroseed top of bank (forage)+ single row bench plantings (forage)+ invasive removal (rip corr)	3.2	4.1	17.3	13.2	20.7	79%	476.74	123.3		
12-12	12-10-6	50	16.6	spread dirt/hydroseed top of bank (forage)	0.4	4.1	5.5	1.4	20.7	9%	4.33	45.7		
12-13	12-10-7	350	16.6	fish bench (rearing)+ double willow lift (refuge)+ spread dirt/hydroseed (forage)+ single row of plantings (forage) +invasive removal (rip corr)	4.1	4.1	21.0	16.9	20.7	102%	355.95	-6.0		
12-14	12-10-1	250	16.6	layback (rearing)+ double willow lift (refuge)+ dirt/hydroseed (forage)+ invasive removal (rip corr) + single row bench plantings (forage) (transition zone added to Total Offsets tab)	6.9	4.1	32.2	28.1	20.7	170%	424.16	-174.2		
12-15	12-10-2	180	16.6	2 rows bench plantings (forage)+triple willow lift (refuge)+ spread dirt/hydroseed (forage)+ invasive removal (rip corr)	3.4	4.1	18.1	14.0	20.7	84%	151.92	28.1		
12-16	none	670	16.6	triple willow lift (refuge) + spread dirt/hydroseed top of bank (forage)+ invasive removal (rip corr)	2.9	4.1	15.8	11.7	20.7	70%	471.92	198.1		
12-17	none	450	16.6	triple willow lift (refuge) + spread dirt/hydroseed top of bank (forage)+ invasive removal (rip corr)	2.9	4.1	15.8	11.7	20.7	70%	316.96	133.0		
DD12 Totals		***5780***									***7,951.65***		***-2171.7***	***-38%***

Site	alternative site name	Total length (LF)	affected fish/LF (based on high population year)	mitigation option selected	offset multiplier (increase in habitat capacity over existing - as measured in fish density)	present capacity	new capacity of repair area (fish/LF): old + increase due to mitigation	capacity change with repair = new capacity - present capacity	Target = capacity + affected	percent capacity increase toward offsetting impact	length offset	length of repair (ft)still requiring offset (negative indicates the site has exceeded the target capacity)	DD remaining totals	DD % remaining
17-7	17-10-1	800	16.6	triple willow lift (refuge) + dirt/hydroseeding (forage) + 1 row bench plantings (forage) + invasives removal	3.2	4.1	17.3	13.2	20.7	79%	635.74	164.3		
17-9	17-10-2	700	16.6	triple willow lift (refuge) + dirt/hydroseeding (forage) + 1 row bench plantings (forage) + invasives removal (rip corr)	3.2	4.1	17.3	13.2	20.7	79%	556.28	143.7		
17-10	17-10-3	200	16.6	triple willow lift (refuge) + dirt/hydroseeding (forage) + invasives removal (rip corrid) + 1 row plantings (forage)	3.2	4.1	17.3	13.2	20.7	79%	158.94	41.1		
17-12	17-10-4	925	16.6	triple willow lift(refuge) + dirt/hydroseeding (forage) + invasive removal (rip corr)	2.9	4.1	15.8	11.7	20.7	70%	651.63	273.4		
17-15	17-10-5	125	16.6	triple willow lift(refuge) + dirt/hydroseeding (forage) + invasive removal (rip corr)	2.9	4.1	15.8	11.7	20.7	70%	88.06	36.9		
17-16	17-10-9	250	16.6	triple willow lift (refuge) + dirt/hydroseeding (forage) + 2 row bench plantings (forage) + landward plantings (rip corr) + habitat weir (refuge) + invasives removal (rip corr)	7.4	4.1	34.3	30.2	20.7	182%	455.12	-205.1		
DD17 Totals		***3000***									***2,545.76***		***454.2***	***15%***
22-3	none	110	16.6	double willow lift (refuge)+ dirt/hydroseed (forage)+ double row bench plantings (forage) + invasive removal	3.0	4.1	16.5	12.4	20.7	75%	81.98	28.0		
22-7	none	350	16.6	layback (rearing)+ double willow lift (refuge)+ anchored rootwads (rearing)+ spread dirt/hydroseed (forage)+tree plantings (rip corr) (transition zone added to Total Offsets tab)	14.3	4.1	62.7	58.6	20.7	353%	1236.70	-886.7		
22-10	22-10-1	300	16.6	double willow lift(refuge) + dirt/hydroseeding (forage)	1.8	4.1	11.3	7.2	20.7	43%	129.77	170.2		
22-12	none	360	16.6	dirt/hydroseed	0.4	4.1	5.5	1.4	20.7	9%	31.14	328.9		
DD22 Totals		***1120***									***1,479.59***		***-359.6***	***-32%***
	TOTALS	**10630**											**-2742.6**	**-26%**

2007 completed repairs

	length of riverward repairs	length offset	length remaining to be offset	percent remaining
DD1	772.5	94.7	677.8	88%
DD3	2079	1091.1	987.9	48%
DD12	2062.5	700.7	1361.8	66%
DD17	2876	329.8	2546.2	89%
DD22	2353	1233.5	1119.5	48%
TOTAL 2007	10143		6693.2	66%

2011 proposed repairs

	length of riverward repairs	length offset	length remaining to be offset	percent remaining
DD1	155	221.4	-66.4	-43%
DD3	575	1174.3	-599.3	-104%
DD12	5780	7951.7	-2171.7	-38%
DD17	3000	2545.8	454.2	15%
DD22	1120	1479.6	-359.6	-32%
TOTAL 2011	10630		-2742.6	-26%

Total Project	20773	3950.6	19%

Additional Mitigation to Complete offset

	mitigation length	Fish Density Deficit	mitigation option selected	offset multiplier	present capacity	new capacity fish/LF	capacity change with repair	Target capacity	percent capacity increase	Length of impact that has been 100% offset	notes
12-3	500	16.6	triple bench plantings + soil/hydroseed top of bank	2.2	4.1	12.9	8.8	20.7	53%	265.5	a 2007 site (that included willows, but no soil or bench plantings)
3-1	382	16.6	triple bench plantings + soil/hydroseed top of bank	2.2	4.1	12.9	8.8	20.7	53%	202.9	2007 repair site 3-1 with only willow lift
22-7	150	16.6	150' transition (refuge)+ double willow lift (refuge)+ spread dirt/hydroseed (forage)	3.6	4.1	19.0	14.9	20.7	90%	134.7	this adds transition zones at each end of 2011 site 22-7
12-14	150	16.6	150' transition (refuge)+ double willow lift (refuge)+ spread dirt/hydroseed (forage)	3.6	4.1	19.0	14.9	20.7	90%	134.7	this adds transition zones at each end of 2011 site 12-14
1-7	100	16.6	woody debris	6.4	4.1	30.3	26.2	20.7	158%	158.1	a completed 2007 repair with willow lifts too high, pilings at toe
17-2	100	16.6	woody debris	6.4	4.1	30.3	26.2	20.7	158%	158.1	a completed 2007 repair with willow lifts too high, pilings at toe (d/s of 3-bridge corridor)
3-5	460	16.6	anchored root wads (rearing)	8.7	4.1	39.8	35.7	20.7	215%	988.4	2007 repair with willow lifts only, rootwads to be added in 2011
3-6	375	16.6	anchored root wads (rearing)	8.7	4.1	39.8	35.7	20.7	215%	805.8	2007 repair with willow lifts only, rootwads to be added in 2011
12-6	250	16.6	double row bank planting	0.6	5.1	8.2	3.1	21.7	18%	46.1	2006 repair with willow lifts only, dirt/hydroseed to be added in 2011
12-6	651	16.6	spread dirt/hydroseed along (forage - to be done in 2011)	0.4	4.1	5.5	1.4	20.7	9%	56.3	2007 repair with willow lifts only, dirt/hydroseed to be added in 2011
17-6	400	16.6	rootwads + spread dirt/hydroseed	9.1	4.1	41.2	37.1	20.7	224%	894.1	2007 repair with willow lifts only, dirt/hydroseed and rootwads to be added in 2011
22-3	273	16.6	double row of bank plantings (forage) spread dirt/hydroseed (forage)+ invasives removal (rip corr)	1.6	4.1	10.7	6.6	20.7	40%	108.9	2007 repair with willow lifts only, dirt/hydroseed and plantings to be added in 2011, addition of plantings gives the invasives removal credit
						Total with additional mitigation				length remaining to be offset -2.9	

Draft - Post-Construction Performance Criteria (23 Feb 11)

Primary Function/ Category	Mitigation Options	Velocity	Width of Low Velocity Area	Linear Wetted Length	Shallow Depth Area	Photopoints	Presence/Absence Fish - ranked qualitatively using high/medium/low using a sumbersible camera	Pool Depth	Position of Structures	Plant Survival
Rearing	Layback (3:1 or shallower) up to 20 feet wide	Compare post-construction velocity with pre-construction at four established flow ranges (low = 10-12 kcfs, medium = 15-20 kcfs, high = 25 kcfs, highest = 30+ kcfs) using a velocimeter	Width of Low Velocity Area - measured using a rod or at highest flows with a dinghy float and distance finder		Measure shallow depth down the bank using as-builts					
Rearing	Layback (3:1 or shallower) 21 feet and wider	Compare post-construction velocity with pre-construction at four established flow ranges (low = 10-12 kcfs, medium = 15-20 kcfs, high = 25 kcfs, highest = 30+ kcfs) using a velocimeter	Width of Low Velocity Area - measured using a rod or at highest flows with a dinghy float and distance finder		Measure shallow depth down the bank using as-builts					
Rearing	single logs in line									
Rearing	anchored single log with rootwad									
Rearing	unanchored woody debris piles	Compare post-construction velocity with pre-construction at four established flow ranges (low = 10-12 kcfs, medium = 15-20 kcfs, high = 25 kcfs, highest = 30+ kcfs) using a velocimeter				Establish photopoints to observe changes in the structure of LWD and monitor for 5-years				
Rearing	anchored rootwads	At the rootwads, compare post-construction velocity with pre-construction at four established flow ranges (low = 10-12 kcfs, medium = 15-20 kcfs, high = 25 kcfs, highest = 30+ kcfs) using a velocimeter					Using a submersible camera, look at presence/absence of fish using a high/medium/low criteria during (March-June) and compare against baseline		1x/year for 5 years complete observations at the absolute low flow (likely August) looking for changes in location and position of the structures	
Rearing	Setback Levee									
Rearing	Slough (or large backwater) habitat creation									
Rearing	Remove bank armoring									
Refuge	Layback transition zone	Compare post-construction velocity with pre-construction at four established flow ranges (low = 10-12 kcfs, medium = 15-20 kcfs, high = 25 kcfs, highest = 30+ kcfs) using a velocimeter	Width of Low Velocity Area - measured using a rod or at highest flows with a dinghy float and distance finder		Measure shallow depth down the bank using as-builts					
Refuge	Fish Bench - at useful elevation; slow velocity and depth up to 30"	Compare post-construction velocity with pre-construction at four established flow ranges (low = 10-12 kcfs, medium = 15-20 kcfs, high = 25 kcfs, highest = 30+ kcfs) using a velocimeter		Measure linear length wetted at four established flow ranges (low = 10-12 kcfs, medium = 15-20 kcfs, high = 25 kcfs, highest = 30+ kcfs)						
Refuge	Habitat Weirs / groins creating backwater (rock outcropping) : reach analysis required	Compare post-construction velocity with pre-construction at four established flow ranges (low = 10-12 kcfs, medium = 15-20 kcfs, high = 25 kcfs, highest = 30+ kcfs) using a velocimeter					Using a submersible camera, look at presence/absence of fish using a high/medium/low criteria during (March-June) and compare against baseline	Obtain bathymetric point samples of depths both upstream and downstream of the habitat weir - measurements possibly taken using side-scan sonar		
Refuge	Willow Lift - double, starting @ OHW	Compare post-construction velocity with pre-construction as well as 2004 & 2007 sites at four established flow ranges (low = 10-12 kcfs, medium = 15-20 kcfs, high = 25 kcfs, highest = 30+ kcfs) using a velocimeter	Width of Low Velocity Area and wetted area - measured using a rod or at highest flows with a dinghy float and distance finder; wetted area at the established flow ranges to be determined per as-builts			Establish photopoints for growth comparisons between number of lifts, also compare to existing 2004 & 2007 lifts				For second lift 100% survival @ 1-year, 80% survival @5-years; quantify survival of the lowest lift tied to flows per year for 5-years
Refuge	Willow Lift - triple spanning wide range of flows	Compare post-construction velocity with pre-construction as well as 2004 & 2007 sites at four established flow ranges (low = 10-12 kcfs, medium = 15-20 kcfs, high = 25 kcfs, highest = 30+ kcfs) using a velocimeter	Width of Low Velocity Area and wetted area - measured using a rod or at highest flows with a dinghy float and distance finder; wetted area at the established flow ranges to be determined per as-builts			Establish photopoints for growth comparisons between number of lifts, also compare to existing 2004 & 2007 lifts				For second and third lift 100% survival @ 1-year, 80% survival @5-years; quantify survival of the lowest lift tied to flows per year for 5-years
Forage	Willow Lift - single @ OHW	Compare post-construction velocity with pre-construction as well as 2004 & 2007 sites at four established flow ranges (low = 10-12 kcfs, medium = 15-20 kcfs, high = 25 kcfs, highest = 30+ kcfs) using a velocimeter	Width of Low Velocity Area and wetted area - measured using a rod or at highest flows with a dinghy float and distance finder; wetted area at the established flow ranges to be determined per as-builts			Establish photopoints for growth comparisons between number of lifts, also compare to existing 2004 & 2007 lifts				Quantify survival of the single lift tied to flows per year for 5-years
Forage	single lift + bank plantings: wildrose, ocean spray, snowberry, red osier dogwood	Compare post-construction velocity with pre-construction as well as 2004 & 2007 sites at four established flow ranges (low = 10-12 kcfs, medium = 15-20 kcfs, high = 25 kcfs, highest = 30+ kcfs) using a velocimeter	Width of Low Velocity Area and wetted area - measured using a rod or at highest flows with a dinghy float and distance finder; wetted area at the established flow ranges to be determined per as-builts			Establish photopoints for growth comparisons between number of lifts, also compare to existing 2004 & 2007 lifts				For bank plantings, 100% survival @ 1-year, 80% survival @ 5-years; Quantify survival of the single lift tied to flows per year for 5-years. Bank plantings to be watered during summer (weather depending) for years 1-3 and weeded annually for 5 years.
Forage	bank plantings on riverward side; above OHW, inundation tolerant plants									For bank plantings, 100% survival @ 1-year, 80% survival @ 5-years. Bank plantings to be watered during summer (weather depending) for years 1-3 and weeded annually for 5 years.
Forage	bank plantings on riverward side - single row									For bank plantings, 100% survival @ 1-year, 80% survival @ 5-years. Bank plantings to be watered during summer (weather depending) for years 1-3 and weeded annually for 5 years.
Forage	bank plantings on riverward side - double row									For bank plantings, 100% survival @ 1-year, 80% survival @ 5-years. Bank plantings to be watered during summer (weather depending) for years 1-3 and weeded annually for 5 years.
Forage	bank plantings on riverward side - triple row									For bank plantings, 100% survival @ 1-year, 80% survival @ 5-years. Bank plantings to be watered during summer (weather depending) for years 1-3 and weeded annually for 5 years.
Forage	spread dirt over riprap and hydroseed									
Riparian Corridor Improvements	Landward Plantings, e.g. cedar, big leaf maple									Landward plantings, 100% survival @ 1-year, 80% survival @ 5-years. Tree plantings to be watered during summer (weather depending) for years 1-3 and weeded annually for 5 years.
Riparian Corridor Improvements	Invasive plants replaced with native plants									
Case-by-case	Mitigation Banks - only where fish credits available									
Case-by-case	Conservation Easements									
Case-by-case	Cottonwood Slough, other habitat projects									

Assumptions/Definitions	
OHW	Stage corresponding to a 1.5 times return occurrence of a 100-year event
As-Builts	Post-construction survey drawings used to verify installation of environmental features and design criteria
Monitoring Flows	
Low	10-12 kcfs
Medium	15-20 kcfs
High	25 kcfs
Highest	30 + kcfs

APPENDIX B

PHOTOS OF CONSTRUCTION SITES

APPENDIX B

PHOTOS OF CONSTRUCTION SITES

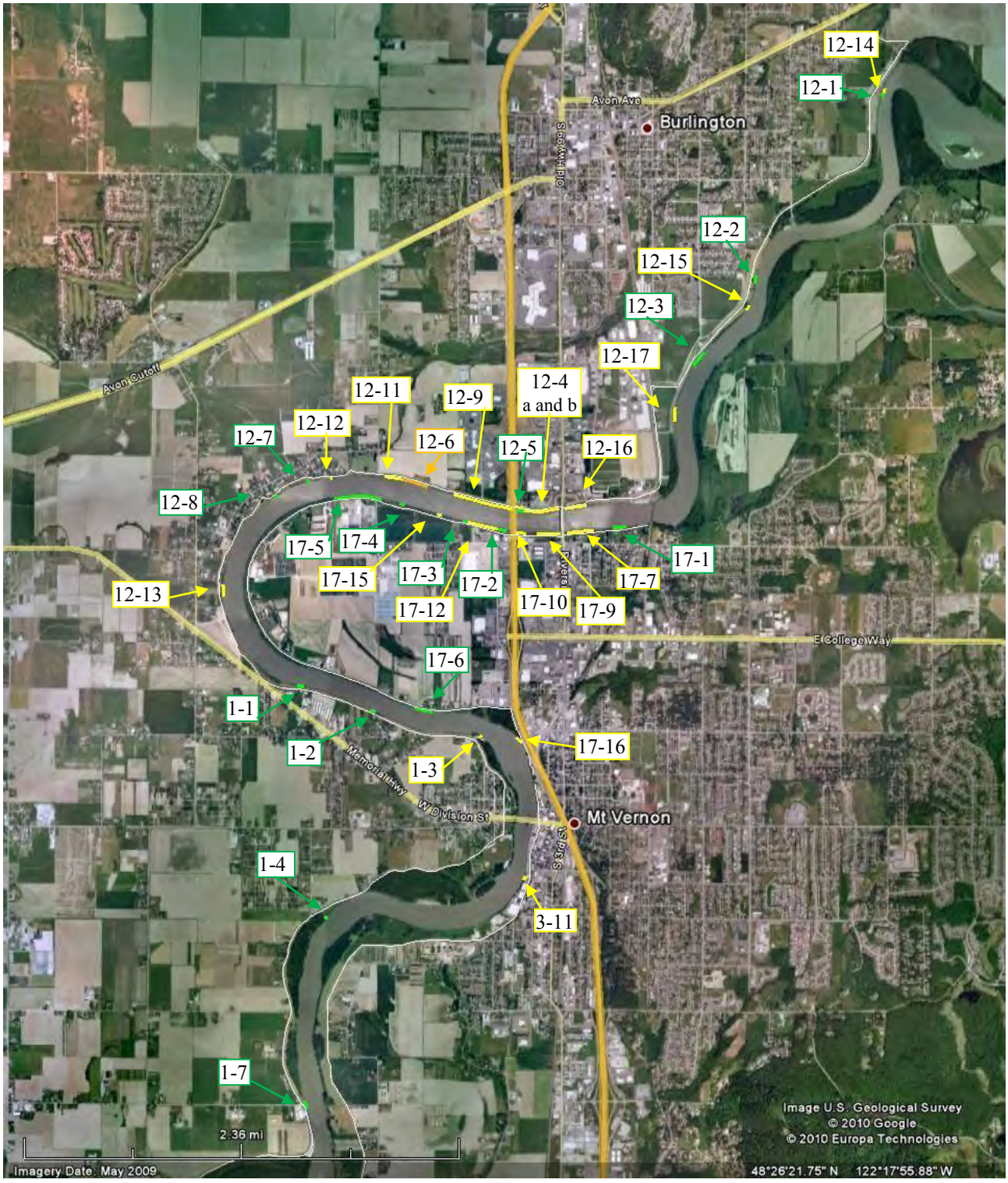

Figure 1: Skagit North

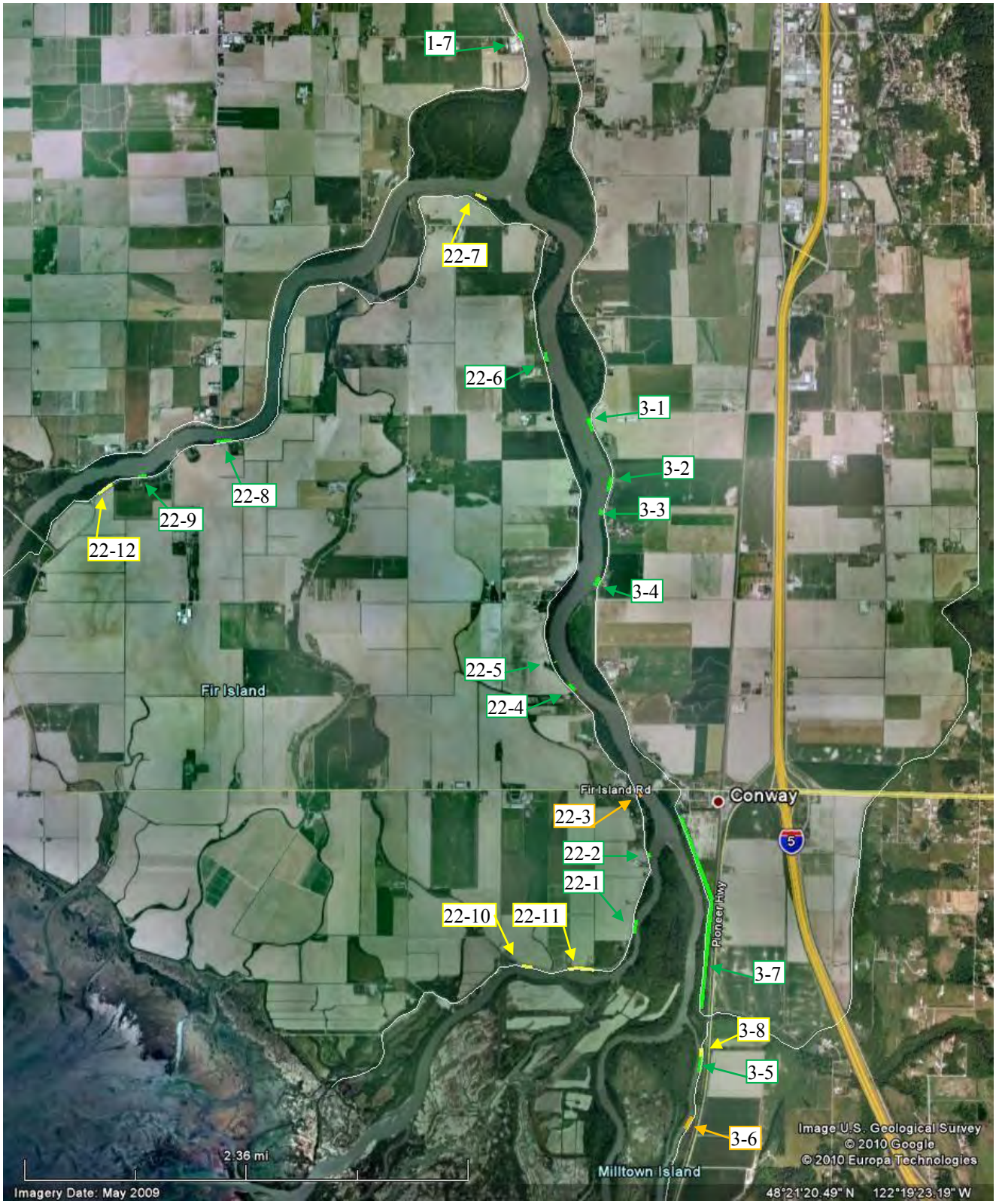

Figure 2: Skagit South

Figure 3: Site 1-1 Length of Repair: 207.5 ft

Figure 4: Site 1-2 prior to repair on 2007 Google Earth Image, Length of Repair: 200ft

Figure 5:Willow growth at repaired Site 1-2, photo taken February 2011.

Figure 6: Site 1-3 Length of Repair: 75ft, 2011 Construction

Figure 7: Site 1-3 Before Construction, December 2009

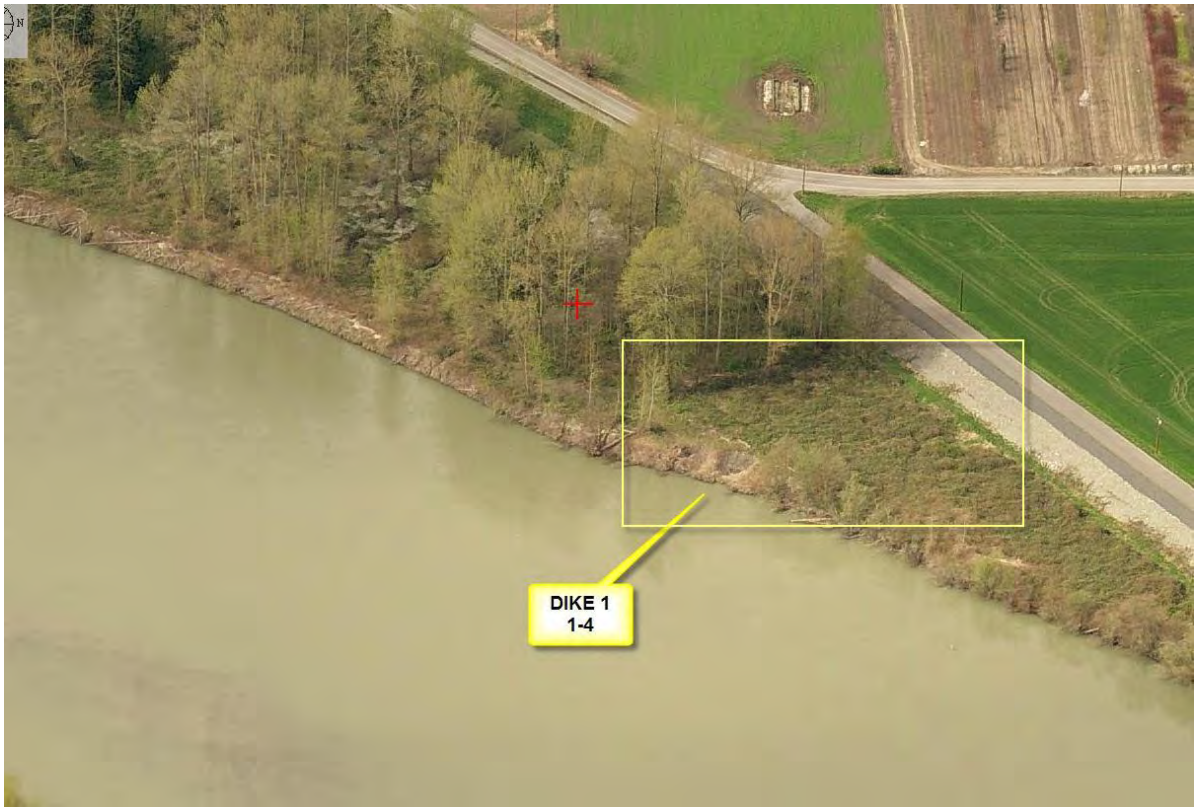

Figure 8: Site 1-4 Length of Repair: 108ft

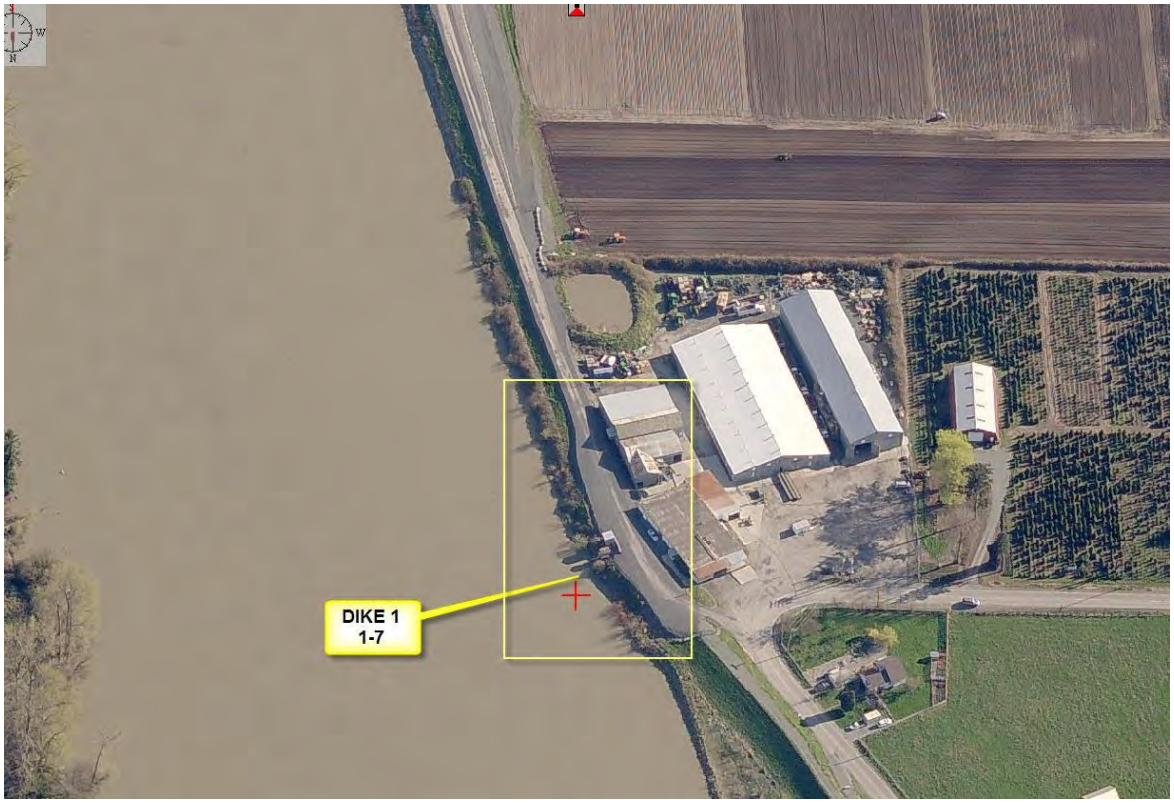

Figure 9: Site 1-7 Length of Repair: 257ft

Figure 10: Site 1-7 Before Construction

Figure 11: Site 1-7 After Construction

Figure12: Site 1-13. February 2011, Before Construction. Site length : 50ft.

Figure 13. Site 1-14. February 2011, Before Construction. Site length: 30 ft.

Figure 14. Site 1-14. February 2011, Before Construction.

Figure 15: Site 3-1 Length of Repair: 382ft

Figure 16: Site 3-2 Length of Repair: 436ft

Figure 17: Site 3-2 Before Construction

Figure 18: Site 3-2 After Construction

Figure 19: Site 3-3 Length of Repair: 139ft

Figure 20: Site 3-4 Length of Repair: 287 ft

Figure 21: Site 3-5 Length of Repair: 460 ft

Figure 22: Site 3-6 Length of Repair: 525ft.

Figure 23: Site 3-6 Immediately After Construction, showing willow lift placement

Figure 24: Site 3-6 After Construction, December 2009, showing rootwads placed at top of bank and willow growth at toe.

Figure 25: Site 3-7 Length of Repair: 6110ft, All work was along the backslope of the levee.



Figure 26: Site 3-8 Length of Repair: 225ft, work will remove brush on riverward side of levee, but will not impact the overstory trees behind the levee, as shown here.

Figure 27: Site 3-11 Length of Repair: 200ft, smaller photo shows one of the sink holes at the site.

Figure 28: Site 12-1 Length of Repair: 109ft

Figure 29: Site 12-2 Length of Repair: 261ft

Figure 30: Site 12-2 (in distance) August 2009 Post Construction, showing willow growth.

Figure 31: Site 12-3 Length of Repair: 511.5ft

Figure 32: Site 12-3. Before and after construction

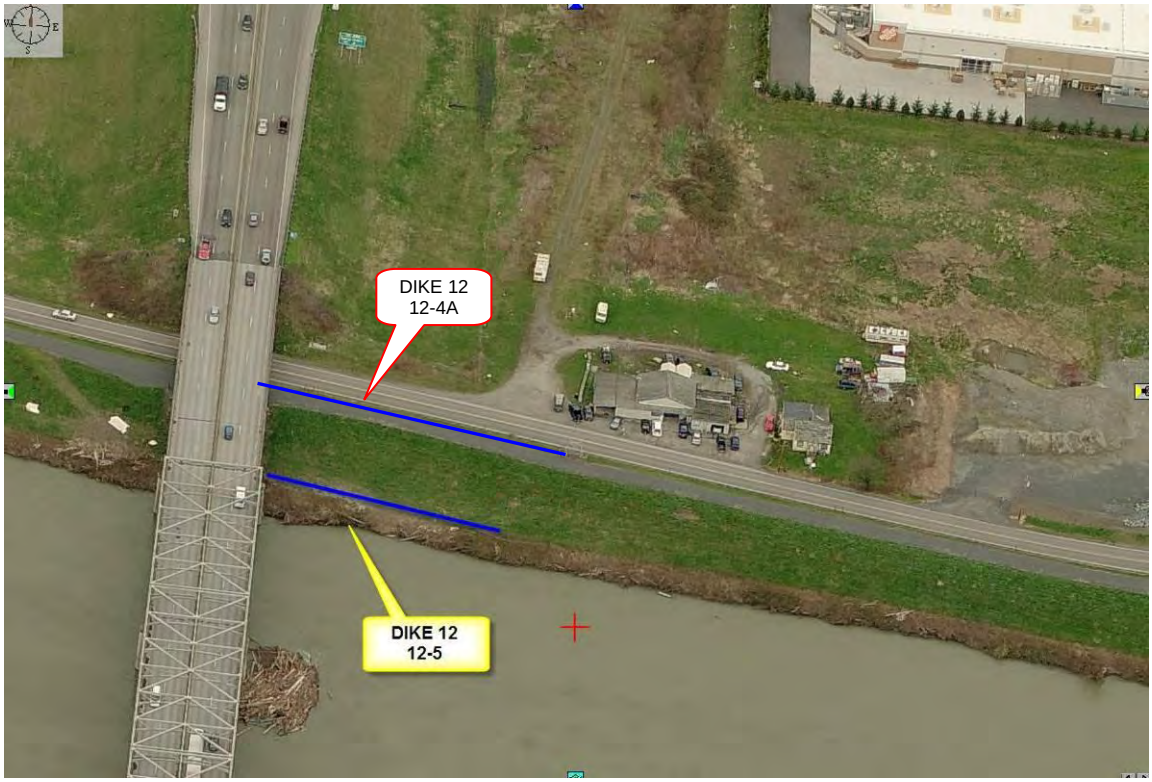

Figure 33: Site 12-5 Length of Repair: 236ft and
Site 12-4a Length of Repair: 250ft

Figure 34: Site 12-4b Length of Repair: 970ft

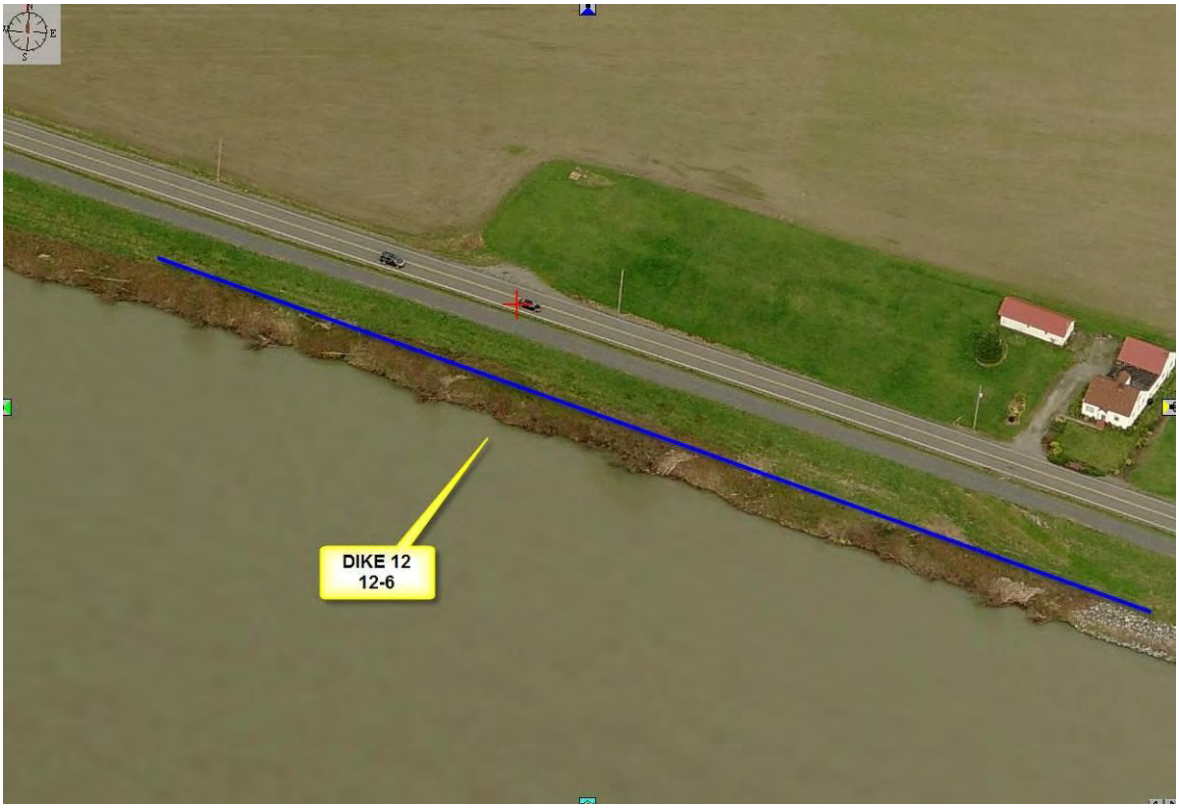

Figure 35: Site 12-6 Length of Repair: 651ft

Figure 36: Site 12-6 Before Construction

Figure 37: Site 12-6 Imediately After Construction,

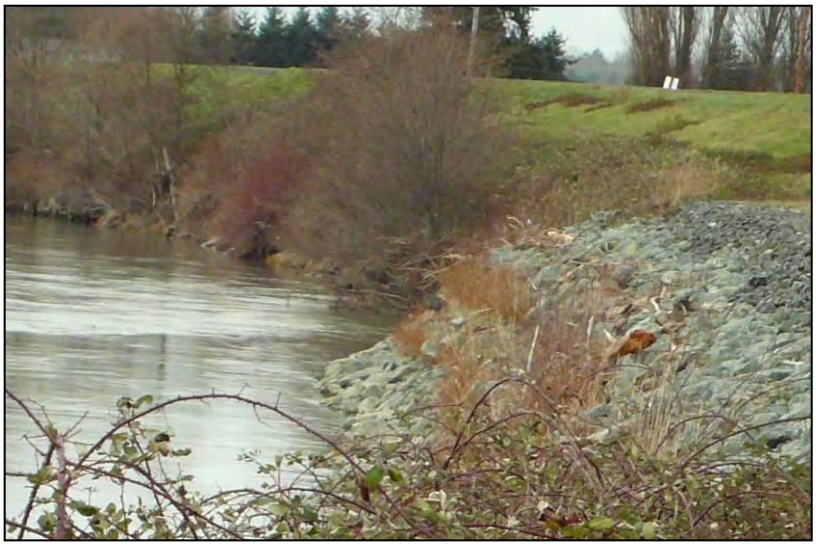

Figure 38: Site 12-6 December 2009, showing willow growth

Figure 39: Site 12-7 Length of Repair: 170ft

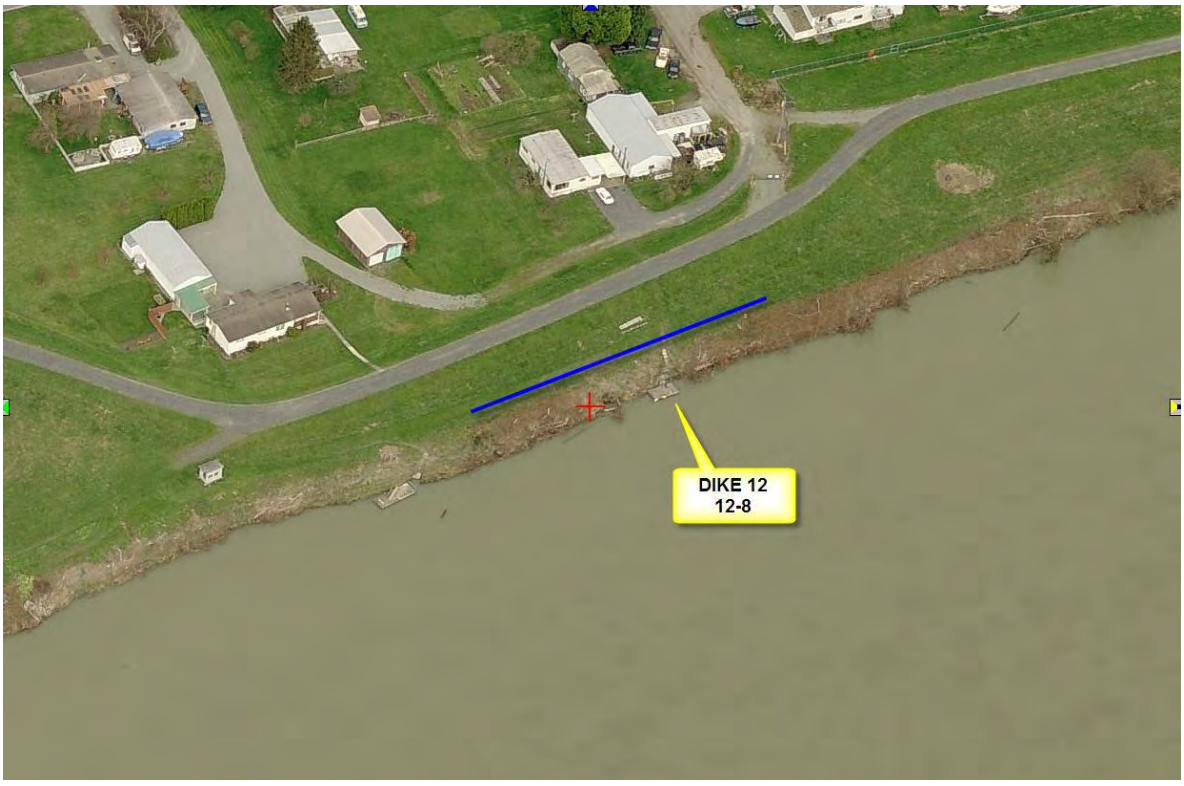

Figure 40: Site 12-8 Length of Repair: 124ft

Figure 41: Site 12-9 Length of Repair: 1850ft

Figure 42: Site 12-11 Length of Repair: 600ft

Figure 43: Site 12-12 Length of Repair: 50ft

Figure 44: Site 12-13 Length of Repair: 350ft. This repair includes creation of a fish bench. The front cedars will likely be impacted, the furthest back may be able to remain.

Figure 45: Site 12-14 Length of Repair: 250ft.

Figure 46: Site 12-15 Length of Repair: 180ft. The large big leaf maples in the foreground will not be impacted by the repair, the trees in the background along the revetment would be removed.

Figure 47: Site 12-16 Length of Repair: 670ft

Figure 48: Site 12-17 Length of Repair: 450ft

Figure 49: Site 17-1 Length of Repair: 400ft

Figure 50: Site 17-2 Length of Repair: 275ft

Figure 51: Site 17-3 Length of Repair: 159ft

Figure 52: Site 17-4 Length of Repair: 170ft

Figure 53: Site 17-5 Length of Repair: 1350 ft

Figure 54: Site 17-5 Before and After Construction

Figure 55: Site 17-6 Length of Repair: 522ft

Figure 56: Site 17-7 Length of Repair: 800ft

Figure 57: Site 17-9 Length of Repair: 700ft

Figure 58: Site 17-10 Length of Repair: 200ft

Figure 59: Site 17-12 Length of Repair: 925ft

Figure 60: Site 17-15 Length of Repair: 125ft

Figure 61: Site 17-16 Length of Repair: 250ft

Figure 62: Site 22-1 Length of Repair: 395ft

Figure 63: Site 22-2 Length of Repair: 118ft

Figure 64: Site 22-3 Length of Repair: 273ft done in 2007, 110 ft to be done in 2011.
Second photo shows site in December 2009.

Figure 65: Site 22-4 Length of Repair: 246ft

Figure 66: Site 22-5 Length of Repair: 70ft. .

Figure 67: Site 22-6 Length of Repair: 359ft

Figure 68: Site 22-7 Length of Repair: 350ft. Some of the large cottonwoods will be lost due to the layback designed for this site. Overstory plantings on the bench will be done for mitigation,

Figure 69: Site 22-8 Length of Repair: 554ft

Figure 70: Site 22-8 immediately after construction in 2007
and in December 2009 showing willow growth.

Figure 71: Site 22-9 Length of Repair: 338ft

Figure 72: Site 22-9 Before and After Construction

Figure 73: Site 22-10 Length of Repair: 300ft

Figure 74: Site 22-11 Length of Repair: 800ft, this site will be repaired by installing a keyway, no riverward work is anticipated. No mitigation required.

Figure 75: Site 22-12 Length of Repair: 162ft

APPENDIX C

2007 AS-BUILT DRAWINGS AND 2011 DESIGN DRAWINGS

Appendix C has been provided as a separate file due to the large file size.
It is available on the Seattle District website http://www.nws.usace.army.mil/ers.

APPENDIX D

REQUESTS FOR ASSISTANCE

Dec 22 06 01:48p John R. Shultz 360.424.2018 p.1

Komorosk C

SKAGIT CO. DIKE DISTRICT #1
C/O DONALD MOE
16706 PENN RD.
MOUNT VERNON WA. 98273
PHONE 360-661-6634 CELL

Douglas T., Weber, PE
Corp of Engineers, Seattle District
Emergency Management Branch
4735 E.Marginal Way South
Seattle Wa. 98124-2255

RE: Rehab/repair assistance for flood damaged levee Dike District #1 on the Skagit River.

Dear Mr. Weber,

We are writing the Corps to request assistance in repairing our levee through PL 84-99. DD1 sustained damage to its levee in several areas, most notably at the north end of the district. Damage included scouring and slippage along the channel. We have yet to survey the damaged areas with Corp personnel. The point of contact will be Donald Moe @360-661-6634.

Sincerely,

Donald T. Moe

Donald Moe
Commissioner DD1

SKAGIT COUNTY DIKE-DRAINAGE
AND
IRRIGATION DISTRICT #3
P.O.BOX 324, CONWAY, WA 98238
dolson@clearwire.net
360-770-0168

12-22-06

Douglas T. Weber, PE
Corps of Engineers, Seattle District
Emergency Management Branch
4735 E. Marginal Way South
Seattle, WA 98124-2255

RE: Skagit County Dike District #3
Rehab/Repair Assistance for flood damaged levee

Dear Mr. Weber,

We are writing to request the Corps' assistance in rehab and repair of flood damage to our levee from the November '06 flood event under PL 84-99. We have surveyed the damage after the event, November 18-22, and have located several areas of rip-rap damage and the settling and cracking of new construction. The full extent of the damage was not known at that time as the river was at 18-20 feet. To get a good idea of the damage, the river needs to be at or below 15 feet. The river has dropped at this time, and we are in the process of assessing further damage.

Our point of contact will be David Olson, 360-770-0168. Thank you for your time.

Sincerely,

David Olson
Chairman
Dike District #3

SKAGIT CO. DIKE- DRAINAGE & IRRIGATION DISTRICT #12
1317 S. ANACORTES ST., BURLINGTON, WA 98233-3037
dkdist12@cnw.com
Phone. 360-757-3484 Fax 360-757-1214

Douglas T. Weber, PE **11/24/06**
Corps of Engineers, Seattle District
Emergency Management Branch
4735 E. Marginal Way South
Seattle, WA 98124-2255

RE: Rehab / repair assistance for flood damaged levee.
Skagit County Dike District # 12 RM 14.1 – 20.7 Skagit river.

Dear Mr. Weber.

We are writing to request the Corps assistance in rehab and repair of flood damage to our levee from the Nov '06 flood event under PL 84-99. We have been out a couple of times Nov 18-22 and have located several areas of rip rap damage. The full extent of the damage is not known at this time as the river was at 18-20'. To get a good idea of the damage the river needs to be at or below 15'. With the predicted cold weather next week we anticipate the river dropping to around the 15' level allowing for additional damage survey work. Our point of contact will be Chuck Bennett, @ 360-708-1593. Thank you.

Sincerely,

Cc: PEK - COE
File

Douglas Barnet & Associates
Consulting Engineering and Project Management
19395 Conway Hill Road
Mount Vernon, WA 98274
(360) 941-3804 Fax (360) 428-3902
e-mail dbarnet@nwlink.com

12/20/2006

Mr Doug Weber PE
Corps of Engineers, Seattle Branch
Emergency Management Branch
4735 E Marginal Way
Seattle, WA. 98124

RE: DIKE DISTRICT NO. 17
REHAB AND REPAIR OF FLOOD DAMAGE

Dear Mr. Weber,

Please consider this letter formal notification of our request for assistance in the Rehab and Repair of Dike District No. 17's diking system caused by the November 2006 flooding event. We have preliminary reports of at least two sites that have suffered damage due to the event. The full extent of the damage will not be known until such time that the river recedes to an elevation that will allow for river review.

If you have any questions please do not hesitate to contact this office.

Sincerely,

Douglas Barnet

Douglas Barnet PE
Applicant Agent

P.O. Box 535
Conway, WA 98238
(360) 445-5463
scdike22@gmail.com

Skagit County Consolidated Diking District No. 22

Douglas T. Weber, PE
Corps of Engineers, Seattle District
Emergency Management Branch
4735 E. Marginal Way South
Seattle, WA 98124-2255

RE: Rehab/repair for flood damaged levee

Mr. Weber.

Skagit County Consolidated Diking District No. 22 is requesting Army Corps of Engineers assistance in in rehab and repair of damage to our levee from the flood event of November, 2006 under PL 84-89. Wether the district has any damage which qualifies under PL 84-99 is unknown at this time. The commissioners look forward to an inspection with Army Corps personnel in the future to determine if we have damage qualifying for assisstance.

The District's point of contact will be: Stan Nelson at (360) 661-1438.

Thank you,

Stanley E. Nelson
Secretary

APPENDIX E

2007 CONSTRUCTION TURBIDITY DATA

APPENDIX F: 2007 Turbidity data

Locations	date	upstream	downstream	change	date	upstream	downstream	change	date	upstream	downstream	change
1-1	Sept 15 AM	5.6	5.9	0.3	Sept 15 PM	5.8	6.0	0.2				
1-2	Sept 16 AM	5.7	6.5	0.8	Sept 16 PM	4.2	5.6	1.4	Sept 17 AM	3.3	4.3	1.0
1-7	Sept 18 AM	4.1	5.2	1.1	Sept 18 PM	4	5.1	1.1	Sept 19 AM	3.4	3.6	0.2
3-5	Sept 21 PM	2.8	4.5	1.7	Sept 22 AM	1.7	3.1	1.4	Sept 22 PM	8.4	8.6	0.2
3-6	Sept 16 AM	3	4.2	1.2	Sept 16 PM	4.1	5.4	1.3	Sept 17 AM	4.7	5.7	1.0
3-6 (con't)	Sept 20 AM	2.3	2.7	0.4	Sept 20 PM	2.8	3.1	0.3	Sept 21 AM	2.4	3.4	1.0
12-1	Sept 14 AM	3.7	3.2	-0.5	Sept 14 PM	4.6	6.7	2.1				
12-3	Sept 12 AM	4.3	8.1	3.8	Sept 12 PM	3.2	6.3	3.1	Sept 13 AM	3.5	5.4	1.9
12-8	Sept 19 AM	4.6	5.6	1.0	Sept 19 PM	4	4.2	0.2	Sept 20 AM	4.3	6.2	1.9
12-8a	Sept 21 AM	2.6	3.4	0.8	Sept 21 PM	3.1	4.2	1.1	Sept 22 AM	2.8	3.4	0.6
17-1	Sept 20 AM	2.5	4.7	2.2	Sept 20 PM	3.6	4.2	0.6	Sept 21 PM	2.1	4.1	2.0
17-2	Sept 16 AM	4.8	3.7	-1.1	Sept 16 PM	3.8	4.5	0.7	Sept 21 AM	2.1	2.2	0.1
17-3	Sept 19 AM	2.8	4.7	1.9	Sept 19 PM	3.3	4.5	1.2	Sept 20 AM	3.1	4.8	1.7
17-4	Sept 17 AM	3.8	4	0.2	Sept 17 PM	5.6	5.8	0.2	Sept 19 AM	3.2	4.7	1.5
17-5	Sept 21 AM	3.1	3.7	0.6	Sept 21 PM	3	3.6	0.6	Sept 22 AM	2.4	2.6	0.2
22-1	Sept 11 AM	2.6	2.7	0.1	Sept 11 PM	4.6	5.2	0.6	Sept 12 AM	2.4	5.2	2.8
22-2	Sept 10 AM	8.7	8.8	0.1	Sept 10 PM	9.1	9.4	0.3				
22-4	Sept 10 AM	4.2	2.4	-1.8	Sept 10 PM	9.6	9.1	-0.5	Sept 11 AM	4	8.2	4.2
22-8	Sept 11 AM	3	8.8	5.8	Sept 11 PM	2.8	3.6	0.8	Sept 12 AM	3.5	3.6	0.1
22-9	Sept 10 AM	2.4	2.9	0.5	Sept 10 PM	8.7	9.3	0.6	Sept 11 AM	3.9	4.2	0.3

Table continued.

Locations	date	upstream	downstream	change	date	upstream	downstream	change	date	upstream	downstream	change
1-1												
1-2	Sept 17 PM	4.3	5.6	1.3	Sept 18 AM	4.3	4.7	0.4	Sept 18 PM	3.2	3.9	0.7
1-7	Sept 19 PM	3.5	5.8	2.3	Sept 20 AM	3.7	5.3	1.6	Sept 20 PM	2.3	3.2	0.9
3-5												
3-6	Sept 17 PM	3.9	6.4	2.5	Sept 18 AM	5.8	6.8	1.0	Sept 18 PM	5.7	6.2	0.5
3-6 (con't)	Sept 21 PM	3.6	4.1	0.5								
12-1												
12-3	Sept 13 PM	5.5	6.1	0.6	Sept 14 AM	4.9	5.3	0.4	Sept 14 PM	4.3	11	6.7
12-8	Sept 20 PM	4.5	6	1.5								
12-8a	Sept 22 PM	3	4.1	1.1								
17-1	Sept 22 AM	3.7	3.9	0.2	Sept 22 PM	2.5	2.9	0.4				
17-2	Sept 21 PM	2.4	3.8	1.4	Sept 22 AM	3.8	4.4	0.6	Sept 22 PM	3.5	3.8	0.3
17-3	Sept 20 PM	3.6	4.9	1.3								
17-4	Sept 19 PM	4.1	5.4	1.3	Sept 20 AM	1.7	2.4	0.7	Sept 20 PM	2.5	4.1	1.6
17-5	Sept 22 PM	2.2	1.8	-0.4								
22-1	Sept 12 PM	3.7	4.8	1.1	Sept 13 AM	4.3	4.5	0.2	Sept 13 PM	3.2	7.6	4.4
22-2												
22-4	Sept 11 PM	2.3	3.9	1.6	Sept 12 AM	4.7	9.1	4.4	Sept 12 PM	3.5	3.6	0.1
22-8	Sept 12 PM	3.2	3.8	0.6	Sept 13 AM	4.6	5.1	0.5	Sept 13 PM	4.2	4.6	0.4
22-9	Sept 11 PM	4.1	4.7	0.6								

Table continued.

Locations	date	upstream	downstream	change	date	upstream	downstream	change	number of samples	largest increase	average increase
1-1									2	0.3	0.3
1-2									6	1.4	0.9
1-7	Sept 21 AM	2.4	3.2	1.8	Sept 21 PM	2.8	3.6	0.8	8	2.3	1.2
3-5									3	1.7	1.1
3-6	Sept 19 AM	2.8	3.1	0.3	Sept 19 PM	3.5	5.8	2.3			
3-6 (con't)									12	2.5	1.0
12-1									2	2.1	0.8
12-3									6	6.7	2.8
12-8									4	1.9	1.2
12-8a									4	1.1	0.9
17-1									5	2.2	1.1
17-2									6	1.4	0.3
17-3									4	1.9	1.5
17-4									6	1.6	0.9
17-5									4	0.6	0.3
22-1									6	4.4	1.5
22-2									2	0.3	0.2
22-4	Sept 13 AM	4.3	4.4	0.1	Sept 13 PM	3.5	4	0.5	8	4.4	1.1
22-8									6	5.8	1.4
22-9									4	0.6	0.5
								Total	**98**	**6.7**	**1.0**

APPENDIX F

TRIBAL AND SHPO COORDINATION

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-3755

REPLY TO
ATTENTION OF

Environmental and Cultural Resources Branch

APR 0 8 2011

Allyson Brooks, Ph.D.
State Historic Preservation Officer
Department of Archaeology and Historic Preservation
Post Office Box 48343
Olympia, Washington 98504-8343

SUBJECT: Skagit Levee Repairs within Diking Districts 1, 3, 12, 17, and 22 request for concurrence with no historic properties adversely affected

Dear Dr. Brooks:

Please find attached for your review and comment a cultural resource report detailing the results of a U.S. Army Corps of Engineers, Seattle District (Corps) cultural resource investigation of 20 proposed levee repair locations along the Skagit River, in Skagit County Washington. The Corps in cooperation with the Skagit County Diking Districts 1, 3, 12, 17, and 22, as the non federal sponsors are proposing to repair approximately 1.9 miles of levee. The proposed repairs are limited to restoring the damaged levee segments to their pre-flood damage condition. In general this entails reshaping and armoring the riverward slope of the levees. The area of potential effect (APE) has been defined as the construction footprint and any associated access roads and staging areas.

Detailed descriptions of each of the repairs are provided in the report; however, all of the work would be confined to the levee prism and would not extend into native sediments. The Diking Districts maintain access roads onto all of their levees; consequently, no new access roads will need to be constructed for any of the proposed repairs. Staging areas would be confined to the inventoried portions of the levees and adjacent paved roads and lots. The inventory consisted of pedestrian transects at seven meter intervals across the APE. Approximately 20 additional feet were inventoried to either side of each of the proposed repair locations to ensure that any minor changes to the repair work would be included in the inventory. A close inspection was made of the dirt from the several mole holes that are common throughout the levee revetments.

The only cultural resource that was located during the inventory was the Skagit Levee system. According to Daryl Hamburg, the Director of Operations of Diking District 17, the levees were first built in 1895 and the Diking Districts were formed in the first part of the twentieth century. These original levees have been modified several times over the last century. Timber pilings were driven in front of the levees in the 1930s in order to slow the water down and prevent undercutting on the banks. Throughout the 1970s and again in the 1990s most of the levees were completely rebuilt into the uniform structures that exist now. Keyways (subterranean impermeable clay walls) were added in several spots in the 1990s. Over seven miles of levee were repaired in 2004 and 2007. The levees are a ubiquitous type, undistinguished for their engineering value. Despite these clear modifications, the levee system played a critical role in the development of the Skagit Valley and consequently they may be eligible for the National Register under Criterion A. At this stage it is difficult to determine if any segments of the original levees are still present, and consequently, they remain unevaluated for the National Register.

The Corps will monitor part of the repair efforts in order to determine if older levee segments are still identifiable in the levees' cross sections. A Historic Property Inventory Form (HPIF) will be completed during monitoring and construction information gained during monitoring will be included on the HPIF. Specifically, monitoring will occur at segments 17-10, 17-12, and 12-11 because timber pilings are still present at these locations. The proposed work will not impact these features; however, their presence indicates that older levee profiles may still exist at these locations. No other cultural resources were located during the inventory.

In addition to the monitoring to gather information about the levee system, the Corps will also monitor the following proposed repair locations.

12-12	This repair site is near the historic townsite of Avon (45SK117) as well as the only site discovered during the 2004 monitoring, the Red Thomas Dump Site (45SK304)
12-13	This repair site is near the historic townsite of Avon (45SK117) as well as the only site discovered during the 2004 monitoring, the Red Thomas Dump Site (45SK304)
22-12	The edge of the repair site is just within the estimated 1970 boundaries of site 45SK087 and there appears to be a community garbage dump adjacent to the site. No evidence of the shell or FMR were found during the survey and it is likely that the site is actually located further behind the levee.
3-8	Several sites are located within one mile of this repair location

The repair work at the levees will involve the replacement of "in-kind" material, e.g. rock and earth will replace rock and earth. The levee alignment and profile will not be altered; hence, the appearance of the levee will not be affected. If the Corps fails to address damages to the levee, future flooding on the Skagit River will continue to erode this unevaluated resource. The Corps has determined that the proposed levee repair project will not adversely affect any historic properties.

The Corps is consulting with the Swinomish Indian Tribal Community and the Upper Skagit Indian Tribes concurrently with this letter. Copies of the cultural resource report and the Corps' correspondence to the tribes have been enclosed. We invite you to concur with our determination. If you have any questions or need additional information, please contact Danielle Storey of my staff at (206) 746 4466 or by email at Danielle.L.Storey@usace.army.mil

Sincerely,

Evan Lewis, Acting Chief
Environmental Resources Section

Enclosures

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-3755

REPLY TO
ATTENTION OF

Environmental and Cultural Resources Branch

APR 0 8 2011

Scott Schuyler, Policy Representative
The Upper Skagit Indian Tribe
25944 Community Plaza Way
Sedro-Woolley, WA 98284

SUBJECT: Section 106 coordination for the Skagit Levee Repairs within Diking Districts 1, 3, 12, 17, and 22

Dear Mr. Schuyler:

Please find attached for your review a cultural resource report detailing the results of a U.S. Army Corps of Engineers, Seattle District (Corps) cultural resource investigation of 20 proposed levee repair locations along the Skagit River, in Skagit County Washington. The Corps in cooperation with the Skagit County Diking Districts 1, 3, 12, 17, and 22, as the non federal sponsors are proposing to repair approximately 1.9 miles of levee. The proposed repairs are limited to restoring the damaged levee segments to their pre-flood damage condition. In general this entails reshaping and armoring the riverward slope of the levees. No work would occur on the landward side of the levees. The area of potential effect (APE) has been defined as the construction footprint and any associated access roads and staging areas.

Detailed descriptions of each of the repairs are provided in the report; however, all of the work would be confined to the levee prism and would not extend into native sediments. The Diking Districts maintain access roads onto all of their levees; consequently, no new access roads will need to be constructed for any of the proposed repairs. Staging areas would be confined to the inventoried portions of the levees and adjacent paved roads and lots. The inventory consisted of pedestrian transects at seven meter intervals across the APE. Approximately 20 additional feet were inventoried to either side of each of the proposed repair locations to ensure that any minor changes to the repair work would be included in the inventory. A close inspection was made of the dirt from the several mole holes that are common throughout the levee revetments.

Because the levee is a built feature, the likelihood of encountering intact prehistoric sites is low. Similar repairs have been made to the over seven miles of the Skagit Levee system since 2004, and only one site has been identified during the associated inventories and monitoring. The only cultural resource that was located during the inventory was the Skagit Levee system. According to Daryl Hamburg, the Director of Operations of Diking District 17, the levees were first built in 1895 and the Diking Districts were formed in the first part of the twentieth century. These original levees have been modified several times over the last century. Timber pilings were driven in front of the levees in the 1930s in order to slow the water down and prevent undercutting on the banks. Throughout the 1970s and again in the 1990s most of the levees were

completely rebuilt into the uniform structures that exist now. Keyways (subterranean impermeable clay walls) were added in several spots in the 1990s. Over seven miles of levee were repaired in 2004 and 2007. The levees are a ubiquitous type, undistinguished for their engineering value. Despite these clear modifications, the levee system played a critical role in the development of the Skagit Valley and consequently they may be eligible for the National Register under Criterion A. At this stage it is difficult to determine if any segments of the original levees are still present, and consequently, they remain unevaluated for the National Register.

The Corps will monitor part of the repair efforts in order to determine if older levee segments are still identifiable in the levees' cross sections. A Historic Property Inventory Form (HPIF) will be completed during monitoring and construction information gained during monitoring will be included on the HPIF. Specifically, monitoring will occur at segments 17-10, 17-12, and 12-11 because timber pilings are still present at these locations. The proposed work will not impact these features; however, their presence indicates that older levee profiles may still exist at these locations. No other cultural resources were located during the inventory.

In addition to the monitoring to gather information about the levee system, the Corps will also monitor the following proposed repair locations.

12-12	This repair site is near the historic townsite of Avon (45SK117) as well as the only site discovered during the 2004 monitoring, the Red Thomas Dump Site (45SK304)
12-13	This repair site is near the historic townsite of Avon (45SK117) as well as the only site discovered during the 2004 monitoring, the Red Thomas Dump Site (45SK304)
22-12	The edge of the repair site is just within the estimated 1970 boundaries of site 45SK087 and there appears to be a community garbage dump adjacent to the site. No evidence of the shell or FMR were found during the survey and it is likely that the site is actually located further behind the levee.
3-8	Several sites are located within one mile of this repair location

The repair work at the levees will involve the replacement of "in-kind" material, e.g. rock and earth will replace rock and earth. The levee alignments and profiles will not be altered; hence, the appearance of the levees will not be affected. If the Corps fails to address damages to the levees, future flooding on the Skagit River will continue to erode this unevaluated resource. Based on the results of the inventory, the Corps has determined that there would be no historic properties adversely affected by this undertaking and invites your comments. We would like know if you have any knowledge or concerns regarding cultural resources, sites of religious importance, or traditional cultural properties at this project location that you would like the Corps to consider in light of this determination. Please note that the Corps will treat any information provided with the greatest confidentiality.

If you have any questions or need additional information, please contact Danielle Storey of my staff at (206) 746 4466 or by email at Danielle.L.Storey@usace.army.mil

Sincerely,

Danielle Storey,
Environmental and Cultural Resources Branch

Enclosures

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-3755

REPLY TO
ATTENTION OF

Environmental and Cultural Resources Branch

APR 0 8 2011

Larry W Campbell
Tribal Historic Preservation Officer
SITC Cultural Resource Protection Office
11430 Moorage Way
La Conner, WA 98257-8707

SUBJECT: Section 106 coordination for the Skagit Levee Repairs within Diking Districts 1, 3, 12, 17, and 22

Dear Mr. Campbell:

Please find attached for your review a cultural resource report detailing the results of a U.S. Army Corps of Engineers, Seattle District (Corps) cultural resource investigation of 20 proposed levee repair locations along the Skagit River, in Skagit County Washington. The Corps in cooperation with the Skagit County Diking Districts 1, 3, 12, 17, and 22, as the non federal sponsors are proposing to repair approximately 1.9 miles of levee. The proposed repairs are limited to restoring the damaged levee segments to their pre-flood damage condition. In general this entails reshaping and armoring the riverward slope of the levees. No work would occur on the landward side of the levees. The area of potential effect (APE) has been defined as the construction footprint and any associated access roads and staging areas.

Detailed descriptions of each of the repairs are provided in the report; however, all of the work would be confined to the levee prism and would not extend into native sediments. The Diking Districts maintain access roads onto all of their levees; consequently, no new access roads will need to be constructed for any of the proposed repairs. Staging areas would be confined to the inventoried portions of the levees and adjacent paved roads and lots. The inventory consisted of pedestrian transects at seven meter intervals across the APE. Approximately 20 additional feet were inventoried to either side of each of the proposed repair locations to ensure that any minor changes to the repair work would be included in the inventory. A close inspection was made of the dirt from the several mole holes that are common throughout the levee revetments.

Because the levee is a built feature, the likelihood of encountering intact prehistoric sites is low. Similar repairs have been made to the over seven miles of the Skagit Levee system since 2004, and only one site has been identified during the associated inventories and monitoring. The only cultural resource that was located during the inventory was the Skagit Levee system. According to Daryl Hamburg, the Director of Operations of Diking District 17, the levees were first built in 1895 and the Diking Districts were formed in the first part of the twentieth century. These original levees have been modified several times over the last century. Timber pilings were driven in front of the levees in the 1930s in order to slow the water down and prevent

undercutting on the banks. Throughout the 1970s and again in the 1990s most of the levees were completely rebuilt into the uniform structures that exist now. Keyways (subterranean impermeable clay walls) were added in several spots in the 1990s. Over seven miles of levee were repaired in 2004 and 2007. The levees are a ubiquitous type, undistinguished for their engineering value. Despite these clear modifications, the levee system played a critical role in the development of the Skagit Valley and consequently they may be eligible for the National Register under Criterion A. At this stage it is difficult to determine if any segments of the original levees are still present, and consequently, they remain unevaluated for the National Register.

The Corps will monitor part of the repair efforts in order to determine if older levee segments are still identifiable in the levees' cross sections. A Historic Property Inventory Form (HPIF) will be completed during monitoring and construction information gained during monitoring will be included on the HPIF. Specifically, monitoring will occur at segments 17-10, 17-12, and 12-11 because timber pilings are still present at these locations. The proposed work will not impact these features; however, their presence indicates that older levee profiles may still exist at these locations. No other cultural resources were located during the inventory.

In addition to the monitoring to gather information about the levee system, the Corps will also monitor the following proposed repair locations.

12-12	This repair site is near the historic townsite of Avon (45SK117) as well as the only site discovered during the 2004 monitoring, the Red Thomas Dump Site (45SK304)
12-13	This repair site is near the historic townsite of Avon (45SK117) as well as the only site discovered during the 2004 monitoring, the Red Thomas Dump Site (45SK304)
22-12	The edge of the repair site is just within the estimated 1970 boundaries of site 45SK087 and there appears to be a community garbage dump adjacent to the site. No evidence of the shell or FMR were found during the survey and it is likely that the site is actually located further behind the levee.
3-8	Several sites are located within one mile of this repair location

The repair work at the levees will involve the replacement of "in-kind" material, e.g. rock and earth will replace rock and earth. The levee alignments and profiles will not be altered; hence, the appearance of the levees will not be affected. If the Corps fails to address damages to the levees, future flooding on the Skagit River will continue to erode this unevaluated resource. Based on the results of the inventory, the Corps has determined that there would be no historic properties adversely affected by this undertaking and invites your comments. We would like know if you have any knowledge or concerns regarding cultural resources, sites of religious importance, or traditional cultural properties at this project location that you would like the Corps to consider in light of this determination. Please note that the Corps will treat any information provided with the greatest confidentiality.

If you have any questions or need additional information, please contact Danielle Storey of my staff at (206) 746 4466 or by email at Danielle.L.Storey@usace.army.mil

Sincerely,

Danielle Storey,
Environmental and Cultural Resources Branch

Enclosures

STATE OF WASHINGTON

DEPARTMENT OF ARCHAEOLOGY & HISTORIC PRESERVATION

1063 S. Capitol Way, Suite 106 • Olympia, Washington 98501
Mailing address: PO Box 48343 • Olympia, Washington 98504-8343
(360) 586-3065 • Fax Number (360) 586-3067 • Website: www.dahp.wa.gov

April 14, 2011

Mr. Evan Lewis
Environmental Resources Section
Seattle District, Corps of Engineers
PO Box 3755
Seattle, Washington 98124-3755

Re: Skagit Levee Repair Project
Log No: 041311-03-COE-S

Dear Mr. Lewis:

Thank you for contacting our department. We have reviewed the professional archaeological survey report you provided for the proposed Skagit Levee Repair Project within Diking Districts 1, 3,12, 17, and 22 along with Skagit River, Skagit County, Washington.

We concur with your Determination of No Historic Properties Affected. We concur with the stipulation for the completion of the HPI forms and monitoring of segments 17-10, 17-12 and 12-11 and those listed in the Table on page 2.

We would appreciate receiving any correspondence or comments from concerned tribes or other parties that you receive as you consult under the requirements of 36CFR800.4(a)(4).

In the event that archaeological or historic materials are discovered during project activities, work in the immediate vicinity must stop, the area secured, and the concerned tribes and this department notified.

These comments are based on the information available at the time of this review and on the behalf of the State Historic Preservation Officer in conformance with Section 106 of the National Historic Preservation Act and its implementing regulations 36CFR800. Should additional information become available, our assessment may be revised. Thank you for the opportunity to comment and a copy of these comments should be included in subsequent environmental documents.

Sincerely,

Robert G. Whitlam, Ph.D.
State Archaeologist
(360) 586-3080
email: rob.whitlam@dahp.wa.gov

DEPARTMENT OF ARCHAEOLOGY & HISTORIC PRESERVATION
Protect the Past, Shape the Future

8.10.07

STATE OF WASHINGTON

DEPARTMENT OF ARCHAEOLOGY & HISTORIC PRESERVATION

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(360) 586-3065 • Fax Number (360) 586-3067 • Website: www.dahp.wa.gov

August 2, 2007

Mr. Mark Ziminske
Environmental Resources Section
Seattle District, Corps of Engineers
PO Box 3755
Seattle, Washington 98124-3755

Re: Skagit River Levee Rehabilitation Project
Log No: 080208-05-COE-S

Dear Mr. Ziminske:

Thank you for contacting our department. We have reviewed the professional archaeological survey report by COE Senior Archaeologist Ron Kent you provided for the proposed Skagit River Levee Rehabilitation Project in Skagit County, Washington.

We concur with your determination of No Historic Properties Affected.

We would appreciate receiving any correspondence or comments from concerned tribes or other parties that you receive as you consult under the requirements of 36CFR800.4(a)(4).

These comments are based on the information available at the time of this review and on the behalf of the State Historic Preservation Officer in conformance with Section 106 of the National Historic Preservation Act and its implementing regulations 36CFR800. Should additional information become available, our assessment may be revised.

In the event that archaeological or historic materials are discovered during project activities, work in the immediate vicinity must stop, the area secured, and the concerned tribes and this department notified. Thank you for the opportunity to comment and a copy of these comments should be included in subsequent environmental documents.

Sincerely,

Robert G. Whitlam, Ph.D.
State Archaeologist
(360) 586-3080
email: rob.whitlam@dahp.wa.gov

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-3755

REPLY TO
ATTENTION OF

Environmental Resources Section

AUG 0 1 2007

Allyson Brooks, Ph.D.
Director and State Historic Preservation Officer
Department of Archaeology and Historic Preservation
Post Office Box 48343
Olympia, Washington 98504-8343

SUBJECT: Request for Expedited Concurrence on a Determination of No Historic Properties Affected for the Skagit River Levee Rehabilitation Projects

Dear Dr. Brooks:

Please find attached for your review and consideration a historic properties report for 17 of the 31 total proposed U.S. Army Corps of Engineers, Seattle District (Corps) Public Law (PL) 84-99 (33 USCA 701n) Emergency Levee Rehabilitation projects to be constructed in 2007 along the banks of the Skagit River in the Burlington, Mount Vernon, Avon, Conway, and Fir Island areas of Skagit County, Washington. This report presents the results of historic property studies for the 17 repair locations in Diking Districts 1, 3 and 22 that are scheduled to be constructed beginning on August 13, 2007. These emergency levee repairs are necessary due to levee damage from major flooding that occurred on the Skagit River in November of 2006. The flooding was caused by intense rains that were the result of a high velocity jet stream from the southwest that brought warm pockets of moisture to the Northwest, a weather pattern that is often referred to as the Pineapple Express. The proposed repairs are limited to restoring the damaged levee segments to their pre-flood damage condition. The recommended general repair plan consists of reshaping and armoring the riverward slopes over the damaged lengths. The riverward slope will be reshaped to the greatest extent possible, and a three foot blanket of class IV riprap will be placed for armor rock. Where possible, "fish shallows" or "scallops" will be incorporated into levee rehabilitation design and willow plantings will be installed.

The Area of Potential Effects (APE) for the repairs was defined as the individual repair boundaries. No new access roads will be constructed or existing roads improved and no staging areas will be employed. Rock materials will be brought directly to the repair locations from existing rock quarries. The Seattle District has been involved in conducting studies for flood control projects in the Skagit River delta for several decades. In 1978 and 1979 the Corps funded cultural resource investigations by Seattle Community College for the proposed Skagit River Levee and Channel Improvement Project (Onat et al. 1979 and 1980). The 1978 and 1979 surveys covered all of the proposed 2007 Diking Districts 1, 3 and 22 levee rehabilitation areas. In 2004 the Corps completed a sample survey and monitoring plan for levee repairs to be carried out that year (Kent 2004) and contracted Archaeological and Historical Services (AHS) of Eastern Washington University to supply a full-time archaeological monitor for the 2004 Skagit

levee rehabilitation construction season (Kent 2005). Many of the monitored levee repair areas are at or close to the 2007 repair areas (Figure 1 of attached report). The full-time monitor did not observe either prehistoric or early historic-period cultural material. The only site recorded during the archaeological monitoring in 2004 was a small refuse dump site in Avon that overlapped the minimum 50 years of age to be recorded.

For its 2007 studies the Corps has completed archival and background research, a search of the Washington Department of Archaeology and Historic Preservation (DAHP) Electronic Historic Sites Database, pedestrian surveys of the 17 individual repair locations in Diking Districts 1, 3 and 22, and has initiated consultation with the Swinomish Tribe with a letter soliciting knowledge and concerns (appendix of attached report). No sites listed in the National Register of Historic Places (NRHP) are located within any of the individual APEs. No documented prehistoric or early historic Native American archaeological deposits are located within any of the APEs. Some of the APEs are located within the boundaries of broadly defined and incompletely recorded historic-period sites that include the town sites of Skagit City, Fir, and Conway. During the pedestrian surveys conducted on 16, 17 and 18 May 2007, no prehistoric or early historic-period cultural materials were observed other than a few scattered river pilings. The Corps' studies presented in the attached report provided documentation that the proposed repairs in Diking District's 1, 3 and 22 have little potential to cause effects to historic properties.

Based on the negative results of the Corps studies for historic properties located within the individual repair area APEs, the Corps requests your concurrence with a determination of No Historic Properties Affected for the 17 levee rehabilitation projects in Diking Districts 1, 3 and 22. No archaeological monitoring is recommended, but the following inadvertent discovery clause will be incorporated into the construction contract or construction plan:

> If during construction activities the Contractor observes items that might have historical or archaeological value, such observations shall be reported immediately to the Corps' Construction Supervisor so that the appropriate authorities may be notified and a determination can be made as to their significance and what, if any, special disposition of the finds should be made. The Contractor shall cease all activities that may result in the destruction of these resources and shall prevent his employees from trespassing on, removing, or otherwise damaging such resources.

If you have questions concerning the project please contact project archaeologist Ron Kent at (206) 764-3576 or via e-mail at ronald.j.kent@usace.army.mil. Copy Furnished (With Enclosure): Mr. Raymond A. Williams, Cultural Resources, Swinomish Indian Senate, Post Office Box 817, LaConner, Washington 98257-0817.

Sincerely,

Mark Ziminske
Chief, Environmental Resources Section

STATE OF WASHINGTON

DEPARTMENT OF ARCHAEOLOGY & HISTORIC PRESERVATION

1063 S. Capitol Way, Suite 106 • Olympia, Washington 98501
Mailing address: PO Box 48343 • Olympia, Washington 98504-8343
(360) 586-3065 • Fax Number (360) 586-3067 • Website: www.dahp.wa.gov

August 30, 2007

Mr. Mark Ziminske
Environmental Resources Section
Seattle District, Corps of Engineers
PO Box 3755
Seattle, Washington 98124-3755

Re: Skagit River Levee Rehabilitation
Log No.: 083007-03-COE-S

Dear Mr. Ziminske:

Thank you for contacting our department. We have reviewed the professional archaeological survey by Senior COE Archaeologist Ron Kent you provided for the proposed COE Skagit River Levee Rehabilitation Project in Diking Districts 12 & 17 in Skagit County, Washington.

We concur with your determination of No Historic Properties Affected. We also concur that monitoring be implemented in areas DD-12-7, 8, DD-17-1 and 5. We look forward to receiving the professional archaeological monitoring report when available. Please note it is important for the monitoring report to demonstrate the stipulations in your letter were followed.

We also would appreciate receiving any correspondence or comments from concerned tribes or other parties that you receive as you consult under the requirements of 36CFR800.4(a)(4).

These comments are based on the information available at the time of this review and on the behalf of the State Historic Preservation Officer in conformance with Section 106 of the National Historic Preservation Act, as amended, and its implementing regulations 36CFR800. Should additional information become available, our assessment may be revised. Thank you for the opportunity to comment on this undertaking and a copy of these comments should be included in subsequent environmental documents.

Sincerely,

Robert G. Whitlam, Ph.D.
State Archaeologist
(360) 586-3080
email: rob.whitlam@dahp.wa.gov

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-3755

REPLY TO
ATTENTION OF

Environmental Resources Section

AUG 2 9 2007

Allyson Brooks, Ph.D.
Director and State Historic Preservation Officer
Department of Archaeology and Historic Preservation
Post Office Box 48343
Olympia, Washington 98504-8343

SUBJECT: Request for Expedited Concurrence on a Determination of No Historic Properties Affected for the Skagit River Levee Rehabilitation Projects in Diking Districts 12 and 17

Dear Dr. Brooks:

Please find attached for your review and consideration a cultural resources report for the proposed U.S. Army Corps of Engineers, Seattle District (Corps) Public Law (PL) 84-99 (33 USCA 701n) Emergency Levee Rehabilitation projects to be constructed in Skagit River Diking Districts 12 and 17 in the Burlington, Mount Vernon, and Avon areas, Skagit County, Washington. This report presents the results of Cultural Resources studies for the 14 repair locations in Diking Districts 12 and 17. The Diking District 12 work was recently pushed forward to begin on Monday 3 September. The Diking District 17 work is scheduled to begin the following week on 10 September. These emergency levee repairs are necessary due to levee damage from major flooding that occurred on the Skagit River in November of 2006. The flooding was caused by intense rains that were the result of a high velocity jet stream from the southwest that brought warm pockets of moisture to the Northwest, a weather pattern that is often referred to as the Pineapple Express. The proposed repairs are limited to restoring the damaged levee segments to their pre-flood damage condition. The recommended general repair plan consists of reshaping and armoring the riverward slopes over the damaged lengths. The riverward slope will be reshaped to the greatest extent possible, and a three foot blanket of class IV riprap will be placed for armor rock. Where possible, "fish shallows" or "scallops" will be incorporated into levee rehabilitation design and willow plantings will be installed.

The Area of Potential Effects (APE) for the repairs was defined as the individual repair boundaries. No new access roads will be constructed or existing roads improved and no staging areas will be employed. Rock materials will be brought directly to the repair locations from existing rock quarries. The Seattle District has been involved in conducting studies for flood control projects in the Skagit River delta for several decades. In 1978 and 1979 the Corps funded cultural resource investigations by Seattle Community College for the proposed Skagit River Levee and Channel Improvement Project (Onat et al. 1979 and 1980). The 1978 and 1979 surveys covered all of the proposed 2007 Diking Districts 12 and 17 levee rehabilitation areas. In 2004 the Corps completed a sample survey and monitoring plan for levee repairs to be carried out that year (Kent 2004) and contracted Archaeological and Historical Services (AHS) of Eastern Washington University to supply a full-time archaeological monitor for the 2004 Skagit

levee rehabilitation construction season (Kent 2005). Many of the monitored levee repair areas are at or close to the 2007 repair areas (Figure 1 of attached report). The full-time monitor did not observe either prehistoric or early historic-period cultural material.

For its 2007 studies the Corps has completed archival and background research, a search of the Washington Department of Archaeology and Historic Preservation (DAHP) Electronic Historic Sites Database, pedestrian surveys of the 14 individual repair locations in Diking Districts 12 and 17, and has initiated consultation with the Swinomish Tribe with a letter soliciting knowledge and concerns (appendix of attached report). No sites listed in the National Register of Historic Places (NRHP) are located within any of the individual APEs. No documented prehistoric or early historic Native American archaeological deposits are located within any of the APEs. Some of the APEs are located within the boundaries of the broadly defined and incompletely recorded historic-period town sites of Avon (45SK117). During the pedestrian surveys conducted on 7, 8 and 9 August 2007, no prehistoric or early historic-period archaeological materials were observed, but historic period wood piles are present in the river at a number repair areas.

Most of the proposed repairs at damaged levee segments were determined to have little potential to cause effects to historic properties, but due to the extensive resloping that is planned to create toes at the wider levee benches and the potential presence of archaeological materials four of those locations, archaeological monitoring will be carried out at repair areas DD-12-7, DD-12-8, DD-17-1, and DD-17-5. An archaeological monitoring plan and protocols for inadvertent discovery of cultural resources and human remains is located in Appendix B of the attached report. The protocols will also be integrated into the construction management plan. Based on the results of the Corps studies the Corps requests your expedited concurrence with a determination of No Historic Properties Affected, with the provision that archaeological monitoring will be conducted at DD-12-7, DD-12-8, DD-17-1, and DD-17-5, as per the monitoring plan in Appendix B of the report. The repairs in Diking District 12 have been pushed forward and are scheduled to begin on Monday 3 September 2007. If you have questions concerning the project please contact project archaeologist Ron Kent at (206) 764-3576 or via e-mail at ronald.j.kent@usace.army.mil. Copy Furnished (With Enclosure): Mr. Raymond A. Williams, Cultural Resources, Swinomish Indian Senate, Post Office Box 817, LaConner, Washington 98257-0817.

Sincerely,

for Mark Ziminske
Chief, Environmental Resources Section

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-3755

REPLY TO
ATTENTION OF

Environmental Resources Section

JUN 10 2008

Allyson Brooks, Ph.D.
Director and State Historic Preservation Officer
Department of Archaeology and Historic Preservation
Post Office Box 48343
Olympia, Washington 98504-8343

SUBJECT: Request for Expedited Concurrence on a Determination of No Historic Properties Affected for the Skagit River Levee Rehabilitation Projects

Dear Dr. Brooks:

Please find attached for your review and consideration a cultural resource investigation report for five proposed U.S. Army Corps of Engineers, Seattle District (Corps) Public Law (PL) 84-99 (33 USCA 701n) Emergency Levee Rehabilitation projects to be constructed in 2008 along the banks of the Skagit River in the Mount Vernon and Fir Island areas of Skagit County, Washington. The report also contains the results of archaeological monitoring conducted in 2007. One repair site (Diking District 1, repair site 4) was constructed in 2007 without being included in the 2007 report and determination of effects. However, it was surveyed prior to the repair and is included in this report. The five repair sites for this year were originally going to be constructed in 2007, but were deferred until 2008. These six repair locations in Diking Districts 1 and 22 that are scheduled to be constructed beginning on July 1, 2008. These emergency levee repairs are necessary due to levee damage from major flooding that occurred on the Skagit River in November of 2006. The flooding was caused by intense rains that were the result of a high velocity jet stream from the southwest that brought warm pockets of moisture to the Northwest, a weather pattern that is often referred to as the Pineapple Express. The proposed repairs are limited to restoring the damaged levee segments to their pre-flood damage condition. The recommended general repair plan consists of reshaping and armoring the riverward slopes over the damaged lengths. The riverward slope will be reshaped to the greatest extent possible, and a three foot blanket of class IV riprap will be placed for armor rock. Where possible, "fish shallows" or "scallops" will be incorporated into levee rehabilitation design and willow plantings will be installed.

The Area of Potential Effects (APE) for the repairs was defined as the individual repair boundaries. No new access roads will be constructed or existing roads improved and no staging areas will be employed. Rock materials will be brought directly to the repair locations from existing rock quarries. The Seattle District has been involved in conducting studies for flood control projects in the Skagit River delta for several decades. In 1978 and 1979 the Corps funded cultural resource investigations by Seattle Community College for the proposed Skagit

River Levee and Channel Improvement Project (Onat et al. 1979 and 1980). The 1978 and 1979surveys covered all of the proposed 2007 Diking Districts 1, 3 and 22 levee rehabilitation areas.

In 2004 the Corps completed a sample survey and monitoring plan for levee repairs to be carried out that year (Kent 2004) and contracted Archaeological and Historical Services (AHS) of Eastern Washington University to supply a full-time archaeological monitor for the 2004 Skagit levee rehabilitation construction season (Kent 2005). Many of the monitored levee repair areas are at or close to the 2007 repair areas (Kent 2007). The full-time monitor did not observe either prehistoric or early historic-period cultural material. The only site recorded during the archaeological monitoring in 2004 was a small refuse dump site in Avon that overlapped the minimum 50 years of age to be recorded.

For its 2008 studies the Corps has completed archival and background research, a search of the Washington Department of Archaeology and Historic Preservation (DAHP) Electronic Historic Sites Database, and previously completed pedestrian surveys of the six individual repair locations in Diking Districts 1 and 22, and initiated consultation with the Swinomish Tribal Community in 2007 with a letter soliciting knowledge and concerns and included an attached map showing the levee repair sites discussed in this report (appendix of attached report). No sites listed in the National Register of Historic Places (NRHP) are located within any of the individual APEs. No documented prehistoric or early historic Native American archaeological deposits are located within any of the APEs. During the pedestrian surveys conducted on 16, 17 and 18 May 2007, no prehistoric or early historic-period cultural materials were observed other than a few scattered river pilings. The Corps' studies presented in the attached report provide documentation that the proposed 2008 repairs in Diking District's 1 and 22 have little potential to cause effects to historic properties.

No archaeological monitoring is recommended, but the following inadvertent discovery clause will be incorporated into the construction contract or construction plan:

> If during construction activities the Contractor observes items that might have historical or archaeological value, such observations shall be reported immediately to the Corps' Construction Supervisor so that the appropriate authorities may be notified and a determination can be made as to their significance and what, if any, special disposition of the finds should be made. The Contractor shall cease all activities that may result in the destruction of these resources and shall prevent his employees from trespassing on, removing, or otherwise damaging such resources.

Based on the Corps' negative findings we request your expedited concurrence with a determination of No Historic Properties Affected. The project will begin construction on or about Monday 1st of July 2008. We apologize for any inconvenience the expedited review may

cause you, but the unusually high number of emergency levee repairs that will be constructed this summer has caused us to fall behind schedule in our Section 106 compliance work. If you have questions concerning the project please contact me at (206) 764-3576 or via e-mail at ronald.j.kent@usace.army.mil. Copy Furnished (With Enclosure): Mr. Raymond A. Williams, Cultural Resources, Swinomish Indian Senate, Post Office Box 817, LaConner, Washington 98257-0817.

Sincerely,

Ronald J. Kent
Acting Chief, Environmental Resources Section

STATE OF WASHINGTON

DEPARTMENT OF ARCHAEOLOGY & HISTORIC PRESERVATION

1063 S. Capitol Way, Suite 106 • Olympia, Washington 98501
Mailing address: PO Box 48343 • Olympia, Washington 98504-8343
(360) 586-3065 • Fax Number (360) 586-3067 • Website: www.dahp.wa.gov

June 12, 2008

Mr. Ronald Kent
Environmental Resources Section
Seattle District, Corps of Engineers
PO Box 3755
Seattle, Washington 98124-3755

Re: Skagit Levee Emergency Rehabilitation Project
Log No: 061208-01-COE-S

Dear Mr. Kent:

Thank you for contacting our department. We have reviewed the professional cultural resources survey report you provided for the proposed Skagit Levee Emergency Rehabilitation Project in Skagit County, Washington.

We concur with your determination of No Historic Properties Affected.

We would appreciate receiving any correspondence or comments from concerned tribes or other parties that you receive as you consult under the requirements of 36CFR800.4(a)(4).

In the event that archaeological or historic materials are discovered during project activities, work in the immediate vicinity must stop, the area secured, and the concerned tribes and this department notified.

These comments are based on the information available at the time of this review and on the behalf of the State Historic Preservation Officer in conformance with Section 106 of the National Historic Preservation Act and its implementing regulations 36CFR800. Should additional information become available, our assessment may be revised. Thank you for the opportunity to comment and a copy of these comments should be included in subsequent environmental documents.

Sincerely,

Robert G. Whitlam, Ph.D.
State Archaeologist
(360) 586-3080
email: rob.whitlam@dahp.wa.gov

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-3755

REPLY TO
ATTENTION OF

Environmental Resources Section

Raymond A. Williams, Cultural Resources
Swinomish Indian Senate
Post Office Box 817
LaConner, Washington 98257-0817

JUN 2 1 2007

RE: Solicitation of Knowledge and Concerns for the 2007 Skagit River Levee Rehabilitation Project (Section 106 National Historic Preservation Act Compliance)

Dear Mr. Williams:

The U.S. Army Corps of Engineers (Corps) proposes to construct emergency levee rehabilitation projects in five Skagit County diking districts this summer (Maps attached). The Corps has determined that the proposed levee rehabilitations are Federal undertakings that may have the potential to cause effects to historic properties and must therefore comply with the procedures set forth within the Seattle District's operating manual (NWSOM 500-1-1, Plans for Natural Disaster Procedures, Emergency Employment of Army and Other Resources, Natural Disaster activities under Public Law-99, Appendix D, Protection of Historic Properties) and Section 106 of the NHPA. The Area of Potential Effects (APE) for each rehabilitation site consists of the levee segment to be repaired and any new access roads and staging areas. A search of the Department of Archaeology and Historic Preservation (DAHP) electronic Historic Sites Inventory Database did not produce evidence for the presence of an historic property listed on the National Register of Historic Places (NRHP) at any of the repair sites, but there are prehistoric and historic-period archaeological sites listed on the Washington State Historic Sites Register in the immediate vicinity of some of the damaged levee locations.

Prior to levee rehabilitation construction a Corps, or contracted archaeologist, will survey the damaged areas to determine if there is a potential for the proposed repairs to cause effects to historic properties. If the archaeologist determines that the proposed work has a potential to cause effects then archaeological testing if possible, or monitoring during certain phases of construction may be necessary. Two National Historic Preservation Act (NHPA) Section 106 compliance reports will be prepared. The report for Diking Districts 1, 3, and 22 will be prepared by a Corps archaeologist. The report for Diking Districts 12 and 17 will be prepared by a contract archaeologist. The reports will include the findings of the investigations for each repair site, recommendations for archaeological monitoring during construction (if any), and a recommended determination of effects to historic properties. If archaeological monitoring is recommended at some repair locations, the report will include a monitoring plan and protocols to be followed. The protocols will include an inadvertent discovery clause that will apply when an archaeological monitor is not present. The Corps' determinations of effects to historic

properties, a report on the result of the investigations, and monitoring plan (if necessary) will be concurred with by the DAHP and reviewed by the Swinomish Tribe prior to the start of construction.

To further identify historic properties, Section 106 of the National Historic Preservation Act (NHPA or the Act) of 1966, as amended (36 CFR 800.4[a][3]), requires Federal agencies to seek information from tribes likely to have knowledge of, or concerns with, historic properties within the project's APEs. We are specifically seeking assistance in identifying properties that may be of religious or cultural significance and may be eligible for the National Register of Historic Places (NRHP), including Traditional Cultural Properties (TCP). Specific guidance concerning the Corps' obligation to contact your tribe regarding this issue is found at 36 CFR 800.4(a)(4), which states that the agency official shall:

> (4) Gather information from any Indian tribe or Native Hawaiian organization identified pursuant to Sec. 800.3(f) to assist in identifying properties, including those located off tribal lands, which may be of religious and cultural significance to them and may be eligible for the National Register, recognizing that an Indian tribe or Native Hawaiian organization may be reluctant to divulge specific information regarding the location, nature, and activities associated with such sites. The agency official should address concerns raised about confidentiality pursuant to Sec. 800.11(c).

We appreciate any assistance you can provide us in our efforts to comply with Section 106 of the National Historic Preservation Act. Please be assured that the Corps will treat any information you decide to share with us with the degree of confidentiality that is required in Section 800.11(c) of the Act, or with any other special restrictions you may require. If you have any questions or information concerning the proposed Skagit County levee rehabilitation APEs, please contact me at (206) 764-3576, or e-mail me (ronald.j.kent@usace.army.mil).

Sincerely,

Ronald J. Kent

Ronald J. Kent, Senior Archaeologist
Environmental Resources Section

APPENDIX G

CLEAN WATER ACT SECTION 404 ANALYSIS

Clean Water Act Section 404 Analysis

Skagit River – Diking District 3 Levee Repair
Rehabilitation of Flood Control Works

Skagit County, Washington

Clean Water Act
Rivers and Harbors Act

Prepared by:

U.S. Army Corps of Engineers
Seattle District
Environmental Resources Section

March 2011

US Army Corps of Engineers
Seattle District

1.0 INTRODUCTION

The purpose of this document is to record the U.S. Army Corps of Engineers (USACE) compliance evaluation of the repair and replacement of 57 non-continuous sections of the Diking Districts 1, 3, 12, 17, and 22 levees on the Skagit River, Skagit County, Washington, pursuant to the Clean Water Act (CWA), and the General Regulatory Policies of USACE. Specifically, Section 404 of the CWA requires an evaluation of impacts for work involving discharge of fill material into the waters of the U.S., and evaluation guidance can be found in the CWA 404(b)(1) Guidelines [40 CFR §230.12(a)]. SThe General Regulatory Policies of the Corps of Engineers [33 CFR §320.4(a)] provide measures for evaluating permit applications for activities undertaken in navigable waters.

The main body of this document summarizes the information presented in Attachment A and includes relevant information from the Environmental Assessment for the project that was collected pursuant to the National Environmental Policy Act (NEPA) of 1969 [42 USC §4321 et seq.]. Attachment A provides the specific USACE analysis of compliance with the CWA Section 404(b)(1) and the General Regulatory Policy requirements.

2.0 PROJECT BACKGROUND

A heavy rainstorm during November 2006 created flooding in many river basins in western Washington. The major flooding that occurred in the Skagit River in November 2006 resulted in extensive damage to several diking district levees. Additional high water events occurred in November 2008 and January 2009, cresting just below flood stage, further damaging the levees. The Corps, with Skagit River Diking Districts 1 (DD1), 3 (DD3), 12 (DD12), 17 (DD17), and 22 (DD22) as the non-federal sponsors, has completed emergency repairs on sections of the levees within Diking Districts 1, 3, 12, 17, and 22, and plans to rework or complete other projects within these diking districts during the approved fish window for in-water work (currently planned for July through August of 2011). Each of these levee systems was designed and constructed for flood control to provide protection from periodic, recurring floods. Most of the repair sections are exempt from analysis under CWA Section 404(f)(1)(B) because they repair the levee to the pre-flood condition such that there is no change to the footprint, profile, construction method or materials. Ten of the 57 repair sites are not exempt from analysis under CWA Section 404(f)(1)(B) due to a change in the character of the fill material, the profile, or the footprint of the repair.

3.0 PROJECT NEED

These levees are integral to protecting life, safety, and property in floodplains along the river. Due to the emergency status of these projects as prescribed by the PL 84-99 Program, the Corps completed the necessary repairs of many of these damaged levee sites during 2007. Further repairs are scheduled for the summer of 2011.

Figure 1. Overview map showing the location of each site that is not exempt from CWA Section 404.

4.0 PROJECT PURPOSE

The project would repair the damaged portions of the Skagit River levees to restore and maintain adequate and reliable flood protection for the residences, businesses, and public infrastructure at the same level that was provided by the levees prior to the 2006 flood event. The Corps has determined that failure

to repair these sites greatly increases the chances of injury, loss of life, severe economic damage, and disruption of commercial, agricultural, and government services.

5.0 PROPOSED ACTION AND ALTERNATIVES

Under the No-Action Alternative, the Corps would not provide assistance to the Skagit County Diking Districts under the PL 84-99 Program; no project features would be implemented. All levees would be left in damaged condition. The No-Action Alternative does not fulfill project goals and objectives as it leaves the levees in a vulnerable condition and thereby increases the risk of injury, loss of life, severe economic damage, and disruption of commercial, agricultural, and government services.

The Preferred Alternative includes repair of the damages and was implemented in 2007 or is proposed to be implemented in 2011. The repair includes 57 sites with a total project length of 27,683 linear feet (5.2 miles). Ten sites are not exempt from Clean Water Act Section 404 (b) (1) analysis. Three sites (3-5, 3-6, and 3-8) include a change in materials from the pre-flood condition. The other seven sites include profile changes and footprint changes that have been designed into the project as environmental enhancement features.

- Site 1-3: This site is scheduled for repair in 2011. The damaged section of levee is 75 LF long on an inside bend of the river, adjacent to an armored section. The downstream end of the armored area is experiencing erosion that could continue behind the armor and unravel the levee. Continued erosion would lead to levee failure and loss of access to Young's Bar. Engineers recommend that the repair include re-grading and armoring the slope to tie in the armored revetment to high ground. Vegetation that would be removed from the revetment face consists of a few alders four to eight inches diameter at breast height, with willows, blackberry, and dogwoods in the understory. Mitigation options included in the design for this repair include a double willow lift starting at OHW, anchored rootwads off the levee toe, and placement of soil and hydroseed over the top of the riverward face and the bench. The footprint of the levee would be expanded by the inclusion of anchored rootwads outside of the levee prism.

- Site 3-5: The The Corps repaired 460 LF of levee in 2007 on the South Fork of the Skagit River. The riverward slope was reshaped to 2H:1V, covered with spall rock, and armored with a three-foot blanket of class IV riprap. No buried toe was constructed. The levee crown was topped with crushed gravel. Vegetation removed was various shrubs on the revetment and bench, ranging from two to ten feet tall, and groundcover dominated by grass. The mitigation option installed in 2007 included one willow lift (~700 willows) along 350 LF of the repair at 1.4 LF below the levee top (6.6 ft above OHW). In 2011, the Corps plans to add additional mitigation to this site by installing anchored rootwads along the entire repair site. This section of the levee was not armored prior to the flood event and the repair activity constitutes a change in materials from pre-flood condition. The footprint of the levee would be expanded by the inclusion of anchored rootwads outside of the levee prism.

- Site 3-6: This is a 2007 levee rehabilitation site that is scheduled to be reworked in 2011. The 2007 repair was 375 LF. The riverward slope was reshaped to 3.5H:1V and armored with a three-foot blanket of class IV riprap. No buried toe was constructed. The section to be constructed in 2011 is 150 LF. Excess riprap was placed on the upper slope during the 2007 construction season to prevent erosion during a flood, but the weight increased the load on the slope. This can cause rotational failure of the levee. The excess rock would be excavated and reused on the downstream end of the site to tie the levee into the bank. A spall layer would be placed below the riprap, and the riprap would be replaced at the toe. Vegetation removed in 2007 consisted of Nootka rose, thimbleberry, salmonberry, shrubby willows, and blackberry on the riverward face that ranged

from two to ten feet tall. Similar vegetation would be removed by the 2011 repair. The rootwads removed from within the levee during 2007 construction were placed onto the riverward face of the levee post-construction, shading the rock, increasing organic inputs to the river, and diversifying the bank line. Any rootwads removed for the 2011 repair would be staged during construction and placed on the levee face post-construction. The mitigation option installed in 2007 included one willow lift (~800 willows) at 10.2 LF below the levee top, at approximately 0.5 ft above OHW. Further mitigation options to be installed in 2011 would include a double willow lift and placement of anchored logs with rootwads throughout the full 3-6 repair site (525 LF). The riverward face above the willow lifts would be covered with soil and seeded with native grasses. This section of the levee was not armored prior to the flood event and the repair activity constitutes a change in materials from pre-flood condition. Also, the footprint of the levee would be expanded by the inclusion of anchored rootwads outside of the levee prism.

- Site 3-8: This site would be constructed in 2011. This site is an un-armored earthen levee segment along Tom Moore Slough and requires 225 LF of repair due to an over-steepened bank. It is adjacent to the 2007 repair at site 3-5. The landward side of the levee is a forested wetland. The riverward revetment and narrow bench are vegetated with grasses, blackberry, Nootka rose, red osier dogwood, multiple willow clumps, and alders. The riverward slope would be reshaped to 2H:1V, covered with spall rock, and a three-foot blanket of class IV riprap. No buried toe would be constructed. The levee crown would be topped with crushed gravel to create a driving surface for inspections. Construction would not disturb the landward slope or wetland. Several mitigation options will be installed at this site. A double willow lift would be installed with the lowest lift at OHW. Anchored logs with attached rootwads would be placed along the toe of the repair to replace lost fish habitat. The riverward face above the willow lifts would be covered with soil and seeded with native grasses. This section of the levee was not armored prior to the flood event and the repair activity constitutes a change in materials from pre-flood condition. Also, the footprint of the levee would be expanded by the inclusion of anchored rootwads outside of the levee prism.

- Site 12-9: This site would be constructed in 2011. The site includes 1,850 LF of riverward repair due to seepage, toe scour, and loss of face rock. Blackberry and grass with some horsetail and Nootka rose dominate the project area. Woody species are scattered along the length of the repair including red osier dogwood, alder, and small willows. The riverward slope would be reshaped to 2H:1V; spall rock and a three-foot blanket of class IV riprap would be placed. No buried toe would be constructed. Mitigation to be implemented at this includes installing a a d willow lift with the lowest lift at OHW or below, covering the riverward bank above the willow lifts with dirt and hydroseeded, planting a double row of native shrubs at the top of the revetment, and installing 1,575 LF of anchored rootwads. The footprint of the levee would be expanded by the inclusion of 1,575 LF anchored rootwads outside of the levee prism.

- Site 12-13: This site would be constructed in 2011. The site includes 350 LF of riverward repair due to toe scour and loss of face rock. The revetment includes two large alders, some young willows, and blackberry. Six large cedars stand along the riverward bench behind the repair area. No buried toe would be constructed. Various mitigation options would be installed at this site. A fish bench would be installed at this site that would be 9 ft wide and would slope from two feet above OHW at the upstream to two feet below OHW at the downstream end and would slope riverward at a 2% grade to avoid fish stranding. The riverward levee slope would be reshaped to 2H:1V, spall rock would be placed, and a three-foot blanket of class IV riprap would be placed. A double willow lift would be installed with the lowest lift at OHW. The riverward bank above the willow lifts would be covered in dirt and hydroseeded following construction. A single row of native shrubs would be planted along the top of the riverward bank. With the installation of the

fish bench it is likely that some of the cedars would be removed. They would be reused as anchored woody debris at nearby repair sites. With the installation of the fish bench the profile of the riverward bank will be changed from the pre-flood condition.

- Site 12-14: This site would be constructed in 2011. The repair site includes 250 LF of riverward repair due to loss of face rock. This site is a gap between two project areas constructed in 2007. The Corps would minimize in-water work as the toe rock appears to be mostly intact, though it may need to be supplemented in some areas. Grass and some bushy willows dominate the project area. The riverward slope would be reshaped to 3H:1V; spall rock and a three-foot blanket of class IV riprap would be placed. No buried toe would be constructed. Mitigation at this site includes laying back the slope, as described, as well as other features added to the design. A double willow lift would be installed with the lowest lift at OHW. The riverward bank above the willow lifts would be covered in dirt and seeded with native grasses following construction. A single row of native shrubs would be planted at the top of the revetment three feet on center. To layback the slope throughout the repair area, a transition zone would be built to connect the layback to the upstream and downstream slopes. The transitions at each end of the layback section would be gradual to avoid scour and would be approximately 40 ft at each end. By laying back the slope of the bank the profile of the riverward bank will be changed from the pre-flood condition.

- Site 17-6: The Corps repaired 522 LF of levee in 2007. In 2007, the riverward slope was reshaped to 2H:1V and armored with a three-foot blanket of class IV riprap. The spall blanket was extended landward from the top of the bank. No buried toe was constructed.. Spalls and gravel were placed on the levee crown and access ramps to provide a driving surface. Cleared vegetation consisted of one clump of willows that were four feet tall. Blackberries dominated approximately 45% of the revetment with grasses dominating the remainder. Mitigation installed in 2007 included two willow lifts spanning 305 LF at 4.3 and 8.0 feet below the levee top (lowest lift at one ft above OHW); 740 willows were planted. In 2011, further mitigation work would be completed at this site. The mitigation effort will include 400 LF of placement of soil and hydroseed on the bench and top of the riverward face and placement of anchored rootwads at the toe for 400 LF. The footprint of the levee would be expanded by the inclusion of anchored rootwads outside of the levee prism.

- Site 17-16: This site would be constructed in 2011. The over-steepened bank requires toe and face rock repair along 250 LF of the revetment. DD17 reported a very deep scour hole at the toe. The site is near Freeway Drive and I-5 and is adjacent to a 2004 levee repair site. This site is forested with large trees and an understory of snowberry and blackberry. There are nine large big leaf maples and a few saplings of the same species, two mature alders, two *Prunus* species, and five very large cottonwoods, three of which are dying presumably from being undercut by the bank scour. The riverward slope will be reshaped to 2H:1V, a one-foot blanket of spall rock will be laid, and a three-foot blanket of class IV riprap will be placed. No buried toe will be constructed. Multiple mitigation options would be installed at this site, including the following. A triple willow lift will be installed with the lowest lift at OHW. The riverward bank above the willow lifts will be covered in dirt and hydroseeded following construction. Two rows of native shrubs will be planted at the top of the revetment three feet on center and a row of tree plantings (15 ft on center) will be completed between the repair area and Freeway Drive. The Corps will add a habitat weir to the upstream end of this site. The weir will be a pyramidal rock structure with a 2H:1V face slope, which will extend 10 feet from the face of the levee. It will extend above OHW to provide hydraulic complexity at many river stages. In section view of the groin, the side slopes that are roughly angled toward upstream and downstream will have a 1H:1V profile. The weir will not change the thalweg of the river or change river dynamics within the reach, but will create

localized changes that include velocity slowing upstream of the structure and pool creation downstream. Both of these effects improve rearing habitat. The footprint of the levee would be expanded by the inclusion of the habitat weir outside of the pre-flood levee prism.

- Site 22-7: This site was deferred from the 2007 construction season, and is planned to be repaired in 2011. The damaged section is 350 LF at the northern point of Fir Island, where the Skagit River splits into the North and South Forks. The site has scour at the toe and into the revetment face. Continued bank erosion would lead to levee failure. The levee would be repaired by re-grading the slope to 3H:1V, placing a spall blanket filter layer and riprap armor to create a toe and provide erosion protection. Several mitigation options would be added to the design at this site. A double willow lift and anchored rootwads would be installed throughout the project site, with the lowest willow lift at OHW. Overstory trees would be planted along the riverward bench. The Corps would clear seven large cottonwoods and five mature alders greater than 12 inches dbh on the bench, ten to twelve smaller alders, and willows less than four inches dbh with a brushy understory along the revetment. Trees removed for the repair would be salvaged and used as anchored woody debris. To layback the slope throughout the repair area, a transition zone would be built to connect the layback to the upstream and downstream slopes. The transitions would be gradual to avoid scour and are expected to be approximately 40 ft on each side. By laying back the slope of the bank the profile of the riverward bank will be changed from the pre-flood condition. The footprint of the levee would also be expanded by the inclusion of anchored rootwads outside of the levee prism.

Two other alternatives for the overall project were considered to address the project purpose. The Non-structural Alternative would relocate all existing residences, commercial structures, utilities, and other infrastructure within the areas protected by the damaged levees to a location outside of the floodplain. The high cost and complicated logistics associated with this alternative were not proportional to the associated increased level of benefit. The Setback Alternative would set the levee inland from the existing footprint in the damaged areas, opening up floodplain and decreasing environmental impacts of repairs. Because the sites are non-continuous and spread throughout the lower Skagit River, this alternative could potentially include building multiple new levees or levee segments. Constructing new levees would result in increased project costs associated with an increased amount of embankment material required. Furthermore, adjacent land is not owned by the diking districts, and the time and cost associated with obtaining the real estate for this alternative is prohibitive. The levees would remain in a damaged and vulnerable state until the real estate could be attained and the setback levee(s) was completed. As these are considered emergency repairs, the setback alternative is cost-prohibitive and does not meet project goals of expedited repair.

6.0 POTENTIALLY ADVERSE EFFECTS (INDIVIDUALLY OR CUMULATIVELY) ON THE AQUATIC ENVIRONMENT

a. Effects on Physical, Chemical, or Biological Characteristics of the Aquatic Ecosystem

The reduction in riparian vegetation and the loss of nearshore roots and undercut banks will reduce fish and wildlife habitat. The use of riprap along the banks perpetuates a design that is considered detrimental to fish and wildlife habitat, especially ESA-listed salmonids. Mitigation for these detrimental effects to edge habitat has been added to the design as bank plantings, unanchored debris piles, anchored large woody debris, slope laybacks, a fish bench and a habitat weir to restore fish habitat values by providing vegetative cover, hydraulic diversity, nutrient input, and instream cover.

Lower Skagit salmon species will be affected by loss of riparian habitat through loss of cover and shade as well as reduced nutrient input from overhanging vegetation and the decay of forest litter. Water temperatures could increase locally due to lack of shading. As the plantings mature, this effect would be

expected to diminish. The heat reflection from the bare rock on the face of the levee is expected to be minimal because of plantings and placement of topsoil and most sites. The lower Skagit River meets state water quality standards for temperature, and the localized increases in temperature are not expected to result in an overall increase in river temperature; therefore, the effects of temperature increases on fish are likely to be minimal.

The loss of large riparian vegetation will reduce natural LWD recruitment. LWD provides crucial cover and holding areas during high flow events when large trees are washed into the river and become lodged in the bank or incorporated into debris jams. Such debris jams provide optimal habitat for juvenile anadromous fish. To counteract this impact the addition of anchored rootwads has been added to project designs to increase habitat complexity and create instream cover at the toe of the levee. Additionally the inclusion of unanchored woody debris piles will create short-term complex debris jams that will improve fish habitat conditions at those locations.

The loss of mature forest stands results in a reduction in nearshore habitat complexity, particularly during high flow events. Inundated vegetation during flood events provides lower flow areas that can be used as refuge areas. Plantings and placement of soil with hydroseeding will begin to address the loss of riparian habitat, however there will be a time lag before plantings begin to function similar to pre-repair habitat. The overall effects of the reduction in riparian habitat may result in a reduction in habitat quality in the lower river.

The 2007 construction effort was not completed during the approved inwater construction period. The construction period lasted from 30 August through 7 October 2007. In-water construction in 2007 may have disturbed juveniles at all sites and upstream adult migrants along the sites in DD22. This disturbance likely displaced fish to the opposite side of the river. Turbidity monitoring during the 2007 showed that increase in turbidity was minor. Construction in 2011 would be limited to the approved inwater construction period which is 15 June to 31 August.

b. Effects on Recreational, Aesthetic, Historical, and Economic Values

There will be some loss of recreational and aesthetic value to the public during and after construction. These impacts will be of temporary duration because the area will return to existing uses after construction, and vegetation similar to pre-repair condition is expected to be re-establish. Levee repair is not expected to change the current trends of economic values of properties or commerce of the lower Skagit region.

In accordance with the National Historic Preservation Act (16 USC 470), historic properties have been investigated, and consultation has been initiated with the Washington State Historic Preservation Office (SHPO). The proposed work will protect known historic properties at the project site from the effects of erosion or catastrophic bank failure. The USACE initiated consultation with the Swinomish Tribe with a letter soliciting knowledge and concerns on June 21, 2007. As of the date of this Environmental Assessment, the Swinomish Tribe has not identified any concerns.

c. Findings

The ten repair sites that are not exempt from Section 404 of the CWA taken alone would not pose a significant environmental impact. Based on the complete analysis of all sites undertaken for the Environmental Assessment (EA), the 57 levee system rehabilitation projects on DD1, DD3, DD12, DD17, and DD22 levees with the associated compensatory environmental work to offset the negative impacts of the levee repair work will not have a significant environmental impact, per the attached EA and Finding of No Significant Impact.

7.0 ALL APPROPRIATE AND PRACTICABLE MEASURES TO MINIMIZE POTENTIAL HARM TO THE AQUATIC ECOSYSTEM

a. Impact Avoidance Measures

Four project alternatives were initially proposed and two were fully evaluated in order to select the best alternative for minimizing cost and impact to the environment. The proposed project action was selected because it will have the least net negative impact on the environment and will provide assurance that the compensatory environmental features will be successful.

b. Impact Minimization Measures

USACE will take all practicable steps during construction of the project to minimize impacts to aquatic and terrestrial resources. Contingencies will be in place if any of the water quality protection measures fail to achieve their intended function. USACE will observe all in-water construction windows to ensure that impacts to migratory fish and birds will be avoided or minimized. The minimization measures will be as follows:

- Project design will incorporate planting of willows and other native plants, placement of anchored rootwads, placement of unanchored debris, and profile changes to create shallower slopes and refuge areas to provide habitat for fish;
- Best management practices (BMPs), such as stormwater runoff prevention, will be used to ensure that no unnecessary damage to the environment occurs;
- Work in 2011 will occur only during the approved in-water work window for the lower Skagit River; and
- A USACE biologist will periodically check on construction progress to ensure BMPs are in place and environmental impacts are properly avoided and minimized.

c. Compensatory Mitigation Measures

Because of the long history of modification of riverbanks within the lower Skagit valley, the habitat is quite degraded, yet the Skagit River remains critical for many endangered salmonids. Due to the extent of recent past and upcoming necessary repairs to the Skagit River levees and the time lag for newly repaired sites to fully provide edge habitat functions, as well as to avoid impacting salmon recovery, the USACE is proposing environmental measures to mitigate for lost functions of the riverine edge habitat.

The USACE initiated formation of a technical working group to develop a strategy for assessing the impacts of the levee repairs and developing measures to offset those impacts. The Technical Working Group included representatives from the Diking Districts, National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), the Skagit River System Cooperative, and the USACE. Through multiple meetings and discussions as well as site visits a new assessment tool was developed that focuses on habitat capacity degradation due to levee repairs and the increase in capacity expected to result from the mitigation options. Using a target quantity of habitat capacity is intended to compensate for impacts to juvenile salmon rearing habitat that result from levee repair. The mitigation options are proposed to be completed through the inclusion of many environmental features at sites throughout the project area, including native plantings, profile changes, and installation of woody debris that will diversify the bankline, create refuge habitat, and improve riparian buffer habitat.

d. Findings

USACE has determined that all appropriate and practicable measures have been taken to minimize potential harm to the environment.

8.0 OTHER FACTORS IN THE PUBLIC INTEREST

a. Fish and Wildlife. USACE is in a consultation process to coordinate construction and impact compensation activities with local Native American Tribes and state and federal resource agencies to minimize impacts to fish and wildlife resources. The 2011 project will take place during the approved in-water work window to avoid impacts to fish. USACE has submitted a Biological Assessment to the NMFS and USFWS for their review of this project.

b. Water Quality. USACE concluded that this project will not violate the state water quality standards found at WAC 173-201A. Of the 57 project sites, only ten sites are not exempt from CWA compliance per section 404(f)(1)(B). The ten sites include a total length of 4535 ft. Of these sites, three project locations (a total of 1210 ft) include a change of materials from an earthen levee to an armored levee for increased protection from scour. Two of these three sites also increase the footprint of the repair due to anchored rootwad placement. The other seven sites are not exempt from CWA compliance strictly due to the placement of habitat enhancement features. Four sites have a change in profile to improve fish habitat including two slope laybacks, one fish bench installation, and one habitat weir installation. The last three sites increase the footprint due to anchored rootwad placement.

A small amount of turbidity occurred during the 2007 construction, but impacts were temporary and localized. During the 2007 construction, 98 turbidity samples were taken downstream from repair efforts at various stages. The average increase over background levels was 0.9 NTU, ranging from 0.3 to 6.7 NTU. Turbidity levels are not expected to increase significantly due to the 2011 construction. Periodic sampling will be conducted downstream of the repairs at a distance appropriate to allow for acceptable mixing and dilution of any released sediment, as allowed under the state regulations (Washington Administrative Code 173-201A-400). If samples indicate that state water quality maximum standards for turbidity are exceeded, project work will be halted and modified so that standards can be met. Turbidity effects were and will be temporary and limited to areas along the shore within a short distance downstream of each project site. Increased turbidity during 2007 construction may have locally affected upstream migration, although the width of the river allows ample space for adults to pass upstream along the opposite bank. Construction in 2011 is expected to have the same low level of impact to turbidity, no impact to pH, and an unknown impact to temperature.

c. Historical and Cultural Resources
See 6.b. above.

e. Environmental Benefits.
This project has no net benefits to the environment. Compensatory environmental features are proposed through multiple design additions at various project sites and are designed to balance the impacts of the complete repair project.

9. CONCLUSION

USACE finds that this project is within the public's interest and complies with the substantive elements of Section 404 of the Clean Water Act.

Attachment A

Clean Water Act 404(b)(1) Evaluation [40 CFR §230]
Permit Application Evaluation [33 CFR §320.4]

404(b)(1) Evaluation [40 CFR §230]

Potential Impacts on Physical and Chemical Characteristics [Subpart C]:

1. **Substrate [230.20]**
   The placement of riprap along the shoreline at sites 3-5, 3-6, and 3-8 will bury the sandy material that serves as substrate during high river flows. Work at the other repair sites did not or will not substantially change the nature of the aquatic substrate in the Skagit River as they repair previously armored banks.
2. **Suspended particulates/turbidity [230.21]**
   Little or no turbidity is expected during construction since the work will occur during summer low flow conditions. Any in-water work did/ would involve individually placed rocks with no uncontrolled dumping. Best management practices (BMPs) for sediment control will be placed before construction begins to minimize any potential turbidity issues.
3. **Water [230.22]**
   The work at the ten sites is not expected to add any nutrients to the water that could affect the clarity, color, odor, or aesthetic value of the water, or that could reduce the suitability of the Skagit River for aquatic organisms or recreation. Most of the non-exempt repair locations are specifically designed to improve edge habitat for salmon.
4. **Current patterns and water circulation [230.23]**
   USACE expects no disruption of current patterns and water circulation during or after construction. A Hydraulic Engineer assisted with the design of the projects, particularly the habitat weir such that it provides fish habitat benefits but is not designed to change or significantly disrupt the flow of the river.
5. **Normal water fluctuations [230.24].**
   Since the water levels in Skagit River are controlled by the operation of three upstream dams, and affected by tide levels, the levee repair work is not expected to have any effect on normal water fluctuations.
6. **Salinity gradients [230.25]**
   The levees of the lower Skagit River may have affected salinity gradients when they were first constructed over 100 years ago; however, the proposed repair work will not change the established salinity gradients.

Potential Impacts on Biological Characteristics of the Aquatic Ecosystem [Subpart D]:

1. **Threatened and endangered species [230.30]**
   USACE has prepared a Biological Assessment for this project that involved coordination with the National Marine Fisheries Service and the U.S. Fish and Wildlife Service to ensure that compliance with the Endangered Species Act is achieved. The BA included a mitigation plan that was developed in concert with USFWS, NMFS, and the Tribes to offset project impacts on endangered salmonids and their critical habitat. The Corps anticipates receiving Biological Opinions from NMFS and USFWS covering the listed salmonid species. The Corps has received draft Terms and Conditions with draft Reasonable and Prudent Measures from both the USFWS and NMFS. Their draft input is aligned with measurements discussed during the consultations to define the mitigation efforts.

2. **Fish, crustaceans, mollusks, and other aquatic organisms in the food web [230.31]**
   Fish may have been impacted during 2007 construction as the majority of the work occurred after the approved in-water work window had closed. The removal of riparian vegetation has a negative impact on habitat for all salmonid species as it leads to higher water temperatures, decreased allochthonous energy sources to the river, and simplifies the shoreline. The conversion of the soft vegetated banks to the rough surface of riprap may cause descaling of juvenile salmonids during high river flows. Loss of complexity of the shoreline habitat reduces availability of refugia from predators and high velocity flow. Mitigation efforts focused on offsetting these impacts by including bank plantings of willows and other native plants, inclusion of anchored rootwads and unanchored debris to create refuge and add nutrients to the system, and designing profile changes that create more diverse banks.
3. **Other wildlife [230.32]**
   Birds and other wildlife may be temporarily displaced during construction due to noise, construction vehicles, and riprap placement. Because these impacts will only occur during the weeks of construction, they are expected to be inconsequential and temporary.

Potential Impacts on Special Aquatic Sites [Subpart E]:

1. **Sanctuaries and refuges [230.40]**
   Not applicable, since the Skagit River is not designated by local, state, or federal regulations to be managed principally for the preservation and use of fish and wildlife resources.
2. **Wetlands [230.41]**
   Field inspections of the project areas determined that no impact to wetlands will occur.
3. **Mud flats [230.42]**
   Not applicable.
4. **Vegetated shallows [230.43]**
   Not applicable.
5. **Corral reefs [230.44**]
   Not applicable.
6. **Riffle and pool complexes [230.45]**
   Not applicable, since riffle and pool complexes are characteristics of streams.

Potential Effects on Human Use Characteristics [Subpart F]:

1. **Municipal and private water supplies [230.50]**
   Not applicable.
2. **Recreational and commercial fisheries [230.51]**
   Impacts to fisheries resources are not anticipated as the mitigation is expected to offset the impacts to rearing habitat. The levee repair work will not prevent access to recreational or commercial fishing.
3. **Water-related recreation [230.53]**
   Because the work was and will be conducted during the summer when water sport and outdoor activities are usually at their peak, the project may temporarily affect/ have affected water-related recreation. Recreational use of the top of levee was restricted while construction machinery was present. These conditions will be repeated during the 2011 construction.
4. **Aesthetics [230.53]**
   During construction there will be some minor disturbance from heavy equipment noise and exhaust. After construction the shoreline will look different because the riprap bank stabilization structure will have replaced green vegetation and trees. The repair sites look less natural initially, but plantings will be done to offset these impacts. It is expected that foliage will begin to develop relatively quickly and the repairs will blend in more with the surroundings.

5. **Parks, national and historic monuments, national seashores, wilderness areas, research sites and similar preserves [230.54]**
   Not applicable.

Evaluation and Testing [Subpart G]:

1. **General evaluation of dredged or fill material [230.60]**
   Bank stabilization material will consist of class IV riprap and quarry spalls. All imported material will be free from contamination and obtained from a permitted local quarry.
2. **Chemical, biological, and physical evaluation and testing [230.61]**
   NA

Actions to Minimize Adverse Effects [Subpart H]:

1. **Actions concerning the location of the discharge [230.70]**
   Since USACE is not selecting a disposal site, but rather is repairing a riprap flood control structure, the actions that will be taken are necessary for the location.
2. **Actions concerning the material to be discharged [230.71]**
   Bank stabilization material will be required to meet USACE standards for placement of riprap. Material will be imported from an approved, clean source.
3. **Actions controlling the material after discharge [230.72]**
   No actions should be required, as the structure is not expected to move after construction; however, should any structural deterioration occur, the responsible Diking Districts will be expected to address it as the owner or bring it to the attention of the USACE.
4. **Actions affecting the method of dispersion [230.73]**
   As described above, the structure is expected to be stable after construction and not disperse. Project drawings that show the design of the structure are included in the appendices to the Environmental Assessment for the project.
5. **Actions related to technology [230.74]**
   No specific advanced technologies will be used to repair the structure.
6. **Actions affecting plant and animal populations [230.75]**
   The USACE has coordinated construction activities and compensatory environmental features with local Native American Tribes and state and federal resource agencies to minimize impacts to fishery and wildlife resources. The majority of the work will take place above the ordinary high water mark. There will be temporary disturbance to wildlife in the project vicinity due to noise from operation of machinery. Planting of the levee face will address lost riparian function by providing cover, shade, and input of nutrients. Compensatory environmental features are proposed throughout the project area. These features are expected to offset impacts to fish and wildlife from the construction activities, the removal of vegetation at the project sites, and the placement of riprap on the riverward banks.
7. **Actions affecting human use [230.76]**
   Repair of the flood control structure did not and is not expected to diminish water quality, but may temporarily impact the aesthetics of the aquatic site.
8. **Other actions [230.77]**
   Best management practices were used in 2007 and will be used in 2011 to ensure that no unnecessary damage to the environment occurs during construction.

General Policies for Evaluating Permit Applications [33 CFR §320.4]

1. **Public Interest Review [320.4(a)]**
   USACE finds this repair to flood control structures to be in compliance with the 404(b)(1) guidelines

and not contrary to public interest.

2. **Effects on wetlands [320.4(b)]**
   See 404(b)(1) evaluation above. No impacts to wetlands are expected.
3. **Fish and wildlife [320.4(c)]**
   USACE has consulted and continues to consult with state and federal resource agencies, tribes and other interested members of the public on this action. Mitigation is proposed to offset edge habitat impacts.
4. **Water quality [320.4(d)]**
   USACE certifies that this project will not violate Water Quality Standards as set forth by the Clean Water Act. USACE will not seek a 401 Water Quality Certification from the State of Washington as the conditions of this project are the same as the certified conditions under Nationwide Permit 3 and Nationwide Permit 27 in which 401 certification has been approved.
5. **Historic, cultural, scenic, and recreational values [320.4(e)]**
   No permit application is necessary for these values, but concurrence from the Washington SHPO is being sought concerning evaluated effects on historic properties. Activities have also been coordinated with local Tribal Nations.
6. **Effects on limits of the Territorial Sea [320.4(f)]**
   Not applicable, since the project will not occur in coastal waters.
7. **Consideration of property ownership [320.4(g)]**
   Access for construction equipment and materials will be via public rights-of-way and real estate rights of entry provided by each of the diking districts, the non-federal sponsors for the repairs.
8. **Activities affecting coastal zones [320.4(h)]**
   The ten sites (1-3, 3-5, 3-6, 3-8, 12-9, 12-13, 12-14, 17-6, 17-16, and 22-7) not exempt from Section 404 have general consistency determination with CZMA via analogy of NWP 3 or NWP 27. These activities are not exempted under CWA Section 404(f) because of minor deviations to the footprint, profile, construction method or materials. However, these activities fall within the parameters of NWP 3 or NWP 27, which the State has predetermined concurrence that the activities are consistent with the State's coastal zone management program. Furthermore, the State has reviewed these projects and provided a letter of verification on 5 May 2011.
9. **Activities in marine sanctuaries [320.4(i)]**
   Not applicable, since the area is not a marine sanctuary.
10. **Other federal, state, or local requirements [320.4(j)]**
    USACE has initiated formal consultation with the National Marine Fisheries Service and the U.S. Fish and Wildlife Service on the findings of the Biological Assessment for the entire suite of 57 repair sites. Extensive coordination with USFWS, NMFS, and the Tribes was completed to develop the mitigation plan to offset project impacts on endangered salmonids and their critical habitat. The Corps anticipates receiving Biological Opinions from NMFS and USFWS covering the listed salmonid species. The Corps has received draft Terms and Conditions with draft Reasonable and Prudent Measures from both the USFWS and NMFS. Their draft input is aligned with measurements discussed during the consultations to define the mitigation efforts.
11. **Safety of impoundment structures [320.(k)]**
    Not applicable, since an impoundment structure is not being built.
12. **Water supply and conservation [320.4(m)]**
    No permit is needed concerning water supply.
13. **Energy conservation and development [320.4(n)]**
    Not applicable.
14. **Navigation [320.4(o)]**
    Not applicable.
15. **Environmental benefits [320.4(p)]**
    No net benefits are anticipated as a result of the repair of the flood control structures. See the Environmental Assessment and the CWA 404(b)(1) evaluation (above) for support for the project.

16. **Economics [320.4(q)]**
    Completion of the project will protect public infrastructure such as roads and powerlines and prevent disruption of commerce and services should flood stage water levels occur in the lower Skagit River.
17. **Mitigation [320.4(r)].**
    To address the loss of riparian habitat and riverine edge habitat function, the USACE has coordinated with NMFS, USFWS, the non-federal sponsor, and the local tribes to develop an appropriate mitigation strategy.

APPENDIX H

ENDANGERED SPECIES ACT COORDINATION

(placeholder – to be released when consultation complete)

APPENDIX I

COMMENTS AND RESPONSES TO PUBLIC NOTICE

The public comment period was open from 1 April to 30 April 2011. No comments were received.

APPENDIX J

REFERENCES FOR TABLE 5: LEVEE REPAIRS SINCE 1975

APPENDIX J

References for Table 5: USACE Rehabilitation Projects in Lower Skagit River Since 1975

DD1

US Army Corps of Engineers (USACE). October 2004. Final Levee Inspection for Dike District Number 1 Levee Rehabilitation USACE Seattle District, Seattle WA.

US Army Corps of Engineers (USACE). January 1991 . Project Information Report for Dike District Number 1 Levee Rehabilitation USACE Seattle District, Seattle WA.

_____. February 1996. Project Information Report for Dike District Number 1 Levee Rehabilitation USACE Seattle District, Seattle WA.

_____. June 2007. Project Information Report for Dike District Number 1 Levee Rehabilitation USACE Seattle District, Seattle WA.

DD3

US Army Corps of Engineers (USACE). October 2004. Final Levee Inspection for Dike District Number 3 Levee Rehabilitation USACE Seattle District, Seattle WA.

US Army Corps of Engineers (USACE). June 2004 . Project Information Report for Dike District Number 3 Levee Rehabilitation USACE Seattle District, Seattle WA.

Skagit County, Cockreham Island

US Army Corps of Engineers (USACE). February 1989. Levee Inspection for Skagit County, USACE Seattle District, Seattle WA.

US Army Corps of Engineers (USACE). January 1980. Project Information Report for Skagit County, USACE Seattle District, Seattle WA.

DD9

US Army Corps of Engineers (USACE). February 1989 . Levee Inspection for Dike District Number 9 Levee Rehabilitation USACE Seattle District, Seattle WA.

US Army Corps of Engineers (USACE). February 1991 . Project Information Report for Dike District Number 9 Levee Rehabilitation USACE Seattle District, Seattle WA.

DD12

US Army Corps of Engineers (USACE). November, 2004 . Final Levee Inspection for Dike District Number 12 Levee Rehabilitation USACE Seattle District, Seattle WA.

US Army Corps of Engineers (USACE). January, 1980 . Project Information Report for Dike District Number 12 Levee Rehabilitation USACE Seattle District, Seattle WA.

_____. March 2004. Project Information Report for Dike District Number 12 Levee Rehabilitation USACE Seattle District, Seattle WA.

_____. November 2004. Project Information Report for Dike District Number 12 Levee Rehabilitation USACE Seattle District, Seattle WA.

DD17

US Army Corps of Engineers (USACE). October, 2004 . Final Levee Inspection for Dike District Number 17 Levee Rehabilitation USACE Seattle District, Seattle WA.

US Army Corps of Engineers (USACE). June, 2007 . Project Information Report for Dike District Number 17 Levee Rehabilitation USACE Seattle District, Seattle WA.

_____. March 2004. Project Information Report for Dike District Number 17 Levee Rehabilitation USACE Seattle District, Seattle WA.

DD22

US Army Corps of Engineers (USACE). October 2004 . Final Levee Inspection for Dike District Number 22 Levee Rehabilitation USACE Seattle District, Seattle WA.

US Army Corps of Engineers (USACE). January, 1991 . Project Information Report for Dike District Number 22 Levee Rehabilitation USACE Seattle District, Seattle WA.

_____. March 1991. Project Information Report for Dike District Number 22 Levee Rehabilitation USACE Seattle District, Seattle WA.

_____. March 1996. Project Information Report for Dike District Number 22 Levee Rehabilitation USACE Seattle District, Seattle WA.

_____. March 2004. Project Information Report for Dike District Number 22 Levee Rehabilitation USACE Seattle District, Seattle WA.

APPENDIX K

FINDING OF NO SIGNIFICANT IMPACT

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-3755

REPLY TO
ATTENTION OF

CENWS-PM-ER

FINDING OF NO SIGNIFICANT IMPACT

Skagit River – Diking Districts 1, 3, 12, 17, and 22 Levees
Rehabilitation of Flood Control Works
Skagit County, Washington

1. Background. The Corps is proposing the following project under the PL 84-99 Program (33USC 701n). Corps rehabilitation and restoration work under this authority is limited to eligible flood control works damaged or destroyed by flood events. The repaired structures must be designed to provide the same level of protection as the original structure. The current Skagit Flood Damage Reduction study showed that, in pre-flood condition, each of the undamaged levees had Probable Failure Points (PFP) and Probable Non-Failure Points (PNP) that corresponded to a range between 10-year and 25-year flood elevations.

A heavy rainstorm during November 2006 caused flooding in many river basins in Western Washington. Additional high water events occurred in November 2008 and January 2009, cresting just below flood stage on the lower Skagit River. These events damaged a number of levee sites, including many in the Skagit River basin in Skagit County, Washington. As a result of requests for Corps of Engineers assistance from Diking District (DD) 1, DD3, DD12, DD17, and DD22, the Corps has repaired levees and proposes to repair additional levees as addressed in the draft Environmental Assessment (EA). These levees are integral to protecting life and property, including public facilities and private residences.

The purpose of the proposed project is to repair the damaged portions of the Skagit River levees to restore and maintain adequate and reliable flood protection for the residences, businesses, and public infrastructure at the same level provided prior to the 2006 flood event. The Corps has determined that failure to repair these levee sites greatly increases the probability of injury, loss of life, severe economic damage, and disruption of commercial, agricultural, and governmental practices and services.

2. Proposed Action. The action consists of emergency levee repairs that occurred in 2007 and additional repairs proposed for 2011. Construction in 2007 repaired damage that occurred as a result of the 2006 flood event. Flood damage reduction benefits are based on restoring the project performance back to the level that existed prior to the damaging event.

The Corps constructed repairs on 32 of these sites in 2007 (16,253 ft), with five of these sites having abbreviated construction that needs to be completed and three sites being deferred. Additional high water events in November 2008 and January 2009 resulted in further damage.

During summer 2011, repairs to 28 sites (11,430 ft) will be constructed. The total project length for all repairs considered in the EA is 27,683 linear feet (5.2 miles).

The majority of the work at each site occurred or will occur above the ordinary high water elevation (OHW). Excavation, clearing, and grubbing generally did not and will not occur below the water line, but it did and will occur on portions of the bank below OHW; material was and will be placed at the toe of the levee. Work above OHW consisted of and will consist of excavation of failed slope material and unsuitable deposits of sand and silt. The construction process was and will be as follows: clear and grub, reshape the slope, spall the slope, and install the armor rock. Mitigation features were or will be installed at all sites to offset the impacts of the construction. The features were designed for each site individually, taking into account the specific characteristics of each location. Mitigation features include willow lifts, bank plantings, a fish bench, a habitat weir, slope laybacks, anchored rootwads, and unanchored woody debris. All disturbed sites were or will be hydroseeded at the end of construction.

3. Summary of Impacts and Compliance. Pursuant to the National Environmental Policy Act, the attached EA has been prepared. The EA evaluates the environmental impacts associated with the emergency action and the preferred alternative and whether those actions would cause significant effects to the quality of the human environment. Because the 2007 repairs were considered an "emergency action" and have already taken place, it is evaluated retrospectively in this EA; only the 2011 proposed action is prospectively reviewed in the EA.

Based on the analysis in the EA, the levee rehabilitation projects on DD1, DD3, DD12, DD17, and DD22 levees have cumulative effects under NEPA and adverse affects to ESA-listed species. The main environmental impacts associated with levee repair come from the removal of riparian vegetation along the riverward side of the levees and replacing it with riprap. The reduction in riparian vegetation, loss of large woody debris recruitment, and loss of nearshore roots and undercut banks reduces or eliminates fish and wildlife habitat. The Corps has worked with the Diking Districts, the Skagit River System Cooperative, the U.S. Fish and Wildlife Service (USFWS), and the National Marine Fisheries Service (NMFS) to assess impacts and analyze potential mitigation options to fully offset the impacts to edge habitat. The proposed designs for the 2011 construction season include mitigation features that are designed to offset impacts from the full slate of 2007/2011 levee rehabilitation project.

This project will fully comply with the Endangered Species Act. A Biological Assessment (BA) was prepared and transmitted to the USFWS and NMFS dated February 2, 2011 with a determination of "*no effect*" for northern spotted owl, marbled murrelet, and eulachon, a determination of "*not likely to adversely affect*" for Southern Resident killer whale, and a determination of "*likely to adversely affect*" Coastal/Puget Sound bull trout, Puget Sound Chinook salmon, and Puget Sound steelhead, as well as designated critical habitat for Chinook and bull trout. The BA included a mitigation plan that was developed in concert with USFWS, NMFS, and the Tribes to offset project impacts on endangered salmonids and their critical habitat. The Corps anticipates receiving Biological Opinions from NMFS and USFWS covering the listed salmonid species. The Corps has received draft Terms and Conditions with draft Reasonable and Prudent Measures from both the USFWS and NMFS. Their draft input is aligned with measures discussed during the consultations to define the mitigation efforts. Once

the Corps receives the Draft Biological Opinions from NMFS and USFWS, the Corps will revisit the EA to determine whether the findings are still appropriate. This project will comply with Sections 401 and 404 of the Clean Water Act. The project has complied with the National Historic Preservation Act and the Corps has notified all recognized Native American Tribes in the project vicinity. This project complies with the Coastal Zone Management Act.

4. Finding. Based on the attached environmental documentation, coordination, and analysis conducted by the Corps environmental staff, I find the proposed action, which includes the levee rehabilitation together with the compensatory mitigation, will not result in significant adverse environmental impacts. The proposed action is not a major Federal action significantly affecting the quality of the human environment and therefore, does not require preparation of an environmental impact statement.

23 MAY 2011
Date

Anthony O. Wright
Colonel, Corps of Engineers
District Commander