Chapter 7 – History of Flood Management in the Skagit River Basin

7.0 Historical Flood Management

Many studies have been conducted to find the best approach to flood risk reduction in the Skagit River Basin.

7.1 Historical Flood Management - Studies Conducted

U.S. Army Corps of Engineer (USACE) and private study reports date back to the late 1800s. They go by many different names describing the type of study: preliminary examinations (used primarily to identify problems), surveys (used to determine if improvements are cost effective), reports, reexaminations, and GDMs (General Design Memorandums). There are also many USACE Annual Reports that to some degree supplement the aforementioned studies. Over the years, the reports grew in size and substance taking a look at many different approaches to flood control/flood risk reduction projects. For ease in reading, portions of the studies are arranged by the subject matter, they covered.

7.1.1 Log Jam Removal

An examination of Skagit River was made on October 1874, by Major Michler, in compliance with provisions of the river and harbor act of June 23, 1874, to ascertain the nature and extent of the jams or rafts, which interrupt its navigation. . . . The lower jam, at the time of this examination, was found to be about 1,700 feet long and 460 feet wide. . . . The second jam is only about a mile above the first, is similar in character, and about 4,000 feet long and 1,000 feet wide, the width being variable. (***Source:*** *USACE Annual Report, 1875*)

In 1877, nothing further having been done by the government, two men who had settled on the river lands above the rafts undertook to cut a steamboat channel through them with saws and axes, cutting loose the key logs during low water, leaving them to float off during floods. Assisted by occasional volunteers and by contributions of tools and provisions from parties interested in opening the river to navigation, the two originators of the project persevered in their work of hardship and danger for two years, until a passage wide enough for steamboats had been cut through; since which time those portions of the raft which were fast to the banks have floated off, leaving the channel clear. (***Source:*** *USACE Annual Report, 1881*)

About the year 1879, the Mount Vernon logjam was cut by private enterprise. After it was cut up the greater part of it went out, and, from what I have been able to learn, much of the drift which was floated out from this jam lodged in what was then the main steamboat channel, Old Main River, and completely closed it. Since the breaking up of the logjam and the construction of dikes in the river, confining the waters of the river and preventing them to a very great extent from spreading over the adjacent country, the floods in the lower river have naturally increased in height. The country to the west of Avon, however, has been to a very great extent reclaimed, and now contains many of the richest and most valuable farms in the State of Washington.

(***Source:*** *USACE Survey of Skagit River from its mouth to Sedro, Washington, December 11, 1897*)

BNSF Railroad Bridge Log Jam, Burlington, WA (1999)
(Courtesy of Skagit County Public Works)

7.1.2 Potential Flood Control Projects

Possible methods of relief from floods that should be considered include the following, either singly or in combination:

a. Flood prevention by reservoirs or detention basins, including natural river valley storage.
b. Flood protection by:
   (1) Dikes (levees)—
      (a) A revision or reconstruction of present system.
      (b) A system of emergency dikes built back of the present ones or for protection of special localities.
   (2) Channel improvements—
      (a) Straightening and enlarging present channel by widening and deepening, with possible bank protection.
      (b) Removal of drift and possible construction of drift barriers, clearing banks of timber and underbrush
c. Flood diversion by construction of an outlet or relief channel.

(***Source:*** *USACE Preliminary Examination of Skagit River, Washington, with a view to control the floods, February 26, 1925*)

43. Possible means of flood prevention would be: (*a*) Storage or detention reservoirs on the upper portion of the river or on the tributaries; (*b*) revision or reconstruction of the present diking system according to a properly designed plan; (*c*) a system of emergency dikes built back of the present ones; (*d*) construction of an outlet or relief channel above the Great Northern Railway bridge running to Padilla Bay; (*e*) straightening, widening, and deepening the channel of the present river bed with proper bank protection; (*f*) digging an entire new channel or channels through the delta with necessary bank protection; (*g*) enlargement of channel way at bridges; (*h*) removal of drift and construction of drift barriers; or some combination of these methods. *(**Source:** USACE Preliminary Examination of Skagit River May 9, 1928)*

82. Protective measures considered. – Four plans for reducing flood damage in the Skagit Basin have been considered: Storage of floodwaters, diversion of flood waters, modification of the existing diking system, and channel improvement. *(**Source:** USACE Preliminary Examination of Skagit River March 29, 1937)*

9. Basin objectives for flood control. Studies to date have confirmed that improved flood protection in the delta downstream from Sedro-Woolley is the highest priority need in the basin. Immediate flood control measures are needed to prevent large losses in areas that have developed markedly since the last major floods in 1951 and 1921, and are now only partially protected by levees. Long-range flood control measures to provide flood protection in the range of 75- and 100-year frequency will be required to permit future urban, residential and industrial developments. This type of high-level flood protection is required to realize enhancement benefits. However, the immediate need is for measures to relieve the hazard of flood damages from more frequent floods. The estimated average annual flood damage of $2,216,000 in the Skagit flood plain downstream from Sedro Woolley under present conditions is an excellent indication of the economic importance of immediate flood control measures. Basin planning to date has been directed toward developing first priority flood control and related measures that can be constructed with sound economic feasibility under present conditions, and to assure that these projects will retain their feasibility when considered with potential future projects. Possible means of providing flood control in the delta area include upstream storage, levee and channel improvements, and diversion. Current studies have indicated that single-purpose flood control storage is not economically feasible at the present time. Because added power in Cascade projects in the Pacific Northwest will not be marketable until at least 1975, consideration of a multipurpose upstream storage development to provide immediate flood protection for the delta area is not practical. Thus, the first-priority projects to provide immediate flood relief for the delta area are the authorized Avon Bypass and the levee and channel improvements downstream from the Bypass. *(**Source:** USACE Avon Bypass Skagit River Reactivation Report, November 1963)*

4. DISCUSSION OF PRIOR STUDIES, REPORTS, AND EXISTING WATER PROJECTS. In the 1920's and 1930's, two Corps studies were authorized by Congress to evaluate the need for flood control projects along the Skagit River. Neither study {see HD125 (69th-1st) and HD 157 (73rd-2nd)} resulted in a project recommendation. However, in 1936 Congress authorized the Avon Bypass Project (ABP) that would have diverted between 60,000 and 120,000 cfs of Skagit floodwaters through a bypass from Burlington to Padilla Bay. Never very popular with local residents, the ABP was classified inactive in 1952. Based on a subsequent Corps study, in 1966 Congress authorized another project that would have provided levee improvements and river channel deepening (L&CP) along the Skagit River from Burlington to the mouths and added recreation as a project purpose to the ABP. Advanced Engineering and Design Studies were begun in 1977 for the L&CP, resulting in completion of a GDM & EIS late in 1979. The project recommended in the GDM would have improved 50.4 miles of levees providing 100-year or SPF protection to urban areas and 50-year protection to rural areas at a cost of about $55 million. Bonds for the local share of project costs were defeated by Skagit County voters at the polls in November 1979 and the L&CP was deferred. Subsequently, both the ABP and the L&CP were deauthorized. *(**Source:** USACE Skagit River Flood Damage Reduction Study and Reconnaissance Addendum, March 29, 1997)*

7.1.3 Channel Improvement/Setback Levees

291. A system of dikes proportioned to carry the entire flow at a surface elevation approximating that obtaining under natural conditions, would include so much valuable agricultural land as to be prohibitive. A system of dikes proportioned to carry the entire flood flow within the lateral limits of the natural river channel and at velocities below the point of scour would require high and expensive dikes and would require, in addition, the raising of all bridges in the improved section and the construction of an expensive drop or series of drops at or near tidewater. The latter would also involve the construction of navigation locks. Upon investigation it was found that a compromise between these two extreme systems including some channel improvement would produce the cheapest method of flood protection. *(**Source:** USACE Report on Skagit River, Washington May 18, 1932)*

117. … A system of dikes proportioned to carry the entire flood flow at a surface elevation approximating that obtaining under natural conditions would include within the waterway so much valuable agricultural land as to be prohibitive in cost. *(**Source:** USACE Preliminary Examination of Skagit River March 29, 1937)*

119. Channel improvement. – Instead of creating the additional waterway required for passage of the flood waters by dikes alone it might be possible, and more economical, to combine dikes and channel improvement to provide the necessary cross-sectional area. This scheme would involve the construction of a protection dike on the right bank of the river from the high ground above Burlington to a point just upstream from the Great Northern Railway bridge. No dike is provided for the left bank along this stretch, as it is desirable to utilize this Nookachamps Creek area for storage at the higher river stages. This storage is valuable in that it reduces the flood

crests past the Great Northern bridge. The existing diked channel below the Great Northern bridge has an estimated maximum capacity of 140,000 second-feet, but the channel would not carry this discharge for long, as the dike material would soon become water-soaked and fail. To provide for a discharge of 220,000 second-feet (the greatest of actual record) below this point it would be necessary to enlarge the channel and to use the dredged material for the construction of adequate dikes. *(**Source:** USACE Preliminary Examination of Skagit River March 29, 1937)*

120. It is estimated that a channel from Sedro-Woolley to Skagit Bay via the North Fork of the Skagit River, adequate to carry safely a discharge of 220,000 second-feet, could require the excavation of approximately 56,000,000 cubic yards of material, and the acquisition of about 5,000 acres of agricultural land for right of way. It might be desirable in the interest of flood control to swing the outlet of the North Fork to the south, thus giving a charter route to tide-enter. This would also add navigation by reducing the amount of silting in the southern end of Swinomish Slough channel. *(**Source:** USACE Preliminary Examination of Skagit River March 29, 1937)*

100. Modification of existing diking system. – In its natural condition Skagit River, during flood periods, overflowed its banks and inundated a large portion of the delta. The flood waters reached Puget Sound not alone through the river channels proper, but also through the many sloughs and small drainage channels, and by passing directly across the flats. The existing dikes hold the river partially in bounds, although during severe floods the dikes frequently fail by "boils" before being overtopped. A system of dikes proportioned to carry the entire flood flow at a surface elevation approximating that obtaining under natural conditions would include within the waterway so much valuable agricultural land as to be proportioned to carry the entire flood flow at a surface elevation approximating that obtaining under natural conditions would include within the waterway so much valuable agricultural land as to be prohibitive in cost. *(**Source:** USACE Report on Survey for Flood Control of Skagit River & Tributaries July 30, 1940)*

102. Channel improvement. – Instead of creating the additional waterway required for passage of the flood waters by dikes along it might be possible, and more economical, to combine dikes and channel improvement to provide the necessary cross-sectional area. This scheme would involve the construction of a protection dike on the right bank of the river from the high ground above Burlington to a point just upstream from the Great Northern Railway bridge. No dike is provided for the left bank along this stretch, as it is desirable to utilize this Nookachamps Creek area for storage at the higher river stages. This storage is valuable in that it reduces the flood crests past the Great Northern bridge. The existing diked channel below the Great Northern bridge has an estimated maximum capacity of 140,000 second-feet, but the channel would carry this discharge for long, as the dike material would soon become water-soaked and fill. To provide for a discharge of 220,000 second-feet (the greatest of actual record) below this point it would be necessary to enlarge the channel and to use the dredged material for the construction of adequate dikes. *(**Source:** USACE Report on Survey for Flood Control of Skagit River & Tributaries July 30, 1940)*

103. It is estimated that a channel from Sedro-Woolley to Skagit Bay via the North Fork of the Skagit River, adequate to carry safely a discharge of 220,000 second-feet, could require the excavation of approximately 56,000,000 cubic yards of material, and the acquisition of about 3,000 acres of agricultural land for right of way. *(**Source:** USACE Report on Survey for Flood Control of Skagit River & Tributaries July 30, 1940)*

17. Flood protection by widening the Skagit River channel and setting back levees was also considered. To achieve the same results as the Bypass and levee improvements, the channel would have to be widened from 300 to 600 feet from the downstream limits of Sedro-Woolley to the mouth of the river, a distance of over 20 miles. This work would be infeasible as the cost would be about six to seven million dollars more than the cost of equivalent flood protection with the Bypass and downstream levee and channel improvements. One of the principal reasons for the higher cost of this plan is that much of the land on both banks of the river is well developed, and widening would require costly relocations and acquisition of land. ***(Source:*** *USACE Avon Bypass Skagit River Reactivation Report, November 1963)*

18. Widening of the river at its mouth, proposed as a flood control measure by local residents in the basin would provide only very localized flood protection. Such widening would lower flood stages slightly for a short distance upstream from the mouth of the river, but would not provide flood protection for the upper delta in the vicinity of Mount Vernon and Burlington. ***(Source:*** *USACE Avon Bypass Skagit River Reactivation Report, November 1963)*

7.1.4 Dams/Reservoirs

Faber dam sites Nos. 1 and 2. Below mouth of Sauk a 300 foot dam would back water up to the Gorge plant of the City of Seattle, and a 200 foot dam would give 1,700,000 acre feet of storage, which, if 600,000 acre feet were kept for flood control, would keep all ordinary floods down to 100,000 second feet on main river. Both of these sites are near the Faber ferry, Mr. Parker has cross-sections and geological reports, together with area and capacity curves. Make field investigations to determine feasibility of dam at both of these sites and if a good site is found, reservoir surveys should be made. **The Dalles on the Skagit River**. A site for a low head dam, which would back the water up to the tailwater of Baker River plant. Mr. Parker has suggested that in order to gain additional head, the water might be led from this dam through a tunnel to a power plant near the mouth of Finney Creek. **An earth fill dam could be built at Hamilton**, provided floods could be controlled so as not to exceed 100,000 second feet, this requirement being necessary on account of lack of necessary spillway capacity. The various dams proposed and under construction by the City of Seattle are matters of more or less general knowledge. However, in connection with the Ruby Dam, Mr. Parker says that by raising the elevation 35 feet above the elevation of water at the international boundary they can get complete regulation of the upper river, and with this in view the City is making unofficial negotiations with the Canadian authorities, and if any satisfactory basis for this development can be determined by these officials, the matter will be taken up directly through the State Department for final adjustment. ***(Source:** USACE MFR Dated May 18, 1928)*

279. *Flood prevention* – Works for flood prevention include all means of reducing the rate of flood flow. In this class are placed reservoirs or detention basins for the purpose of storing flood flows and feeding the water gradually back to the streams. Detention basins constructed for the sole purpose of storing floodwaters are impracticable on the Skagit River because of their great cost in proportion to the benefits. In the preceding discussion of the four major power projects–the Ruby, Cascade, lower Sauk, and upper Baker projects–some consideration was given to using the reservoirs connected with these projects for the joint benefit of power and of flood control. ***(Source:** USACE Report on Skagit River, Washington May 18, 1932)*

280. For the Ruby Reservoir, it was suggested that 200,000 acre-feet of storage be reserved for the storage of floodwaters. This amount of storage could be obtained in the 11 feet between elevations 1,700 and 1,689 feet, and would be sufficient to hold a 24-hour flow of 100,000 second-feet (the estimated maximum flood). If a free overflow spillway were used there would also be a temporary retention of flow above the spillway crest due to the time required to build up storage to a point that would create the head necessary for discharge of the flood waters. Such temporary retention would be beneficial in the delta area as it would probably delay the time of arrival of the crest from the upper Skagit sufficiently to insure that the crests from the lower tributaries would have already passed out. ***(Source:** USACE Report on Skagit River, Washington May 18, 1932)*

282. For the Sauk Reservoir, it was suggested that the 200,000 acre-feet between elevation 498 and 475 feet could be reserved for the storage of flood waters at no great detriment to power production. Actual flood discharge records are almost nil at this site, but the crest discharge of the 1921 flood has been estimated as about 70,000 second-feet[1]. The flood of February 1932 reached a crest discharge of 68,500 second-feet and the maximum 24-hour discharge about 51,400 second-feet. The 200,000 acre-feet would have been sufficient to hold all of the run-off for the maximum day for either of these two floods and could have held 96.2 percent of the run-off for the 3 maximum days of the February 1932 flood. In addition to the 200,000 acre-feet, there would be about 75,000 acre-feet of temporary storage above the spillway crest during a major flood. ***(Source:** USACE Report on Skagit River, Washington May 18, 1932)*

283. For the upper Baker Reservoir, it was suggested that the 39,500 acre-feet between elevations 704 and 694 feet could be reserved for the storage of flood waters at no great sacrifice of power. This amount of flood storage would retain over 70 percent of the maximum known 24-hour discharge of the stream. ***(Source:** USACE Report on Skagit River, Washington May 18, 1932)*

[1] In 2003 the Sauk River crested 107,000 cfs 18.89, 100 yr flood per USGS 11/10/03 Skagit Flood Control Meeting

83. Storage. – Reference has already been made to the two existing reservoirs on the river system. Although these two reservoirs have in the past operated to reduce flood flow, no reliance can be placed upon their efficiency at future flood periods, insomuch as both of these are now regulated solely to meet the exigencies of power demand. ***(Source:** USACE Preliminary Examination of Skagit River March 29, 1937)*

76. Detention reservoirs. – There are three power reservoirs in the Skagit River system: Shannon Lake on Baker River, and Diablo reservoir and Ross Lake on the upper Skagit River. As pointed out in paragraph 50, Shannon and Diablo reservoirs were effective in reducing the crest of the 1932 flood, although no provision had been made for flood storage in the reservoirs, Diablo Dam is now used principally to create head for the Diablo power plant of the city of Seattle and to provide daily pondage, Ross Dam furnishing practically all storage for the city's downstream power plants. Ross Dam was completed to elevation 1365 feet in 1939 and a timber bulkhead to elevation 1380 has since been added, giving a total storage capacity of 100,000 acre-feet. ***(Source:** USACE Report on Survey for Flood Control of Skagit River & Tributaries July 30, 1940)*

79. Storage. – Reference has already been made to the existing reservoirs on the river system. Although these reservoirs might, under normal power operation, furnish incidental flood control storage, such use cannot be assured for future floods. Numerous undeveloped power sites exist in the Skagit Basin (see H. Doc. 187, 73rd Cong., 2nd sess., p. 76 et seq.) but of the sites only four (including the Ruby site, now partially developed by Ross Dam) combine favorable dam sites with sufficient storage capacity to make them effective as flood control reservoirs. These four are the Ross (Ruby) site on the upper Skagit River, the Cascade site on the Cascade River, the lower Sauk site on the Sauk River, and the Baker Lake site on the upper Baker River. ***(Source:** USACE Report on Survey for Flood Control of Skagit River & Tributaries July 30, 1940)*

75. Ross Reservoir. – The city of Seattle owns and operates a series of hydroelectric power plants on the upper Skagit River. The uppermost site, Ross Dam and Reservoir, provides the necessary seasonal storage for the downstream plants, which are primarily head development projects with storage being limited to pondage. The system lies within the Mount Baker National Forest and all development has been done under Federal Power Commission license. The Federal Power Commission has required a storage reservation for flood control in Ross Reservoir. At the Commission's request, the Corps of Engineers is studying the flood storage requirement and recommendations will soon be made regarding the storage needed and the operating procedure. It is expected that the storage requirement will not exceed 200,000 acre-feet. By coincidence, winter flood storage required to realize a high degree of control on the upper Skagit does not seriously interfere with power production. Flood storage in Ross Reservoir cannot prevent major floods on the lower river, but it is estimated that peak

discharges at Sedro-Woolley will be reduced from 15,000 to 25,000 second-feet. *(**Source:** USACE Report on Survey for Flood Control of Skagit River February 21, 1952)*

81. Solutions considered. – Storage. – Flood control by storage has long been advocated as a possible solution to the Skagit Basin flood problems. Several sites for dams and reservoirs exist but not have been found at which a Federal project could be justified at this time. Justification of plans for storage in the Skagit Basin must depend principally on the benefits that could be obtained from hydroelectric power production at the storage sites. At only four sites can storage in significant amounts be obtained. They are the following:

- Faber site on Skagit River near Concrete
- Cascade site on the Cascade River
- Upper Sauk site on Sauk River above Darrington
- Upper Baker site on Baker River above Shannon Lake

Investigation of small, run-of-the-river power projects without flood control value was not undertaken in this study. *(**Source:** USACE Report on Survey for Flood Control of Skagit River February 21, 1952)*

83. With regard to the fish requirements, existing water supply and flow conditions are normally quite satisfactory for maintenance of salmon runs, and no improvements for that purpose are needed. The U.S. Fish and Wildlife Service and the Washington State Departments of Fisheries and Game were advised in 1949 of the studies being made on Skagit River and their comments were invited. In their replies they were unanimous in opposing the construction of a high dam at the Faber or lower Sauk sites because of the extensive loss to anadromous fishes that would result. They advised that the Skagit River is the best salmon stream in the State of Washington, with the exception of the Columbia River, and that construction of a dam at the Faber site would be a severe blow to all salmonoid migratory species now utilizing the Skagit. The reasons they gave were that the dam would be too high for the salmon to pass successfully, and the reservoir would flood large spawning grounds. The Sauk River and tributaries are highly regarded for the spawning areas they contain, and for the large steelhead and salmon population they support. The State Department of Fisheries submitted the opinion that a dam at the lower Sauk site would destroy the Skagit River as an important producer of anadromous fishes. *(**Source:** USACE Report on Survey for Flood Control of Skagit River February 21, 1952)*

85. The possibility of storage in the existing reservoir of Baker Dam was investigated. Winter flood control storage could be provided either by reducing the normal operating pool level or by raising the dam. It was found that neither method was economically feasible and that an equivalent amount of protection could be obtained at less cost by other means. *(**Source:** USACE Report on Survey for Flood Control of Skagit River February 21, 1952)*

12. Upstream storage. Few potential sites for upstream storage development are available in the Skagit River basin. A favorable site on the Sauk River six miles upstream from its confluence with the Skagit River appears to be the only location in the Skagit River basin at which major upstream storage is possible. Single purpose flood control storage on the Sauk is not feasible; however, a dam at this site could develop approximately 700,000 acre-feet of multiple-purpose storage. About 250,000 acre-feet of storage would be usable for flood control. This amount of storage would increase the 35-year flood protection in the delta afforded by the Avon Bypass and downstream levee and channel improvements to more than a 100-year level of protection. Effective storage in the Sauk River reservoir, with the present level of flood protection, could control a 10-year flood at Mount Vernon to 91,000 c.f.s. corresponding to minimum capacities of downstream levees with minor sandbagging. The Sauk River storage, together with the levee and channel improvements, would yield 30-year frequency flood protection in the delta. Multi-purpose storage in the Sauk project could also provide hydroelectric power, irrigation, recreation, and low flow augmentation in addition to flood storage. The largest multiple-purpose benefit for the project would be hydroelectric power. Because the hydroelectric power would not be marketable before 1975, the project could not be scheduled for in-service operation prior to 1975. As the project could not be justified until the power is marketable, the Sauk project should be considered a potential element in a future plan of water resource development. The Sauk River has large migratory runs of salmon and steelhead which constitute a significant part of both the sports and commercial fishery of the region. Opposition can be expected from fish and wildlife interests on any major storage project in the Skagit River basin. Such opposition is another reason that storage on the Sauk River should be considered only as a possible element of a future basin plan. Therefore the Avon Bypass and the channel and levee improvements in the delta would provide an immediate and very much needed first increment in a basin flood control plan. *(**Source:** USACE Avon Bypass Skagit River Reactivation Report, November 1963)*

47. UPSTREAM STORAGE

Ross Dam, on the upper main stem of the Skagit River, reserves 120,000 acre-feet of storage for winter flood control. This storage controls the Skagit River watershed upstream from Ross Dam. Operation of this storage has been assumed in all plans studied. Additional upstream flood storage is necessary to achieve the higher level of flood protection warranted in the delta for expansion of urban-type development, and to aid in protecting lands not now protected. In this last category, are lands upstream from Sedro-Woolley and lands in the delta in the vicinity of Nookachamps Creek, across the river from Burlington. As an initial criterion, an objective of a minimum 100-year frequency flood protection has been established for important urban areas. Subsequent studies will consider standard project flood projection. Preliminary hydraulic and hydrologic studies indicate that added flood storage of approximately 250,000 acre-feet are required in the upper river system for 100-year frequency flood protection. *(**Source:** USACE Skagit River Basin Flood Control and Other Improvements, March 1965)*

Five major hydroelectric dams have been built in the Skagit River Basin, with three of them being basically run-of-the-river and two of them ~ Ross and Upper Baker - having significant storage. Under provisions in their FERC permits, both dams provide flood control storage. Ross Dam (completed in 1949) provides about 120,000 acre-feet of flood control storage. Upper Baker (completed in 1959) originally provided 16,000 acre-feet for lost valley storage. As a follow-on to the PS&AW Comprehensive Study, a feasibility study verified that the provision to increase Upper Baker Dam's flood storage from 16,000 to 74,000 acre-feet, contained in its FERC permit, was justified. Based on HD 149 (95th) and approval by the Secretary of Army, the additional storage became available in 1977. Combined Ross and Upper Baker dams are able to reduce major flood flows in the lower valley by about 25,000 to 35,000 cfs. All remaining major flood control storage dam sites in the basin are located on river segments that are part of the National Wild and Scenic River System, thus precluding their use for future flood storage dams. *(**Source:** USACE Skagit River Flood Damage Reduction Study and Reconnaissance Addendum, March 29, 1997)*

7.1.5 Skagit River - Upper Baker Lake Flood Control Project

The planning study, carried out under the Puget Sound and Adjacent Waters Comprehensive Study authority, was completed in 1975. It recommended additional flood control storage be provided by a change in operation of Upper Baker Dam, owned by Puget Sound Power and Light Company (PSP&L) now known as Puget Sound Energy (PSE). In 1977, Congress authorized the project and storage was available during the winter of 1977-78. As part of Puget Sound Energy's (PSE) operating license of Baker Dam (amended by congress in 1976), PSE must maintain 16,000 acre feet of reservoir storage as replacement of valley storage eliminated by the development of the project. In addition, the license requires an additional 58,000 acre-feet of Federally authorized flood control volume up to a total of 100,000 AF of storage as requested by the Corps district engineer. The evaluation of additional storage under FERC's relicensing of the PSE hydroelectric project was deferred to the Skagit GI as part of a settlement agreement signed by interested parties to the 2006 FERC relicensing process. (USACE, 2009)

The flood control operation is governed by an agreement between the Corps and PSE, documented in the Water Control Manual for the dam. Under the agreement (and consistent with Article 32 of the license), PSE operates the Upper Baker project to provide 16,000 acre-feet of flood control storage space between November 1 and November 15. This requires that Baker Lake be drawn down to elevation 724.5 feet msl (NAVD 88) (3.2 feet below full pool) by November 1 of each year. Additionally, the agreement specifies that under normal operating conditions the full 74,000 acre-feet of flood control storage be provided from November 15 to March 1; this requires that Baker Lake be drawn down to elevation 711.56 feel msl (NAVD 88) by November 15 of each year (16.2 feet below full pool). (USACE, 2009)

During flood events when natural flow in the Skagit River is forecasted to exceed 90,000 cfs at Concrete, the Corps assumes responsibility for Baker Lake flood control regulation and coordinates the Upper Baker Project operation with Seattle City Light's Ross Lake reservoir on the Upper Skagit River to reduce the flood peak in the Lower Skagit River valley. Collectively, Baker Lake and Ross Lake reservoirs control runoff from about 40 percent of the Skagit River basin. The flood control storage space is used to retain water during floods that can be later released as the unregulated flood flows in the Skagit River recede (PSE, 2004). Additional information on PSE's Baker River Hydroelectric Project is provided in the following section. (USACE, 2009)

7.1.6 Diversion Channels

A high water Relief Channel can be built from above bridge #36 to Padilla Bay capable of carrying 100,000 sec. ft. This will require a water area of 80,000 sq. ft. with a velocity of flow of 5 ft. per second, or a cross section of 2000 ft. width with a depth of water of 10 ft. Such a high water channel would leave the land within the dykes in the same condition for farming purposes as it is at present but would effectively remove the danger of floods because, as soon as the discharge gets above a maximum of plus or minus 70,000 sec. ft. the surplus water will flow into the high water relief channel to Padilla Bay. As mentioned before, the waters flowing through the breaks in the dyke ahead of bridge #35 flow west to Swinomish Slough and Padilla Bay; they follow the Anacortes Branch of the Great Northern Railway. The relief channel should therefore follow approximately the same course, which would call for the relocation of some five miles of railroad. As the country traversed by the high water channel is of low elevation, there would be practically no excavation required, except what is wanted for the building of the dykes. *(**Source:** Proposed Flood Control, Skagit River, Robert Herzog, Assistant Engineer, GNRR, September 22, 1922)*

Below Sedro Woolley the river changes its general westerly course to one nearly south. At this point the distance to Padilla Bay is somewhat less than that to Skagit Bay, and a large portion of the flood overflows before the construction of dikes, as well as of those occurring afterwards due to the breaking of the dikes in this vicinity, have been into Padilla Bay through the Samish River[2], Joe Leary slough[3], and Indian and Telegraph sloughs. Artificial diversion channels would naturally follow the same general routes. (***Source:*** *USACE Preliminary Examination of Skagit River, Washington, with a view to control the floods, February 26, 1925*)

During a flood in 1932, which reached its maximum on Feb. 28th with a discharge of 158,000 second-feet, as recorded at Concrete gaging station about 9[4] miles above Burlington, the dikes failed at a point about 1/4 mile above the Great Northern Railway bridge and the greater portion of the valley to the west and southwest of Burlington was flooded. The flooded area was drained into the Joe Leary slough[5] and to the southwest into drainage, which eventually reached the Puget Sound through Telegraph, Indian, Sullivan and various unnamed sloughs and channels. *(**Source:** USACE Skagit River Flood Control River Enlargement and Dikes 1932)*

[2] The Samish River doesn't flow into Padilla Bay.
[3] This is incorrect, it should have read Gages Slough.
[4] This figure is incorrect. Concrete is approx. 36 miles above Burlington.
[5] This is incorrect, it should have read Gages Slough.

The most economical plan of diversion in the delta for the flood of 220,000 second-feet appears to be a by-pass channel with a capacity of 120,000 second-feet from Avon (mile 13) to Skagit Bay, a distance of 5.6 miles. The cost of such a by-pass, estimated at $4,500,000, is somewhat more than is considered justified by probable benefits. ***(Source:** USACE Report on Skagit River, Washington May 18, 1932)*

294. *Flood diversion* – Occasionally flood flows can be diverted from the places where harm is done to other places where the flood is less objectionable. The desirability of diverting a portion of the flood flows of the Skagit River is apparent. If a diversion could be effected upstream from Burlington at a reasonable cost, the danger and loss occasioned by floods in the delta area could be eliminated or reduced. No opportunity of diverting the flood flows exists above Sedro-Woolley. Two possible alternative diversion channels have been suggested below Sedro-Woolley – one, to divert just above Burlington, and the other to divert at Avon, below Burlington. The first of these would utilize the low land now occupied by Joe Leary Slough, and will be called the Joe Leary by-pass. The second will be called the Avon by-pass. … ***(Source:** USACE Report on Skagit River, Washington May 18, 1932)*

295. In designing both of these by-passes, locations and types of construction were proposed that required the absolute minimum of expenditure. The details of location and design might be questioned, but at least they represent the works having the minimum cost. If, as was expected, the cost of either or both of these plans proved to be unnecessary to work out improved or more satisfactory plans calling for a greater cost. ***(Source:** USACE Report on Skagit River, Washington May 18, 1932)*

109. Two possible routes exist by which a portion of the flood waters might be diverted from the Lower Skagit Basin; one, 9.6 miles long, to divert just upstream from Burlington and discharge into Padilla Bay by way of Joe Leary Slough; and the other to divert at Avon, downstream from Burlington, and also to discharge into Padilla Bay. The latter route, 5.6 miles long, is referred to herein as the Avon By-pass. The area protected by either by-pass is identical, about 66,000 acres, or 93 percent of the area flooded west of Sedro-Woolley. ***(Source:** USACE Preliminary Examination of Skagit River March 29, 1937)*

112. The alignment of the proposed Avon By-pass, as contemplated in the project document, was such as to deliver the diverted flood waters by the most direct route to Padilla Bay. Subsequent to the preparation of that report, oyster growing has been established as an industry on Padilla Bay, thereby creating a condition not anticipated in the project document. The Padilla Point Oyster Company has objected to the proposed discharge of flood waters from Skagit River into Padilla Bay, fearing that silt from the river would destroy the planted oysters and the value of the holdings as potential oyster lands. ***(Source:** USACE Preliminary Examination of Skagit River March 29, 1937)*

113. Under the plan of diversion only the top strata of the river waters would be diverted, the lower and heavier silt-bearing strata continuing to flow in the existing river channel. No records of stream flow at the proposed point of diversion are available, but from records of the gaging stations at Sedro-Woolley and Concrete it is estimated that the By-pass would have carried flood waters on only five, or possibly six, occasions in the last 28 years for a total of between nine and 18 days. ***(Source:*** *USACE Preliminary Examination of Skagit River March 29, 1937)*

114. It is pointed out in paragraph 86 that pollution of oyster beds would, under present conditions, follow any major flood. The Department of Health of the State of Washington withholds certification of shellfish growing areas where pollution is a menace to the public health. After careful study of the proposed Avon By-pass the Department states that, "This department feels it would not be detrimental to the public health to allow the construction of the Avon By-pass." ***(Source:*** *USACE Preliminary Examination of Skagit River March 29, 1937)*

95. Diversion. – As pointed out in paragraph 85, diversion of part of the flood flows of the Sauk River might be made to the North Fork of the Stillaguamish River near Darrington. Such a diversion would very materially reduce the flood heights through the Skagit River delta area, but would add to the already serious flood threat in the Stillaguamish basin. No further consideration, therefore, should be given to such diversion. ***(Source:*** *USACE Report on Survey for Flood Control of Skagit River & Tributaries July 30, 1940)*

98. The Avon By-pass, together with necessary channel improvement and revetment of the portion of the river between the high ground upstream from Burlington and the point of diversion, is the project adopted by the Flood Control Act of 1936. ***(Source:*** *USACE Report on Survey for Flood Control of Skagit River & Tributaries July 30, 1940)*

99. The opposition of local interests to the construction of the Avon By-pass, as expressed at the public hearing (see par. 77), is caused largely by the desire of these interests to avoid or reduce the very heavy contribution required of them under the adopted project. It is probably utterly impossible for them at the present time to make the required contribution and it may continue to be impossible for many years to come unless the required contribution is lowered by act of Congress. It is possible that a detailed survey of the proposed by-pass and a reappraisal of the required right-of-way would show that the right-of-way costs could be reduced slightly from those stated in the authorization, but such reduction would be too small to alter the ability of local interests to make the required contribution. ***(Source:*** *USACE Report on Survey for Flood Control of Skagit River & Tributaries July 30, 1940)*

68. Existing Corps of Engineers flood control projects. – Authorized project. – The Flood Control Act of 1936 authorized a project for the partial control of floods in the lower valley by diversion of part of floodwaters through a bypass to be constructed between the river at Avon and Padilla Bay. Other project works include channel widening and bank reveting between Burlington and Avon, concrete control works at the head of the bypass, and a concrete weir near the outlet.

The latest approved estimated cost is $3,150,000 for construction and $1,832,000 for lands and damages (1938 annual report of the Chief of Engineers). Local interests are required to provide without cost to the United States all lands, easements, and rights-of-way necessary for the construction of the project, hold and save the United States free from damages due to the construction works, and maintain and operate all the works after completion in accordance with regulations prescribed by the Department of the Army. The terms of local cooperation have not yet been met and no Federal funds have been appropriated for this project. *(**Source:** USACE Report on Survey for Flood Control of Skagit River February 21, 1952)*

Front Street, Mount Vernon, WA (1951)
(Courtesy of Roger Fox Collection)

The Avon Bypass project to divert a portion of floodwaters from Skagit River to Padilla Bay, was authorized by the Flood Control Act of 1936. Assurances of local cooperation were not forthcoming and the project has been inactive since 1952. … The project consists of a diversion channel eight miles long that would have a design capacity of 60,000 c.f.s. Structures include a gated intake control, a downstream overflow weir, an intermediate weir and eight new highway and two new railroad bridge crossings. The project includes extension end improvement of four miles of levees on the right bank of Skagit River immediately above the intake control structure. … The Avon Bypass project would cost $23,250,000, of which $4,150,000 are local interests costs. Average annual benefits of $2,102,000 for the project and average annual costs of $823,000 yield a benefit-cost ratio of 2.5 for the project. *(**Source:** USACE Avon Bypass Skagit River Reactivation Report, November 1963)*

23. Status of local support. The Skagit County Commissioners, by letter of 1 August 1962, indicated their willingness to furnish local cooperation. A copy of their letter is shown as Exhibit I of the Reactivation Report; The project is well supported by nearly all elements of state and local governments. A public hearing was held in Mount Vernon, Washington, on 10 January 1964 to present the Corps' plan for levee and channel improvement, and for the inclusion of recreation in the Bypass project. A portion of this meeting was devoted to the Avon Bypass. A record of the public hearing is attached as Exhibit 4. The Bypass project was indorsed by representatives of the State of Washington, the Board of County Commissioners of Skagit County, the City of Mount Vernon, the Skagit County Flood Control Council representing a majority of Diking Districts in the valley, granges, and various individuals and diking and drainage districts. A petition signed by 219 persons supported the Bypass. A list of proponents for the project is shown on Page 2 of the Public Hearing Record. *(**Source:** USACE Avon Bypass Skagit River Reactivation Report, November 1963)*

24. Opposition to the Bypass project was expressed by representatives of Fire District No. 6 and Diking District No. 12, on the grounds that the Bypass cost would be excessive, would sever the Districts, and make access difficult. Several landowners along the path of the Bypass channel objected to the loss of farmland that would result from construction of the project. A petition signed by 740 persons was presented by a citizen's group that opposed the use of the Bypass on the following grounds:

a. The Bypass will not provide protection for major floods.
b. The Bypass will endanger a new area to flood hazard.
c. The Bypass will cause eventual silting-up of shallow Padilla Bay.
*(**Source:** USACE Avon Bypass Skagit River Reactivation Report, November 1963)*

Modification of the authorization for the Avon Bypass is an important part of this report. Accordingly, a detailed description of the proposed Bypass is included herein. The present plan for the project, shown on plate 7, has on eight mile channel with intake from the Skagit River about 1 mile downstream from Burlington and proceeding westward through Gages Slough and along the southerly fringe of Bayview Ridge to Padilla Bay. The channel would be 360 feet wide at the bottom. Flow depths for a normal capacity of 60,000 c.f.s. would be about 25 feet. The channel would have four control structures, as shown on plate 8, included a gated concrete intake, two collapsible type immediate weirs to control groundwater levels, and an ungated concrete outlet structure to control channel velocities and to prevent saltwater intrusion into the channel. The intake and outlet channel structures would be equipped with gated and screened sluices to control channel water levels during non-flood periods, to accommodate interior drainage runoff, and to prevent entrapment of migratory fish. The route would require construction of eight highway and two railroad bridges, alteration of a natural gas pipeline and an oil pipeline, and relocation of miscellaneous local utilities. The project also includes improvement and extension of four miles of levee on the right bank of Skagit River immediately above the Bypass intake. The Avon Bypass would cost $23,940,000, and would have a benefit-to-cost ratio of 1.6 to 1 with other elements of the basin plan. *(**Source:** USACE Skagit River Basin Flood Control and Other Improvements, March 1965)*

7.1.7 Skagit River Avon Bypass Flood Control Project

This Corps project included a diversion channel from near Burlington to Padilla Bay, a gated control structure near the intake, a control weir near the outlet and a levee on the right bank upstream from the bypass. This project was first authorized by the Flood Control Act of 1936, but was classified inactive in 1952 because local requirements could not be met. Site selection studies were completed again in the 1960s, and construction authorized. However, the sponsor was not able to meet local participation requirements. The project was deauthorized January 1, 1990, under provisions of Public Law 99-662. (USACE, 2009)

7.1.8 Dredging

Dredging could be expected to benefit navigation only at the mouth of the river, as the depth of water from a short distance inside the mouth to Mount Vernon is ample, and above Mount Vernon the character of the river and navigation are such that it is impracticable to benefit navigation by that means. If a channel were dredged from deep water inside the mouth to deep water outside, boats could then enter and leave the river independent of the tide, so that they could run on a fixed time table. But aside from their more regular hours of leaving I do not believe any material advantage would result. . . . While dredging might possibly increase the slope of the flood water for a short distance back from the mouth at low tide, I do not see how it could be of much benefit during high tides. If dredging would prevent the tide rising in the river it would be of some benefit to dredge, but as long as it does not do this, it does not appear that the dredging would do much good, for no matter what might be the slope of the water surface in the river during low tide, at high tide the slopes and heights would be the same as they are now. (***Source:*** *USACE Survey of Skagit River from its mouth to Sedro, Washington, December 11, 1897*)

95. Dredging main river channels. – Local interests have also stated that the bed of Skagit River and its forks is rising to the extent that flood stages are higher now than they were in the past. To check this statement, two river-sounding surveys have been compared. A detailed survey of the river was made by the Corps of Engineers about 1930. Using similar data and contact points, a check survey of both forks and the main river up to Mount Vernon was made in 1950. Average river-bottom profiles were drawn and it was found that no significant overall change had taken place in the river channels in the past 20 years. However, below the diked areas where the river enters Skagit Bay the tide flats are increasing because Skagit River

serves quite a large suspended load, whereas in the river channels to which flood stages are related, a condition of stability or equilibrium has been reached. Because of this natural state of equilibrium between the erosive and filling power of the river, it is believed that any lowering of the river bottom by dredging would merely be temporary. If major levee improvements were ever undertaken, a likely source of material would be from the river bottom, but for the reasons just cited, no appreciable increase in carrying capacity should be attributed to the channel excavation. No further study of flood relief by dredging main river channels is believed warranted at this time. *(**Source:** USACE Report on Survey for Flood Control of Skagit River February 21, 1952)*

14. Proposed Improvement. – The proposed improvement would provide for a barge channel 6 feet deep and 100 feet wide through bars in the Skagit River between Mount Vernon, about mile 14, and Concrete, Washington about mile 54. The estimated bottom and a typical section of the proposed channel are shown on enclosure No. 3. The channel depth would be measured below the water surface profile for a flow of 9,000 cubic feet per second. Channel side slopes would be 1, vertical, on 6, horizontal. The channel would be in the deepest part of the natural streamshed. Spoil would be deposited within the banks of the high water channel, but as far outside the dredged channel as possible. No attempt would be made to maintain the channel at a fixed location, but as streamshed conditions change, maintenance dredging would be accomplished along the most favorable alignment. After project completion, barges and log rafts towed from upriver points assembled in the vicinity of Mount Vernon or in the North Fork until the conditions are favorable. The tows would then be moved through the North Fork and cut over the entrance bar at high tide. Minor shoals below Mount Vernon would be dredged to the extent necessary to permit barges to reach the lower part of the North Fork in time to move out at high tide. *(**Source:** USACE Feasibility Report Skagit River, WA (Navigation), January 18, 1963)*

16. Deepening the Skagit River to carry flood flows is not feasible. Substantial deepening of the river to carry flood flows would undermine existing levees along the river banks. The Skagit River carries large quantities of bed sediment estimated at more than 500,000 cubic yards annually. An excavated channel of sufficient depth to carry flood flows would require annual dredging to remove deposited sediment and would be economically impracticable. *(**Source:** USACE Avon Bypass Skagit River Reactivation Report, November 1963)*

7.1.8 Levees

In my opinion, the only manner in which the farmers of the Skagit Valley can get relief from the disastrous freshets which visit them is by a proper system of diking. The State law is very full and explicit in regard to diking. . . . I am of the opinion that the greater part of the trouble on the Skagit River is due to the incomplete system of dikes. The river is divided into several diking districts, but I don not understand that any one general and systematic plan for the construction of dikes for the lower river has ever been agreed upon. In some places the dikes seemed to be unnecessarily high, in other dangerously low, and in a good many places they are weak and thin and for long distances they are entirely too near the river banks. The placing of the dikes so near the river banks confines the waters so much that at times of freshets an abnormal rise is produced, and it also exposes the dike to the swift current, which soon washes it away. The greater part of the breaks in the dikes along the Skagit River within the past two or three years have been due to this cause, or to the fact that the dike was so near the bank of the river that the bank gave out underneath and actually tumbled the dike into the river. It appears to me that the proper solution of this problem requires the formation of the entire part of the Skagit Valley needing dike protection into a single diking district and the appointment of a competent experienced civil engineer to take entire charge of the building and maintenance of all the dikes on the river. (***Source:*** *USACE Survey of Skagit River from its mouth to Sedro, Washington, December 11, 1897*)

In the absence, however, of any well studied or properly coordinated plans they have in many cases been improperly designed and located, the distance apart varying from 680 feet to over 1,200 feet along the main river above the forks. In general, in an effort to enclose as much land as possible, they have been placed close to the riverbank without reference to the area required for the passage of floodwaters. As a result, frequent breaks have occurred due both to overtopping and undermining riverbank and dikes. (***Source:*** *USACE Preliminary Examination of Skagit River, Washington, with a view to control the floods, February 26, 1925*)

It appears undesirable to impose any further restrictions upon the natural valley storage by the construction of additional dikes unless arrangements be made by means of spillways and gates to utilize these areas as reservoirs in times of large floods. This has particular application to an area on the south bank adjoining the Nookachamps Creek which it has been proposed to protect by dikes. This area, approximately 10 square miles in when flooded to an average depth of seven feet has a reservoir capacity of about 45,000 acre feet. This is sufficient to absorb a discharge of some 22,000-acre feet per second for 24 hours or double that amount for 12 hours and acc9ounts for the smaller discharge at Mount Vernon then Sedro-Woolley. (***Source:*** *USACE Preliminary Examination of Skagit River, Washington, with a view to control the floods, February 26, 1925*)

Under the present plan of development, it is proposed to provide for a flood discharge of 220,000 second-feet, which equals the floods of 1909, the maximum of the years of record. With a discharge of 220,000 second-feet, the water surface in the river at a point east of Burlington will be approximately elevation 42. (This elevation was determined by the probable elevation in the 1921 flood and is thought to be conservative for a discharge of 220,000 second-feet), while the elevation of tidewater 18 miles below varies from 8.17 at high tide to -10.83 at low tide.[6] At the inception of this study it was proposed to confine the improvement necessary to increase the capacity of the channel to 220,000 second-feet to a system of dikes, except for a short section of channel excavation at the Great Northern Railway bridge near Mount Vernon. It was found to be impractical to confine the improvement to a system of dikes as proposed for various

[6] Hand written note: (referred to mean sea level).

reasons and that any efforts toward making the present channel adequate to handle a discharge of 220,000 second-feet would, to a major extent, consist of channel enlargement. . . . The elevation of the water surface in the plan as proposed at present will be about 42 feet at a point east of Burlington, the upper end of the section requiring improvement in order to protect Skagit Valley. With a water surface elevation of about 34 the Great Northern Railway bridge would be adequately protected, as this structure withstood the 1921 flood when the water surface is reported to be in excess of elevation 38. ***(Source:** USACE Skagit River Flood Control River Enlargement and Dikes 1932)*

288. *Flood protection* .– Works for flood protection do not reduce the flood flows, but protect against them. These works include levees, or dikes, and channel improvements. Channel improvements on the Skagit for the benefit of navigation alone are not justified, except possibly some snagging and minor works; so that the entire cost of such improvements could not be divided between navigation interests and parties benefited by flood-control works, but should be carried entirely by the latter. ***(Source:** USACE Report on Skagit River, Washington May 18, 1932)*

289. Study was given to the improvement of Skagit River below Burlington by a coordinated system of dikes and channel betterment as a means of protecting the delta area from floods. The study was limited to such improvements as might be required to safely carry a flood of 220,000 second-feet, this being the discharge of the 1909 flood at Sedro-Woolley–the largest of actual record, although a flood of almost double this discharge is believed to have occurred about 1815. ***(Source:** USACE Report on Skagit River, Washington May 18, 1932)*

290. At the beginning of this study it was intended to confine the improvements, excepting for a certain amount of channel excavation at the Great Northern Railway bridge, to a system of dikes. Upon investigation, however, it was found to be impracticable to confine the improvement to a system of dikes. In its natural condition the Skagit River, during flood periods, overflowed its banks and inundated a large portion of the delta. The flood waters reached Puget Sound, not along through the river channel proper, but also through the many sloughs and small drainage channels and by passing directly across the flats. At the present time the river is partially held in bounds by dikes that have been constructed by local organizations. These dikes have been constructed without a well-developed general plan and are entirely inadequate to handle a major flood. During severe floods the dikes frequently fail by boils before being overtopped. ***(Source:** USACE Report on Skagit River, Washington May 18, 1932)*

291. A system of dikes proportioned to carry the entire flow at a surface elevation approximating that obtaining under natural conditions, would include so much valuable agricultural land as to be prohibitive. A system of dikes proportioned to carry the entire flood flow within the lateral limits of the natural river channel and at velocities below the point of scour would require high and expensive dikes and would require, in addition, the raising of all bridges in the improved section and the construction of an expensive drop or series of drops at or near tidewater. The

latter would also involve the construction of navigation locks. Upon investigation it was found that a compromise between these two extreme systems including some channel improvement would produce the cheapest method of flood protection. ***(Source:** USACE Report on Skagit River, Washington May 18, 1932)*

292. This compromise scheme involved the construction of a protection dike on the right bank of the river from the high ground above Burlington … to a point just upstream from the Great Northern Railway Bridge. No dike was provided for the left bank along this stretch, as the adjacent Nookachamps area affords considerable storage at the higher river stages. This storage is valuable in that it reduces the flood crests past the Great Northern Bridge. The existing diked river system below the Great Northern Bridge has an estimated crest flood capacity of 140,000 second-feet. The diked channel would not carry this amount indefinitely as the dike material would soon become water-soaked and fail. To provide for a flow of 220,000 second-feet below this point, it was planned to enlarge the channel and to use the dredged material for the construction of adequate dikes. ***(Source:** USACE Report on Skagit River, Washington May 18, 1932)*

118. A system of dikes proportioned to carry the entire flood flow within the lateral limits of the natural river channel and at velocities below the point of scour would require high and expensive dikes, and, in addition, the raising of all bridges in the improved section and the construction of an expensive drop or series of drops at or near tidewater. The latter would probably also involve the construction of navigation locks. ***(Source:** USACE Preliminary Examination of Skagit River March 29, 1937)*

72. The levees were built at various times starting in 1897 without the benefit of an over-all plan or design. These levees have been constructed of materials most readily available, usually fine river sand and silt. Heights vary from 5 to 10 feet, side slopes average about 1 on 2.5 or steeper, and top widths are narrow, usually only 2 or 3 feet. The floods of November 1949 and February 1951 afforded a good opportunity to observe the effectiveness of the levee system. Major levee breaks occurred during both floods below the forks and during the larger flood (February 1951) severe breaks between Burlington and the forks were averted by extensive flood fighting and the fact that the dangerously high river stages were of short duration. The failure of certain levee sections reduced river stages so that other breaks did not occur. In all major past floods of record similar levee breaks have taken place in one or two scattered areas with the result that only part of the flood plain has been inundated at any one time. The pattern of levee failures has not been consistent, and no means exists for predicting the location of future breaks. Since 1932 the levees upstream from Mount Vernon have been raised and strengthened more than downstream levees so that more breaks would be expected in the downstream areas for medium floods. Higher floods of the magnitude of those in 1909, 1921, and 1951, would endanger the entire levee systems from Burlington downstream. ***(Source:** USACE Report on Survey for Flood Control of Skagit River February 21, 1952)*

Levee Break at Fir Island, Mount Vernon, WA (2001)
(Courtesy of Skagit County Public Works)

89. Levee improvement. – Existing levees vary in height usually from 5 to 8 feet, with a few sections about 10 feet high. The levees generally have a very narrow top width, frequently less than 2 feet, which results in an inadequate cross section subject to leakage and wash-outs. For cost estimates of improvements to the existing levees, a standard cross section having a top width of 12 feet and side slopes of 1 on 2.5 was used. A 12-foot top width is required for proper stability and access for maintenance. Estimates were made for modifying and raising all main river levees from Burlington downstream. Water surface profiles for assumed design floods were computed and a 3-foot freeboard allowed. The existing levee alignment was followed in most cases. *(**Source:** USACE Report on Survey for Flood Control of Skagit River February 21, 1952)*

92. The maximum flood of record (1909) had an estimated discharge of 220,000 second-feet at Sedro Woolley. Taking into consideration the existence of Ross Reservoir, a recurrence of the 1909 flood under existing conditions would result in a discharge of about 185,000 second-feet at Sedro-Woolley, requiring a channel capacity below Burlington of about 170,000 second-feet. These reductions in peak flow would be caused first by storage in Ross Reservoir, which would give a lower peak at Sedro-Woolley, and second, by natural storage in the Nookachamps Creek area. The least degree of protection believed advisable for a Federal flood control project is one which would give protection against a flood somewhat greater than the maximum of record. For the discussion herein, a flow of 250,000 second-feet at Sedro-Woolley may be considered as the minimum design flood. The flow of 250,000 second-feet at Sedro Woolley would be reduced

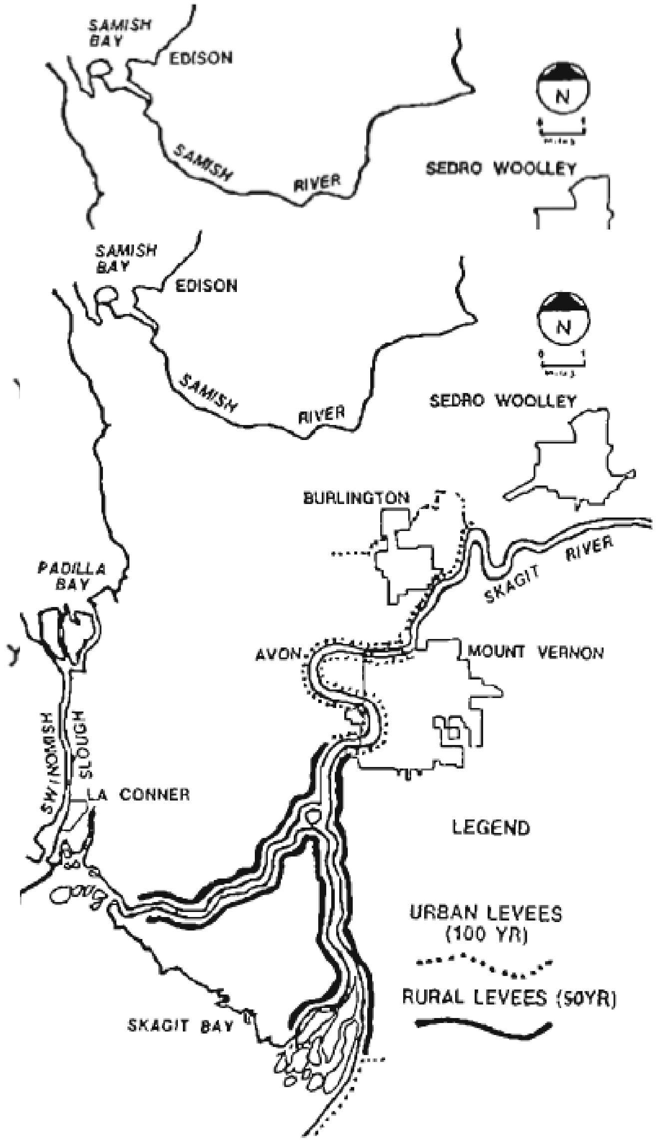
by natural storage in the Nookachamps Creek area so that 220,000 second-feet would be the resulting discharge to be taken care of below Burlington. ***(Source:** USACE Report on Survey for Flood Control of Skagit River February 21, 1952)*

10. Levees. The Skagit River flood plain downstream from Sedro Woolley is protected by 43 miles of riverbank levees. These levees have capacities varying from 91,000 to 143,000 cubic feet per second. Overtopping of low areas in the levee system begins at flows of 84,000 c.f.s. Through sandbagging of low areas and minor flood fighting, the levees can provide capacity for a 91,000 c.f.s. flow with an average minimum freeboard of one foot. The levee system now affords protection from probable floods of once in 3 to once in 10 years. Levee and channel improvements proposed in the forthcoming survey report would give the entire levee system a minimum capacity of 120,000 cubic feet per second to protect against floods with an expected occurrence of once in seven years. ***(Source:** USACE Avon Bypass Skagit River Reactivation Report, November 1963)*

11. Protection for flows exceeding 120,000 c.f.s. would require major raising of the existing levee system. The existing levee system rests on sand and silt foundations prevalent in the delta. Differential heads of water in flood flow periods result in seepage through levee foundations, causing boils and blowouts that flood adjacent croplands. The semi-pervious foundation conditions preclude any general raising of levees without extensive broadening of the levee sections, construction of cutoffs to reduce seepage, and relocation of the road systems adjacent to the levee system. A project to provide flood protection by major levee and channel improvements would cost six to seven million dollars more than a project to provide equivalent flood protection with the Bypass and downstream levee and channel improvements, and was therefore found infeasible. ***(Source:** USACE Avon Bypass Skagit River Reactivation Report, November 1963)*

43. IMPROVEMENT OF EXISTING LEVEE SYSTEM
The existing levee system rests on a foundation of silts and sands common to the delta area. Differential heads of water in flood flow periods result in seepage through levee embankment and levee foundations, causing boils and blowouts that flood adjacent croplands. The semi-pervious foundation conditions preclude any general raising of levees without extensive broadening of the levee sections, construction of cutoffs to reduce seepage and relocation of the road systems adjacent to the levee system. Major raising of the levee system was found uneconomical. The costs of providing flood protection by not major raising of levees to accommodate a flow of 144,000 c.f.s. downstream from Sedro-Woolley would exceed $28,000,000. This compares to the estimated $23,940,000 cost of the Avon Bypass to provide essentially the same degree of protection. Major levee raising would result in backwater effects from confining flows between levees that would cause more than a 3-foot rise in water surface upstream from Sedro-Woolley. The cost of levees to protect upstream areas from these backwater effects is not included in the above major levee raising cost. Because these studies showed the Avon Bypass to be a more economical and more effective plan than raising the

levees, no further consideration was given to major raising of the levee system. *(**Source:** USACE Skagit River Basin Flood Control and Other Improvements, March 1965)*



Alternative 3A – Rural and Urban Levees

Description: This alternative would involve improving the existing levee system to raise the level of protection for rural land to 50-year and for urban land, including Burlington and west Mount Vernon on the right bank and Mount Vernon on the left bank. The levee design would include allowances for wave action, superelevation, and future sedimentation. Rural levees would have a freeboard (factor of safety) of 2 feet and urban levees 3 feet. Drainage outlets would be modified as required. Flood plain management would still be required for areas outside the urban levees, including zoning, flood warning system, etc.

Effects:

Flood Damage Reduction: 34,900 acres of land would be provided rural protection (50-year), and 6,600 acres of land would be provided urban protection (100-year). The project would raise 100-year water surface elevations in the Samish overflow area by about one foot east of I-5 and ½ foot west of I-5. The effect would be negligible in the Nookachamp-Clear Lake area. *(**Source:** USACE Levee Improvement Study December 1978)*

Alternative 3B – Rural and Urban Levees

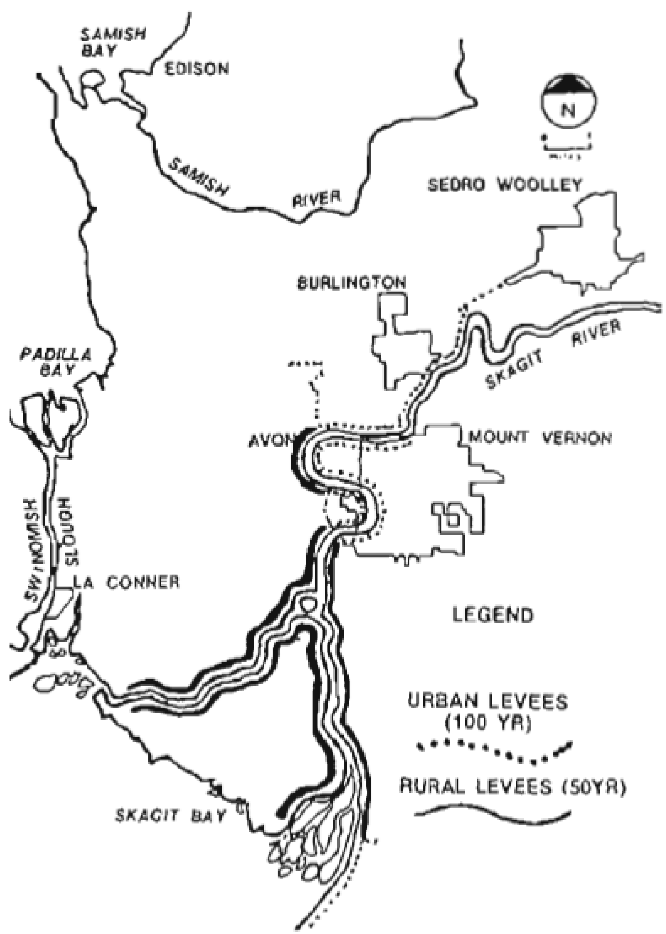
Description: This alternative would involve improving the existing levee system to raise the level of protection for rural land to 50-year and for urban land, including Burlington, Avon, and west Mount Vernon on the right bank and Mount Vernon on the left bank. The levee design would include allowances for wave action, superelevation, and future sedimentation. Rural levees would have a freeboard (factor of safety) of 2 feet and urban levees 3 feet. Drainage outlets would be modified as required. Flood plain management would still be required for areas outside the urban levees, including zoning, flood warning system, etc. (Source: USACE Levee Improvement Study December 1978)

Effects:

Flood Damage Reduction: 29,700 acres of land would be provided rural protection (50-years), and 11,800 acres of land would be provided urban protection (100-year). The project would raise 100-year water surface elevations in the Samish overflow area by about 3 feet east of 1-5 and 2 feet west of 1-5 and in the Nookachamps-Clear Lake area by about 1/2 foot. *(**Source:** USACE Levee Improvement Study December 1978)*

Alternative 3C – Rural and Urban Levees

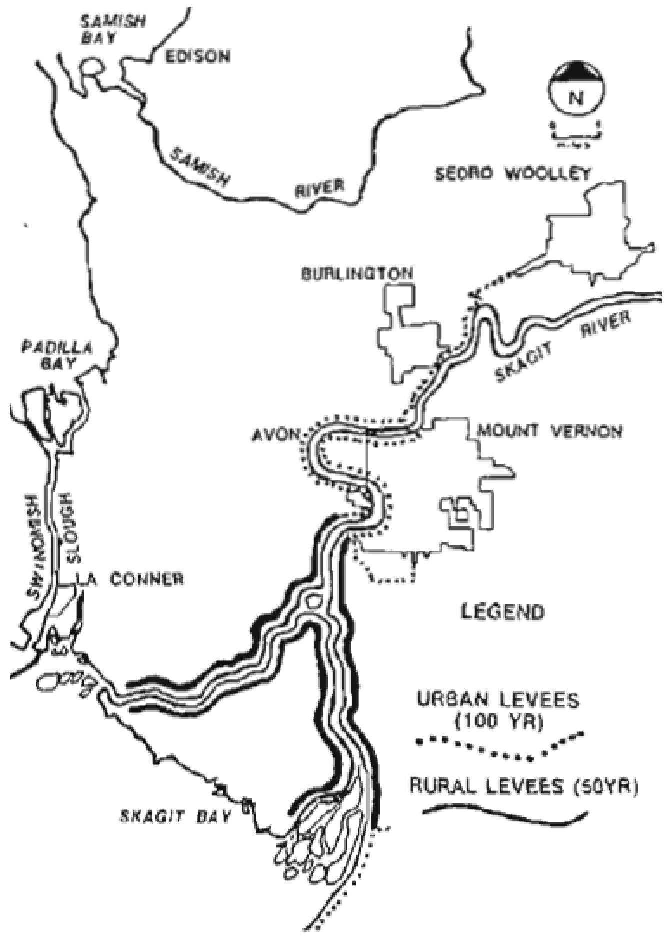
Description: This alternative would involve improving the existing levee system to raise the level of protection for rural land to 50-year and for urban land, including west Sedro Woolley, Burlington, and west Mount Vernon on the right bank and Mount Vernon on the left bank. The levee design would include allowances for wave action, superelevation, and future sedimentation. Rural levees would have a freeboard (factor of safety) of 2 feet and urban levees 3 feet. Drainage outlets would be modified as required. Flood plain management would still be required for areas outside the urban levees, including zoning, flood warning system, etc.



Effects:

Flood Damage Reduction: 34.900 acres of land would be provided rural protection (50-year), and 16,800 acres of land would be provided urban protection (100-year). The project would prevent 100-year Skagit floods from overflowing to the Samish. However, flooding would still occur due to Samish River flows on 14,500 acres. The Nookachamps-Clear Lake area would experience an increase in the 100-year water surface elevation of about 1.5 feet. *(**Source:** USACE Levee Improvement Study December 1978)*

Alternative 3D – Rural and Urban Levees



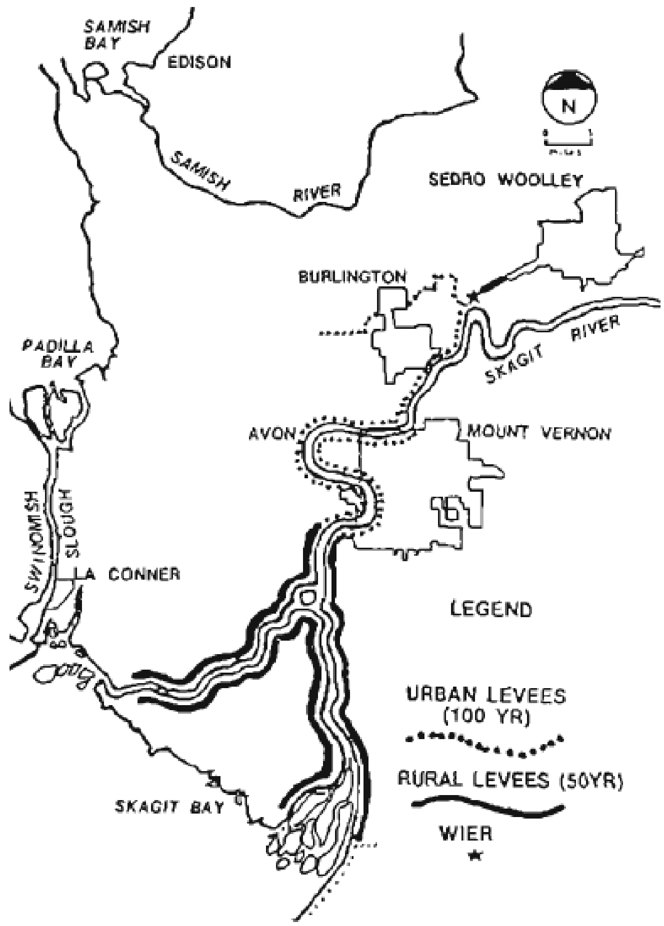
Description: This alternative would involve improving the existing levee system to raise the level of protection for rural land to 50-year and for urban land, including west Sedro Woolley, Burlington, Avon, and west Mount Vernon on the right bank and Mount Vernon on the left bank. The levee design would include allowances for wave action, superelevation, and future sedimentation. Rural levees would have a freeboard (factor of safety) of 2 feet and urban levees 3 feet. Drainage outlets would be modified as required. Flood plain management would still be required for areas outside the urban levees, including zoning, flood warning system, etc. (Source: USACE Levee Improvement Study December 1978)

Effects:

Flood Damage Reduction: 29,700 acres of land would be provided rural protection (50-year), and 22,000 acres of land would be provided urban protection (100-year). The project would prevent 100-year Skagit floods from overflow to the Samish. However, flooding would still occur due to Samish River flows on 14,500 acres. The Nookachamps-Clear Lake area would experience an increase in the 100-year water surface elevation of about 4.5 feet. *(**Source:** USACE Levee Improvement Study December 1978)*

Alternative 3E – Rural and Urban Levees

Description: This alternative would involve improving the existing levee system to raise the level of protection for rural land to 50-year and for urban land, including Burlington, Avon, and west Mount Vernon on the right bank and Mount Vernon on the left bank. The levee design would include allowances for wave action, superelevation, and future sedimentation. Rural levees would have a freeboard (factor of safety) of 2 feet and urban levees 3 feet. A weir would be built between Burlington and Sedro Woolley to limit 100-year Samish overflows to the same as under existing conditions. Drainage outlets would be modified as required. Flood plain management would still be required for areas outside the urban levees, including zoning, flood warning system, etc (Source: USACE Levee Improvement Study December 1978).



Effects:

Flood Damage Reduction: 40,000 acres of land would be provided rural protection (50-year), and 11,800 acres of land would be provided urban protection (100-year). The project would raise 100-year water surface elevations in the Nookachamps-Clear Lake area by about one foot. ***(Source:*** *USACE Levee Improvement Study December 1978)*

7.1.9 Skagit River Levee and Channel Improvements Flood Control Project

This Corps project was authorized by Congress in 1966. The project would have involved levee raising and strengthening and channel modifications from the Burlington Northern railroad bridge in Mount Vernon to the mouth of the Skagit River. Advance engineering and design studies were started in 1977 and a general design memorandum was completed in 1979. The report recommended a change in the authorized project to provide 50-year flood protection to rural lands downstream of Mount Vernon and 100-year flood protection for the urban areas from Mount Vernon to Sedro-Woolley, with standard project flood protection for downtown Mount Vernon. Nonstructural measures were included to reduce flood damages in the Nookachamps Valley and the Sterling area. In November 1979, Skagit County voters rejected a proposition to provide funding for the local share of costs. Skagit County withdrew as the sponsor, and, consequently, further effort on this project was terminated. The project was deauthorized in July of 1995 under provisions of Public Law 99-662. (USACE, 2009)

Reconnaissance Phase Alternative Plans. The RR identified three alternative plans to the "Do Nothing" condition. These included: 1) a Samish Bypass Overflow Channel (diverting 80,000 cfs. above Burlington through the Bypass to Samish Bay), 2) Improvement of the Existing Levee System (to provide 100-year urban protection and 25-year or greater rural protection) with constructed overflow levee segments in rural areas to permit the system to be overtopped without failing, and 3) Alternative 2 (with possibly higher levels of protection) in combination with a levee to protect the Nookachamps-Clear Lake Area (with an overflow that would provide protection similar to the other rural areas). *(**Source:** USACE Skagit River Flood Damage Reduction Study and Reconnaissance Addendum, March 29, 1997)*

Alternative 2. This alternative would provide a high level of protection to the urban areas of the delta through a system of new and raised levees with overflow sections at critical locations in rural areas designed to overtop without failure. This alternative had originally been suggested by two Skagit County Commissioners because they felt it had the best chance to improve the existing dangerous situation within the financial capability of the County to provide its share of project funding. They also believed this plan would insure that the currently rural areas of the county on the flood plain, primarily used for agriculture, would remain rural, not be removed from the 100-year flood plain, and not undergo conversion from farmland into residential and commercial developments. The cost of the plan, as identified in the RR, would have be about $49 million. Following approval of the RR, NPD Real Estate raised some questions regarding the analysis. A further review was also made of this plan. When the proper cost adjustments were included in the analysis, the total project cost increased to $53.5 million with a benefit-to-cost ratio of 1.1 to 1.0. While this is close to unity, it does justify moving forward into the feasibility phase where the analysis can be refined and the most advantageous plan determined. *(**Source:** USACE Skagit River Flood Damage Reduction Study and Reconnaissance Addendum, March 29, 1997)*

Alternative 3. This alternative looked promising at the time of the RR. However, based on questions raised by NPD Real Estate regarding the analysis, a further review was made of this plan. Originally, this plan had considered combining levee improvements with floodproofing properties in the area that would experience increased flooding due to project construction. When the costs of buying out and relocating these properties in the floodway near the Nookachamps and obtaining flowage easements where flooding would be increased by project construction are included in the economic analysis, the benefit-to-cost ratio for this alternative dropped to 0.8 to 1.0, at best. No further consideration of this alternative in the feasibility study is anticipated.

Based on the RR, Alternative 2 would involve upgrading about 39 miles of existing river levees and providing about 11 miles of new levees, five levee overflow segments, and about a mile of overbank widening (several hundred feet) between Burlington and Mount Vernon. If the improvements had been in place during the November 1990 floods, flood damages would have been significantly reduced. Expected average annual flood damage reduction benefits total about $4.9 million. For larger floods (at least through the 100-year) the urban areas would have been protected and flooding in rural areas limited to 2 to 3 feet deep. Catastrophic levee failures and the resulting potential for significant loss of life and property would be eliminated up to the project design level. For flows over about 146,000 cfs., the control structures would begin to operate. In the 100-year event, about 80,000 cfs would be expected to pass over the overflows. For events exceeding the design level of the project, discharges and flooding would approach the conditions in the without-project condition. However, having defined the areas for controlled overtopping will reduce overall flood damages somewhat and significantly reduce the danger to life, since new development in those areas should be minimal. *(**Source:** USACE Skagit River Flood Damage Reduction Study and Reconnaissance Addendum, March 29, 1997)*

7.1.10 West Mount Vernon Section 205 (Small Flood Control) Study

In May of 1992, Skagit County requested Corps assistance under authority of Section 205 of the 1948 Flood Control Act with the particularly acute flood problems of West Mount Vernon. Current flood fighting efforts usually cut off access across the State Highway bridge between downtown Mount Vernon to West Mount Vernon, creating a potentially dangerous situation for residents of West Mount Vernon. The Reconnaissance Study was completed in 1994 and determined that levee improvements along with non-structural measures and bridge modifications were worthy of further study. A plan was developed to fund the local share of study costs by Skagit County, the city of Mount Vernon, and the Washington State Department of Transportation. However, in June 1995 Skagit County declined to proceed with feasibility studies at that time and further work was deferred. the City did purchase and remove several homes located along the most flood prone section of the river bank and enlarged the bridge span to increase conveyance on the right bank. (USACE, 2009)

7.1.11 Hamilton Section 205 (Small Flood Control Study)

A Section 205 Flood Control Study was completed for the Town of Hamilton, WA. The study found no Federal interest in the project due to lack of economic justification. (USACE, 2009)

7.1.12 Skagit Flood Risk Management and Ecosystem Restoration Study

This study is being conducted under the authority of Section 209 of the Flood Control Act of 1962 (PL87- 874). Skagit County is the local sponsor. In 1993, a Reconnaissance Study of reducing flood damages in the Lower Skagit River Basin was completed which determined that levee improvements with overtopping segments and non-structural measures were worthy of further investigation during feasibility studies. In 1994, Skagit County asked that further work be deferred. Following the November 1995 flood, Skagit County requested the study be resumed. In July 1997, Skagit County and the Corps executed a Feasibility Cost Sharing Agreement (FCSA) and initiated the current feasibility study. (USACE, 2009)

7.2 Historical Flood Management - Study Areas - Federal

The Corps has constructed several navigation and ecosystem restoration projects in the Skagit River Basin and has authority for flood control operations at Puget Sound Energy's Baker River hydroelectric project. A summary of these projects is provided below. (USACE, 2009)

View of the Skagit
(Courtesy of Skagit County Public Works)

7.2.1 Skagit River Navigation Project

The mattress sill at the head of North Fork, the dikes closing off subsidiary sloughs and the training dike at the mouth of the South Fork, were completed in 1911 with the exception that the latter dike is 5,550 feet shorter than the project length of 16,000 feet. . . . The expected results were not, however, secured, and the controlling depth over the3 bar at the mouth of the South Fork does not exceed 1 ½ feet at mean lower low water (***Source:*** *USACE Preliminary Examination of Skagit River, Washington, February 8, 1928*) The mattress sill was removed in l970 as it had become a hazard to navigation. Uncompleted portions of the project (increasing the depth at Skagit City bar by dredging and training dikes and extending the training dike to 16,000 feet) were deauthorized October 3, 1978. ***(Source:*** *USACE, Skagit River Flood Risk Management and Ecosystem Restoration Feasibility Study - Read Ahead Draft, 2009*)

111. The Avon By-pass, together with necessary channel improvement and revetment of the portion of the river between the high ground upstream from Burlington and the point of diversion, is the project adapted by the Flood Control Act of 1936. Some of the revetment, on

the right bank of the river just above Burlington, has been completed as a Works Progress Administration project for work relief under the engineering direction of this office. *(**Source:** USACE Preliminary Examination of Skagit River March 29, 1937)*

7.2.2 Deepwater Slough Section 1135 Ecosystem Restoration Project

This project is located on the south fork of the Skagit River between Freshwater and Steamboat Sloughs (referred to as Deepwater Slough) and the adjacent Milltown Island, south of the town of Conway entering the east side of the Skagit Bay estuary, in Skagit County, WA. The second and distinct portion of this area is Milltown Island on the east side of the Milltown area, bounded by Steamboat Slough to the west and Tom Moore Slough to the east. This project restored river and tidal influence to 204 acres of the Washington Department of Fish and Wildlife Skagit Wildlife Area that has been affected by the Corps' Skagit River Navigation Project. The existing dike structures in the Deepwater Slough area and Milltown Island have created a system of disconnected habitats. With the dikes in place, there was no hydraulic connectivity between these habitats and the river and estuarine environment to support nutrient transfer. These dikes also had limited the creation of subsidiary and blind channels. Construction was completed in 2001 which included approximately 8,300 linear feet of new dikes and augmentation and rehabilitation of 10,000 linear feet of existing dikes. A bridge crossing for Deepwater Slough was installed and the environment was enhanced with native species plantings and large woody debris placement. The dike at Milltown Island was breached through the use of explosives in three locations to restore tidal and riverine flows. By restoring the natural hydrologic processes that form habitat a variety of new habitats have been created and enhanced. These habitats include main tidal channels, subsidiary channels, blind channels, and estuarine emergent marsh to benefit both waterfowl and juvenile salmon. (USACE, 2009)

7.2.3 Swinomish Navigation Channel

This completed navigation project separates Fidalgo Island from the Skagit County mainland. Dredging and diking of this inland passage were completed in l937. The 11-mile-long channel connects Padilla Bay on the north with Saratoga Passage on the south. The channel is used extensively by tugboats with log tows, recreational craft, and freight vessels. In 1965, the Corps of Engineers completed removal of projecting rock points obstructing navigation near the south end of the channel. The south jetty, west of Goat Island, was rehabilitated in 1973. (USACE, 2009)

7.2.4 La Conner Streambank Erosion Control Project

Additional bank erosion control measures to prevent damage to structures in the La Conner Historical District were authorized by Section 603, Public Law 99-662. A Decision Document was prepared which showed that a shore protection project along 1,500 feet of the La Conner waterfront would be economically feasible and there would be a Federal interest in such a project. Preconstruction engineering and design began in fiscal year 1991 with preparation of the Design Memorandum and Environmental Assessment. These were completed in March 1994. Following completion of Plans and Specifications and acquisition of the necessary permits and needed real estate interests, construction began in September 1995 and was substantially finished by December with mitigation planting being completed in April 1996. (USACE, 2009)

7.3 Historical Flood Management - Study Areas - Non Federal

Numerous non-Federal water resources projects have been constructed and are in operation in the Skagit River Basin. These projects include dams in the upper basin and a series of levees extending throughout basin. (USACE, 2009)

7.3.1 Puget Sound Energy Baker River Hydroelectric Project

Puget Sound Energy owns and operates a hydroelectric project on Baker River, a tributary of the Skagit. The project consists of two power-generating dams and two reservoirs. These dams impound the two reservoirs Lake Shannon and Baker Lake, respectively. Both reservoirs are fed primarily by melting snow from the Cascade Mountains (PSE, 2008). (USACE, 2009)

The project begins about a mile upstream from Baker River’s confluence with the Skagit at Lower Baker Dam, inside the town of Concrete. Lower Baker Dam is the older component of the project, completed in 1925. It is a 285-foot-tall, 550-foot-long concrete gravity arch structure. Lower Baker Dam can generate up to 85 megawatts of power. The dam’s reservoir, Lake Shannon, controls a total of 299 square miles of watershed via 84 square miles of local drainage and 215 square miles of drainage above Upper Baker Dam (Puget Sound Energy, 2008). (USACE, 2009)

Upper Baker Dam was completed in 1959. A concrete gravity dam, it measures 312 feet high and 1200 feet long. At maximum capacity, Upper Baker can produce 105 megawatts of power (PSE, 2008). The dam’s reservoir, Baker Lake, controls 215 square miles of watershed (Puget Sound Energy, 2008). (USACE, 2009)

Together, the two dams can serve the peak power demand of about 190,000 households. On average, they can serve the total power demand of about 60,000 households (PSE, 2008). The Baker Dams are used for flood storage during the November through March flood season. Combined with storage capacity at Seattle City Light’s hydropower projects on the Skagit River, the dams in the Skagit Basin have the capability to control approximately 40% of the Skagit watershed (USACE, 2009)

7.3.2 Seattle City Light Skagit Hydroelectric Project

Seattle City light also owns and operates a large hydroelectric project in the Skagit Basin. Located far upstream on the Skagit River, the project begins just upstream of the town of Newhalem and extends upstream about 30 miles, turning northward out of Skagit County and extending into Canada. The project consists of three reservoirs and three dams. High in the North Cascades, the project is fed primarily by snowmelt. (USACE, 2009)

At the downstream end of the project, in Newhalem, is the Gorge Dam Powerhouse. The dam is located 2 miles upstream. To connect the facilities, a tunnel was constructed to convey water from the dam to the powerhouse. The dam, tunnel, powerhouse were completed in 1924. Sitting behind the dam, Gorge Lake extends upstream to the second dam, Diablo Dam. Diablo Dam was completed, and Diablo reservoir filled, in 1930. Construction slowed by the Great Depression, the Diablo powerhouse did not come online until 1936. Diablo reservoir continues upstream until the third dam, Ross Dam. Ross Dam impounds the very large Ross Lake, which turns northward, out of Skagit County, and across Whatcom County.[7] The watershed extends into Canada, as well. Ross Dam and powerhouse came online in 1951 (SCL, 2008). (USACE, 2009)[8]

The three dams provide about 39% of Seattle City Light's power generation capability. Gorge Dam has a maximum capacity of 199.2 megawatts. Diablo Dam can output 159.3 megawatts. Ross Dam can generate up to 352.6 megawatts (SCL, 2008). In addition to power generation, Ross Dam Reservoir on the Skagit River controls the drainage from 978 square miles of watershed. Ross Dam is used for flood storage during the November through March flood season. Combined with storage capacity at PSE's Baker Project, the dams in the Skagit Basin have the capability to control approximately 40% of the Skagit watershed (USACE, 2009)

[7] There is no part of Ross Lake that is in Skagit County.

[8] This statement appears to be incorrect. First power generated from Ross Dam was in 1952. See ***12/25/52 C.H.)***