# CENTRALIA FLOOD DAMAGE REDUCTION STUDY

## ABSTRACT

Centralia and Chehalis are two cities in southwestern Washington that lie in close proximity on the flood plain of the Chehalis River. The Seattle District investigated the feasibility of reducing flood damages in these cities and portions of the surrounding area which average about $3 million annually. A wide range of alternative methods for reducing flood damages was considered. A modification of the existing, privately owned Skookumchuck Dam to provide flood control storage was selected as the tentatively recommended plan based on its superior fulfillment of the planning objectives and criteria. The estimated cost of this plan is $18,200,000. The environmental impacts of this plan include alteration of the hydraulic regime of wetlands associated with the Skookumchuck River and impacts to waterfowl and small fur bearing mammals in the reservoir area. Mitigation for these impacts include the purchase of 50 acres of land and installation of wood-duck nesting boxes along the river. The benefit-to-cost ratio is 1.5 to 1.

The lead agency is the U.S. Army Corps of Engineers, Seattle District.

SEND YOUR COMMENT TO THE DISTRICT ENGINEER
BY NOV 8 1982

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# CENTRALIA FLOOD DAMAGE REDUCTION

## EXECUTIVE SUMMARY

The Centralia-Chehalis Flood Damage Reduction Study was conducted in partial response to a congressional resolution adopted 19 April 1946 by the U.S. House of Representatives. This report addresses the need and desirability of undertaking a plan to reduce flood damages in the cities of Centralia and Chehalis and vicinity in southwestern Washington.

Flooding from the Chehalis, Skookumchuck, and Newaukum Rivers is a major problem in the two cities. About 4,600 acres of land lie in the standard project flood plain of the Skookumchuck River. Average annual damages are estimated at $2,998,000.

A wide range of structural and nonstructural alternatives was examined to address the flood damage reduction objective. In evaluating these alternatives, legal, financial, policy, social, economic, and environmental criteria were considered as well as public and agency input.

The report tentatively recommends modifying the existing, privately owned Skookumchuck Dam to provide a minimum of 17,000 acre-feet of flood control storage during winter months (28,500 acre-feet in November and December). The 200-year flood on the Skookumchuck River at Centralia would be reduced from 13,300 cubic feet per second (c.f.s.) to 6,700 c.f.s. (equivalent to about a current 4-year flow). The modifications include construction of a 12-foot-diameter, 1,200-foot-long outlet tunnel and addition of a 17-foot-high by 136-foot-wide bascule gate to the currently ungated spillway. The environmental impacts of this plan include alteration of the hydraulic regime of wetlands associated with the Skookumchuck River and impacts to waterfowl and small fur bearing mammals in the reservoir area. Mitigation for these inputs include the purchase of 50 acres of land and the installation of wood-duck nesting boxes along the river. The total cost is estimated to be $18,200,000 (October 1982 price level). The average annual benefits would be $2,506,000 compared to average annual cost of $1,654,000 for a benefit-to-cost ratio of 1.5 to 1. This alternative has the highest net benefits and has been designated the National Economic Development Plan. Since it has a minimum impact on essential fish and wildlife populations and habitat, it has also been designated the Least Environmentally Damaging Plan.

Implemention is proposed under cost sharing and financing arrangements which are satisfactory to the President and the Congress. If the plan were authorized under policies covered by existing law, the Federal Government would assume the total costs including operation and maintenance. The city of Centralia would be required to administer and enforce regulations and publicize flood-plain information to insure compatibility between future development and flood damage reduction levels provided by

the project. The flood control operation of the project would be by Pacific Power and Light Company under direction from the Corps of Engineers. By letter dated 11 January 1982, the State of Washington indicated their support of the project and expressed their views on cost sharing. The city of Centralia indicated their intent to sponsor the project in a letter dated 3 December 1981.

CENTRALIA FLOOD DAMAGE REDUCTION

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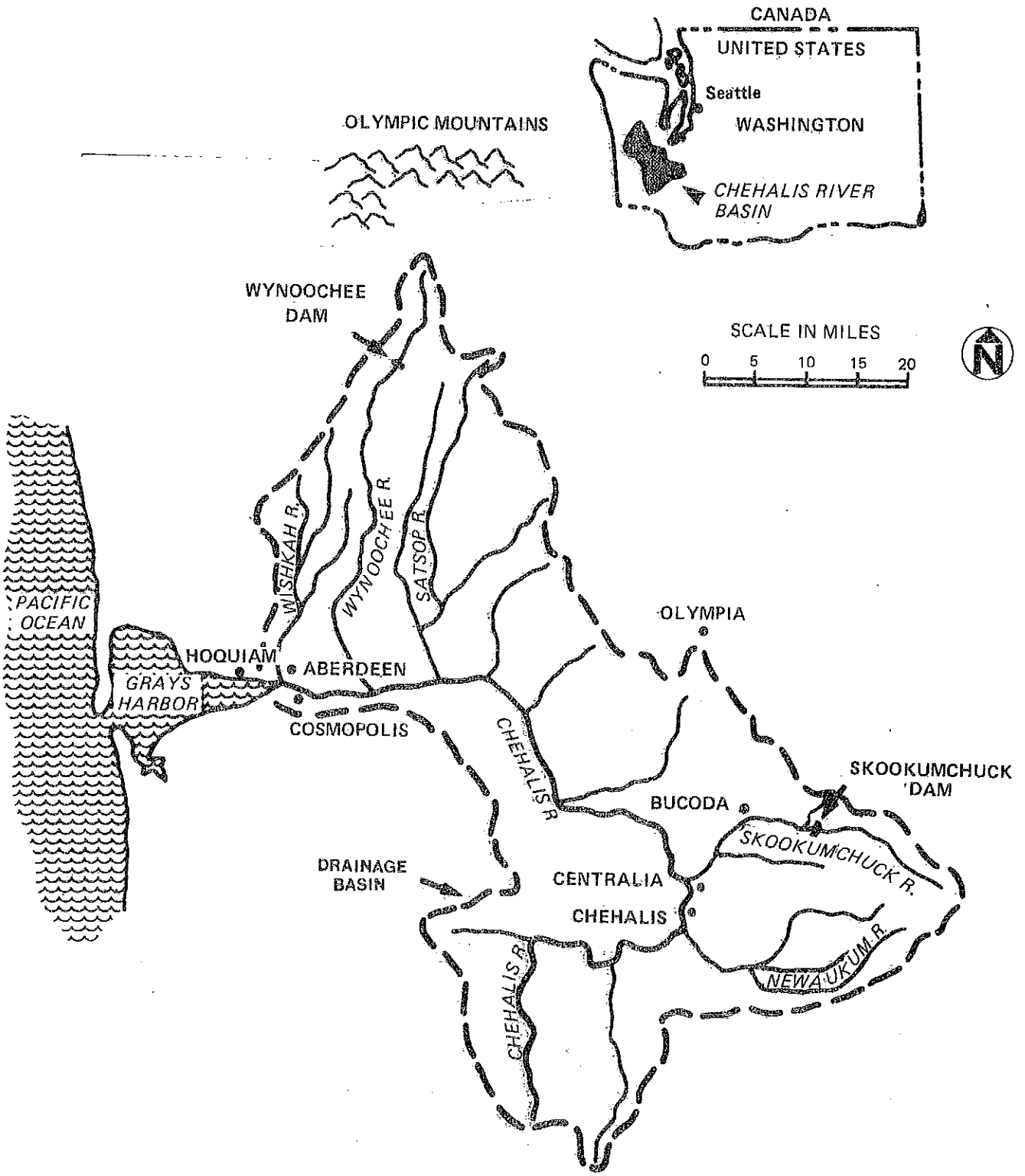
# SECTION 1. BACKGROUND

1.01 Study Authority. This study was conducted under authority of a resolution adopted 19 April 1946 by the Committee on Flood Control of the House of Representatives requesting the U.S. Army Corps of Engineers (Corps) to review its report on the Chehalis River and tributaries to determine whether any modification of the recommendations should be made. The complete resolution is presented in appendix D.

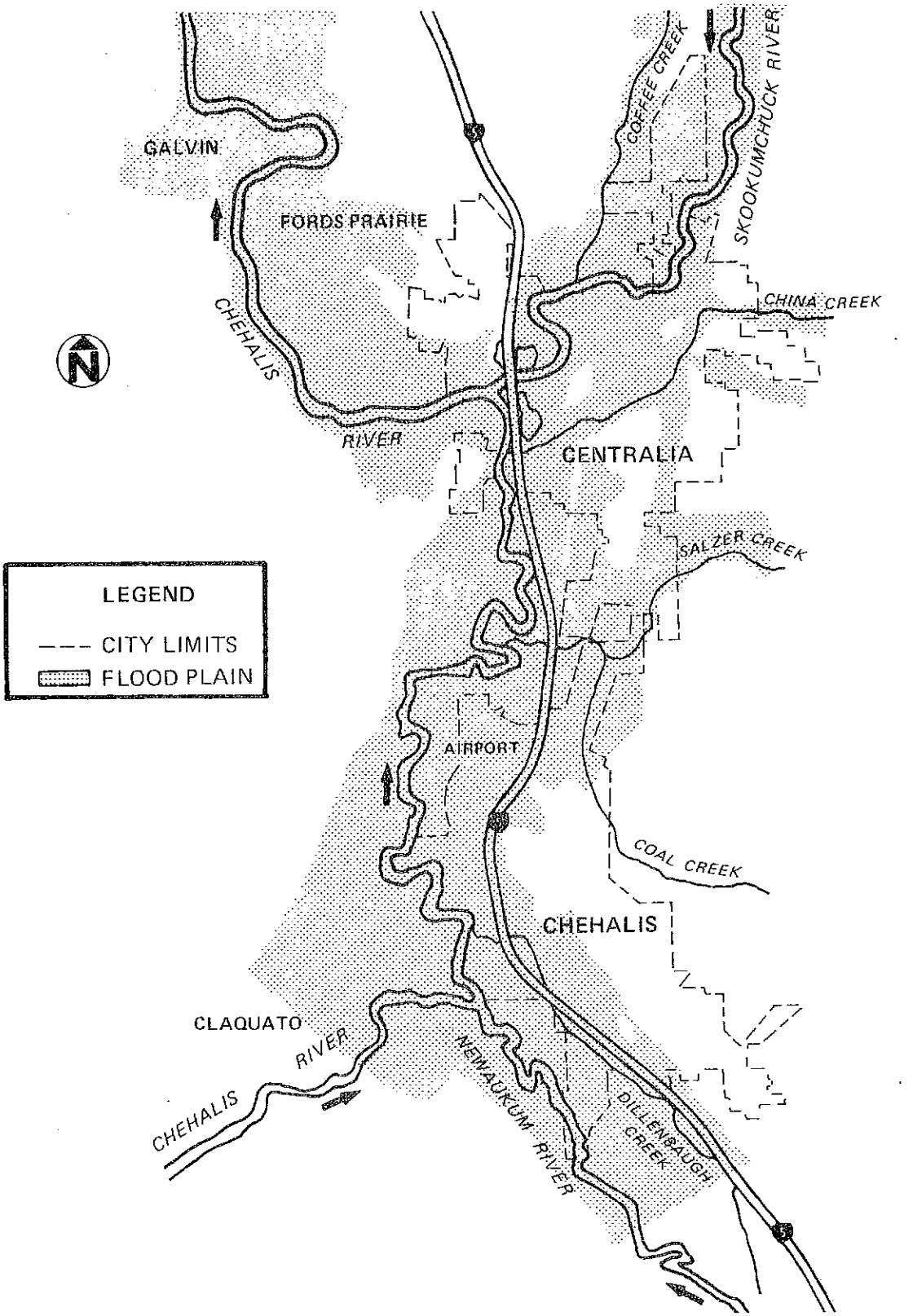
1.02 Type of Study. This report presents the results of a feasibility study undertaken by the Seattle District, Corps of Engineers. The report is an interim response to the study authorization for the purpose of reporting to Congress for their action on the need for and desirability of undertaking a plan to reduce flood damages along the Chehalis, Skookumchuck, and Newaukum Rivers in the vicinity of Centralia and Chehalis, Washington.

1.03 Study Area Location. The study area considered under the study authority is the entire Chehalis River basin of 2,114 square miles (figure 1-1). Preliminary studies indicated that measures for flood damage reduction were potentially feasible for the urban areas of Aberdeen-Hoquiam-Cosmopolis and Centralia-Chehalis and recommended that more detailed studies be performed for those areas. The basin study was divided into three portions: an interim report covering south Aberdeen-Cosmopolis, an interim report covering Centralia-Chehalis, and a final basin report covering both north Aberdeen-Hoquiam and any other identified water resource problems in the basin. Subsequently, another interim report has been prepared covering the addition of hydropower and fish hatchery facilities at the existing Corps of Engineers' Wynoochee Dam. The flood problem area under consideration in this interim report is the flood plain in the vicinity of Centralia and Chehalis (figure 1-2), including the Chehalis River from Galvin to Claquato, the Skookumchuck River from its mouth to near the Centralia city limits, and the Newaukum River from its mouth to near the Chehalis city limits. The 100-year flood would inundate 9,200 acres within this area, of which about 6,800 acres are agricultural or undeveloped land. The 2,400 acres that have been developed for commercial, industrial, residential, or public use contain about 2,390 residences (6,500 persons) and 315 commercial, residential, or public structures. The plan area (figure 1-3) discussed in this draft report and draft environmental impact statement (DEIS) includes: the portion of the flood problem area east of Interstate Highway 5 and north of Salzer Creek, the Skookumchuck River flood plain from Interstate Highway 5 (just upstream of its mouth) to the Skookumchuck Dam (located at river mile (R.M.) 21.9), and the Skookumchuck Dam Reservoir. In the plan area the standard project flood (SPF) would cover about 1,050 acres of open water or flowing river; 2,618 acres of agricultural, undeveloped, or rural public land; and 1,982 acres of urban development.



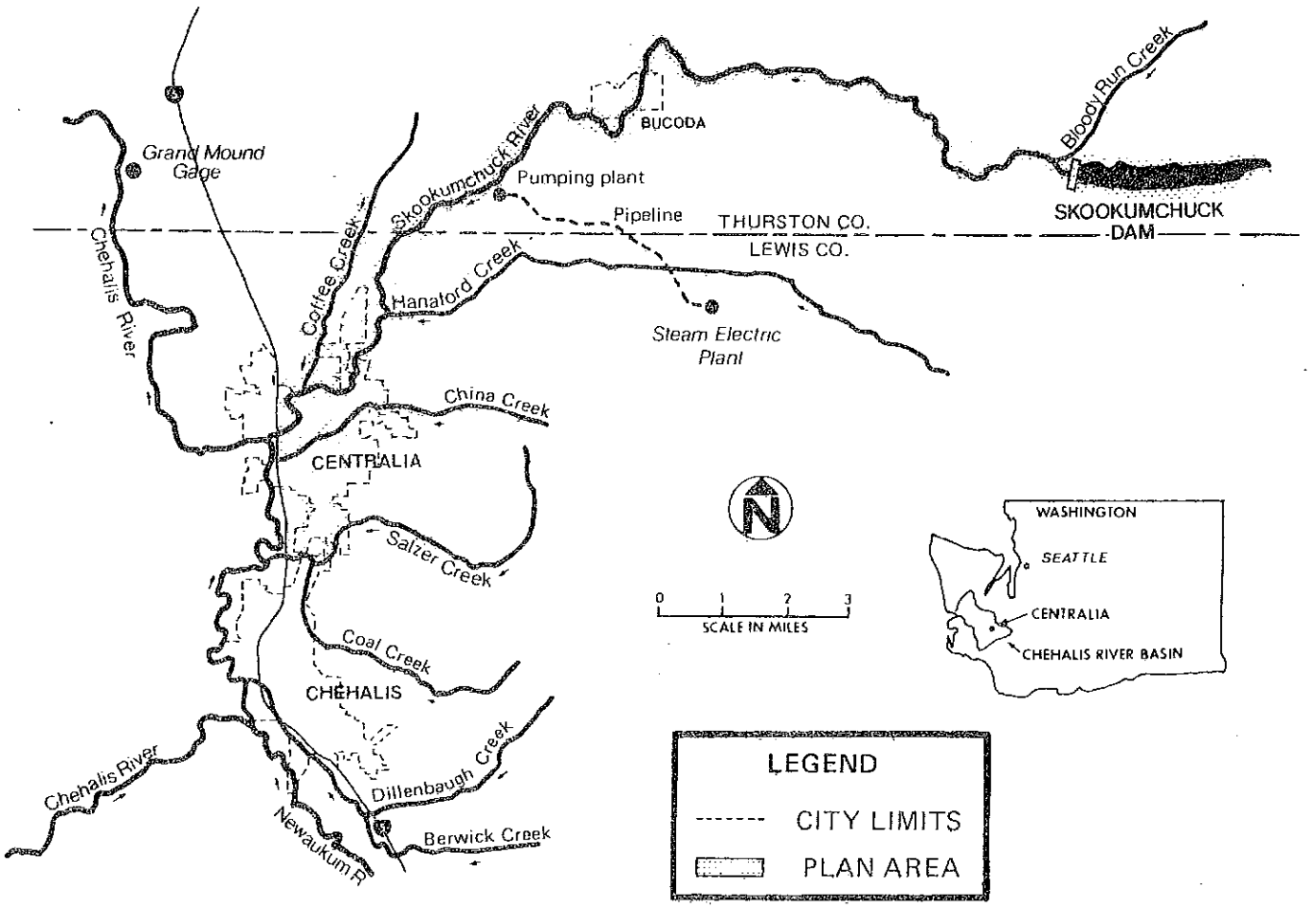

# CHEHALIS RIVER BASIN

## FIGURE 1-1




# CENTRALIA-CHEHALIS FLOOD PROBLEM AREA

## FIGURE 1-2




# PLAN AREA

## FIGURE 1-3

1.04 Needs. Flood damage reduction is the principal water resource related need within the Chehalis basin and concern about flooding was the primary impetus for the 1946 study resolution. The study was suspended in 1949 due to a lack of an economically justified alternative. The study was resumed in 1966 at the request of the citizens in Centralia and commissioners of Lewis, Thurston, and Grays Harbor Counties primarily because of increasing flood damages in the basin. Hydropower and fish artificial production enhancement needs of the Chehalis River basin are being addressed through a separate report, Wynoochee Hydropower/Fish Hatchery. In addition, natural production needs exist in the Chehalis River basin. Fisheries benefits from natural production which can be provided through flood control measures are often substantial but are sometimes difficult to accurately quantify. Nevertheless, these natural production needs should be bolstered whenever possible.

1.05 Major flooding in the basin occurs during the winter season, usually from November through February, as a result of heavy rainfall, occasionally augmented by snowmelt. Flooding may be either widespread throughout the Chehalis basin or localized in subbasins. Within the Centralia-Chehalis area, major floods may result when flooding of the Chehalis River causes overflow into the two cities and the commercial areas between them or when the Skookumchuck and Newaukum Rivers flood. The most severe flooding occurs when the Chehalis reaches flood stage concurrently with flooding on the Skookumchuck and Newaukum. Flooding also occurs near the mouths of Coffee, China, Salzer, Coal, and Dillenbaugh Creeks primarily due to high stages caused by backwater from the main rivers. The greatest flood discharge on the Chehalis River at Centralia and Chehalis during the last 50 years occurred in January 1972. That flood had a discharge of 49,200 cubic feet per second (c.f.s.) at the Grand Mound gage 7 miles downstream of Centralia and recurrance interval of 35 years. The area experienced recent floods in January 1971, January 1972, January 1974, and December 1975. Additional detail on hydrology and flood characteristics is presented in appendix E.

1.06 Minor or local tributary streams are generally characterized by rising to peak a few hours after intensive rainfall and remaining at flood stage for several hours. The Skookumchuck River peaks slower, up to a day after the rainfall, and will stay above flood stage for a couple days. The Chehalis River peaks much slower, a day or two after the rainfall, and remains at flood stage for a week or more in major floods. The gradient along the Skookumchuck River is about 6.3 feet per mile. During a 100-year flood the Skookumchuck River channel velocity would range from about 3.2 to 7.6 feet per second (f.p.s.) with the overbank flooding averaging about 3 feet deep with a velocity of about 0.3 to 1.7 f.p.s. The Chehalis River gradient is much less, about 2.1 feet per mile which would result in channel velocities of 1.3 to 7 f.p.s. and overbank velocities of 0.6 to 1.5 f.p.s. During a SPF, the overbank and channel velocities in the study area would be similar to those experienced during a 100-year flood, except the Skookumchuck overbank velocity would increase to 1 to 3 f.p.s. and the average flooding

depth would increase to about 5 feet. Plate 1 shows the extent of the 100-year, 200-year, and SPF flood plains under existing conditions. Average annual equivalent flood damages under existing conditions in the plan area are estimated at $2,998,000. Additional information on flood damages is presented in appendix C.

1.07 Pertinent References. Corps of Engineers' reports on the Chehalis basin completed in 1931, 1935, and 1944 all concluded that flood control improvements were not economically justified. However, in 1944 Congress authorized a levee system to protect Aberdeen, Hoquiam, and Cosmopolis. That authorization expired in 1952. An interim report under the current study authority was transmitted to Congress on 20 November 1978. The report recommended construction of a levee system to protect the south side of the Chehalis River at its mouth in the city of Aberdeen and town of Cosmopolis. Remaining major flood damage reduction needs in the Chehalis basin in the vicinity of Aberdeen and Hoquium will be considered in the final Chehalis basin report. In the Centralia-Chehalis area, the lower 1,700 feet of Coffee Creek were modified in 1966 under authority of Section 208 of the 1954 Flood Control Act. A flood-plain information report was completed in June 1968 for the Chehalis and Skookumchuck Rivers in the Centralia-Chehalis area, and a hydraulic floodway study for the same area was completed in August 1974. A second hydraulic floodway study was completed in March 1976 covering the Chehalis and Newaukum Rivers in the vicinity of Chehalis. In addition, a comprehensive framework study of the water and related lands needs of the Columbia River-North Pacific region was completed in 1972 under the direction of the Pacific Northwest Rivers Basin Commission. This study identified the Centralia-Chehalis area as an area where levees should be constructed for urban flood damage reduction. More detail on these studies can be found in appendix D.

1.08 Existing Reservoir Projects. There are two major reservoir projects in the Chehalis River basin: Wynoochee Dam and Skookumchuck Dam. Wynoochee Dam, completed by the Corps of Engineers in 1974, is located at R.M. 52 on the Wynoochee River and provides flood control for the Wynoochee Valley and water supply for Aberdeen. Skookumchuck Dam, completed in 1970 by Pacific Power and Light (PP&L) Company (as agent for the owners, a group of eight public and private utilities) on the Skookumchuck River about 22 river miles upstream from the river mouth, provides an assured water supply for the coal-fired Centralia Steam Electric Plant. The dam stores water during the late fall and winter for release during the low flow period of summer and early fall. The storage releases are carried instream for about 14 miles to the pumping plant which diverts water through a 3-mile pipeline to the plant. On 5 May 1981, the Federal Energy Regulatory Commission (FERC) accepted for filing an application for exemption from PP&L for a 980 kilowatt (kW) generating facility at Skookumchuck Dam that would use existing excess discharges from the dam to generate power. In July 1982, FERC approved the application from PP&L.

## SECTION 2. PLANNING OBJECTIVES AND CRITERIA

2.01 Planning Objectives. Planning objectives are statements of the primary water and related land resources management need or needs of the study area which lead to the study. For this study the planning objective is the reduction of flood damages within the flood problem area in the vicinity of the cities of Centralia and Chehalis. This area includes the flood plains of the Chehalis River from Galvin to Claquato, the Skookumchuck River from the mouth to near the Centralia city limits, and the Newaukum River from the mouth to near the Chehalis city limits. Alternative plans were formulated to meet this objective.

2.02 Planning Criteria.

a. General. In formulating plans to meet the planning objective, a wide range of planning criteria was considered. These criteria were used to screen and evaluate alternative plans and to measure each plan's contribution to the National Economic Development (NED), Environmental Quality (EQ), Regional Development (RD), and Other Social Effects (OSE) accounts of the Water Resources Council's Principles and Standards. This comparative evaluation of alternative plans is presented in section 3. The criteria considered include identified outputs, factors, and conditions which impose constraints and limitations on the planning process and rules and guidelines for evaluation of the plans. The criteria also include other needs, opportunities, and concerns, in addition to the primary planning objective. Not all the criteria are compatible, and no plan could fully satisfy all of them. Applicable planning criteria for the study are presented in the following paragraphs under the account to which they are primarily related.

b. National Economic Development Criteria. The NED criteria consist of needs to be addressed by the alternative plans that would result in NED benefits and the constraints that are applied to the calculation of these benefits. The pertinent NED criteria are as follows:

- Reduce flood damages within the cities of Centralia and Chehalis and vicinity.

- Reduce future floodproofing costs in the flood plain in the cities of Centralia and Chehalis and vicinity.

- Improve outdoor recreation opportunities along the Chehalis, Newaukum, and Skookumchuck Rivers, consistent with local and regional recreation needs and desires.

- Contribute to development of hydroelectric potential of area.

- Annual benefits of any plan must exceed its annual costs unless combined beneficial NED and EQ effects outweigh combined adverse NED and EQ effects.

- The congressionally mandated Federal interest rate will be used to determine annual costs and discount future benefits (7-7/8 percent for Fiscal Year (FY) 1983).

- A 100-year project economic life will be used to evaluate flood damage reduction plans.

- Each separable unit or purpose of a plan must provide benefits at least equal to costs unless combined beneficial NED and EQ effects outweigh combined adverse NED and EQ effects.

- Average annual costs will include interest and amortization of construction costs and provision for annual maintenance, operation, and major replacement.

- Economic efficiency of alternative plans will be measured by net benefits. Total annual benefits minus total annual costs equal net benefits.

- Each plan must be complete within itself and include all actions necessary to realize its economic benefits.

- Each plan should be stable as related to economic conditions and realize its economic benefits under a range of reasonable future economic conditions.

c. Environmental Quality Criteria. The EQ criteria which follow consist of specific environmental resources-related constraints and opportunities. These include criteria imposed by Federal, state, and local regulations and those uniquely related to the Centralia-Chehalis area. The significant environmental resources of the Centralia-Chehalis are described in section 3 of the DEIS.

- Preserve natural and beneficial values of undeveloped portions of the flood plain in the study area in conformance with Executive Order 11988. Requirements of Executive Order 11988 are presented in more detail in appendix D.

- Preserve wetlands in the study area in conformance with Executive Order 11990. Requirements of Executive Order 11990 are presented in more detail in appendix D.

- Maintain the passage of anadromous fish in Chehalis, Newaukum, and Skookumchuck Rivers and tributaries, including China, Salzer, Coal, and Dillenbaugh Creeks.

- Preserve anadromous fish spawning areas in the study area.

- Preserve the shore zone habitat along the Chehalis, Newaukum, and Skookumchuck Rivers, including shallow water areas and riparian zone, overstory, and wetland vegetation critical to fish and wildlife.

- Preserve or salvage significant (as determined by National Register of Historic Places criteria) historic and prehistoric cultural resources sites affected by potential project construction or effects in accordance with the authorities contained in existing legislation and Executive Orders, including the National Historic Preservation Act of 1966; the Reservoir Salvage Act of 1960, as amended by Public Law 93-291; and Executive Order 11593.

- Comply with the State of Washington Shoreline Management Program as administered by Lewis and Thurston Counties and the cities involved. This program is described in more detail in appendix D.

- Comply with the land use plans of the cities of Centralia and Chehalis. These plans are described in more detail in appendix D.

- Protect any threatened or endangered species in the study area and their critical habitat.

- Preserve water quality in the study area in conformance with Section 404 of the Clean Water Act of 1972 (Public Law 92-500, as amended).

- Maintain existing air quality in the study area.

- Preserve esthetic values along the Chehalis, Skookumchuck, and Newaukum Rivers and tributaries.

d. Regional Development Criteria. The RD criteria which follow consist of opportunities related to increased economic efficiency within the Centralia-Chehalis study area that do not necessarily provide increases in NED. This list also includes areas of concern listed in Section 122 of Public Law 91-611.

- Increase employment in Lewis County during plan implementation.

- Contribute to community development and growth by reduction of the depressing economic effects of flood damages within the cities of Centralia and Chehalis.

- Increase net income to businesses in Centralia and Chehalis during plan implementation.

- Encourage local expenditures for improvement of community facilities (streets, sidewalks, utilities, parks).

- Increase property values within the study area.

- Increase tax revenues within the study area.

e. Other Social Effects Criteria. The OSE criteria listed below include those engineering policy standards that are applied to all alternatives to assure the maintenance of public health and safety, and those opportunities and constraints related to the social well-being of people. This list also includes areas of concern listed in Section 122 of Public Law 91-611.

- Levee systems in urban areas should be designed, when feasible, to control the SPF if overtopping of a lesser design would cause a sudden catastrophic loss of life and property.

- Levees and floodwalls in urban areas must include an appropriate height allowance (called freeboard) above the design water surface to provide a safety margin. Dams and other water retention structures must include a similar allowance to prevent overtopping.

- Avoid increased flooding in unprotected areas.

- Increase community cohesion within the cities of Centralia and Chehalis.

- Avoid the relocation of residential properties.

- Avoid the relocation of public facilities and properties, and the resulting inconvenience to residents during construction.

- Avoid increased noise levels in the study area.

- Maintain recreation access to the Chehalis, Skookumchuck, and Newaukum Rivers and tributaries.

## SECTION 3. FORMULATION AND EVALUATION OF ALTERNATIVES

3.01 Plan Formulation Approach. The plan formulation process begins with the identification of the planning objective and the planning criteria. A wide range of structural and nonstructural alternatives is then identifed to address the planning objective while considering the planning criteria. Each alternative's contribution to the NED, EQ, RD, and OSE accounts of the Water Resources Council's Principles and Standards is evaluated. The planning criteria form the basis of comparison of the plans and measurement of their contribution to the four accounts. Alternatives are screened, evaluated, and refined as the result of technical studies and an extensive program of coordination. The final alternatives are again thoroughly evaluated against the planning criteria and a detailed system of accounts is developed to measure their contribution to the NED, EQ, RD and OSE accounts. Based on the results of this analysis, an alternative that results in maximum net economic return (NED Plan), an alternative that makes a net contribution to environmental quality (EQ Plan), or is least damaging to the environment (LED Plan) and a nonstructural plan is designated. The most effective plan which best meets the planning objectives and criteria is selected as the recommended plan.

3.02 Preliminary Analysis and Screening of Alternatives. A wide range of structural and nonstructural alternatives were considered during preliminary planning. In addition to the "No Action" option, these included:

| Structural Alternatives | Nonstructural Alternatives |
|---|---|
| • Multipurpose Storage (6 sites) | • Land Use Regulations |
| • Small Headwater Dams (13 sites) | • Flood Insurance |
| • Channel Clearing | • Floodproof Structures |
| • Channel Excavation | • Evacuation and Relocation |
| • Channel Excavation with Levees | • Purchase of Development Rights |
| • Urban Area Levees | • Watershed Management |
| • Urban Area Levees with River Modifications | |

The description of the preliminary alternatives and the evaluation and assessment of them is presented in appendix D.

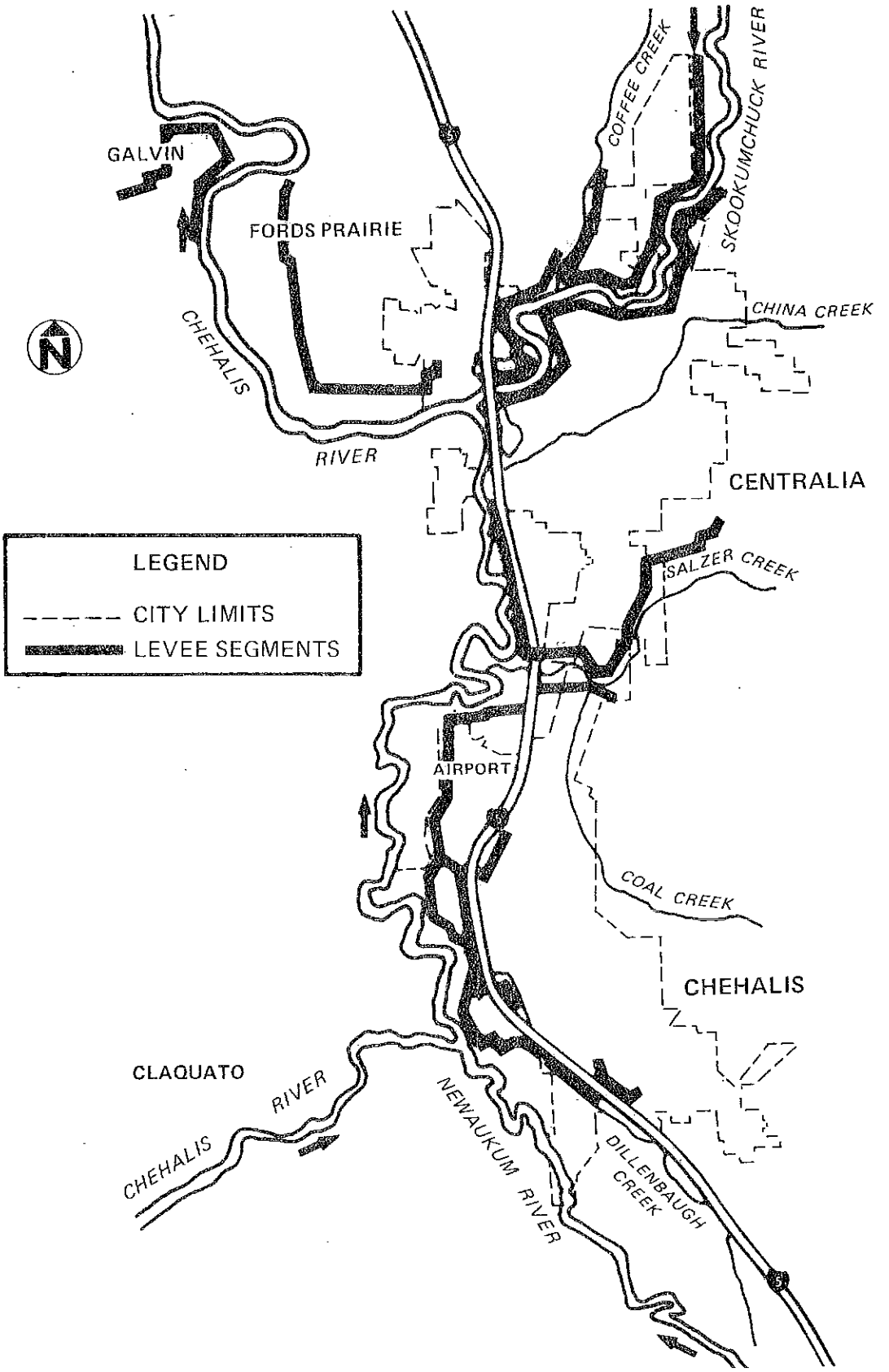
3.03 Based on iterative process of technical, economic and environmental evaluation of alternatives as explained in appendix D and public and agency input received through the public brochures, public meetings, and other means two viable alternatives emerged: No Action and

Skookumchuck Dam Modification. During this process, a range of alternative levee segments protecting the urban areas of Centralia and Chehalis, as well as the semiurban Fords Prairie and Galvin areas, were considered as illustrated in figure 3-1. Only those levee segments protecting the city of Centralia from flooding from the Chehalis and Skookumchuck Rivers and Salzer and Coffee Creeks met the requirements of economic justification. However, urban levees were not a viable alternative due to adverse environmental effects that led to lack of public acceptability. Table 3-1 is a summary comparison of the final alternatives. The more detailed system of accounts evaluation is presented in appendix D.

3.04 Alternative 1 - No Action. No new action would be taken for flood damage reduction through either structural or nonstructural means. Development of the flood plain would be restricted through existing zoning, the State of Washington Flood Control Zone Program, the Shoreline Management Program, and any new ordinances developed for continued participation in the Flood Insurance Program. Existing regulations generally prohibit most development within the hydraulic floodway and require floodproofing of new structures within the flood plain. The Federal Flood Insurance Program indemnifies insured property owners against losses. Undeveloped lands in the flood plain might be set aside for uses compatible with occasional inundation such as recreation, fish and wildlife enhancement, open space, or certain agricultural activities. The response of alternative 1 to key criteria is presented in the following paragraphs.

a. National Economic Development Criteria. The rate of increase in flood damages within the study area would be reduced by existing and future land use controls restricting development in the flood plain. Flood damages to existing residential and commercial development in the flood plain would continue. Average annual existing damages within the area proposed for protection are estimated at $2,998,000. Growth in damages to residential contents is expected to increase at about a 2.6 percent annual rate. Floodproofing would be required for any new structure located within the flood plain. The average annual cost of future floodproofing was not estimated for the entire flood plain but would be about $1,386,000 on an average annual basis for the most developed areas of Centralia.

b. Environmental Quality Criteria. Development of the undeveloped portions of the flood plain would be controlled by existing and possible future state and local land-use regulations. This would generally preclude any development in the floodway and require floodproofing of all future flood plain developments. These regulations would tend to preserve the natural and beneficial flood plain values. However, residential and commercial development would be expected to continue in those flood plain areas zoned for such development. Wildlife habitat in the study area would continue to be reduced by urban development although a certain amount of habitat would remain along the study area rivers and




# LEVEE SEGMENTS CONSIDERED

## FIGURE 3-1

TABLE 3-1

SUMMARY COMPARISON OF FINAL ALTERNATIVES

| | Alternative 1 - No Action (without condition) | Alternative 2 - Skookumchuck Dam Modification |
|---|---|---|
| PLAN DESCRIPTION | | |
| STRUCTURAL MEASURES | None | • Flood control outlet tunnel<br>• Bascule gate on spillway<br>• Shotcrete on spillway chute<br>• Operating agreement with PP&L |
| NONSTRUCTURAL MEASURES | Development of the flood plain would be restricted through existing and future state and local land-use regulations. | Same as Alternative 1 |
| FLOOD REDUCTION AT CENTRALIA (200-year flood) | None | • Skookumchuck River flow reduced from 13,300 c.f.s to 6,700 c.f.s.<br>• Flood depth reduced 2 to 5 feet |
| FISH AND WILDLIFE MITIGATION | None | • Purchase 50 acres of land<br>• Install wood duck nesting boxes |
| RESPONSE TO KEY CRITERIA | | |
| CONSTRUCTION COSTS | | |
| Federal[1/] | None | $18,200,000 |
| Non-Federal[1/] | | None |
| TOTAL COSTS | | $18,200,000 |
| NED CRITERIA | | |
| 1. TOTAL AVERAGE ANNUAL BENEFITS | | |
| Existing Conditions | | $2,132,000 |
| With Future Development | | $2,506,000 |
| 2. TOTAL AVERAGE ANNUAL COSTS | | $1,654,000 |
| 3. ANNUAL BENEFITS MINUS ANNUAL COSTS | | |
| Existing Conditions | | $478,000 |
| With Future Development | | $852,000 |
| 4. BENEFIT-TO-COST Ratio | | |
| Existing Conditions | | 1.3 |
| With Future Development | | 1.5 |

1/Under existing law.

TABLE 3-1 (con.)

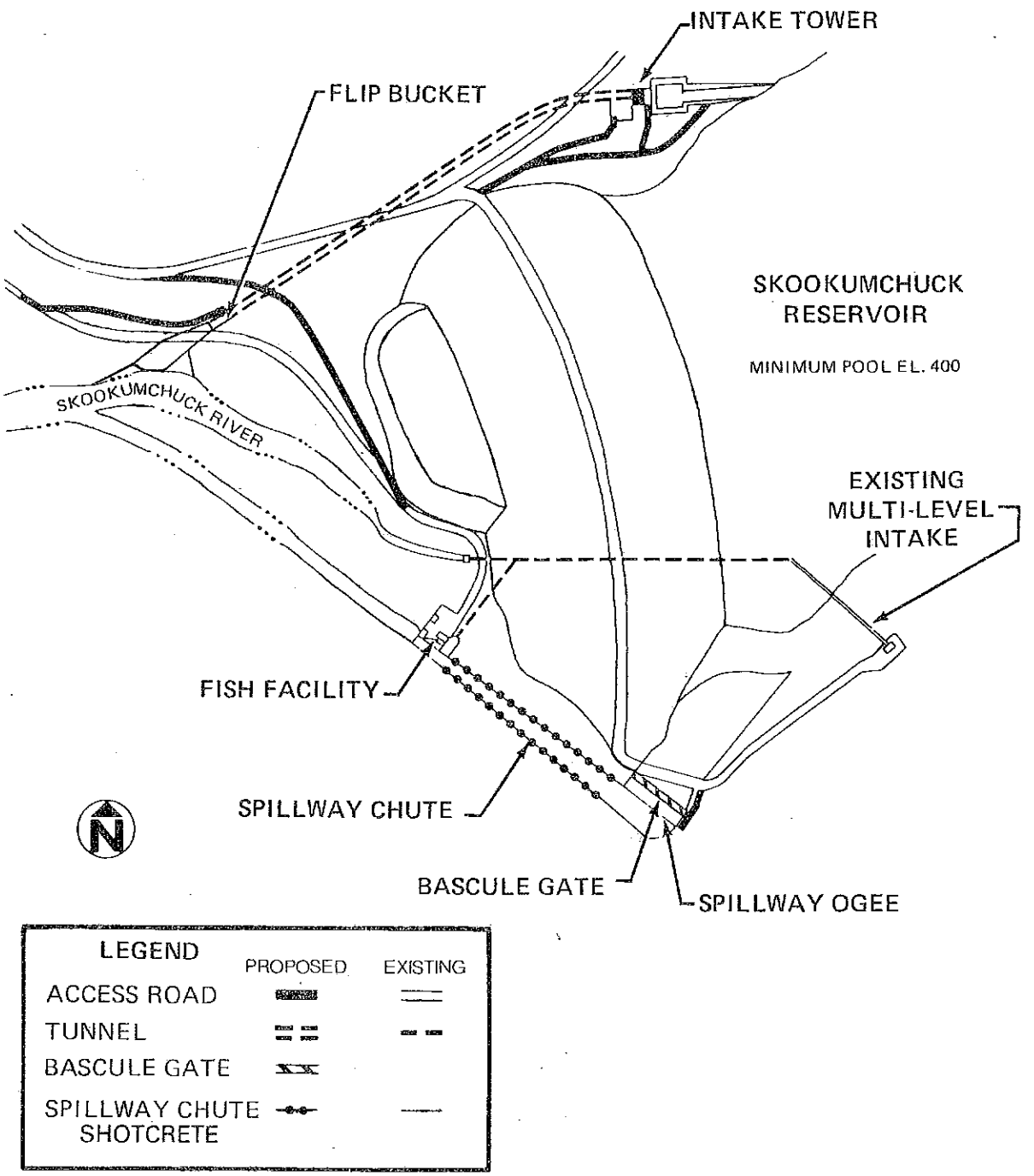
| EQ CRITERIA | Alternative 1 - No Action (without condition) | Alternative 2 - Skookumchuck Dam Modification |
|---|---|---|
| 1. Preserve the natural and beneficial values of the undeveloped portions of the flood plain (Executive Order 11988). | Flood plain development controlled by existing and future state and local land-use regulations. | Some potential for increased pressure to develop remaining flood prone areas. |
| 2. Preserve anadromous fish spawning and rearing habitat. | Continue existing trend. | Loss of eggs due to scouring during peak floods reduced. Some improvement in flows. |
| 3. Preserve the shore zone habitat. | Continue existing trend. | Continue existing trend. |
| 4. Comply with state and local land-use plans and regulations. | Flood-plain development subject to land-use plans and regulations. | Compatible with state and local land use plans. |
| RD CRITERIA (SUMMARY) | Not Applicable. | Contribute to regional development through flood damage reduction and increase in employment and business income during construction. |
| OSE CRITERIA (SUMMARY) | Not Applicable. | Net contribution to social well-being, due to increased health, safety, and well-being resulting from 2- to 5-foot reduction in flooding. |

creeks. The Chehalis, Newaukum, and Skookumchuck Rivers and China, Coal, Salzer, and Dillenbaugh Creeks would continue to support runs of coho and chinook salmon, with potential increases in production on the Chehalis resulting from expected improvements in water quality due to improved sewage treatment. Salmon spawning areas in the lower Skookumchuck River would continue to produce fall chinook and coho salmon. A more complete description of the affected plan area environment is contained in section 3 of the DEIS.

c. Regional Development Criteria. The overall pace of future growth in the Centralia-Chehalis area should remain below that of the State of Washington. Population projections reflect an average annual growth rate ranging between 0.8 and 1.1 percent. Employment in the major lumber and wood products industries should remain relatively stable. Per capita incomes are also expected to continue below the state average due to seasonality of the basic industries. Trade and service industries and tourism and recreation are expected to rank among the most important growth sectors. The cities of Centralia and Chehalis would increase in importance as trade and service centers because of the continued growth and development of Seattle to the north and Portland to the south, with resulting increases in commercial and recreational traffic through the area.

d. Other Social Effects Criteria. Residents within the study area flood plain would remain subject to public health and safety threats because of periodic flooding. About 1,900 and 2,260 residential structures are within the Skookumchuck River 100-year and 200-year flood plain, respectively. Public facilities and properties would also be impacted. Raising or floodproofing new residential development in the flood plain would remove some of the adverse health and safety impacts of flooding. With respect to community cohesion, the traditional society of the study area would continue to be impacted by the urban influences of the growing major population centers to the north and south. Esthetic values along the study area streams would tend to be preserved by existing and proposed floodway regulations which would control development on the stream banks. Urban growth, however, would continue to impact undeveloped flood plain areas. Demand for additional recreation opportunities and for access to the recreation resources of the study area rivers and streams is expected to increase.

3.05 Alternative 2 - Skookumchuck Dam Modification (National Economic Development Plan, Nonstructural Plan, Least Environmentally Damaging Plan, Tentative Recommended Plan). This alternative, shown in figure 3-2, would use up to 28,500 acre-feet of the water supply storage in the existing Skookumchuck Dam Reservoir for flood damage reduction purposes during winter months. To operate a dam for flood control, the ability to rapidly drawdown a full reservoir after a flood is necessary. Since the capacity of the existing low level outlet is too small to lower the flood pool within a reasonable time period, a 12-foot-diameter flood control tunnel would be built through the rock in the north (right bank)




# SKOOKUMCHUCK DAM MODIFICATIONS

## FIGURE 3-2

abutment. The tunnel would be concrete lined, about 1,200 feet long, and have a capacity of 3,000 c.f.s. at minimum flood control pool (elevation 435) and 5,000 c.f.s. at maximum design pool (elevation 492). In order to control the flood control pool above the spillway crest, a bascule gate 17 feet high by 136 feet wide would be added to the currently ungated spillway, cut in rock on the south (left bank) abutment. The flood storage at the dam would reduce the 200-year Skookumchuck River flood flow at Centralia from 13,300 c.f.s. to 6,700 c.f.s. (equivalent to about an existing 3-year flood). The reduction in flood height would range from 2 to 5 feet depending upon the location. The 200-year flood plain would be reduced by about 1,500 acres of which about 770 would be in the immediate Centralia area. Flood damages would be significantly reduced on the remaining flood plain upstream of Centralia. The Chehalis River Valley downstream of Centralia would also experience reduced flooding. The 200-year Chehalis River flow at Grand Mound would be reduced 5,000 c.f.s., a height reduction of about 1/2 foot. The total cost of alternative 2 is estimated at $18,200,000, including engineering design, supervision, and administration. The tunnel and gate were analyzed separately and in combination with each other. The maximum net benefits were realized by the combination plan. Alternative 2 has been designated as the NED, the LED, and the Nonstructural Plan. It has the highest net benefits of the final alternatives. With planned mitigation features, adverse environmental impacts would not be significant and the potential exists for some enhancement of fishery flows over those currently provided. Although the plan is not nonstructural in the strictest sense of the word, it is considered a nonstructural plan since it would permit maximum use of a previously constructed dam and involves no stuctures in the flood plain receiving damage reduction. Since the plan best meets the various evaluation criteria it has been selected as the tentatively recommended plan. The response of alternative 2 to key criteria is presented in the following paragraphs and displayed in table 3-1.

a. National Economic Development Criteria. Alternative 2 would have total average annual benefits of $2,506,000, including $2,449,000 for flood damage reduction and $56,000 for elimination of future floodproofing costs. A potential power loss of about $4,000 could occur. The total average annual economic cost for the plan is $1,654,000 and the benefit-to-cost ratio is 1.5 to 1. The plan would have net benefits of $852,000. The proposed dam modification maximizes benefits within the constraints imposed by PP&L. This occurs because significant construction costs would be necessary for any amount of flood storage at the existing dam. The proposed dam modification provides the maximum amount of flood storage to which the dam owner will agree to provide. Any larger volume of flood storage could adversely affect the current water supply function of the dam and would be absolutely unacceptale to the owner. The combined tunnel and spillway modification has greater net benefits than either the tunnel or the spillway modification individually.

b. Environmental Quality Criteria. Table 3-1 presents the response of alternative 2 to four of the key environmental quality

criteria for the study area. Adverse environmental impacts of this plan include alteration of the hydraulic regime of wetlands associated with the Skookumchuck River and impacts to waterfowl and small fur bearing mammals in the reservoir area. Beneficial impacts involve some potential for improvement of fishery flows and reduced scouring and destruction of fish eggs by peak flows. The alternative is compatible with the land use plans of Lewis and Thurston Counties. Mitigation for the adverse impacts include the purchase of 50 acres of land and the installation of wood-duck nesting boxes along the river.

c. Regional Development Criteria. Alternative 2 would result in increased employment in Thurston and Lewis Counties during construction, and more business activity and greater business income as a result of project construction. There could be a rise in property values due to the reduction of flooding and elimination or reduction of floodproofing requirements with possible resulting increases in tax revenues. The plan could also have a secondary effect of encouraging local expenditures for improvement of public facilities no longer prone to flood damages.

d. Other Social Effects Criteria. Alternative 2 would result in a net contribution to social well-being due to increased health and safety resulting from the significantly reduced flooding. The recommended plan would reduce flooding depths throughout the Skookumchuck River Valley from the dam to Centralia. The plan would not require any residential, commerical, or industrial properties. Increasing the amount of flood storage beyond the 17,000 acre-feet (28,500 acre-feet in November and December) is not feasible at this time because of the requirements of the dam owner for preserving the complete water supply capability of the dam. For floods exceeding the 200-year event, a decreasing amount of flood reduction would be realized by the dam modification through the standard project flood event, which would be similar to the flooding in such an event under existing conditions.

e. Other Potential Measures. An analysis was made of the potential measures which could be combined with the tentatively recommended plan, including minimum provisions for hydropower and local protection measures. Minimum provisions for hydropower would increase construction costs by about $2.1 million. Construction of a powerhouse for two 3-megawatt (MW) units, including appropriate fish and wildlife mitigation, would total about $8 million. The plant factor of 11.3 percent would yield average annual benefits of $328,000. When compared to the average annual benefits of $830,000, the benefit-to-cost ratio would be about 0.4 to 1.0. Thus, there is no current justification for additional hydropower facilities and no justification for including minimum provisions for hydropower. To reduce residual flood damages, levee segments along the Chehalis and Skookumchuck Rivers and Coffee and Salzer Creeks were analyzed. These local protection measures were not incrementally justified when added to dam modification and probably would not be publically acceptable.

## SECTION 4. TENTATIVELY RECOMMENDED PLAN

4.01 Plan Description. The tentatively recommended plan consists of modifying the existing, privately owned Skookumchuck water supply dam to permit flood control operation during winter floods. Currently the dam is filled to the spillway crest during the first heavy rains in the fall, passes inflow during winter and spring months, and is drawn down during the summer and fall to provide water supply for the 1,400-MW Centralia Steam Electric Plant and supplemental flows for fisheries. For flood control operation, the reservoir would be drawn down from the normal reservoir pool (about elevation 445 to 460 feet) during October to the minimum flood control pool (elevation 435 feet) by 1 November, held at that elevation until 1 January, and gradually filled, reaching the spillway crest (elevation 477 feet) by 1 March. This change in operation would provide a maximum of 28,500 acre-feet of flood control storage in November and December. On 1 February the storage would total 17,000 acre-feet, which is the storage used in determining flood reduction. In order to use the dam for flood control, several structural modifications must be accomplished. These include the following.

- Construction of a 1,200-foot-long, 12-foot-diameter outlet tunnel in rock (including an intake gate tower and outlet flip bucket and plunge pool) in the right abutment to permit evacuation of the reservoir during flood control operation.

- Addition of a 17-foot-high by 134-foot-wide bascule gate on the crest of the currently ungated spillway on the left abutment.

- Addition of shotcrete to the sides of rock cut in which the spillway chute is located.

4.02 Existing Skookumchuck Dam. Skookumchuck Dam, shown on plate 3, is located in Thurston County, Washington, about 12 miles northeast of Centralia at R.M. 21.9 on the Skookumchuck River. The dam is a compacted earthfill embankment rising about 160 feet above the original streambed (190 feet above the rock at the base of the core trench). The dam axis is curved (radius 2,000 feet) and lies approximately north-south. The crest (design elevation 497 feet) is 30 feet wide and about 1,340 feet long. The spillway, located in rock on the left abutment, is an ungated side channel type with an open concrete lined chute terminating in a stilling basin with a flip bucket. The spillway ogee crest, 130 feet long, is set at elevation 477 feet. The chute is 25 feet wide with concrete side walls about 10 feet high which provide 1 foot of freeboard over the 10,000 c.f.s. spillway design flow profile. The cut rock slopes above the walls are stabilized with wire mesh held by rock bolts. The existing outlet works include a multilevel intake with gates at elevations 449, 420, and 378 feet, a steel conduit with segments of

36-inch-diameter pipe (260 feet and 200 feet long) connected by 380 feet of 72-inch pipe laid in a rock cut under the dam; and an outlet structure with two 24-inch Howell Bunger valves that discharge through energy dissipation chambers into the spillway stilling basin. The maximum discharge through the existing regulating multilevel outlet works is about 150 c.f.s.

4.03 Construction of the project caused impacts to the fish and wildlife habitat in the Skookumchuck River basin. To mitigate for damages to wildlife, PP&L acquired 900 acres downstream of the dam and turned it over to the Washington Department of Game (WDG) to manage for wildlife. Fisheries mitigation included construction of a multilevel regulating outlet to control river temperatures and fish passage facilities. A fish trapping facility at the base of the spillway can be used to collect upstream migrants for transport to any desired location. Downstream migrants are assisted by modifications to the spillway. A 4-foot-square fish passage sluice, located in the spillway ogee (invert elevation 464 feet), permits fish passage when the reservoir is between the spillway crest and elevation 464. The spillway chute includes two 2-foot-high concrete walls 4 feet apart to concentrate low flows and assist fish passage during periods of low discharge. An 18-inch pipeline provides 20 c.f.s. (30 c.f.s. maximum capacity) from the diversion outlet to fish rearing ponds operated by the Washington Department of Fisheries (WDF) downstream from the dam on the right bank.

4.04 PP&L has received permission from the FERC for the installation of a 980 kW hydropower generation facility at Skookumchuck Dam. The turbine/generator unit would be located at the downstream end of the existing 72-inch diversion pipe on a rock foundation. The operation would use much of the water normally passed through the outlet works to the stilling basin.

4.05 Hydrology. Riverflows generated within the Chehalis basin originate primarily from rainfall, occasionally augmented by snowmelt. Maximum riverflows occur during the winter season from November to February. From February through the late summer, riverflows generally recede to the lowest base, which occurs during the fall. A description of flooding and flood damages is provided in paragraphs 1.05 and 1.06. The average annual runoff of the Chehalis River at the U.S. Geological Survey (USGS) streamgage station at Grand Mound (about 7 miles downstream of Centralia) is estimated to be 2.08 million acre-feet. The streamflow patterns for the Skookumchuck and Newaukum Rivers are similar, although annual runoff is substantially smaller.

4.06 Because there are no streamgaging stations in the immediate Centralia study area, it was necessary to derive the design streamflow. The USGS streamgage near Grand Mound on the Chehalis, two streamgages on the Skookumchuck, and one on the Newaukum in the vicinity of the plan area provided an excellent record. Flood frequencies for these streamgages were computed in accordance with Water Resources Council (WRC) Bulletin 17A. Design streamflows for the 25-, 50-, 100-, and 200-year

TABLE 4-1

EXISTING PEAK DISCHARGES
(c.f.s.)

| Location | Return Interval | | |
|---|---|---|---|
| | 100-Year | 200-Year | SPF |
| Skookumchuck River Floods | | | |
| Skookumchuck River Above Bloody Run Creek | 7,400 | 8,250 | 13,900 |
| Skookumchuck River above Hanaford Creek | 10,300 | 11,300 | 17,300 |
| Skookumchuck River at Mouth | 12,200 | 13,300 | 20,000 |
| Discharge at Chehalis-Skookumchuck River Confluence | 53,000 | 57,750 | 70,000 |
| Chehalis River Floods | | | |
| Chehalis River above Skookumchuck River | 45,000 | 49,500 | 60,000 |
| Discharge at Chehalis-Skookumchuck River Confluence | 56,000 | 62,000 | 75,000 |

TABLE 4-2

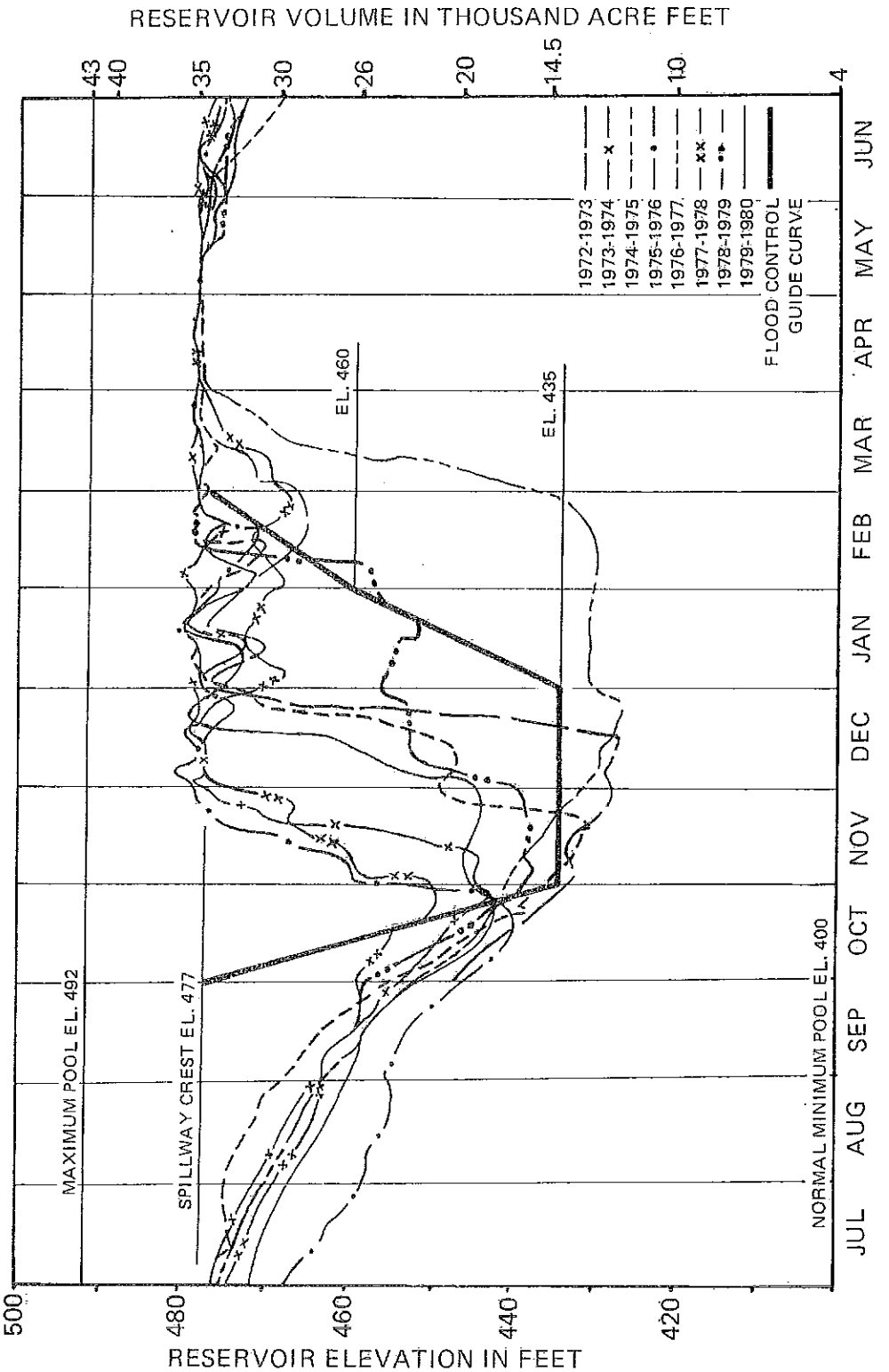
PEAK REGULATED DISCHARGES
(c.f.s.)

| Location | Return Interval | | |
|---|---|---|---|
| | 100-Year | 200-Year | SPF |
| Skookumchuck River Below Bloody Run Creek | 3,000 | 3,000 | 13,900 |
| Skookumchuck River Near Bucoda | 5,200 | 5,300 | 17,300 |
| Skookumchuck River at the Mouth | 6,350 | 6,700 | 20,000 |

floods on the Chehalis, Skookumchuck, and Newaukum Rivers in the study area were developed using North Pacific Division's computer program Streamflow Synthesis and Reservoir Regulation (SSARR) to combine and route hydrographs from the principal upstream tributaries, with intermediate inflow through the Chehalis-Centralia river reach to the USGS streamgage location at Grand Mound. SPF estimates were made for the Chehalis River between Chehalis and Centralia, the Skookumchuck River at the mouth, and the Newaukum River at the mouth. Peak discharges for the 100-year flood, 200-year flood, and SPF for locations within the study area are presented in table 4-1. More detailed and complete hydrology data is presented in appendix E.

4.07 The existing Skookumchuck Dam operation is essentially a fill and spill project. The reservoir fills to the spillway crest early in the flood runoff season with the first heavy rains. Once the reservoir is full, inflow to the reservoir passes over the ungated spillway (capacity 28,000 c.f.s. with reservoir at elevation 492 feet). Historic reservoir levels from 1972 to 1980 are shown on figure 4-1. The dam stores water for use at the Centralia Steam Electric Plant and provides minimum fishery flows in the Skookumchuck River. Coordination with PP&L indicated that flood control storage could be available at Skookumchuck Dam during winter months when the storage was not needed for water supply. A flood control guide curve (figure 4-1) was developed that provides PP&L with their required degree of reliability for their water supply as well as providing flood control storage. This high degree of reliability for water supply would insure adequate water would be available for use of the existing fish passage sluice throughout the juvenile steelhead outmigration period. After structural modifications are made, maximum flood control storage during November and December would be 28,500 acre-feet. This would be gradually reduced to 17,000 acre-feet on 1 February (reservoir elevation 460 feet) and 8,000 acre-feet on 1 March (reservoir elevation 477 feet). This reduction in flood control storage during January and February diminishes the amount of flood damage reduction provided by the project but it is considered absolutely essential by PP&L to insure impoundment of the basin runoff and maintenance of the current reliability of their water supply. During these months some additional flood control storage would be provided by drawing down the reservoir prior to large storms.

4.08 The flood reduction discussed in this report is based on the 17,000 acre-feet storage provided above elevation 460 on 1 February. This storage would permit the reduction of the existing peak discharges identified in table 4-1 to those regulated by flood control operation of Skookumchuck Dam, which are shown in table 4-2. Flood discharges greater than the 200-year event are reduced through the SPF, which would be unaffected by flood control operation of the dam. The estimated probable maximum flood (PMF) is 33,000 c.f.s. The estimated spillway design flood (SDF) is also 33,000 c.f.s. because there would be less than a 5 percent alteration in the PMF peak by the reservoir and no surcharge storage is available. The existing spillway has a capacity of




# HISTORIC RESERVOIR LEVELS

## FIGURE 4-1

28,000 c.f.s. The modifications to the spillway in combination with the flood control tunnel (capacity 5,000 c.f.s. with maximum pool at elevation 492 feet) would permit the SDF to pass the dam safely. The flood control outlet is sized to pass the downstream bank full volume (3,000 c.f.s.) at minimum flood control pool. This will permit the reservoir to be drawn down quickly following a flood to restore its flood control storage capacity.

4.09 Flood Plain Investigation. Hydraulic analyses were conducted to define flooding potential under existing and proposed flood protection conditions and to delineate design criteria for modifications at Skookumchuck Dam. Analyses of flood potential under present conditions are based on flooding history, existing topographic features, and flood fighting experience. The analysis of flood protection methods, which consisted of alternative levee alinements and dam modification, included the effect of sedimentation, wind wave effects, swellhead due to bridges, and water surface superelevation at the outside of river bends. Analyses of flood water surface elevations on small tributaries were primarily based on previous analyses by other agencies. Hydraulic considerations used in the design of the dam modifications included: the spillway design flood, freeboard, drawdown, waves, flood control storage, and releases and sedimentation. These items are discussed in paragraph 4.11. Additional information on the flood analyses under existing and project conditions and the design considerations used in the dam modifications is in appendix E.

4.10 Geotechnical Considerations. Skookumchuck Dam spans a bedrock canyon cut in interbedded units of jointed basalt and massive flow breccia with subordinate amounts of lapilli tuff and occasional soft contact or weathered zones between lava units. The outlet channel will be cut in a combination of these materials and the tunnel will be largely excavated in massive breccia. A rock septum may be grouted and left as a cofferdam at the upstream end of the intake channel excavation. The gate structure will also be founded on massive breccia, but additional investigation may show repositioning or special foundation treatment for the flip bucket due to an extensive underlying soft zone. The new spillway ogee section would be founded in breccia underlain by highly fractured basalt and may require special foundation treatment. Waste rock from the above excavations may be disposed of downstream from the dam in a former construction waste area.

4.11 Design Criteria. The following paragraphs discuss criteria used in designing the modifications to the existing Skookumchuck Dam. More detailed information is provided in appendix E and section 2 of the DEIS.

a. Spillway Design Flood. The modifications of Skookumchuck Dam would enable the project to safely pass the PMF inflow of 33,000 c.f.s. at maximum design pool elevation 492 feet. During the PMF condition, 28,000 c.f.s. would be discharged over the spillway and 5,000 c.f.s. would be discharged through the proposed flood control outlet.

b. Freeboard. The embankment design crest elevation of 497 feet provides 5 feet of freeboard above maximum design pool elevation 492 feet. The actual dam crest is about 0.5 to 1.0 foot higher than the design crest. This provides between 5.5 and 6.0 feet of freeboard which is considered adequate.

c. Drawdown. Drawdown requirements can be met through use of the proposed outlet tunnel. At a maximum pool elevation of 492 feet, the dam impounds 43,000 acre-feet. The flood control outlet is designed to discharge about 800 c.f.s. (greater than the highest 4-month average flow of 770 c.f.s.) at pool elevation 402 feet (elevation at which reservoir volume is 10 percent of the storage at full pool) and 3,000 c.f.s. at the flood control pool elevation 435 feet. If the flood control outlet is discharging 3,000 c.f.s., the approximate bank full capacity downstream, reservoir drawdown from elevation 492 to 402 can be accomplished within about 11 days. If inflow is increased to 1,000 c.f.s. and outflow limited to that provided by one intake gate, drawdown from pool elevation 492 feet to 415 feet can be accomplished in about 23 days.

d. Waves. Maximum observed wind velocity-duration data from the Toledo, Washington, weather station are considered generally representative of the Skookumchuck Dam project and was used in the evaluation. The reservoir generally lies in an east-west orientation where easterly winds become the critical direction for wave generation on the embankment face. The effective fetch length from the east is 1 mile and the design wind velocity is 70 miles per hour with a minimum duration of 12 minutes. With these conditions the maximum wave runup on the embankment face was computed to be 5.6 feet, which is less than the existing freeboard above elevation 492.

e. Flood Control Storage and Releases. Flood control storage of 28,500 acre-feet is provided between pool elevation 435 and 492 feet. This storage is sufficient to control a flood of 200 years at Skookumchuck Dam and would reduce the 200-year Skookumchuck River discharge at Centralia from 13,300 c.f.s. to 6,700 c.f.s., which is about a current 3-year event. In order to evacuate the reservoir to elevation 460 (the elevation from which the regulated discharges were derived) within a minimum of 5 days following a major flood that fills the reservoir to elevation 492 feet, the flood control outlet must discharge a minimum of 3,000 c.f.s.

f. Environmental Considerations. Under present conditions during most of the year, PP&L provides a minimum release of 95 c.f.s. to meet their current diversion needs (60 to 65 c.f.s.) and instream flow requirements (30 c.f.s.) below the diversion. The flood control guide curve was developed based on a minimum release of 110 c.f.s., which meets PP&L's total water rights for diversion (80 c.f.s.) and the instream flow requirements (30 c.f.s.) below the diversion (about 2.5 miles downstream of Bucoda). The increase of 15 c.f.s. over

existing conditions during minimum flows would provide some improvement to the stream fishery in the entire Skookumchuck River below the dam until PP&L uses their entire diversion water right. Even then, some benefit would accrue to the fishery due to increased flow between the dam and the diversion (about 14 miles of stream). However, these benefits are not directly attributable to the project, even though the project may serve as a catalyst for them. From 15 September to 30 October, PP&L currently provides a minimum release of 140 c.f.s. to facilitate upstream migration of prespawning adult salmonids. Since this is the time when the reservoir normally will have to be drawn down to the flood control guide curve, the analysis of project conditions included an increase of 5 c.f.s. (to 145 c.f.s.) in the minimum release and an increase in duration of 2 weeks (1 September to 15 September). This minor additional flow to assist spawning, requested by WDF and WDG, would provide some benefit to the fishery and is not expected to adversely affect flood control capability or water supply reliability.

g. Sedimentation. The potential for reservoir sedimentation was estimated using observed USGS data from the Skookumchuck River and, for comparison, observed sedimentation in the Howard A. Hanson Reservoir on the Green River in western Washington, which has basin characteristics similar to the Skookumchuck Valley. The evaluation indicated that a sediment accumulation during the project's 100-year economic life should have no significant impact on the project's flood control operation.

4.12 Structural Features.

a. Flood Control Outlet Works. The flood control outlet works (see plate 4) would be located in the right abutment and consist of an approach channel, double entrance intake tower, concrete lined tunnel, and flip bucket with plunge pool. The outlet works is designed to discharge 3,000 c.f.s. at minimum flood control pool and 5,000 c.f.s. at maximum design pool. The following paragraphs discuss elements of the outlet works.

(1) Approach Channel. The 250-foot-long, trapezoidal-shaped channel will be excavated in rock and have a bottom width of 25 feet, an invert elevation of 394 feet, and 1 horizontal (H) on 10 vertical (V) sloping sides. During maximum flood control releases of 3,000 c.f.s. with the pool at 435, maximum average velocities of about 2.5 f.p.s. will exist in the channel and energy losses will be negligible.

(2) Intake Tower. The concrete intake tower will be 16 feet by 24 feet in plan and about 135 feet high above the approach channel invert. The intake will have two entrances (invert elevation 394 feet), each 5 feet wide by 7 feet high and controlled by tainter gates. Based on a centerline elevation of 397.5 feet, the outlet discharge/pool relationship is shown in table 4-3.

TABLE 4-3
OUTLET TUNNEL DISCHARGE-RESERVOIR POOL ELEVATION RELATIONSHIP

| Pool | Elevation (feet) | Discharge (c.f.s.) |
|---|---|---|
| Maximum Design | 492 | 5,000 |
| Intermediate | 450 | 3,600 |
| Minimum Flood Control | 435 | 3,000 |
| Minimum Drawdown | 402 | 800 |

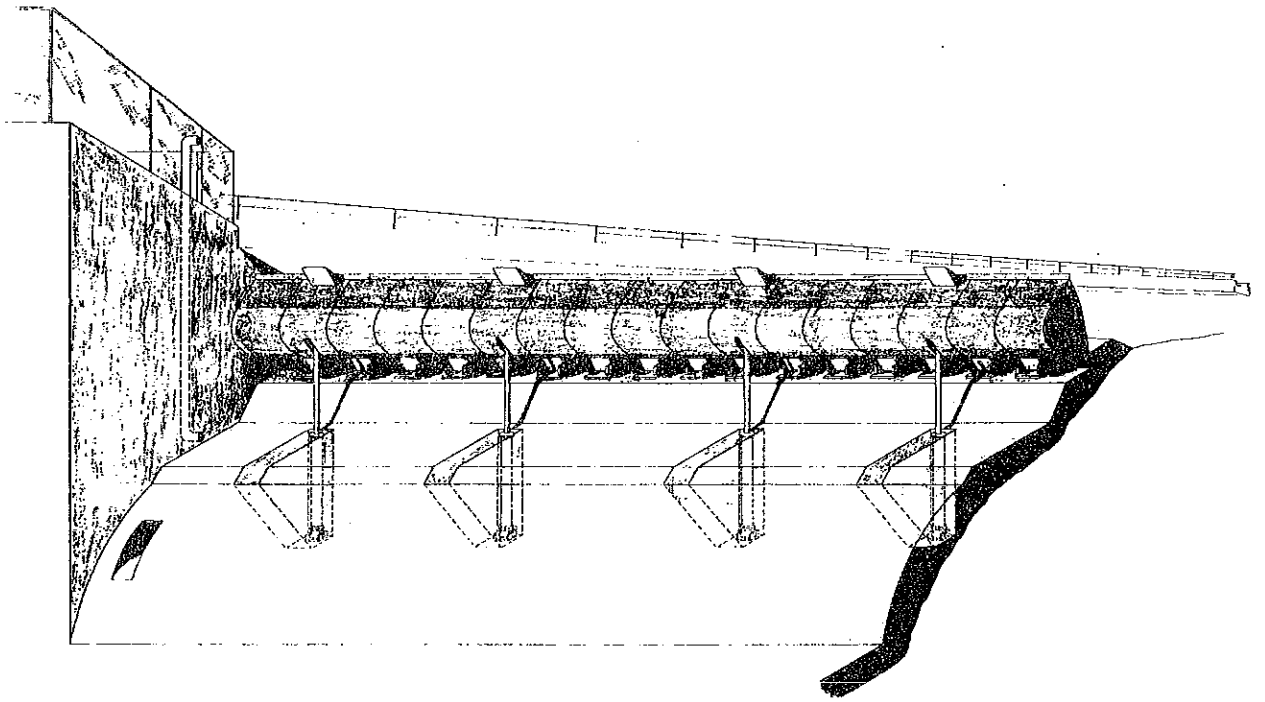
Three vertical shafts would be located in the tower. The center shaft would contain a stairwell for access to the entrances and the outer two will provide air supply downstram of the entrance tainter gates. One transferrable 9.5-foot-wide by 13-foot-high roller gate would be provided for emergency closure capability. A trashrack structure would be incorporated into the intake tower upstream from the entrance to minimize debris movement through the outlet.

(3) Tunnel. A transition section would connect the double entrance via a parabolic drop to a 12-foot-diameter, concrete lined tunnel. The tunnel would slope at about 3 percent to maintain supercritical flow conditions. During SPF conditions, a maximum discharge of 5,000 c.f.s. would result in water depths up to about 10 feet and average velocities about 70 f.p.s. in the tunnel. During the maximum flood control discharge of 3,000 c.f.s., depths and velocities of approximately 7.5 feet and 50 f.p.s., respectively, would occur.

(4) Energy Dissipation. A flip bucket would be utilized at the downstream end of the tunnel to deflect the water jet from the outlet into the river channel. The bucket would transition from the 12-foot tunnel diameter at the portal to a 20-foot width to reduce flow depths. The bucket crest would be set at elevation 356, above the estimated maximum tailwater elevation of 354 feet. A jet throw distance of about 150 feet would exist during maximum outlet discharge conditions. A plunge pool would be partially constructed by removal of overburden to bedrock in the area between the flip bucket and existing Skookumchuck River channel.

b. Spillway Modifications. The discharge capacity of the existing uncontrolled side channel spillway is computed to be 28,000 c.f.s. at the design pool elevation. The following paragraphs discuss details of the proposed modifications (plate 5).

(1) Crest Gate. A 17-foot-high by 136-foot-wide bascule-type (pelican version) gate, shown in the cutaway figure 4-2, would be added to the existing spillway crest to provide control of reservoir pool elevations up to an elevation of 492 feet with 2 feet of freeboard. The gate would be designed so that in the lowered position, its geometry will provide continuity with the existing ogee.



# SPILLWAY GATE

## FIGURE 4-2

(2) Ogee Crest Modification. The existing crest would be widened from 130 feet to 136 feet and extended 15 feet upstream to provide for the bascule gate operating equipment. The additional width would facilitate placement of the gate in the manufacturer's standard 8-foot-wide sections and compensate for any decrease in discharge capacity which may occur due to energy losses caused by the slightly less efficient spillway crest geometry.

(3) Chute Lining. The existing spillway chute is located in a rock excavation on the left abutment. At its upper end, the chute converges from a width of 40 feet to 25 feet and has 1 H on 4 V side slopes. The walls are concrete lined 7 to 13 feet vertically above the invert with excavated rock side slopes above the concrete lining. During SDF discharge, the water surface in the chute would overtop the concrete lined portion of the walls by 4 to 13 feet but would still be contained in the excavated rock channel. To prevent damage to the rock portion of the chute and possible damage to the existing concrete lined walls, the rock slopes of the chute would be faced with shotcrete up to the SDF water surface profile (about an average of 10 feet).

(4) Fish Passage. Removal of the existing ogee crest will also require removal of the existing fish sluice. The fish sluice will be replaced at its current location as part of the reconstructed ogee monolith. The relocated fish sluice will have the same dimensions as the current fish sluice, but the invert will be lowered about 2 feet (to elevation 462 feet) so the sluice can pass under the bascule gate's operating machinery.

4.13 Access Roads. New access roads would be required to construct and maintain the approach channel, intake tower, downstream tunnel portal, and flip bucket. A portion of the existing fish facility access road would be rerouted to avoid conflict with the plunge pool. These roads are shown on plate 3 and would be gravel surfaced. Construction of the plunge pool would require relocation of one power pole and about 400 feet of the 18-inch steel pipe which supplies water to the fish rearing ponds.

4.14 Real Estate. Acquisition of real estate interests (purchase in fee, temporary and/or permanent easements) is needed to provide for 50 acres of mitigation land to be conveyed to the State of Washington for management; construction and inspection of structural modifications; and meteorological, streamgage, and radio repeater stations. The requirements of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646) will be satisfied.

4.15 Cultural Resources. A cultural resources reconnaissance performed in late 1977 by the University of Washington, Office of Public Archaeology, identified five historic sites on potential levee alinements in Centralia. A cultural resources reconnaissance performed in 1981 by Seattle District personnel did not identify any significant sites which

would be affected by dam modification. Coordination was maintained with the State Historic Preservation Officer. During postauthorization planning, a cultural resources survey would be performed only if potential sites were identified during preliminary planning and engineering (PP&E) studies. If necessary, a salvage/preservation program would be developed based on the results of the cultural resources survey.

4.16 Environmental Considerations. The primary environmental consideration in this study was maintaining the already high water quality of the Skookumchuck Reservoir and River. Beneficial impacts due to plan implementation would include some potential for reduced scouring and destruction of fish eggs by peak flows. Instream flows for the Skookumchuck River would be increased from the current minimum of 95 c.f.s. during salmonid rearing periods and 140 c.f.s. during spawning migration periods, to a minimum flow of 110 c.f.s during rearing and 145 c.f.s during spawning. The increase of 15 c.f.s. is necessary to permit PP&L to divert their entire water right. In addition, the 145 c.f.s. flow period for spawning would be increased by 2 weeks. Increased flow is expected to benefit salmonid populations in the Skookumchuck River below the dam. During construction, in water work in the river and reservoir will be minimized by manipulation of the river and reservoir heights. Minimizing inwater construction activities will minimize turbidity and related water quality impacts such as reduced dissolved oxygen levels. During the late winter refilling of the reservoir, reservoir elevation will be increased gradually over a 2-month period instead of being raised rapidly. This slower refill, although a necessary procedure for flood control, may provide direct benefits to wildlife by allowing more time for utilization of food resources at the gradually rising waters edge. However, adverse impacts could not be completely avoided. These include: alteration of the hydraulic regime of wetlands associated with the Skookumchuck River and impacts to waterfowl and small fur bearing animals in the reservoir area. For further information, see section 4 of the DEIS.

4.17 Fish and Wildlife Mitigation. Impacts associated with the plan would occur in the Skookumchuck Reservoir and along the Skookumchuck River from the dam downstream to the river's mouth at Centralia. Impacts to the reservoir include loss of bank denning mammals, reduction in wildlife habitat value, and reduction in waterfowl habitat value. Impacts to the river include changes in inundation frequency of wetlands along the river and outside the areas receiving flood damage reduction benefits, with resultant reductions in wildlife and waterfowl habitat value. Due to excessive costs and low returns expected for mitigation efforts aimed at specific impacts, resource agencies expressed a preference for the acquisition of a single large parcel of land to be added to the existing mitigation area provided by PP&L for impacts associated with the original construction of Skookumchuck Dam. This parcel of land (figure EIS-1), approximately 50 acres in size, presently is composed of

second growth cedar forest, second growth Douglas fir forest, and a series of small wetland areas surrounding a stream. This area is contiguous with the existing PP&L/WDG mitigation lands and has been identified as an important travel corridor for local deer and elk populations. This land, currently owned by Scott Timber Company, would be purchased by the Corps of Engineers and transferred to the WDG who whould be responsible for all management and maintenance costs. Specific management activities haye not been identified at this time, but any activity would be funded by WDG as part of the Skookumchuck Wildlife Habitat Management Project. In addition, mitigation for impacts to waterfowl and waterfowl habitat would be accomplished by the purchase and installation of 30 wood-duck nesting boxes along the Skookumchuck River. Although a number of species of waterfowl would be impacted by the proposed project, resource agencies expressed a desire to provide mitigation focused on a single high value species. Funds for construction, installation, and maintenance of these wood-duck nesting boxes would be provided to the U.S. Fish and Wildlife Service (FWS), who would then perform all activities related to this mitigative effort. Since adverse impacts to fisheries resources are not anticipated, no mitigation measures for fisheries are planned. More detailed information on mitigation measures is contained in section 2 of the DEIS.

4.18 Project Costs. Estimated project costs are summarized in table 4-4 and detailed in appendix E. Under existing law, all project costs would be Federal since the project involves a major flood control dam. All costs are based on unit prices established from the best information available for October 1982 price level.

TABLE 4-4

SUMMARY OF PROJECT COST ESTIMATE
(October 1982 Price Level)

| Feature | Cost |
|---|---|
| Dam | $13,850,000 |
| Spillway Modifications | (5,400,000) |
| Intake Tower/Approach Channel | (6,170,000) |
| Tunnel | (1,800,000) |
| Flip Bucket/Plunge Pool | (480,000) |
| Fish and Wildlife | 100,000 |
| Access Roads | 550,000 |
| Permanent Operating Equipment | 700,000 |
| Engineering and Design | 1,600,000 |
| Supervision and Administration | 1,400,000 |
| TOTAL COSTS | $18,200,000 |

4.19 Plan Implementation. Implementation of the plan will require the development of a contractual agreement between the Corps of Engineers and PP&L to cover pertinent items regarding design, construction, operation, and maintenance of the project. The agreement would include: any required temporary and/or permanent easements for preconstruction planning, construction, and/or operation; review of project design; development of operational guidelines and an operation and maintenance manual; reimbursement to PP&L for costs incurred; periodic inspections and dam safety assurance; and any other required items. A separate agreement would be developed with the WDG to cover the acquisition of the mitigation land by the Corps of Engineers in fee and the transfer to the WDG for their operation and maintenance of the land in conjunction with the land provided to them by PP&L as mitigation for construction of the project.

4.20 Construction Schedule. PP&E is projected to require 3 years for completion, with construction requiring 2 years. A PP&E and construction schedule is presented in appendix E.

4.21 Operation and Maintenance. The flood control modifications would be operated and maintained by PP&L under terms of an agreement with the Corps. During the flood control season the flood control tunnel and spillway gates would be operated in accordance with an operation and maintenance (O&M) manual prepared by the Seattle District. An inspection of the project and flood control features would be conducted annually by Corps and PP&L personnel to insure that any developing conditions which could adversely affect the flood control works are recognized and corrected in a timely manner. The mitigation measures would be operated and maintained by WDG.

4.22 Economics of the Plan.

a. Methodology. The economic justification of the plan can be demonstrated by comparing the average annual charges with average annual NED benefits which would be realized from the plan. A 100-year period of economic analysis was selected in analyzing the plan because the dam modification would provide major long-term urban flood damage reduction. Benefits and costs were based on October 1982 prices. The first year of project operation was assumed to be 1990. Benefits and costs of the plan would accrue at different periods of time. These were made comparable by conversion to an equivalent time basis using the proper interest rate for water resource projects (7-7/8 percent for FY 1983). Additional information on the economic analysis for flood control benefits is found in appendix C.

b. Average Annual Benefits.

(1) Inundation Reduction Benefits. Inundation reduction benefits were based on analysis of damages under with and without project conditions. Damages were established by surveys and were designated by category of land use and type of loss. Monetary losses were considered

for physical damages caused by inundation; costs incurred in fighting or anticipating floods; business or other financial losses resulting from decreased production, net profits and wages, and increased cost of normal operation; and increased living expenses for individuals and families. Annual inundation reduction benefits under existing prices and conditions (October 1982) amount to $2,132,000, reflecting almost a 71 percent reduction in the current average annual flood damage level of $2,998,000. Without project flood damages are expected to increase in the future and thus inundation reduction benefits which would accrue from implementation of the recommended project would increase over time. Future inundation reduction benefits were based on an assessment of existing and projected flood plain regulations which would generally require floodproofing for new construction and major renovations within the 100-year flood plain. Inundation reduction benefits are not claimed for the lands intended for mitigation. Growth in damages to new or remodeled structures would be insignificant. However, the value of contents of households already in the flood plain would continue to increase. Public facilities and utilities as well as expenditures for emergency aid to flood victims are also expected to increase. Projected increases in the value of residential contents were increased at an annual rate of 2.6 percent based on the projected rate of increase in per capita income. The increase was limited to 75 percent of structure value. The growth in damages to public facilities and expenditures for emergency aid was projected to grow at a 0.8 percent annual rate for 50 years and remain constant thereafter based on the projected population growth in the flood plain. The total average annual inundation reduction benefits for the recommended plan, including future growth in flood damages, were estimated to be $2,450,000 (this includes $130,000 average annual benefits for damages reduced downstream of Centralia).

(2) Elimination of Floodproofing Costs. Under the existing and projected flood plain regulations, all new flood plain development would be required to be floodproofed up to the 100-year flood level. The plan would eliminate the need for floodproofing for about 109 acres of land expected to be developed. This saving of future floodproofing cost would be a project benefit. Average annual benefits for saving of future floodproofing were based on projections of future flood plain growth in the absence of a project and the projected cost of floodproofing new residential structures. These average annual savings are estimated at $56,000.

c. Annual Costs. Annual costs include interest and amortization on the investment costs and the average annual costs of operation and maintenance. A 2-year construction period and a 7-7/8 percent interest rate has been used for the analysis. Additional annual charges of $4,000 were attributed to reduced hydropower capability because of flood control operation of the dam. Table 4-5 summarizes total plan costs.

d. Economic Justification. Table 4-6 presents a summary of annual costs and benefits and a benefit to cost ratio under existing and future conditions. Existing conditions include benefits which would accrue to

the recommended plan if it were constructed and in place in October 1982. Future conditions include growth in benefits projected to occur over the 100-year project life beginning with project completion estimated for 1990.

TABLE 4-5

PLAN COSTS
(October 1982 Prices and 7-7/8 Percent Interest)

| | |
|---|---|
| Total Estimated Construction Cost | $18,200,000 |
| Interest During Construction | 1,467,000 |
| Total Investment Cost | $19,667,000 |
| | |
| Annual Costs | |
| Interest and Amortization | $1,550,000 |
| Potential Power Loss | 4,000 |
| Operation and Maintenance | 100,000 |
| | |
| TOTAL AVERAGE ANNUAL COSTS | $1,654,000 |

TABLE 4-6
BENEFIT-COST COMPARISON
(October 1982 Prices)

| Category | Existing Conditions (October 1982) | Including Future Growth (1990-2090) |
|---|---|---|
| Inundation Reduction Benefits | $2,132,000 | $2,450,000 |
| Elimination of Floodproofing Costs | - | 56,000 |
| Total Annual Benefits | $2,132,000 | $2,506,000 |
| Annual Charges | $1,654,000 | $1,654,000 |
| Benefit-to-Cost Ratio | 1.3 | 1.5 |

4.23 Non-Federal Cost Sharing Requirements. Congressional authorization of specific projects in the period 1936-1941 established the general policy on cost sharing for flood control reservoirs. In the past the Corps of Engineers has generally recommended similar requirements in subsequent proposals. On major reservoirs, the Federal Government has assumed the total costs (including O&M) allocated to the flood damage reduction function. Since the dam has been previously constructed by PP&L and the water supply and hydropower facilities have been or would be constructed by PP&L, the only purpose for dam modification is flood

damage reduction. Thus, non-Federal cost sharing would not be required under the existing law. However, as local sponsor, the city of Centralia would be required to accomplish certain items, including the following:

- Continue to participate in the National Flood Insurance Program.

- Administer and enforce flood-plain regulations to prevent undue increase in the flood damage potential, prevent unwise future development in the flood plain and insure compatibility between future development and protection levels provided by the project.

- Publicize flood-plain information in the area concerned, and at least annually, inform affected interests regarding the limitations of the protection afforded by the project.

4.24 The city of Centralia, a governmental unit organized under Washington State law, has the authority and ability to carry out the local cooperation for the plan. The city of Centralia has indicated their willingness to provide items of local cooperation by letter dated 3 December 1981 (exhibit 3 to appendix B). The State of Washington expressed their views on cost sharing by letter dated 11 January 1982 (exhibit 5 to appendix B).

4.25 Environmental Effects of Plan. The principal beneficial environmental impacts of the plan would be a significant reduction in flood damages in the Skookumchuck River Valley, including the communities of Centralia and Bucoda; a minor reduction in flood damages for the Chehalis River Valley below Centralia; and an anticipated improvement of conditions for anadromous fish in the Skookumchuck River. The principal adverse environmental impacts of the plan would be an anticipated reduction in wetland areas associated with the Skookumchuck River with possible reductions in habitat values and secondary impacts to dependent wildlife populations, reductions in available waterfowl habitat in the reservoir, and a loss of a small number of fur bearers (beavers and muskrats) in the reservoir. With planned mitigation features, adverse environmental impacts associated with the plan would be minor. These features would include: acquisition of 50 acres of second growth cedar and Douglas fir forest with wetland areas along a stream and installation of wood-duck nesting boxes along the Skookumchuck River. The proposed mitigation lands are contiguous to the existing 900-acre WDG Skookumchuck Wildlife Management Project which was established as mitigation for construction of the Skookumchuck Dam by PP&L. Adverse impacts to fisheries resources are not anticipated; no mitigation measures for fisheries are planned. Pursuant to Section 7(c) of the Endangered Species Act, the FWS, by letter dated 20 January 1982 (appendix B, exhibit 16), indicated that there are no listed or proposed species occurring within the area of the project. In compliance with the Clean Water Act of 1977, a Section 404(b)(1) evaluation of the

impacts of instream fill activities associated with the recommended plan was conducted and is presented in appendix A. A Section 404(r) exemption will be obtained to meet the requirements of the Clean Water Act. Local management programs include the Thurston Region Shoreline Master Program which designates the Skookumchuck River Valley flood plain (including the reservoir area) as "conservancy," except for the area around Bucoda which is classified "urban." The plan is consistent with the shoreline designations of the program and, thus, satisfies consistency with the state and national coastal zone management requirements. The effects of the recommended plan on particular resources recognized by Federal policies are presented in table 4-7. A complete discussion of the environmental impacts associated with the plan is presented in the DEIS.

TABLE 4-7
EFFECTS OF THE PLAN ON RESOURCES OF PRINCIPAL NATIONAL RECOGNITION

| Types of Resources | Principal Sources of National Recognition | Measurement of Effects |
|---|---|---|
| Air Quality | Clean Air Act, as amended (42 U.S.C. 1857h-7, et seq.) | No effect |
| Areas of Particular Concern Within the Coastal Zone | Coastal Zone Management Act of 1972, as amended (16 U.S.C. 1451, et seq.) | No effect |
| Endangered and Threatened Species Critical Habitat | Endangered Species Act of 1973, as amended (16 U.S.C. 1531, et seq.) | No effect |
| Fish and Wildlife Habitat | Fish and Wildlife Coordination Act (16 U.S.C. Sec 661, et seq.) | No direct loss, long-term alterations to wildlife habitat, and a reduction in carrying capacity is anticipated. |
| Flood Plains | Executive Order 11988, Flood Plain Management | 200-year flood plain reduced by 1,500 acres. No change in standard project flood (SPF) flood plain. |
| Historic and Cultural Properties | National Historic Preservation Act of 1966, as amended (16 U.S.C. Sec 470, et seq.) | No effect |
| Prime and Unique Farmland | CEQ Memorandum of 1 August 1980; Analysis of Impacts on Prime or Unique Agricultural Lands in Implementing the National Environmental Policy Act | No effect |
| Water Quality | Clean Water Act of 1977 (33 U.S.C. 1251, et seq.) | No effect |
| Wetlands | Executive Order 11990, Protection of Wetlands, Clean Water Act of 1977 (42 U.S.C. 1857h-7, et seq.) | 170 acres of riverine wetlands and riparian forest would be removed from 200-year flood plain. Development (and subsequent loss) of a portion of these wetland areas is anticipated. No change in SPF flood plain. |
| Wild and Scenic Rivers | Wild and Scenic Rivers Act, as amended (16 U.S.C. 1271, et seq.) | No effect |

## SECTION 5. COORDINATION

5.01 Coordination Framework. A series of public meetings and workshops has been held as the Chehalis basin study has progressed. The initial basin study meeting was held in 1946. Workshops and meetings on the Centralia-Chehalis study were held in 1974, 1976, and 1980. As part of the public involvement process, public brochures and a status report were prepared which presented factual data on the study and afforded an opportunity for comment and feedback on the study alternatives. There have been four editions of the brochure to date. Additional detail on the public involvement is presented in appendix B.

5.02 Coordination with Key Agencies.

a. General. The study has been coordinated with a wide range of Federal, state, and local agencies through the study brochure and through specific coordination on key study issues. A list of these agencies is presented in appendix B. The results of the coordination with key agencies are outlined below.

b. Pacific Power and Light Company. Extensive coordination has been maintained with PP&L regarding the use of Skookumchuck Dam for flood damage reduction. PP&L has agreed to such use of the dam as seen in their letter attached as exhibit 4 to appendix B provided that the reliability of the water supply function of the dam is not adversely affected.

c. City of Centralia. The major local issues and concerns have been channel dredging as an alternative to levees, the environmental impacts, and induced damages resulting from levee construction. The city of Centralia has agreed to provide the local cooperation requirements as reflected in their letter attached as exhibit 3 to appendix B.

d. Washington State Department of Ecology. The WDE represents the governor's office in matters dealing with flood control. Coordination has been maintained with the WDE with regard to compatibility of the various plans with the State of Washington Shoreline Management and Flood Control Zone Programs and with regard to cost sharing under former President Carter's water policy. Their view on cost sharing is presented as exhibit 5 to appendix B.

e. Fish and Wildlife Service. The FWS has prepared a draft Fish and Wildlife Coordination Act report and provided recommendations to the Corps of Engineers. An item by item response to the draft FWS recommendations is included in appendix B. Table 5-1 summarizes and combines similar draft recommendations and draft Corps responses.

TABLE 5-1

DRAFT FWS RECOMMENDATIONS

| Recommendation | Recommendation Number | Response |
|---|---|---|
| Construction activities be coordinated and design plans approved by WDE, WDF, and WDG. Sedimentation during construction should be minimized with appropriate technology. All borrow/spoil areas be identified before construction. | 1, 2, 3 | Coordination will be maintained with concerned agencies throughout advance engineering and design studies, preparation of plans and specifications, project construction, and operation. Corps will retain final approval authority for plans. Coordination will include location of borrow/spoil areas and determination of appropriate means to minimize sedimentation. |
| Mitigation costs be treated the same as other joint costs and allocated among beneficial purposes. | 4 | The only purpose for modification of the dam is flood damage reduction, so there are no joint costs. Mitigation measures will be shared on the same basis as the flood damage reduction features. |
| An agreement and funding be developed between the Corps and conservation agencies to evaluate construction activities and mitigation. | 5 | Specific monitoring measures would be developed during PP&E studies to evaluate construction activities and mitigation measures. |
| Minimum or better instream flows must be provided for anadromous fish. The Corps should at least abide by the existing agreement between WDF and PP&L. | 6 | Minimum or better instream flows will be provided (110 c.f.s. generally with 145 c.f.s. during September and October). |
| Reservoir inflow temperatures should be monitored. Project operations should provide optimum fishery water temperatures below the dam. | 7 | A monitoring program would be established and the project would be operated to provide optimum instream water temperatures whenever reservoir conditions permit. |

TABLE 5-1 (con.)

| Recommendation | Recommendation Number | Response |
|---|---|---|
| Mitigation should be accomplished for steelhead outmigrant losses if the reservoir fails to fill due to project operations and outmigrants are not passed over the dam. | 8 | Operation of Skookumchuck Dam for flood control would not change the probability of reservoir filling. |
| Wildlife conservation area of 50 acres should be established to mitigate for project-induced impacts to wildlife resources. | 9 | 50 acres will be obtained to mitigate for project impacts on wildlife resources. |
| 30 wood-duck nesting boxes should be erected along the Skookumchuck River and maintained during project life. | 10 | The construction and maintenance of 30 wood-duck nesting boxes will be included to mitigate for project impacts on waterfowl. |
| The reservoir should be raised slowly during refilling to improve plant growth and increase plant availability for wildlife. | 11 | Reservoir refill would be accomplished gradually except when periods of heavy rain and potential flooding occur during refill and require flood storage with accompanying variations in reservoir elevations. |
| The reservoir and Skookumchuck River should be open for year-round public use with full consideration given to access for the handicapped. | 12 | The Skookumchuck Dam and Reservoir are and would remain the property of the consortium that owns and operates the Centralia Steam Electric Plant. Development of recreation, if appropriate, would be a responsibility of PP&L and independent of the dam modification. |

5.03 Coordination of Draft Report. (This paragraph will be completed after public review of the draft report and DEIS.)

## SECTION 6. TENTATIVE CONCLUSIONS AND RECOMMENDATIONS

6.01. Tentative Conclusions. This study has included an examination of all practical alternatives, including nonstructural alternatives, for meeting the study objective to reduce flood damages in the Skookumchuck River Valley, the cities of Centralia and Chehalis, and the Chehalis River Valley downstream of the cities. The plan for modification of Skookumchuck Dam for flood damage reduction, coupled with implementation and enforcement of flood plain regulations, is the most effective alternative in reducing flood damages in the plan area and is the plan most favored by local interests. The potential adverse environmental impacts of this plan have been carefully considered and mitigation included where they appear to be significant. The plan is consistent with national policy, statutes, and administrative directives. The plan has been reviewed in light of the overall public interest, as well as the stated views of other interested agencies and the concerned public as expressed through correspondence, public meetings, and workshops. I have concluded that, on balance, the total public interest would be best served by implementation of the tentative recommended plan.

6.02 Tentative Recommendations. I have carefully considered the economic, environmental, and social ramifications of providing flood control storage at the existing, privately-owned Skookumchuck River Dam and find that such development is feasible and in the overall public interest. I tentatively recommend construction authorization for improvements to Skookumchuck Dam, as described in this report, subject to cost sharing and financing arrangements with responsible non-Federal agencies sponsoring the project which are satisfactory to the President and Congress and with such modifications thereof as in the discretion of the Chief of Engineers may be advisable. The dam modifications include construction of a new low level flood control tunnel, spillway modifications including a gate on the spillway crest, and such other items as required for flood control operation of the dam. Implementation of the tentatively recommended plan will require the development of a contractual agreement between the Corps of Engineers and PP&L, as agent for the dam owners, to cover pertinent items regarding design, construction, and operation and maintenance of the project for flood control. Separate agreements would be developed with WDG and any other agency as necessary for construction and operation of the project.

6.03 Prior to construction, local interests would, in addition to the general requirements of law for these types of projects, agree to comply with the following requirements:

- Continue to participate in the National Flood Insurance Program.

- Administer and enforce flood-plain regulations to prevent undue increase in the flood damage potential, prevent unwise future development in the flood plain and insure compatibility between future development and protection levels provided by the project.

- Publicize flood-plain information in the area concerned, and at least annually, inform affected interests regarding the limitations of the protection afforded by the project.

NORMAN C. HINTZ
Colonel, Corps of Engineers
District Engineer