Walla Walla District
5 Sept 57

## Navigation Improvement - Lewiston to Limepoint

Improvement of the waterway above Lewiston is an important step in the development of certain resources of the Central Snake River canyon. It is a coordinated feature with power production now urgently needed in the Columbia River Basin. The Columbia River "308" Review Report dated 1948 contained a plan for future development of locks and dams at Clarkston and Asotin. In addition, the report recommended immediate improvement of an open-river channel to a project depth of 6 feet and a width of 150 feet for transportation of limestone, timber, and other products.

Studies for the current report contemplate a plan for development of the reach between Lewiston and Limepoint which is considered to be more beneficial, more economical, and generally more desirable. As compared to earlier plans, the height of Lower Granite Dam would be increased and the pool elevation at the structure controlled so as to provide a constant water-surface elevation at the head of the pool regardless of inflow; Asotin Dam would be located a short distance downstream from the site originally considered, at the head of the Lower Granite pool, and would be correspondingly increased in height; Clarkston Dam would be eliminated and the head that would have been developed by that project would be jointly developed by the Lower Granite and Asotin projects. The navigation development would be improved by stabilization of water levels in the Lewiston port area, by elimination of one lockage in passages upstream from Lewiston, and by reducing the over-all length of semi-open-river reaches with a resultant reduction in channel work. Power benefits would be materially increased by the improved head development. Additional minor incidental benefits would also be realized.

The importance of waterway improvement between Lewiston and Limepoint is emphasized by the general economic benefits and savings that would result from new development of large quantities of limestone needed for industrial and agricultural use and its mass movement by water transport. The limestone is locked economically within the Middle Snake Canyon by lack of economic haul routes to the use areas of the Lower Columbia Basin. The future heavy industrial demands for limestone are considered to require early development of these new sources. Further, the need of lime for treatment of agricultural lands west of the Cascade Range is rapidly increasing.

The extension of slack-water improvement into the canyon reach will also enhance other resources in addition to limestone development. The land transportation of timber products to the head of the proposed slack-water pool from unharvested forest areas in precipitous regions of the Snake and Salmon River canyons would be made possible and practical.

Pertinent data relative to the Lower Granite Lock and Dam and the Asotin Lock and Dam are summarized below.

## Lower Granite Lock and Dam

Lower Granite Dam is located in the State of Washington immediately upstream from Wawaii in Whitman and Garfield Counties. It is 27 miles downstream from Lewiston, Idaho, and Clarkston, Washington. This project is a part of the authorized lower Snake River development for navigation and power production.

Principal differences between the previously proposed project and the present project are the normal reservoir elevation, method of reservoir operation, and size of power installation. The present dam would have a maximum effective height of 102 feet with reservoir at elevation 735 msl, in contrast to the previously proposed height of 82 feet at elevation 715 msl. Power installation would be increased from 450,000 kw to 600,000 kw. The reservoir would be operated to maintain an elevation 735 msl at Lewiston under all conditions of river flow by varying the water surface elevation at the dam. In contrast the project with normal reservoir elevation 715 msl gave water surface elevation 735 at Lewiston during high flood flows. Protective levees would be constructed in the vicinity of Lewiston and Clarkston and would be identical for either reservoir. The higher pool elevation will give much better conditions for port development and, with the constant water surface, construction and use of port facilities should be greatly enhanced.

## Asotin Lock and Dam

Asotin Dam would be located in the states of Washington and Idaho on Snake River immediately above the town of Asotin and 146.8 miles above the mouth. Principal purposes of the project would be development of slack-water navigation to mouth of Grande Ronde River and power production.

The dam would have an effective height of 107 feet creating a reservoir extending almost to the Washington-Oregon border and having a surface area of 3,900 acres. No storage would be provided at this project. A navigation lock 86 feet wide and 540 feet long would provide passage for barge traffic up to 14 feet of draft and a lift of 107 feet from elevation 735 to 842 msl. The dam structure would be a straight gravity-type concrete structure with a rockfill abutment having a crest length of 2,860 feet at elevation 861 msl. Height of dam from foundation to the crest is estimated to be approximately 180 feet. A concrete ogee spillway located between the powerhouse and navigation lock will pass a flood flow of 640,000 cfs. Power facilities will consist of 4 units of 96,000 kw each for a total capacity of 384,000 kw. Initially only 3 units will be installed with provisions for 1 unit to be installed at a later date.

As at the lower Snake River projects, facilities will be provided for passage of migratory fish, consisting of attraction and collection facilities on each side of the river with two fish ladders over the dam.

Facilities for waterfowl will consist of developing shoreline nesting areas. Lands affected by the reservoir would be in Washington and Idaho. Except for small areas of tillable land on narrow river benches at the foot of steep mountain slopes, the land in the reservoir area is unsuitable for cultivation. Improvements in the reservoir comprise about 10 ranch units and 20 miles of county road. Acquisition of ranch units and relocation of the road are contemplated.

Construction cost of the project is estimated to be approximately $120,000,000 with three generators installed.

Portland District
12 Sep 57

NAVIGATION LOCK, BONNEVILLE PROJECT,
COLUMBIA RIVER, OREGON AND WASHINGTON

The existing navigation lock at Bonneville is located south of the powerhouse and on the Oregon shore. It is designed to accommodate ocean-going vessels and is 76 feet wide and 500 feet in length, with a depth of 24 feet over the sill at adopted low water.

The downstream approach is located at an angle from the main channel of the river and river traffic is required to make a sharp turn upon entering the approach channel. The current at the turn or approach entrance is frequently turbulent and requires very cautious and difficult navigation to enter. A moorage basin is provided in this approach for passing traffic and for tows which must be broken up before entering the lock.

The upstream approach is also hazardous from a navigation standpoint. At the upstream guide wall a strong cross current runs toward the powerhouse intake and tows must approach the upstream guide wall with caution to avoid collisions which cause damage to both the equipment and the lock facilities.

In addition to the hazards existing at the approaches, increasing delays are being experienced by navigation interests, as many tows are made up of multiple barges necessitating breaking up the tows in order to negotiate the lock, and reassembling after passage. A greater portion of the tows are expected to be of a size requiring breaking to pass Bonneville as the waterway is improved upstream.

The proposed plan involves the construction of an entirely new lock which would accommodate both expected ocean-going ship traffic and barge tows estimated to use the facility over the coming years. In the interest of standardization, the proposed structure itself would be the same size as the locks installed upstream at The Dalles and McNary projects, 675 feet in length and 86 feet in width, but with an over-sill depth of 27 feet to correspond with the deeper draft project authorized in this reach of the river. This lock would be located south of the existing structure and would be so aligned that the approaches from either end would be virtually straight, thus eliminating most, if not all, of the navigating difficulties encountered at the present structure.

This plan would require the removal or relocation of a number of buildings and facilities in the Bonneville housing area and the Tanner Creek fish hatchery. A section of the main line of the Union Pacific Railroad would also need to be relocated for a distance of about 3,800 feet. A railroad spur presently serving the powerhouse would need to be relocated and a bridge provided over the new lock approach. Considerable quantities of rock and other material would have to be excavated for the approach channels and new lock site. The estimated construction cost is about $23,500,000.

An important advantage of building in a new location would be that traffic could continue uninterrupted through the present lock during the 2-year construction period required for the new lock.

CORPS OF ENGINEERS

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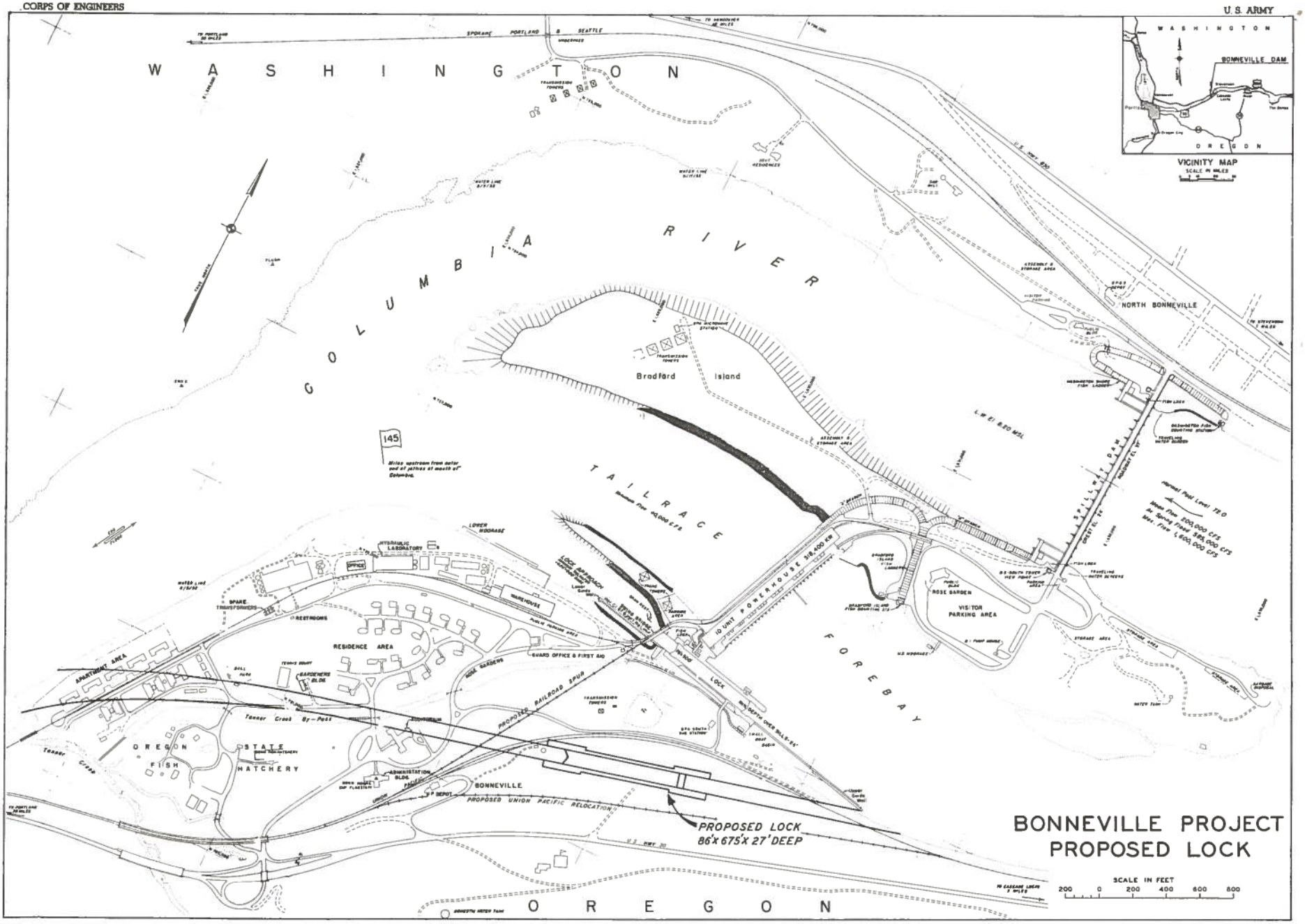


Portland District
12 Sep 57

# VANCOUVER LAKE AREA, CLARK COUNTY, WASHINGTON

The Vancouver Lake area is a low-lying tract of land bordering Columbia River adjoining and downstream from the city of Vancouver, Wash. The tract contains about 9,800 acres including two large lakes of about 3,500 acres and an extensive network of sloughs and lagoons. A portion of the area bordering the river has been improved and several large industrial developments have been built extending downstream from the city. Such developments include the facilities of the Port of Vancouver, an aluminum reduction and fabrication plant, a carborundum plant, a grain elevator, lumber and plywood mills, a power substation, railway trackage, and highway access. A public housing development occupies an area along the eastern boundary adjoining the city. Other residential and small homesite tracts exist along the higher elevations of the eastern boundary. The balance of the usable land consists of farm lands.

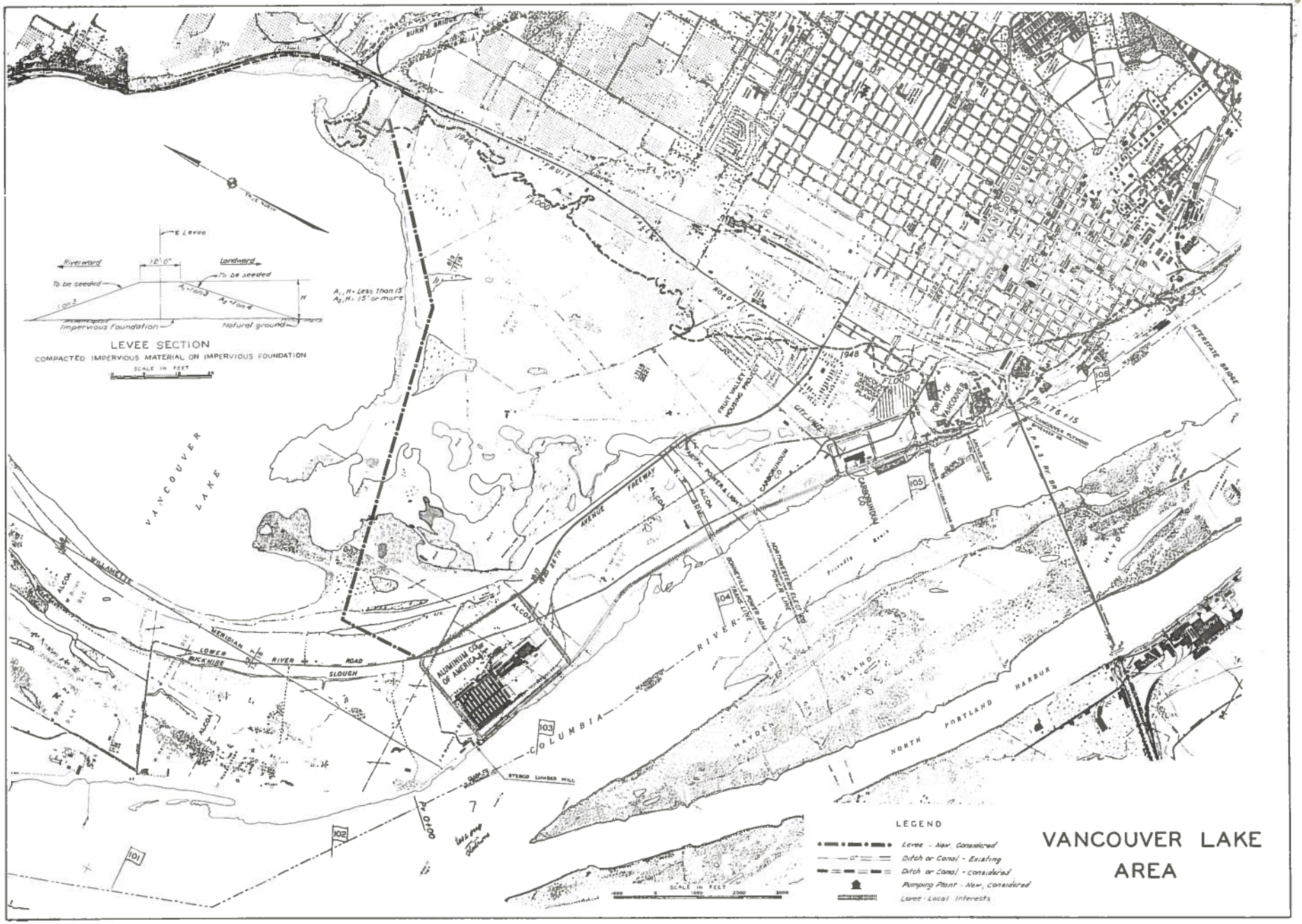
Improvements to provide protective works for the Vancouver Lake area were authorized by the Flood Control Act of 1950, in accordance with plans proposed in H. D. 531. Study after authorization showed the large project, as originally contemplated, to be economically infeasible. Accordingly, local interests have requested that consideration be given to protection of a reduced area consisting of about 2,500 acres of the original area lying south of Vancouver Lake.

Under natural conditions all of the 2,500 acres and improvements would be subject to frequent flooding. Some of the larger industries have, however, constructed levees and built up their properties by filling so that protection is provided for all but the largest floods. Similarly, local interests have provided some protection for the public housing area along the eastern boundary. The individual protective works presently constructed plus additional work contemplated along the river front could be incorporated into a levee system to provide protection to the entire reduced area which is vitally needed for industrial expansion.

The proposed work under the reduced Federal project would consist of a levee along the south side of Vancouver Lake tying into high ground on the east boundary and into the river front levee, provided by local interests, on the west. Such a levee system would prevent direct flooding from the river and would preclude outflanking and flooding from the rear.

The proposed portion of the project along the south side of Vancouver Lake would be constructed of material obtained from the lake bottom by bucket or pipeline dredge. The river front levee as planned by local interests would be built from material dredged from the river.

The estimated cost of the reduced Federal project amounts to $1,523,000. Since the principal benefit would come from enhanced land values through provision of an area for industrial development, local participation may be required.


LEVEE SECTION
COMPACTED IMPERVIOUS MATERIAL ON IMPERVIOUS FOUNDATION
SCALE IN FEET
Riverward
Landward
To be seeded
12'-0"
Impervious foundation
Natural ground
A1 H- Less than 15
A2 H- 15' or more
VANCOUVER LAKE
COLUMBIA RIVER
HAYDEN ISLAND
NORTH PORTLAND HARBOR
WILLAMETTE
LOWER BUCKMIRE SLOUGH
MERIDIAN ROAD
ALUMINUM CO. OF AMERICA
STERCO LUMBER MILL
FRUIT VALLEY ROAD
FRUIT VALLEY HOUSING PROJECT
VANCOUVER DRAINAGE PUMPING PLANT
PORT OF VANCOUVER
GITZ-LINTZ
PACIFIC POWER & LIGHT
CARBORUNDUM CO.
ALCOA
BONNEVILLE POWER ADM. TRANSMISSION LINE
NORTHWESTERN ELECTRIC POWER LINE
MAYOR
INTERSTATE BRIDGE
VANCOUVER AIRPORT
LEGEND
Levee - New, Considered
Ditch or Canal - Existing
Ditch or Canal - Considered
Pumping Plant - New, Considered
Levee - Local Interests
VANCOUVER LAKE AREA

Portland District
12 September 1957

# GATE CREEK DAM, WILLAMETTE RIVER BASIN, OREGON

The proposed Gate Creek Dam would be located on Gate Creek about 0.4 of a mile upstream from the confluence with McKenzie River and about 27 miles east of Eugene, Oregon.

As proposed the project would consist of an embankment-type dam about 1,190 feet in length at a crest elevation of 1,017 feet, above mean sea level, with a free-overflow chute-type spillway. The dam would have a maximum height of 270 feet from foundation to crest.

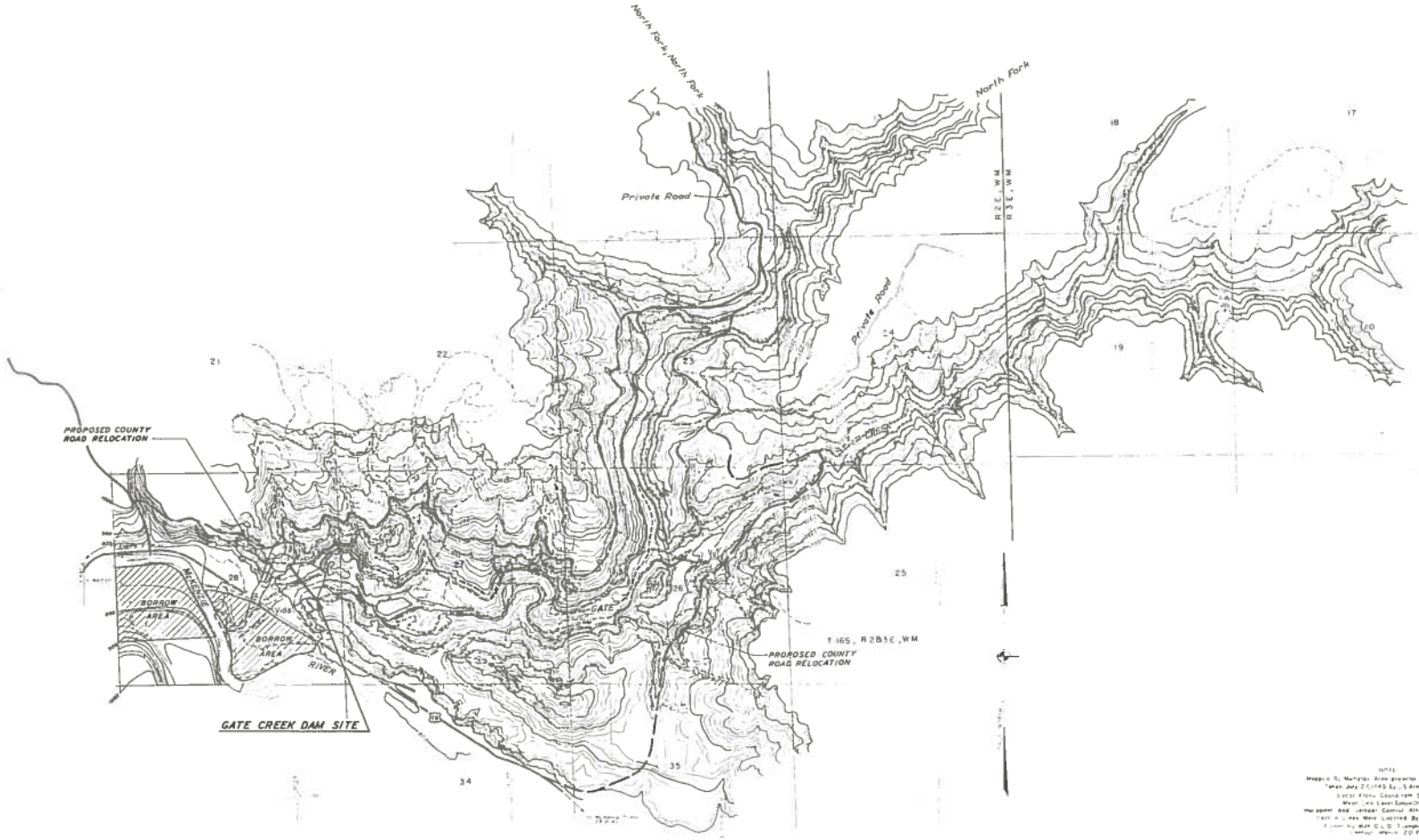
The reservoir at normal pool elevation of about 1,000 feet above mean sea level would extend up Gate Creek for a distance of approximately 4 miles and would have a surface area of about 605 acres. The total storage capacity would amount to 55,000 acre-feet, of which 50,000 acre-feet would be usable for flood control. Stored flood waters would be evacuated as rapidly as downstream channel stages would permit, but not in excess of 1,500 cubic feet per second from the reservoir.

The project would be one of three headwater storages designed to provide the minimum control of the McKenzie River deemed necessary for effective flood-control on Willamette River. Following the season of major floods the reservoir would be gradually filled, and stored water would be released to supplement low water flows in the interests of irrigation, navigation, and other uses. A power installation is not planned in connection with Gate Creek.

About 1,400 acres of land would be acquired for the reservoir and construction purposes. Few improvements exist within the reservoir area which is mainly undeveloped. Lands and improvements in and near the settlement of Vida, located adjacent and downstream from the dam site, would be required in connection with construction. Several miles of county road and about 1 mile of the McKenzie River Highway would have to be relocated.

Estimated construction cost is about $14,700,000.

A small number of anadromous fish spawn in Gate Creek. Also the stream is of minor importance for resident game fish. No fish passage facilities would be required, but a share of the artificial propagation facilities for McKenzie River Basin would be borne by Gate Creek Dam. The cost estimates reflect such costs.




LEGEND

NORMAL POOL ELEV. 1000

MINIMUM POOL ELEV. 885

PROPOSED ROAD RELOCATION

# GATE CREEK RESERVOIR

SCALE IN FEET

1000 0 1000 2000 3000 4000 5000

Portland District
12 September 1957

# CASCADIA DAM, WILLAMETTE RIVER BASIN, OREGON

The proposed Cascadia Dam would be located on South Santiam River at about river mile 59.8 upstream from the confluence with willamette River and about 10 miles east of the city of Sweet Home, Oregon.

The dam as proposed would be a rock-fill type structure about 1,170 feet long at crest elevation of 991 feet, above mean sea level, with a free-overflow chute spillway with a crest elevation of 967 feet. The height of the dam from foundation to crest would be about 255 feet. A power installation is not proposed.

The reservoir would have a surface area of about 1,700 acres at normal pool elevation and the total storage capacity would amount to 160,000 acre-feet, of which 145,000 acre-feet would be available for flood-control purposes.

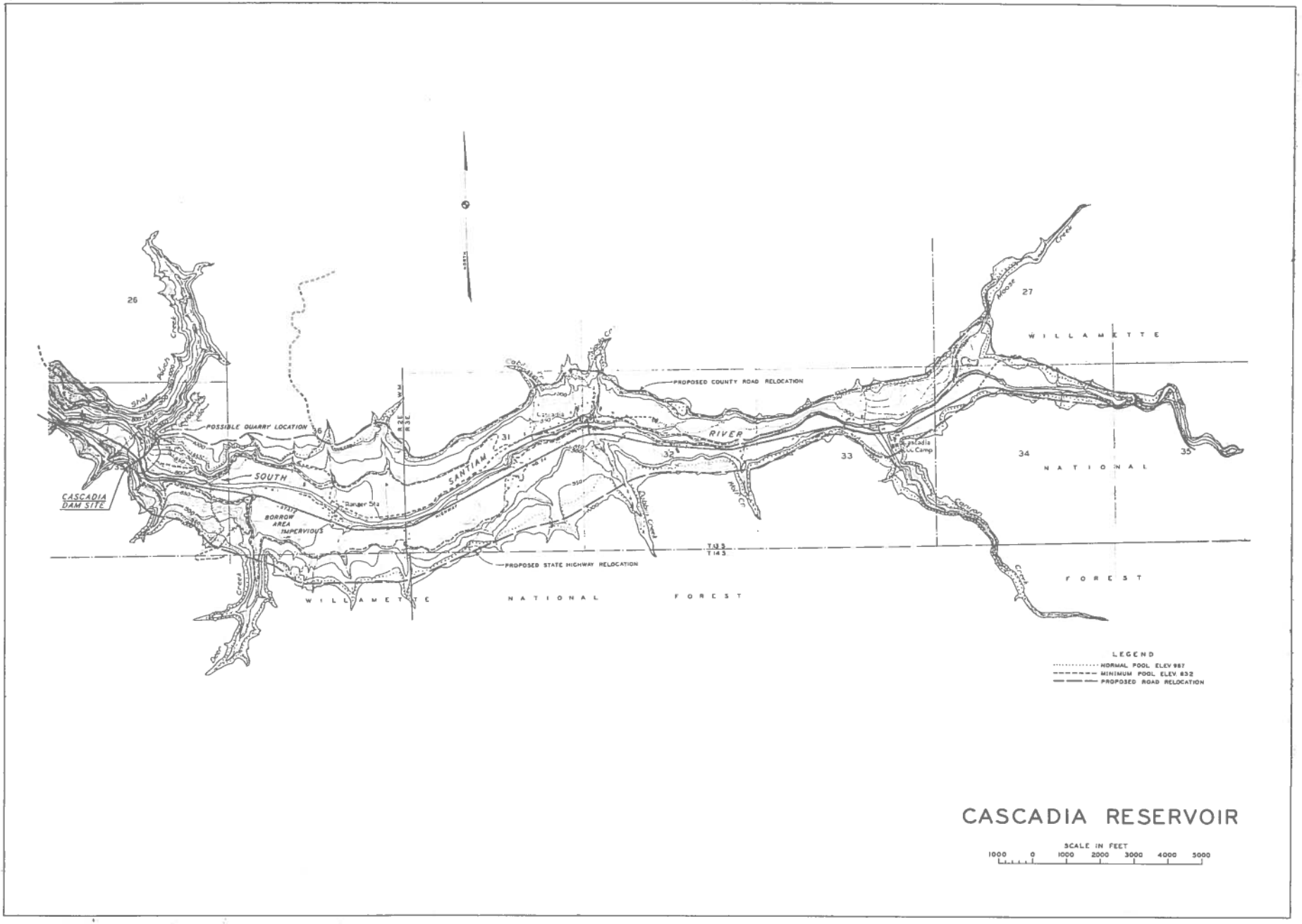
The reservoir would be operated in conjunction with other reservoirs in the system to control floods in the Santiam River Basin and along the willamette River. Flood waters impounded during the flood season would be evacuated as rapidly as downstream channel stages would permit. Releases at the dam, however, would not exceed 6,000 cubic feet per second. At the end of the flood season the reservoir would be filled for conservation releases during the low flow season.

It would be necessary to acquire about 3,300 acres of land for the project. Approximately 60 percent of the reservoir land is virgin timber, 35 percent is cut-over land, and 5 percent is under cultivation. Developments and improvements consist of small farms and summer homes.

Construction of the reservoir would necessitate the relocation of about 7 miles of U. S. Highway No. 20, 5 miles of county road, and 1.5 miles of timber access road. A State park and small park provided by a lumber company would be inundated. A U. S. Forest Service Ranger Station would have to be relocated. The project area is utilized for recreational purposes and this use would undoubtedly be increased after the project was built necessitating provision of facilities for the public.

The estimated cost of the proposed project is about $25,200,000.

Cascadia Dam would block the South Santiam River to migratory fish and flood spawning and rearing areas. Fish passage facilities would be required at the dam and the project would have to bear a share of the artificial propagation facilities for anadromous fish for the South Santiam Basin. In addition, the established facilities of the Forest Service would have to be relocated which may result in added administrative and harvesting costs for the timber in the watershed. Project costs reflect such adverse effects.


26
27
WILLAMETTE
NATIONAL
FOREST
PROPOSED COUNTY ROAD RELOCATION
POSSIBLE QUARRY LOCATION
SOUTH
SANTIAM
RIVER
CASCADIA DAM SITE
BORROW AREA IMPERVIOUS
Ranger Sta
Cascadia Public Camp
PROPOSED STATE HIGHWAY RELOCATION
T13S
T14S
R2E
R3E
31
32
33
34
35
36
LEGEND
NORMAL POOL ELEV 987
MINIMUM POOL ELEV 832
PROPOSED ROAD RELOCATION
CASCADIA RESERVOIR
SCALE IN FEET
1000 0 1000 2000 3000 4000 5000

Portland District
12 September 1957

# STRUBE DAM, WILLAMETTE RIVER BASIN, OREGON

The proposed dam site would be located on the South Fork McKenzie River about 2 miles downstream from Cougar Dam and about 2-1/2 miles upstream from the confluence of the South Fork with McKenzie River. The principal purpose of the project would be to reregulate flows from the power plant at Cougar Dam.

The Strube project as proposed would consist of an earth-fill dam about 2,500 feet long at the crest and 68 feet in height above normal tailwater. The spillway would be a concrete overflow structure with crest gates. The reservoir would impound about 5,900 acre-feet of which about 3,000 acre-feet would be usable. With such an amount of storage to reregulate flows from Cougar, an increase in the power installation at Cougar would be feasible to permit the operation of that plant on a low-load factor for peaking purposes. A power plant containing one unit of 4,500 kilowatts would be installed which would permit power generation from the regulated releases of the reservoir, thereby furnishing additional energy to the system.

The reservoir, with a maximum pool elevation of 1,236 feet above mean sea level, would inundate approximately 230 acres of National Forest lands containing a fairly heavy stand of timber. Two Forest Service campgrounds would also be inundated. A Forest Service road extending up the South Fork along the valley floor is to be relocated along the left bank of the river in connection with the Cougar project. A section of this road between Strube dam site and Cougar Dam would, however, have to be relocated in connection with this proposed project to provide access to lands along the right bank.

The subject area and the vicinity is extensively used for recreational purposes and such use is expected to grow with the development of Cougar and the proposed Strube project.

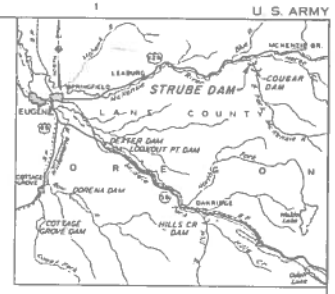
Any adverse effects on natural propagation of fish, caused by the proposed Strube project, would be provided for by addition to the artificial facilities being planned for the Cougar project.

The principal function of the proposed Strube Dam and Reservoir would be to increase the power capacity of Cougar; add a small block of power from Strube; control the fluctuating releases from Cougar; and provide a more uniform flow in the stream below Strube.

The estimated construction cost is about $6,000,000.

CORPS OF ENGINEERS

U. S. ARMY




VICINITY MAP
SCALE IN MILES


SCALE IN FEET
2000 0 2000 4000

# STRUBE DAM

Portland District
12 September 1957

# FERN RIDGE DAM, WILLAMETTE RIVER BASIN, OREGON

Fern Ridge Dam is located on Long Tom River 23.6 miles above the confluence with Willamette River and about 11 miles westerly from Eugene, Oregon.

The existing project was completed in 1942 as a unit of the plan for development of the water resources of the Willamette Basin in the interest of flood control, irrigation, power development, navigation, pollution abatement, and other incidental multiple-purpose uses.

Subsequent to completion of this project a portion of the flood waters from Amazon Creek, originating in an adjacent watershed, have been diverted into the Fern Ridge Reservoir resulting in increasing the drainage area above the dam.

Due to the enlarged watershed and compilation of more complete hydrological information, it is now desirable and is therefore proposed to increase the present usable storage capacity of 95,000 acre-feet to at least 110,000 acre-feet in order to control floods more effectively. The additional 15,000 acre-feet of storage required can be obtained by raising the flood-control pool 1.5 feet from the present elevation of 373.5 to 375.0 feet, above mean sea level.

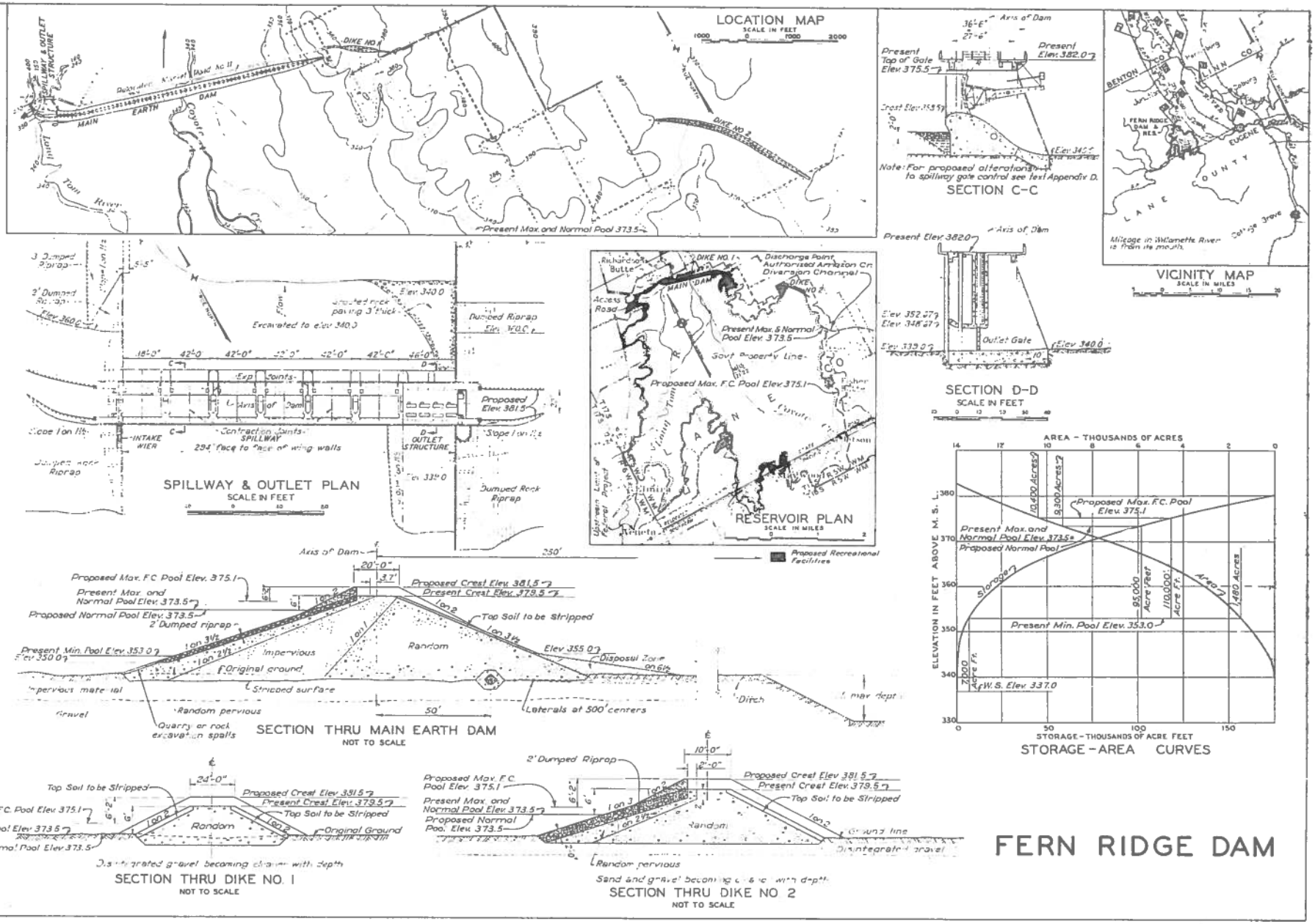
These modifications would require building up the earth and gravel fill section of the dam over the entire 11,000-foot length of the structure in order to maintain the 6 feet of freeboard. Only minor modifications would be required at the gated concrete spillway in order to change the automatic operation of the gates to manual operation during short periods when the pool exceeds elevation 373.5 feet.

The Government has already acquired the fee title to all reservoir lands below elevation 373.5, mean sea level datum, and in addition has acquired flowage easements up to elevation 377.0 feet or 3.5 feet above normal pool.

The additional storage proposed would be required only for floods occurring infrequently or once in approximately 25 years and would be evacuated as rapidly as practical after passage of the flood peak. About 1,000 acres of land, over which the Government already has flowage easements, would be flooded for the short interval during which the surcharge would be in effect.

Proposed modification would provide control of larger floods and improve operation of the project in the interest of conservation.

Estimated construction cost is about $100,000.


LOCATION MAP
SCALE IN FEET
1000 0 1000 2000
DIKE NO. 1
DIKE NO. 2
MAIN EARTH DAM
SPILLWAY & OUTLET STRUCTURE
Present Max. and Normal Pool 373.5
Present Top of Gate Elev. 375.5
Present Elev. 382.0
Crest Elev. 359.5
Elev. 340.0
Note: For proposed alterations to spillway gate control see text Appendix D.
SECTION C-C
VICINITY MAP
SCALE IN MILES
BENTON CO.
LINN CO.
FERN RIDGE DAM & RES.
EUGENE
LANE COUNTY
Coburg
Junction City
Mileage in Willamette River is from its mouth.
SPILLWAY & OUTLET PLAN
SCALE IN FEET
Excavated to elev. 340.0
Dumped Riprap
Elev. 340.0
Exp. Joints
Contraction Joints
SPILLWAY
294' face to face of wing walls
INTAKE WIER
OUTLET STRUCTURE
Proposed Elev. 381.5
Slope 1 on 1½
Dumped Rock Riprap
Elev. 335.0
RESERVOIR PLAN
SCALE IN MILES
Richardson Butte
Access Road
Discharge Point Authorized Amazon Ck Diversion Channel
Present Max. & Normal Pool Elev. 373.5
Govt. Property Line
Proposed Max. F.C. Pool Elev. 375.1
Upstream Limit of Federal Project
Proposed Recreational Facilities
Present Elev. 382.0
Elev. 352.27
Elev. 348.27
Elev. 333.0
Outlet Gate
SECTION D-D
SCALE IN FEET
AREA - THOUSANDS OF ACRES
ELEVATION IN FEET ABOVE M. S. L.
10,400 Acres
9,300 Acres
Proposed Max. F.C. Pool Elev. 375.1
Present Max. and Normal Pool Elev. 373.5
Proposed Normal Pool
Storage
Area
95,000 Acre Feet
110,000 Acre Ft.
1480 Acres
Present Min. Pool Elev. 353.0
2000 Acre Ft.
W.S. Elev. 337.0
STORAGE - THOUSANDS OF ACRE FEET
STORAGE - AREA CURVES
Axis of Dam
Proposed Max. F.C. Pool Elev. 375.1
Present Max. and Normal Pool Elev. 373.5
Proposed Normal Pool Elev. 373.5
2' Dumped riprap
Proposed Crest Elev. 381.5
Present Crest Elev. 379.5
Top Soil to be Stripped
Present Min. Pool Elev. 353.0
Elev. 350.0
Impervious
Random
Original ground
Elev. 355.0
Disposal Zone
Stripped surface
Impervious material
Gravel
Random pervious
Quarry or rock excavation spalls
Laterals at 500' centers
Ditch
SECTION THRU MAIN EARTH DAM
NOT TO SCALE
Top Soil to be Stripped
Proposed Max. F.C. Pool Elev. 375.1
Proposed Normal Pool Elev. 373.5
Present Max. and Normal Pool Elev. 373.5
Random
Original Ground
Disintegrated gravel becoming cleaner with depth
SECTION THRU DIKE NO. 1
NOT TO SCALE
2' Dumped Riprap
Proposed Max. F.C. Pool Elev. 375.1
Present Max. and Normal Pool Elev. 373.5
Proposed Normal Pool Elev. 373.5
Proposed Crest Elev. 381.5
Present Crest Elev. 379.5
Top Soil to be Stripped
Random
Ground line
Disintegrated gravel
Random pervious
Sand and gravel becoming cleaner with depth
SECTION THRU DIKE NO. 2
NOT TO SCALE
FERN RIDGE DAM

Portland District
12 Sep 57

# CHANNEL IMPROVEMENTS, WILLAMETTE RIVER BASIN, OREGON

A system of reservoirs has been planned for control of floods in the Willamette River Basin to secure the maximum practical damage reduction obtainable by reservoirs. A material reduction in stages and damages will be obtained by the completed system, but some damages will still remain as sufficient economically feasible and practical storage sites cannot be developed for desirable control throughout the basin. Because the desirable degree of control could not be obtained, the objective of the selected system of reservoirs was to reduce the more frequent floods to minor damage stages through the more highly developed areas of the basin.

Flood periods often occur with very short intervals of time separating them throughout the flood season as the result of periods of intense rainfall from Pacific storms. Because of this condition, reservoirs must be evacuated as rapidly as possible following a flood to provide space for a subsequent flood that may follow. To secure the greatest effectiveness from the reservoir system in reducing damage a maximum practical rate for reservoir evacuation has been selected. Such a rate corresponds to the average bankfull capacity of the streams below the reservoirs. As long as average bankfull capacity is not exceeded, damages will be kept to a minimum. At normal bankfull capacity, however, numerous old channels, sloughs, depressions away from the stream, and many highly productive tracts bordering the stream at elevations below normal bankfull capacity will be flooded causing minor damage and inconvenience. Prolongation of flooding by reservoir releases has caused severe criticism of the operation of the existing reservoirs and the condition will be more pronounced as the reservoir system is completed.

In order to alleviate the induced flooding of lands below normal bankfull capacity of the various streams, a program of channel improvement is proposed in conjunction with the storage reservoirs to prevent flooding at normal bankfull capacity wherever practical. Such work would consist generally of a low type of levee, designed to withstand frequent overtopping and constructed to build up the average bank elevation at those locations subject to flooding at stages below normal bankfull capacity.

Along one major reach of Willamette River from the mouth of the McKenzie River to the mouth of Long Tom River, channel improvements are impractical. This reach has a normal bankfull capacity of 40,000 c.f.s. while a capacity of 60,000 is required for reservoir operation. To secure an increase of 50 percent in channel capacity a system of low levees would be required. Low levees designed for a flow of 60,000 c.f.s. in the reach would be subject to overtopping on the average by

the controlled flows of a flood that may be expected every other year. Such frequent overtopping would make a low levee impractical; consequently, supplemental levees are proposed for the reach.

Similarly along lower McKenzie River, channel improvements are impractical. The stream flows in an unstable meandering channel. Reservoirs planned within the basin would provide a low degree of control along the lower McKenzie. With the controlled flow of the annual flood in excess of the normal bankfull capacity of the stream, channel improvements to confine normal bankfull capacity would be continually outflanked along the unstable river channel. Therefore, supplemental levees are considered the most practical improvement for the lower McKenzie River.

Along some other reaches of the streams in Willamette Basin, it would be impractical to construct the channel improvements necessary to confine flows at normal bankfull stages, but the incremental damages remaining after reduction by the reservoir system would not justify supplemental levees with foreseeable economic development. Such minor channel improvements as would alleviate the most significant damages are proposed for such areas.

Estimates of costs of the channel improvements required to operate the reservoir system, regardless of the practicability of constructing such improvements, have been made for all reaches of the streams below the reservoirs in the basin. The costs for the various streams and reaches of a stream are tabulated below.

| Stream or reach | Cost |
|---|---|
| Willamette River mile 185.1-176.3, right bank | $ 782,000 |
| Willamette River mile 181.6-176.5, left bank | 795,000 |
| Willamette River mile 176.5-150.5, left bank | 1,164,000 |
| Willamette River mile 176.1-161.1, right bank | 750,000 |
| Willamette River mile 150-60 | 1,086,000 |
| McKenzie River mile 0-16.5 | 810,000 |
| Santiam River mile 0-11.9 (including right bank Willamette River from mile 115.5-104) | 1,523,000 |
| South Santiam River mile 0-18.5 | 122,000 |
| North Santiam River mile 0-16.3 | 113,000 |
| Middle Fork Willamette River mile 0-16.3 | 388,900 |
| Calapooya River mile 0-27.4 | 887,000 |
| Coast Fork Willamette River | Completed |
| Long Tom River | Completed |

CORPS OF ENGINEERS

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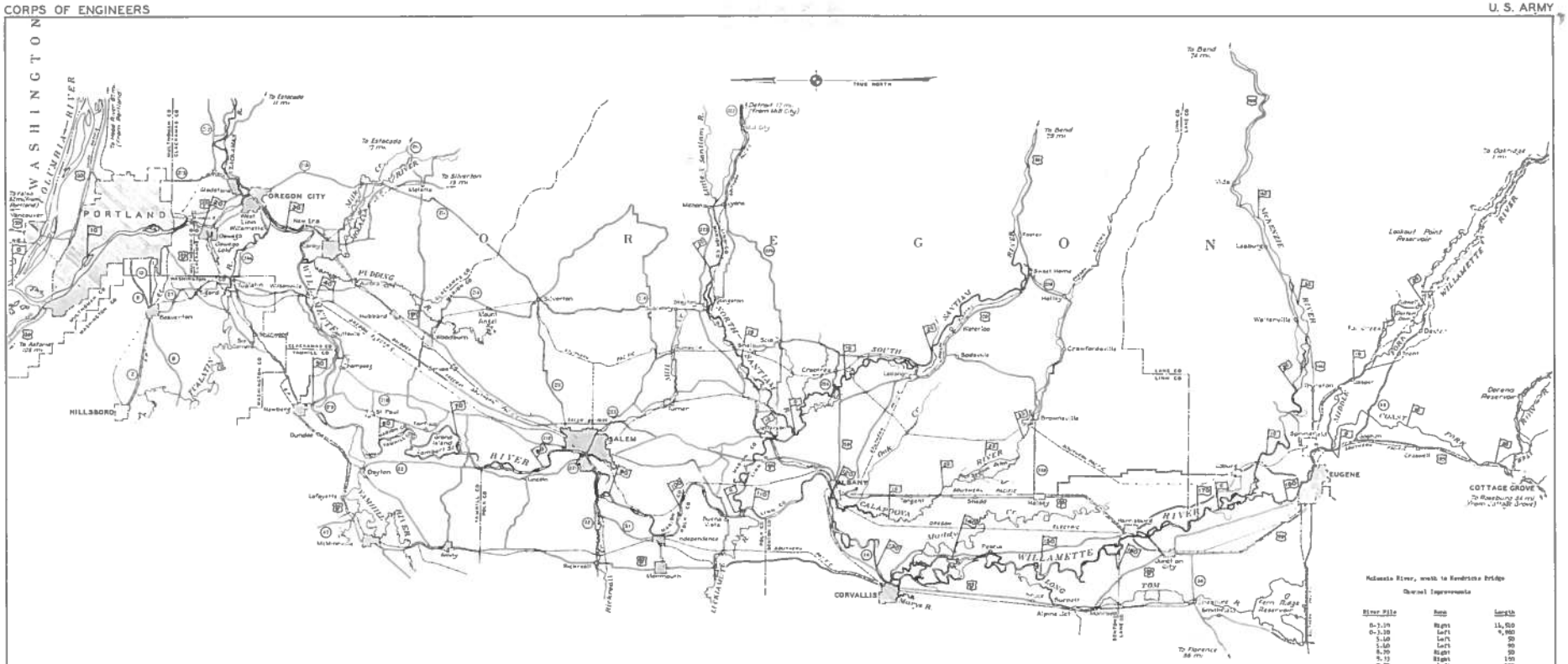



SCALE IN MILES

Willamette River, Newberg to Albany

Channel Improvements

| River Mile | Bank | Length |
|---|---|---|
| 60.4 | Right | 100 |
| 61.0 | Right | 700 |
| 65.7 | Right | 100 |
| 67.8 | Left | 700 |
| 68.6 | Left | 60 |
| 68.8 | Left | 400 |
| 83.9 | Left | 100 |
| 84.2 | Left | 150 |
| 84.6 | Left | 100 |
| 84.6 | Left | 300 |
| 90.1 | Right | 1,500 |
| 89-91 | Left | 9,400 |
| 89-91 | Left | 700 |
| 89-91 | Left | 300 |
| 89-91 | Left | 700 |
| 91.4 | Left | 600 |
| 92 | Left | 300 |
| 92.9 | Left | 900 |
| 93 | Left | 100 |
| 93.4 | Left | 300 |
| 94.1 | Left | 300 |
| 95.5 | Left | 150 |
| 95.7 | Left | 750 |
| 96.5 | Left | 750 |
| 97.8 | Right | 100 |
| 99.87 | Right | 350 |
| 104.0 | Left | 450 |
| 104.05-108.45 | Right | 20,750 |
| 108.7 | Left | 700 |
| 108.95 | Left | 150 |
| 108.75 | Left | 500 |
| 109.1 | Left | 100 |
| 109.4 | Left | 350 |
| 110 | Left | 600 |
| 109.05-115.90 | Right | 14,800 |
| 111.8-112.1 | Left | 2,750 |
| 111.8-111.8 | Left | 700 |
| 112.1 | Right | 700 |
| 112.6 | Right | 450 |
| 119.7 | Left | 110 |
| 119.8 | Left | 450 |

Willamette River, Albany to Springfield

Channel Improvements

| River Mile | Bank | Length |
|---|---|---|
| 127.0 | Right | 700 |
| 127.2 | Right | 200 |
| 127.3 | Right | 300 |
| 127.1 | Left | 110 |
| 128.15 | Left | 420 |
| 128.3 | Left | 900 |
| 128.6 | Left | 200 |
| 129.8 B | Right | 100 |
| 129.8 A | Right | 60 |
| 133.75 | Right | 900 |
| 133.5 | Right | 200 |
| 133.6 | Right | 300 |
| 133.8 | Right | 400 |
| 134.9 | Right | 150 |
| 137.5 | Left | 60 |
| 139.5 | Left | 700 |
| 142.0 | Left | 300 |
| 143.5 | Left | 100 |
| 143.6 | Left | 100 |
| 143.45 | Left | 300 |
| 143.75 | Left | 300 |
| 143.8 | Left | 250 |
| 144.0 | Left | 350 |
| 145.6 | Left | 500 |
| 146.0 | Right | 140 |
| 144.6 | Left | 360 |
| 144.8 | Left | 400 |
| 149.6 | Left | 600 |
| 149.7 (1) | Left | 100 |
| 149.7 (2) | Left | 100 |
| 149.7 (3) | Left | 100 |
| 150.90-176.00 | Left | 83,070 |
| 161.45-175.90 | Right | 51,230 |
| 176.75-182.55 | Right | 20,613 |
| 176.35-181.10 | Left | 16,475 |

Santiam River, mouth to forks

Channel Improvements

| River Mile | Bank | Length |
|---|---|---|
| 0-11 | Right | 29,380 |
| 0-11 | Left | 35,360 |

Calapooya River, mouth to intake of Sodom Ditch

Channel Improvements

| River Mile | Bank | Length |
|---|---|---|
| 0-20.15 | Channel | 52,000 |

North Section

Channel Improvements

| River Mile | Bank | Length |
|---|---|---|
| 0.90 | Left | 40 |
| 1.50 | Left | 400 |
| 1.60 | Right | 170 |
| 1.70 | Right | 40 |
| 2.05 | Left | 60 |
| 2.70 | Left | 60 |
| 3.50 | Left | 40 |
| 3.70 | Left | 120 |
| 4.70 | Right | 80 |
| 5.80 | Right | 270 |
| 6.95 | Right | 200 |
| 7.05 | Right | 180 |
| 9.30 | Right | 130 |
| 9.60 | Right | 30 |
| 9.65 | Right | 130 |
| 10.40 | Right | 90 |
| 11.80 | Right | 150 |
| 12.60 | Right | 150 |
| 12.62 | Right | 110 |
| 12.80 | Right | 170 |
| 14.75 | Right | 50 |
| 16.70 | Right | 40 |
| Fish Hatchery | Right | 90 |
| Mahama #1 | Right | 110 |
| Mahama #2 | Right | 6 |

South Section

Channel Improvements

| River Mile | Bank | Length |
|---|---|---|
| 1.20 | Left | 80 |
| 1.45 | Left | 80 |
| 1.57 | Left | 90 |
| 1.85 | Left | 80 |
| 3.90 | Left | 50 |
| 4.55 | Left | 170 |
| 6.45 | Left | 80 |
| 7.15 | Left | 90 |
| 7.25 | Left | 130 |
| 7.60 | Left | 60 |
| 7.85 | Left | 80 |
| 7.90 | Left | 60 |
| 8.10 | Left | 40 |
| 9.45 | Right | 70 |
| 10.25 | Left | 120 |
| 11.15 | Right | 250 |
| 11.40 | Right | 120 |
| 11.55 | Right | 20 |
| 11.05-11.85 | Right | 170 |
| 11.12 | Right | 80 |
| 12.30 | Right | 200 |
| 12.95 | Left | 40 |
| 13.25 | Left | 150 |
| 13.15 | Right | 70 |
| 14.95 | Left | 80 |
| 17.05 | Left | 180 |
| 17.75 | Right | 100 |
| 18.55 | Left | 70 |

McKenzie River, mouth to Hendricks Bridge

Channel Improvements

| River Mile | Bank | Length |
|---|---|---|
| 0-3.19 | Right | 15,820 |
| 0-3.18 | Left | 4,980 |
| 3.40 | Left | 90 |
| 3.60 | Left | 90 |
| 4.70 | Right | 50 |
| 5.13 | Right | 150 |
| 5.70 | Left | 120 |
| 10.47 | Left | 70 |
| 12.13 | Left | 170 |
| 12.13 | Left | 90 |
| 12.50 | Left | 200 |
| 12.77 | Left | 200 |
| 12.90 | Right | 60 |
| 13.00 | Right | 170 |
| 13.97 | Left | 140 |
| 14.73 | Left | 55 |
| 14.77 | Left | 75 |
| 15.50 | Left | 370 |
| 15.97 | Left | 130 |
| 16.14 | Left | 60 |
| 16.50 | Left | 100 |

Middle Fork Willamette River

Channel Improvements

| River Mile | Bank | Length |
|---|---|---|
| 1.5-1.75 | Left | 1,990 |
| 1.50-4.8 | Right | 19,910 |
| 7.5-12.0 | Left | 4,730 |
| 9.5-10.1 | Left | 3,000 |
| 17.95-18.3 | Left | 8,180 |

# WILLAMETTE RIVER BASIN
# CHANNEL IMPROVEMENT

# SUPPLEMENTAL LEVEES, WILLAMETTE RIVER BASIN, OREGON

Increased channel capacities are essential as supplementary adjuncts in streams below storage reservoirs in order to operate the reservoirs effectively for flood control. Captured flood waters must be evacuated, during flood seasons, as rapidly as downstream conditions will permit.

Without improvement of the channels, damages would be induced on certain low-lying lands by the necessary releases.

Channel improvements, as generally contemplated, would increase the channel capacity of a reach so that damage from inundation would be prevented up to the average bankfull stage, which is deemed the minimum essential stage or capacity required for releases from reservoirs following floods.

In certain reaches, channel improvements to normal bankfull capacity would not provide a satisfactory solution to the problem. One such major reach extends along the left bank of Willamette River from Eugene to the mouth of Long Tom River where the average capacity is about 40,000 cubic feet per second. Reservoirs upstream require a capacity of 60,000 cubic feet per second for effective flood control. As the prime purpose of increasing channel capacities is to allow effective reservoir operation, the average capacity of this particular reach would have to be increased about 50 percent. Such improvement, within this reach, would be essentially low levees, which if designed for a flow of 60,000 cubic feet per second would be overtopped by flows expected about every year, under natural conditions and about once every 2 years with reservoir control. Any structures built to withstand such frequent overtopping would be costly to build and maintain. Therefore, supplemental levees, on both banks of the Willamette River throughout this reach, would provide the most satisfactory means of increasing the channel capacity and would increase the flood protection for lands along the reach.

Another critical reach is along the lower McKenzie River. A channel capacity of 20,000 cubic feet per second would be required for effective operation of the reservoirs upstream from the reach. Such a discharge is about equal to the average bankfull capacity of the stream in this location. The channel of the McKenzie River in the lower reaches is very unstable and minor channel improvements would be of doubtful benefit. Even with reservoir control, flows from uncontrolled areas would be expected to exceed a capacity of 20,000 cubic feet per second on an average of every other year. The higher flows would result in such frequent overtopping of this type of improvement that there would be a continual threat of outflanking.

Accordingly, channel improvements to confine flows for reservoir operation are not considered adequate for this reach, and supplemental levees would provide the most practical means of increasing the channel capacity for reservoir releases and at the same time further reduce flood damages in the area.

Several fairly large tracts of land lying along the Willamette River downstream from the mouth of the Long Tom River are at elevations which subject them to inundation from the uncontrolled flows of fairly frequent floods. Minor channel work would prevent direct overflow during reservoir evacuation, but such work would be costly to maintain and would be of slight benefit for flood control. Present and foreseeable developments within these areas, however, would not justify the costs of levees of sufficient height for adequate protection.

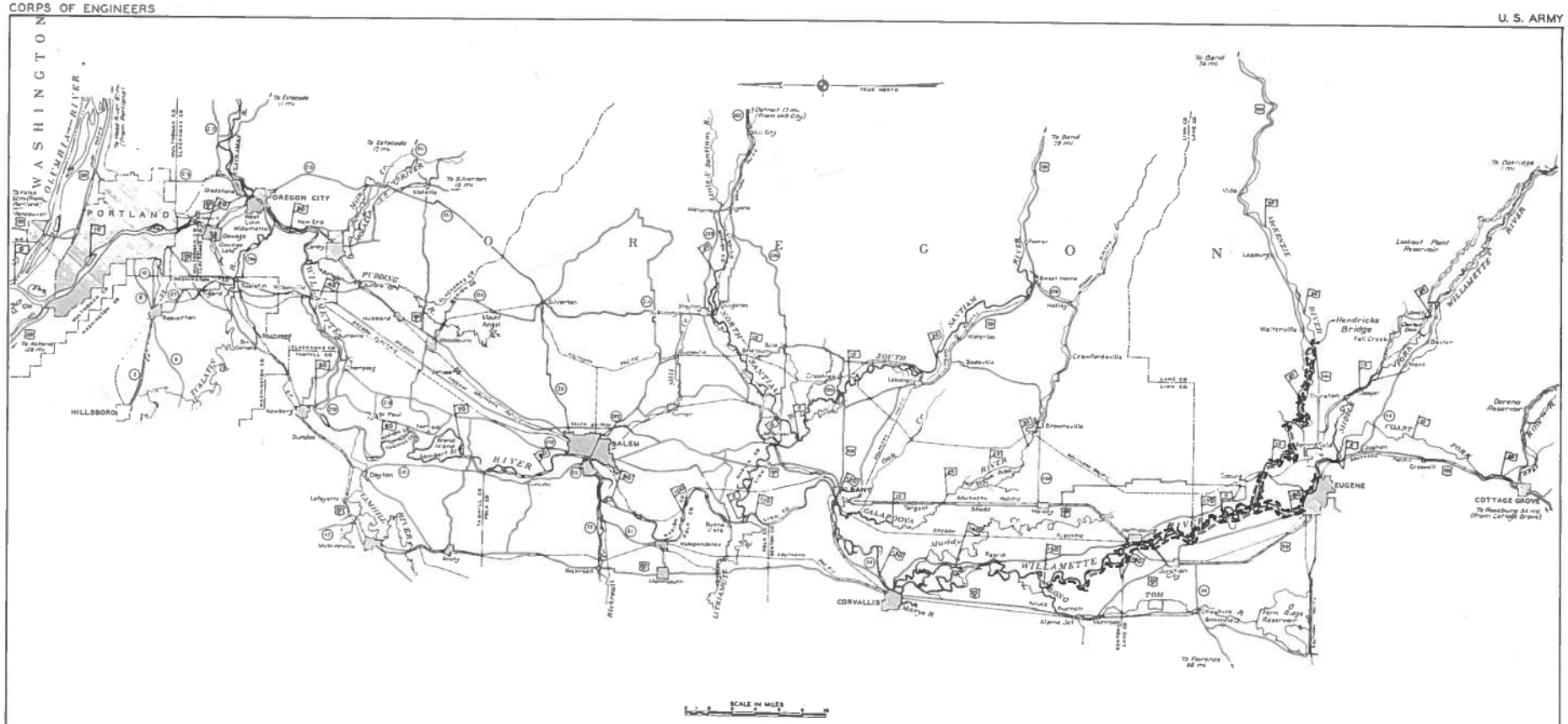
The improvements proposed for construction at this time would consist of supplemental levees along both banks of the Willamette River from Eugene to the mouth of the Long Tom River and along lower McKenzie River from Hendricks Bridge downstream about 21 miles to the confluence with Willamette River. The proposed levees would consist of disconnected stretches connecting to high ground.

The benefits derived from supplemental levees would result from a further reduction of the annual flood damages remaining after crediting storage reservoirs with the damage prevented by them.

The estimated costs are $6,931,000.

CORPS OF ENGINEERS

U. S. ARMY




LEGEND

PROPOSED LEVEES

# WILLAMETTE RIVER BASIN
# SUPPLEMENTAL LEVEES