

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

EFFECT OF SACRAMENTO DEEP WATER CHANNEL
ON
FLOOD PLANE ELEVATIONS IN LOWER YOLO BY-PASS

January 1949

EFFECT OF SACRAMENTO DEEP WATER
CHANNEL ON FLOOD PLANE ELEVATIONS
IN LOWER YOLO BY-PASS

Introduction

On January 13, 1949 there was transmitted to this office by the Director of Public Works, a letter from the District Engineer, U. S. Department of the Army, requesting views and comments of the Department and also those of the State Reclamation Board on the relative merits of two suggested locations for the Sacramento Deep Water Ship Channel in Lower Yolo By-pass on the six mile section extending northerly from the junction of Cache and Miner sloughs, with particular reference to the effect of each location on flood plane elevations in Lower Yolo By-pass. The alternate locations submitted are as follows:

- (1) "Adjusted Project Document Alignment" along the easterly side of Prospect Island and Little Holland Tract, which would sever from the By-pass only such of the easterly portions of Prospect Island as would be necessary to secure a fairly straight alignment without encroachment on Miner Slough.
- (2) "Alternate Alignment" extending on a straight line from the junction of Cache and Miner sloughs diagonally across the easterly one-third of Lower Yolo By-pass to connect with the "Adjusted Project Document Alignment" near the northerly end of Little Holland Tract, which would sever from the By-pass about three-fourths of Prospect Island and one-fifth of Little Holland Tract.

The location of the Deep Water Channel showing both alignments and required spoil areas are delineated on the accompanying map. The Alternate Alignment would make possible the permanent reclamation of about seventy-five per cent of Prospect Island and about twenty per cent of Little Holland Tract over which the State has acquired by purchase flowage easements for the passage of flood waters.

Hydraulic Analyses

Hydraulic analyses have been made to ascertain the effect of both alignments on Project flood planes in Lower Yolo By-pass, between the junction of Cache and Miner sloughs and Lisbon, for use in considering the relative merits of the two locations and submitting comments thereon to the District Engineer for forwarding with his recommendations to the Chief of Engineers.

In a previous report of the Division of Water Resources, entitled "Magnitude, Stage and Frequency of Flood Flows of Sacramento River near Rio Vista," December, 1942, studies were presented on the magnitude, stage and frequency of occurrence of floods in Lower Yolo By-pass under conditions both prior and subsequent to the construction of the Sacramento River Flood Control Project, including Project flood plane elevations at the junction of Cache and Lindsay sloughs for various conditions.

Utilizing the results of studies made in that report it was determined that, with a flow of 490,000 second feet in Yolo By-pass above Miner Slough and a combined flow at Rio Vista of 579,000 second feet, an elevation of 17.6 feet U.S.E.D. Datum at Lindsay Slough would result under existing conditions with the maximum recorded high tide of 9.6 feet at Collinsville. With the same quantities and an assumed maximum high tide at Collinsville of 12.0 feet, the elevation used by the Corps of Engineers in computing the adopted Project flood plane, an elevation of 19.1 feet would be obtained at Lindsay Slough. The elevations of 17.6 feet and 19.1 feet were the bases for establishing flood plane elevations at Lindsay Slough for each of the proposed Deep Water Channel locations.

Current meter measurements were made at Dixon Ridge by the Division of Water Resources during the floods of 1936, 1937 and 1938 at which time water surface elevations were obtained at Dixon Ridge and Lisbon. During the floods of 1940, 1941 and 1942, measurements were made in Yolo By-pass at Elkhorn, in Sacramento By-pass and on Putah Creek and stages obtained in Yolo By-pass at Elkhorn, Mouth of Sacramento By-pass, Lisbon and near Dixon Ridge for which flows at Lisbon were obtained by means of routing studies. The direct current meter measurements covered flows up to nearly 200,000 second feet, and upstream measurements and routed values to nearly 300,000 second feet. Rating curves for both Lisbon and Dixon Ridge were prepared from studies of these data and projected to stages for Project flood of 490,000 second feet. Values indicated by the curves are as follows:

Flows in Second Feet	Water Surface Elevations in feet, U.S.E.D. Datum		Flows in Second Feet	Water Surface Elevations in feet, U.S.E.D. Datum	
	At Dixon Ridge	At Lisbon		At Dixon Ridge	At Lisbon
50,000	14.0	15.6	300,000	20.9	23.2
100,000	16.4	18.4	350,000	21.7	24.0
150,000	17.9	20.1	400,000	22.4	24.7
200,000	19.1	21.3	450,000	23.1	25.4
250,000	20.1	22.3	490,000	23.7	26.0

No data were available from which could be readily ascertained flood plane elevations at various points between Lindsay Slough and Dixon Ridge. It was therefore necessary to compute flood plane elevations for the ten mile reach of by-pass between Lindsay Slough and Dixon Ridge for each assumed elevation at Lindsay Slough, for each of the following three conditions:

- (1) Present by-pass conditions.
- (2) By-pass conditions with Adjusted Project Document Channel Alignment.
- (3) By-pass conditions with Alternate Channel Alignment.

Surveys of Lower Yolo By-pass between the junction of Cache and Miner sloughs and Dixon Ridge, scale one inch equals 400 feet, with elevation sections across the by-pass at about one-half mile intervals, were made available by the Corps of Engineers. Cross sections with horizontal scale one inch equals 400 feet and vertical scale one inch equals ten feet were plotted from these surveys and the boundaries of the utilizable portions of the By-pass under each of the three conditions delineated thereon.

Studies were made of past current meter measurements and water surface elevations at Elkhorn, Lisbon and Dixon Ridge to determine the appropriate value of "n" to use with the Manning formula in computing flood plane elevations between Lindsay Slough and Dixon Ridge. This was found to be 0.035. The elevations at Dixon Ridge and Lisbon for the Adjusted Project Document Alignment condition were obtained from the rating curves established for present conditions by adjusting water levels so that the product of the wet area and the cube root of the square of the hydraulic radius would be the same for both conditions.

Trial flood plane calculations with the use of Manning formula and "n" values of 0.045 and 0.040 resulted in elevations at Dixon Ridge higher than the values established from the rating curves and indicated the subsequently verified value of an "n" of 0.035. Trial computations with the use of Kutter formula demonstrated an "n" value of 0.041 should be used with that formula to obtain the flood plane elevations derived with Manning formula and an "n" of 0.035.

Flood planes for each of the three conditions were then calculated upstream from each of the two starting elevations at Lindsay Slough using the Manning formula with an "n" of 0.035 and a flow of 490,000 second feet. The starting elevations at Lindsay Slough were assumed to be 0.1 and 0.2 foot higher with the Adjusted Project Document Alignment and the Alternate Alignment, respectively, than under present conditions in order to compensate for the accumulative divergence in flood plane elevations above the beginning of the two alignments one-half mile downstream. Each of the six flood planes so established terminated at the respective elevations at Dixon Ridge previously calculated from the rating curves.

The results of the computations are graphically presented on the accompanying drawing, "Effect of Sacramento Deep Water Channel on Flood Plane Elevations in Lower Yolo By-pass". On that drawing the following information and data are delineated:

- (1) Water surface elevations between Lindsay Slough and Lisbon under present conditions starting with an elevation of 17.6 feet at Lindsay Slough (9.6 feet at Collinsville).
- (2) Water surface elevations with Adjusted Project Document Channel Alignment with 17.7 feet at Lindsay Slough (9.6 feet at Collinsville).
- (3) Water surface elevations with Alternate Channel Alignment with 17.8 feet at Lindsay Slough (9.6 feet at Collinsville).
- (4) Water surface elevations under present conditions starting with 19.1 feet at Lindsay Slough (12.0 feet at Collinsville).
- (5) Water surface elevations with Adjusted Project Document Channel Alignment with 19.2 feet at Lindsay Slough (12.0 feet at Collinsville).

- (6) Water surface elevations with Alternate Channel Alignment with 19.3 feet at Lindsay Slough (12.0 feet at Collinsville).
- (7) Average ground elevations longitudinally through Yolo By-pass.
- (8) Elevations of crown of existing East Levee of Yolo By-pass.
- (9) Elevations of crown of existing West Levee of Yolo By-pass.
- (10) Adopted Project elevations for levee crowns.

For purposes of ready geographical identification there have been delineated on the drawing the locations of each of the twelve cross sections used in the computations, Lindsay Slough, Miner Slough, Solano-Yolo county line, north end of Liberty Island, north end of Little Holland Tract, Dixon Ridge and Lisbon, and also the corresponding Yolo By-pass Project miles.

Conclusions

As a result of the hydraulic analyses to ascertain the effect of the proposed construction of the Sacramento Deep Water Channel at each of the two alternate locations on flood plane elevations in Lower Yolo By-pass with a flow of 490,000 second feet, and a combined flow of 579,000 second feet in Sacramento River at Rio Vista, it is found that:

- (1) ~~Assuming the construction of the Sacramento Deep Water Channel on the Adjusted Project Document Alignment, and a stage of 17.7 feet at Lindsay Slough, the increase in flood plane elevations in Lower Yolo By-pass above those under present conditions would be 0.1 foot at Lindsay Slough, 0.5 foot at Miner Slough, 0.6 foot at Solano-Yolo county line, 0.7 foot at north end of Liberty Island, 0.7 foot at north end of Little Holland Tract, 0.8 foot at Dixon Ridge and 0.6 foot at Lisbon.~~
- (2) Assuming the construction of the Sacramento Deep Water Channel on the Alternate Channel Alignment, and a stage of 17.8 feet at Lindsay Slough, the increase in flood plane elevations in Lower Yolo By-pass above those under present conditions would be 0.2 foot at Lindsay Slough, 1.5 feet at Miner Slough, 1.6 feet at Solano-Yolo county line, 1.6 feet at north end of Liberty Island, 1.6 feet at north end of Little Holland Tract, 1.0 foot at Dixon Ridge and 0.6 foot at Lisbon.

OK

- (3) ~~Assuming the construction of the Sacramento Deep Water Channel on the Adjusted Project Document Alignment, and a stage of 19.2 feet at Lindsay Slough, the increase in flood plane elevations in Lower Yolo By-pass above those under present conditions would be 0.1 foot at Lindsay Slough, 0.5 foot at Miner Slough, 0.6 foot at Solano-Yolo county line, 0.7 foot at north end of Liberty Island, 0.7 foot at north end of Little Holland Tract, 0.8 foot at Dixon Ridge and 0.6 foot at Lisbon.~~
- (4) Assuming the construction of the Sacramento Deep Water Channel on the Alternate Channel Alignment, and a stage of 19.3 feet at Lindsay Slough, the increase in flood plane elevations in Lower Yolo By-pass above those under present conditions would be 0.2 foot at Lindsay Slough, 1.2 feet at Miner Slough, 1.5 feet at Solano-Yolo county line, 1.4 feet at north end of Liberty Island, 1.4 feet at north end of Little Holland Tract, 1.0 foot at Dixon Ridge and 0.6 foot at Lisbon. *out*
- (5) ~~Assuming the construction of the Sacramento Deep Water Channel on the Adjusted Project Document Alignment and a stage of 17.7 feet at Lindsay Slough, the height of freeboard between the flood plane and the adopted Project elevations for levee crowns would be 7.9 feet at Lindsay Slough, 7.6 feet at Miner Slough, 7.4 feet at Solano-Yolo county line, 7.3 feet at north end of Liberty Island, 7.2 feet at north end of Little Holland Tract, 5.5 feet at Dixon Ridge and 5.6 feet at Lisbon.~~
- (6) Assuming the construction of the Sacramento Deep Water Channel on the Alternate Channel Alignment, and a stage of 17.8 feet at Lindsay Slough, the height of freeboard between the flood plane and the adopted Project elevations for levee crowns would be 7.8 feet at Lindsay Slough, 6.7 feet at Miner Slough, 6.3 feet at Solano-Yolo county line, 6.3 feet at north end of Liberty Island, 6.4 feet at north end of Little Holland Tract, 5.3 feet at Dixon Ridge and 5.6 feet at Lisbon. *OK*
- (7) ~~Assuming the construction of the Sacramento Deep Water Channel on the Adjusted Project Document Alignment and a stage of 19.2 feet at Lindsay Slough, the height of freeboard between the flood plane and the adopted Project elevations for levee crowns would be 6.4 feet at Lindsay Slough, 6.4 feet at Miner Slough, 6.4 feet at Solano-Yolo county line, 6.4 feet at north end of Liberty Island, 6.4 feet at north end of Little Holland Tract, 5.5 feet at Dixon Ridge and 5.6 feet at Lisbon.~~
- (8) Assuming the construction of the Sacramento Deep Water Channel on the Alternate Channel Alignment, and a stage of 19.3 feet at Lindsay Slough, the height of freeboard between the flood plane and the adopted Project elevations for levee crowns would be 6.3 feet at Lindsay Slough, 5.7 feet at Miner Slough, 5.5 feet at Solano-Yolo county line, 5.6 feet at north end of Liberty Island, 5.7 feet at north end of Little Holland Tract, 5.3 feet at Dixon Ridge and 5.6 feet at Lisbon. *out*

- (9) Although the Alternate Channel Alignment would make possible the reclamation of areas over which the State has already purchased flowage easements, it would increase, after initial inundation, the depth and velocity of flow across the area that would still be contained in the By-pass. The maximum increase in mean velocity would be about one foot per second, (from 2.5 to 3.5 feet per second) near the lower end of Liberty Island. The increases in velocity for other conditions and locations would be less than that amount. The average increase in mean velocities would be less than one-half foot per second. OK

It is further concluded that:

- (1) Either of the alternate plans would be satisfactory from an engineering standpoint if Project levee grades and sections are constructed to approved standards and existing sloughs and cuts in Lower Yolo By-pass enlarged to the extent required to maintain the same degree of flood protection now afforded the tidal reclamations.
- (2) Consideration should be given to the effect, if any, that the construction of the alternate plans would have on lands over which easements for the passage of flood waters have been purchased by the State of California.

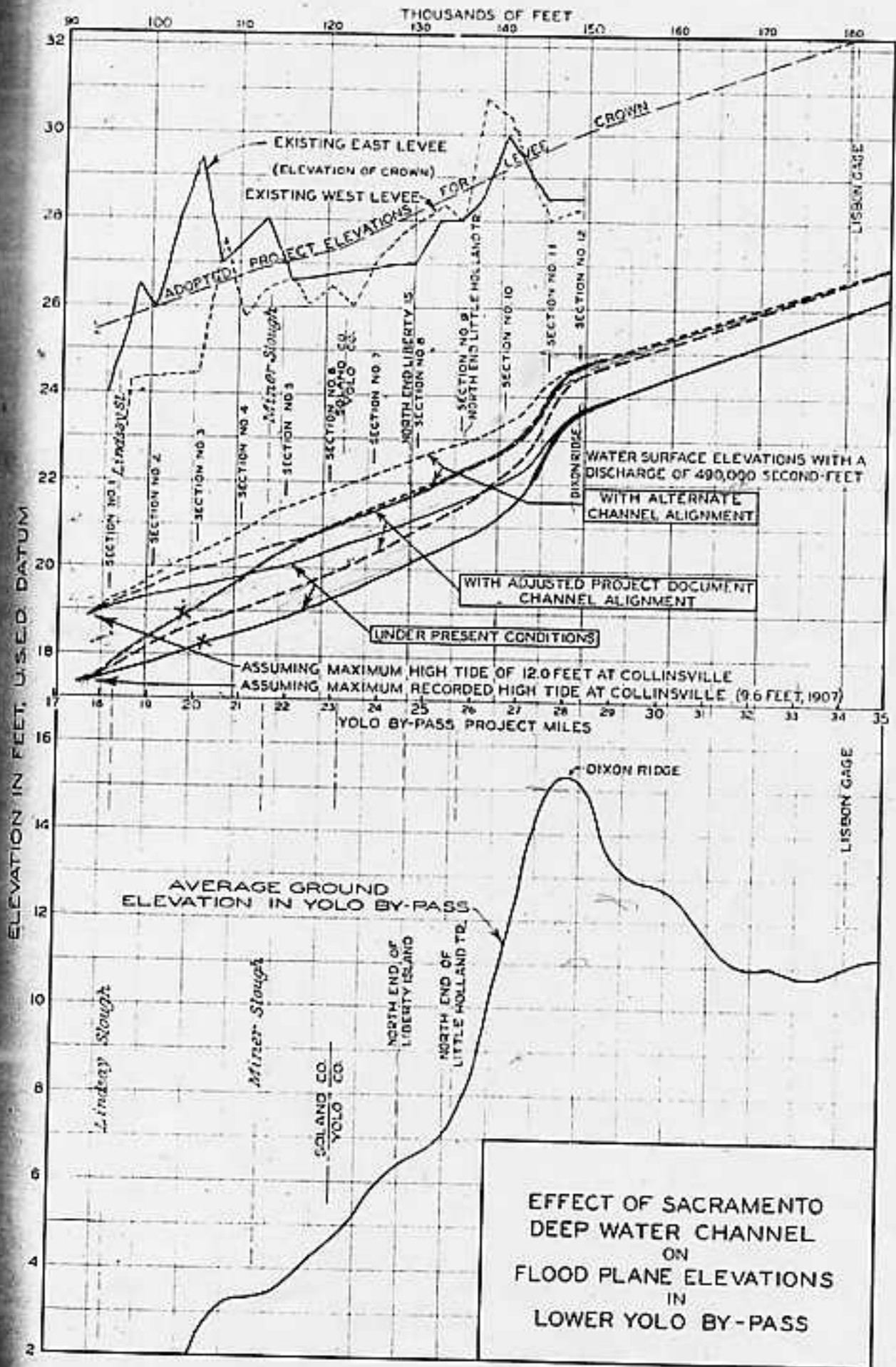
Approved:

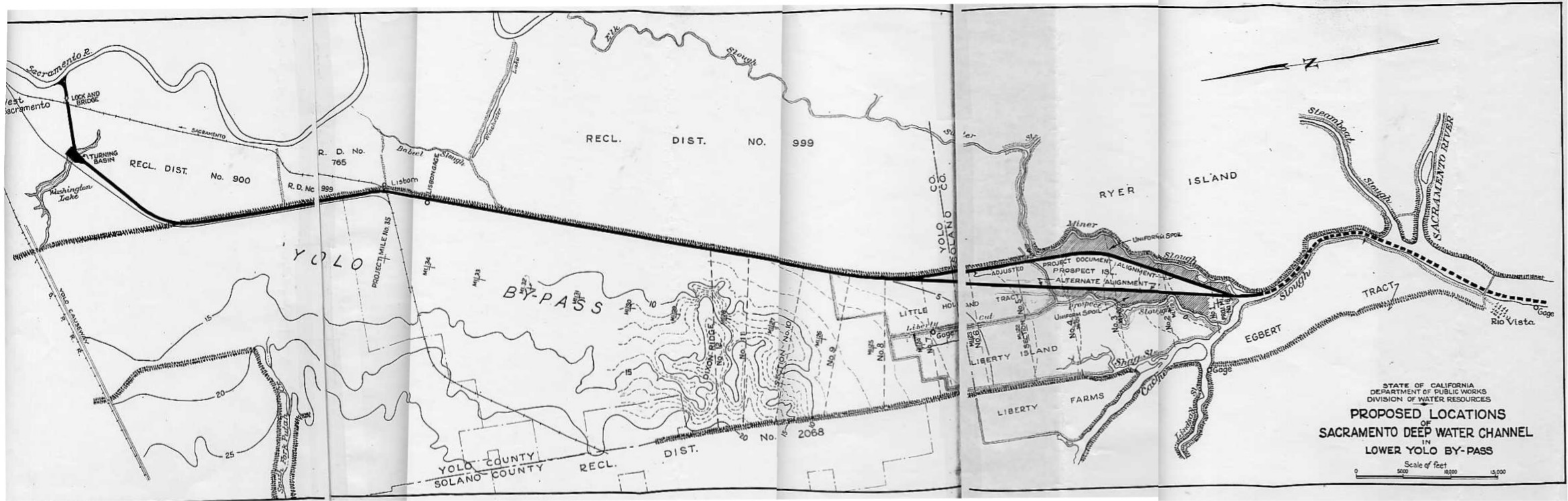
Submitted by:

A. D. Edmonston
Assistant State Engineer

Gerald H. Jones
Principal Hydraulic Engineer

Sacramento, California
January 31, 1949





STATE OF CALIFORNIA
 DEPARTMENT OF PUBLIC WORKS
 DIVISION OF WATER RESOURCES

PROPOSED LOCATIONS OF SACRAMENTO DEEP WATER CHANNEL IN LOWER YOLO BY-PASS

Scale of feet
 0 5000 10,000 15,000